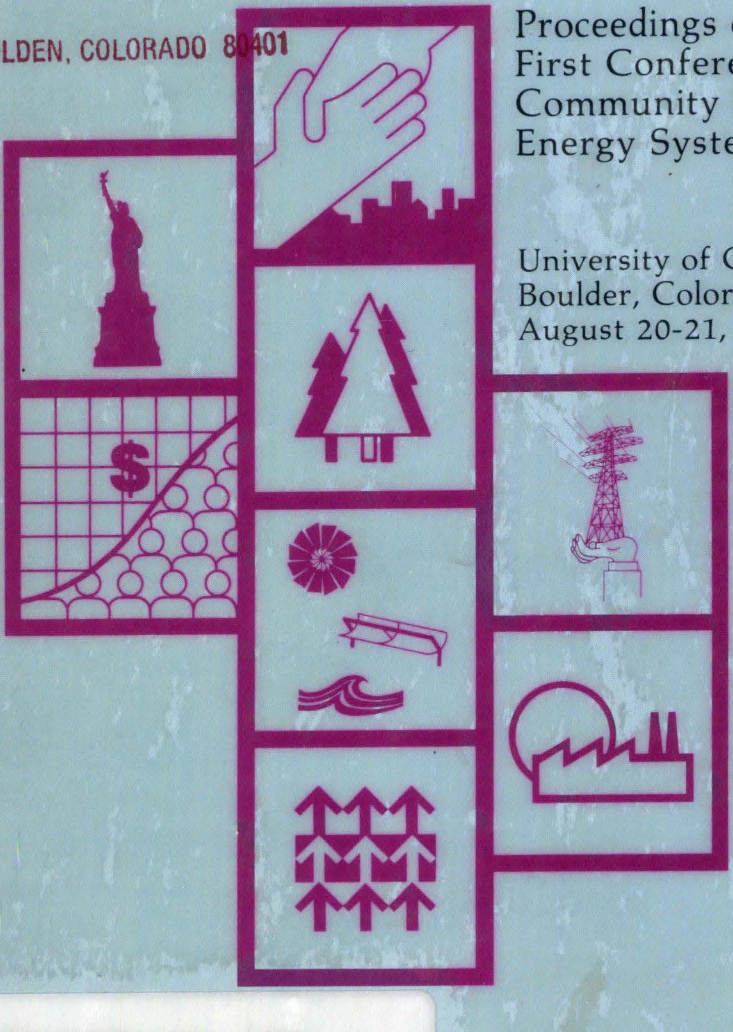
Community Energy Self-Reliance



Proceedings of the First Conference on Community Renewable Energy Systems

University of Colorado
Boulder, Colorado
August 20-21, 1979

Community Energy Self-Reliance

Technical support provided by the MITRE Corporation, Local, State, and Regional Energy Systems Group, Bedford, Massachusetts

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Robert Odland, Chairman
Chief, Community and
Consumer Branch

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Foreword
The Prospect for Locally Controlled Energy Systems*

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Golden, Colorado

A critical factor in the success of American democracy is the balance between centralized and decentralized power centers provided by our Constitution. The centralization-decentralization argument that shapes our Constitution continues to provide a useful frame of reference for analysis of significant political questions. Perhaps the most important of these questions today concerns energy: how to make a transition from concentrated, non-renewable energy sources to more diffuse, sustainable sources, and what the implications of such a transition will be for our future way of life.

Today we cannot speak with certainty about this country's energy future. Efforts to forecast population trends, economic growth rates, and energy usage levels have all grown increasingly sophisticated. Yet the range of opinions among recognized experts is probably broader than the range of opinions among the lay public.

Energy forecasts are judgments made today about tomorrow, using data gathered yesterday. If the smooth flow from yesterday to tomorrow is disrupted, the projections will likely prove erroneous. The Arab embargo, the Iranian shut-down, and Three Mile Island were painful disruptions. And like labor pains, such crises are likely to grow more intense and more frequent before the birth of a post-petroleum era.

That we are coming to the end of the oil age is beyond serious dispute.

*From an address to the American Association for the Advancement of Science, January 8, 1980.

Yet few people have truly come to terms with what this will likely mean for our way of life. To a far greater extent than is generally appreciated, America runs on oil.

The raw materials for plastics, rubber, and a vast array of industrial chemicals are all refined from petroleum, along with motor fuels, heating oil, boiler fuel, and lubricants. Our high degree of petroleum-dependence cannot be accepted with equanimity now that our oil is running out.

The long, thin lines of oil tankers that move black liquid through the world's arteries of commerce originate mostly in unstable areas. Four-fifths of internationally traded oil comes from countries in which a single assassin's bullet could cause a fundamental shift in government.

A central goal of national energy policy is to reduce our reliance on foreign oil. Since domestic oil production continues to decline, this means we seek to steadily reduce our dependence on all petroleum. The consequences—for the environment, for the distribution of power, for the shape of our buildings and of our cities, for the transportation and communications sectors—will likely be far-reaching. It will, almost inevitably, begin to reverse the trend toward large-scale centralized energy production that has dominated the last three decades.

The Effects of Our Energy Choices

As we survey the options available to us, it would be wise to evaluate indirect effects as well as the simply technical and economic parameters of choice. Most energy choices, unfortunately, are made as though competing energy sources were neutral and interchangeable. As defined by most experts, the task at hand is simply to obtain enough energy to meet projected demands at as low a cost as possible. Choices can only swing on small differences in the marginal costs of competing sources.

But energy sources are not neutral and interchangeable. Some energy sources are necessarily centralized because of engineering efficiencies possible with increased scale; others are necessarily dispersed because of the dispersed nature of the resource. Some are exceedingly vulnerable; others are almost impossible to disrupt. Some reduce the number of people employed; others produce many new jobs. Some tend to accentuate the gap between rich and poor; others diminish it. Some inherently dangerous energy sources can be permitted widespread growth only under authoritarian regimes; others can lead to nothing more dangerous than a leaky roof. Some sources can be comprehended only by the world's most elite technicians; others can be assembled in remote villages using local labor and indigenous materials. Over time, such considerations may prove weightier than the financial criteria that dominate and limit current energy thinking.

Appropriate energy sources are necessary, though not sufficient, for the realization of important social and political goals. The kind of world that could develop around energy sources that are efficient, renewable, decentralized, simple, and safe cannot be fully visualized from our present vantage point. Indeed, one of the most attractive promises of such sources is a far greater flexibility in social design than is afforded by their alternatives. Although energy sources may not dictate the shape of society, they do limit its range of possibilities; and decentralized sources are more compatible than centralized ones with social equity, freedom, and cultural pluralism.

The solar prospect offers both the transitional and the ultimate technologies needed for a decentralized energy future. To follow the decentralization argument and assess the choices its advocates are placing before policymakers at all levels of government, we need a clearer understanding of the concept of decentralization.

Decentralization, in the energy context, is usually associated with small-scale facilities, owned and operated by individuals or communities. The term is thus easily associated with such American ideals as local autonomy, personal self-reliance, and Jeffersonian social pluralism. The term is used to evoke a loosely ordered set of economic, technological, social, political, institutional, and environmental qualities and values which, when taken together, describe energy systems quite different than those that prevail today. Many characteristics of decentralized energy systems are mutually reinforcing. For example, small units tend to foster greater social and economic diversity. Such technologies become more an expression and less a determinant of our social structures, functions, and values.

Models for Energy Decentralization

Numerous organizations within our society could become vehicles for implementing decentralized energy systems, or models for new organizations for the ownership and management of decentralized renewable technologies. These existing organizations are decentralized in that consumers retain some direct controls over the policies and activities of the service organization, relatively small numbers of consumers are served by each, and operations are near the consumers. The Solar Energy Research Institute (SERI) has begun to examine the suitabilities of certain of these as organizational models for a decentralized U.S. energy supply system, including:

- *Rural Electric Cooperatives,* which were established originally to extend electric service to sparsely settled rural regions of the country. The local orientation, democratic structure, and self-reliance characteristics of these organizations make them in many respects attractive models for new renewable energy supply organizations.
- *Local government agencies,* which provide consumer control through local elected officials. Such agencies also can combine multiple services, thus lowering total administrative and delivery costs to consumers. For example, urban waste can be burned to generate electricity, thus addressing both the problems of garbage and of power. Financing for renewable-energy technologies can be obtained through municipal taxing and funding powers. The model of a "solar utility" for the purchase, installation, and maintenance of solar equipment was first implemented in Santa Clara, California, and is now being adopted by other cities and counties.
- *Community Development Corporations* (CDC), an outgrowth of the 1960's War on Poverty to revitalize decaying inner city areas. CDCs are locally owned and operated business enterprises. Profits are funneled into other local enterprises, and various training or functional services are provided simultaneously to the locality. Some CDCs are already active in energy-related programs, particularly weatherization for low-income housing.
- *Cooperative organizations,* which are generally flexible and subject to grass-roots local control. "Buying" co-ops can make joint purchases to provide savings to individual residential users of solar equipment. "Producer" co-ops could be utilized for collection and storage of solar energy on a neighborhood scale. Much co-op experience and organizational infrastructure already exist for rural and agricultural cooperatives; efforts to create similar structures in urban areas are underway.

Movers for Energy Decentralization

A basic grass-roots phenomenon of the 1970's was the renewed development across the country of locally based organizations, with a diversity of memberships and purposes, all looking for ways to touch the institutions of daily life. The results of this application of personal energy included day-care centers, food cooperatives, environmental organizations, health care coalitions, women's organizations, minority caucuses, senior groups, consumer action networks, handicapped advocacy organizations, and a multitude of block- or neighborhood-based civic action groups. There are about a quarter million such organizations.

Most neighborhood groups have a natural inclination toward decentralized solar applications, and many have been active in advocacy or development. Community Development Corporations, particularly, have worked on solar projects such as the training of solar installers in Roxbury, Massachusetts, installation of solar hot water heaters in New York City, solar greenhouses in Atlanta and in southern Colorado, and production of flat-plate collectors in San Bernadino, California. The neighborhood movement, virtually nonexistent 15 years ago, now provides a base of active concerned citizens in support of decentralized decision-making.

Solving Local Problems Locally

If decentralization is defined as local efforts to solve locally perceived problems, our recent preoccupation with energy problems has spurred a significant movement toward greater decentralization. Local efforts to alleviate the economic and social disruptions created by escalating energy costs range from neighborhood greenhouse construction to statewide renewable energy planning. Higher energy costs and diminishing reliability are felt everywhere in the country, but the individual solutions emerging from various communities are based on local perceptions, needs, and capabilities, and reflect differing climate, terrain, vegetation, and social or political conditions. For example, the Addison County, Vermont, Regional Planning and Development Commission is studying the use of wood technologies; the Office of Human Concern in Rogers, Arkansas, is building and installing vertical-wall solar air collectors; the town of New Ulm, Minnesota, is studying a district heating system; and the village of Soldiers Grove, Wisconsin, will include passive solar design techniques as part of the relocation and reconstruction of the central business district from the floodplain. Work in progress at SERI includes support for community energy planning in New England, an area that has been particularly hard-hit by recent escalations of prices for imported petroleum.

These examples provide a glimpse of the best qualities of Americans—ingenuity, initiative, cooperation—coming to the fore as we respond to our energy problem. Decentralization in attacking energy problems has brought together a diversity of solutions with a unity of purpose.

To encourage this activity, and to establish a communication network for it, SERI and the United States Department of Energy sponsored the First Annual Conference on Community Renewable Energy Systems at Boulder, Colorado on August 20–21, 1979. Other purposes of the conference were to show how renewable energy can meet community goals, to present examples of successful projects, to discuss the planning and management of renewable energy systems, to identify sources of financial support, to share legal strategies, and to examine utility roles.

We hope that our support of conferences such as this will help communities learn the dynamics of making solar energy happen, and at the same time, promote the energy self-reliance that our country needs.

Acknowledgments

Planning for this conference began in the Spring of 1979, led by Bob Odland and Peter Pollock of SERI, and Abbie Page and Yale Schiffman of the MITRE Corporation. Assisting and advising this group were the following people: Willy Osborn, a consultant to MITRE; Jim Quinn, Mike Power, Jerry Duane, Gene Frankel, Joe Barrow, Tina Hobson, Vary Coates, Allan Hoffman, Steve Cavros, and Andy Krantz, all of DOE; Ben Bronfman, Oak Ridge National Laboratory; Sue Guenther, The National Association of Counties; Gloria McGregor, City of Davis, California; Dusky Rhodes, Center for Renewable Resources; Ron Bruner, University of Michigan; Lee Johnson, Western SUN; Norman Harold, Mid-America Solar Energy Center; Rick Mounts, National League of Cities; George Meier, Southern Solar Energy Center; and Arnold Wallenstein, Northeast Solar Energy Center. SERI extends sincere thanks to all these people and to anyone else who might have been inadvertently omitted. Much credit for the gathering of papers and biographies from conference attendees, technical editing and preparation of conference materials for publication goes to Michael Mitsock of the MITRE Corporation. The session summaries which appear were prepared by SERI, MITRE, and Dartmouth staff, and by David Goldberg of Program Planning/Development Associates. Funding for the conference was provided through SERI by the Solar Planning and Analysis Division (formerly Planning and Technology Transfer Division), Office of Conservation and Solar, United States Department of Energy.

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Section A
Soft Energy Paths

Special Public Lecture by Amory B. Lovins
Friends of the Earth
August 19, 1979

Soft Energy Paths

I spend most of my time running around the energy grapevine and cross-pollinating, and in the process I notice a lot of people converging on a hopeful view of the energy future which I'd like to help you explore by sketching two ways our energy system could evolve over the next 50 years or so. These two paths are technically realistic, but they are not designed as precise forecasts or recommendations. They are rather a qualitative vehicle for ideas, a way of helping us understand better what the energy problem is.

Although I am going to stick mainly to American and British examples, just to be specific, studies on these lines are already done or being done in about a dozen countries. These studies show that, although the technical details differ between and within countries, the same principles apply essentially anywhere. In fact, if you really want to work out numbers in detail, you have to do it for an area much smaller than this country and probably much smaller than Colorado. Some of the most exciting results which we are going to hear described in the SERI Conference just starting are municipal; and county studies of the soft energy path.

I am going to select tonight from a wide range of literature. The basic thesis is set out in *Soft Energy Paths,* which is available fairly cheaply from Harper & Row in a Colophon paperback. If you really want to dig into the arguments, there is a new book out from Friends of the Earth called *The Energy Controversy: Soft Path Questions and Answers,* and this distills the three dozen or so published critiques and responses with a topical cross-index. I do not think new arguments have come up that are not in there. There are also a lot of more recent technical papers; so at least until our discussion, I would like to defer the more seductive technical details in order to concentrate on some fundamental concepts.

Until maybe a couple years ago there was a broad consensus in industry and government, remnants of which, as we have lately seen, still linger here and there—that the energy future ought to be like the past, only more so, and that the energy problem is simply where to get more energy of whatever kind to meet projected demand—but lumping together all the different uses and kinds of energy, treating them as homogeneous, not asking very hard what kind of energy and what it will be used for, but just saying we will need so many total quads of energy in the year X. If you think that is what the problem is, then you might think that the solution looks something like the graph in Figure 1.

Just to discourage us from getting too hung up on numerical details at this point because this is meant as a qualitative sketch, I am going to use a British example here whose qualitative elements are just the same as for the United States. It is essentially a policy of Strength Through Exhaustion: that is, we push very hard on all of the depletable fuels we can find—coal, oil, gas, uranium, presumably there is some oil shale in the United States version—but the important thing that does not show on this graph is that these increasingly scarce fuels are converted faster and faster into premium forms of energy, fluid fuels and especially electricity, in ever larger, more complex, more centralized plants. There are a lot of reasons that this sort of policy does not work—and let me stress again that I am not going to hang my argument on the illustrative numbers shown here which change a bit from year to year, but rather on the qualitative shape.

Some of the reasons this policy does not work are logistical. Some are political. Some are straightforwardly economic, and they show up immediately if you ask how much capital you have to invest to build new energy systems of different kinds in order to deliver energy to final users at a given rate. You can see that, as we go from the traditional direct-fuel systems on which our economy has been built, to North Sea or Arctic oil and gas and synthetic fuels made from coal or from oil shale, the capital intensity goes up about tenfold. And as you go from those, in turn, to central-electric systems, power stations, and electric grids, the capital intensity goes up about another tenfold. It is that roughly hundredfold increase in capital intensity that makes it impossible for any major country outside the Persian Gulf to use these high technologies on a truly large scale, large enough to replace today's oil and gas. They are just so expensive they are starting to look rather like future technologies whose time is past.

They are, however, exactly the systems on which the "hard energy path," as I will call it, relies for most of its growth. Let me again switch back to the United States example where you see the same qualitative elements (Figure 2). If you run out the numbers for the United States or for most other countries, you find typically that just the first ten years of that sort of program would require you to put into the energy sector its present quarter or so of all discretionary investment in the whole

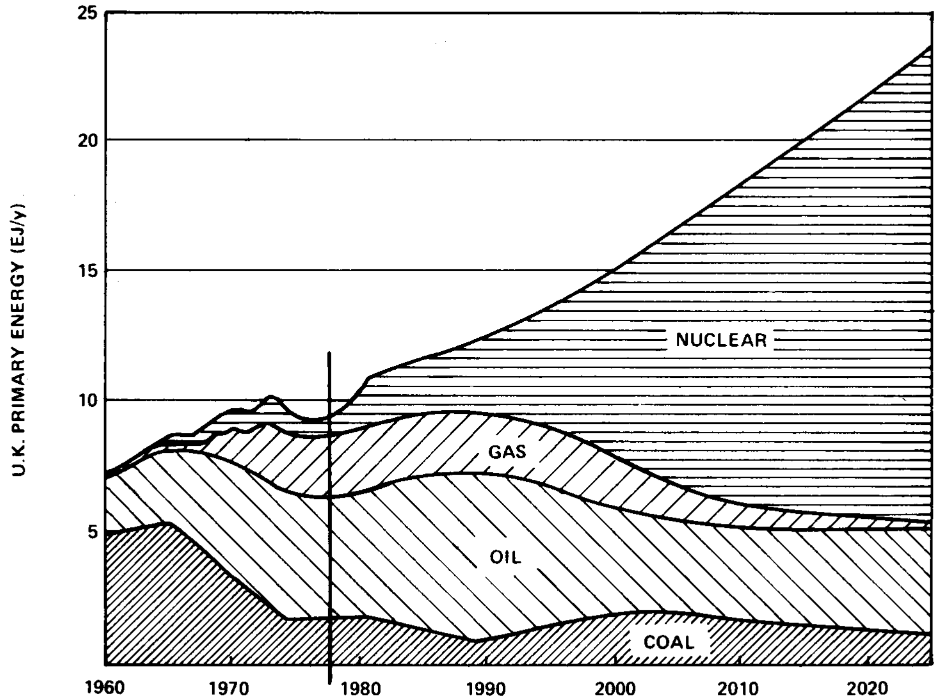

Figure 1. HARD ENERGY PATH (FLOWERS COMMISSION, SEPTEMBER 1976)

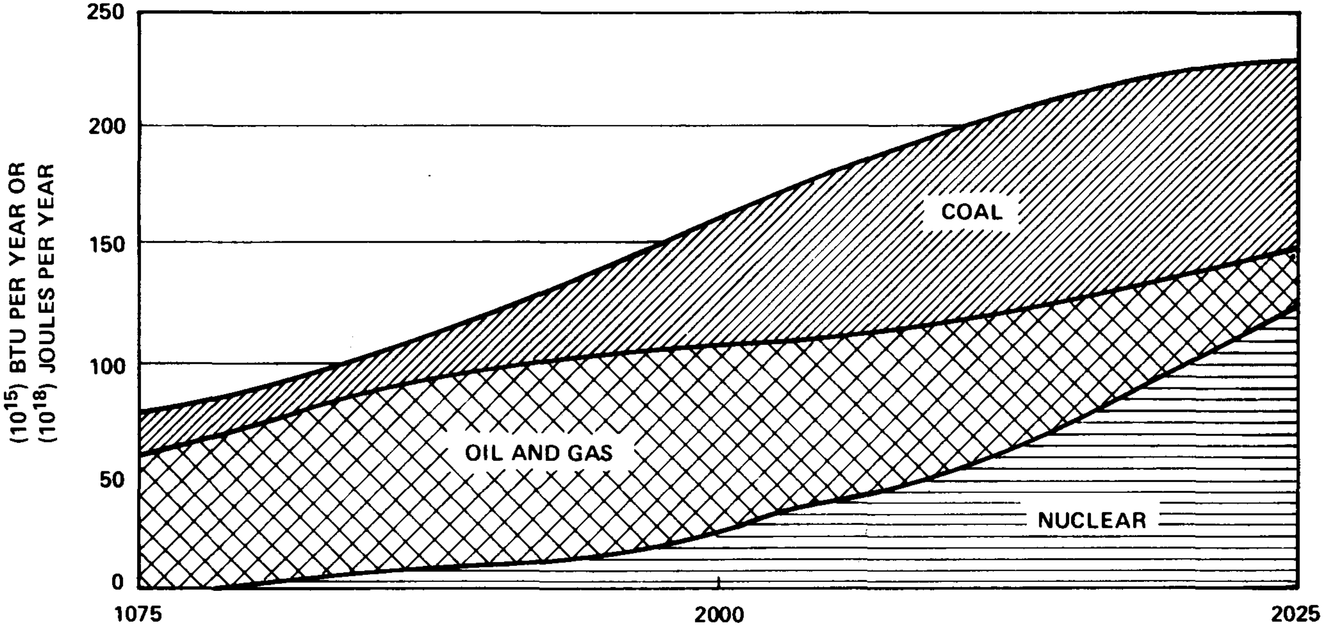

Figure 2. SCHEMATIC OF FUTURE U.S. GROSS PRIMARY ENERGY USE

economy, plus about two thirds of all the rest—which means you would not even have the money left to build the things that were supposed to *use* all that energy. The further up this sort of curve you went, the heavier the burden would become. You cannot suddenly start putting ten or a hundred times as much capital as before into each unit of energy-supplying capacity and not have serious problems getting the capital to put to those uses without running out somewhere else.

In fact, that is just the beginning of your problems with this sort of policy. The energy system, itself, would give you a lot of electricity—you would have that coming out your ears, and it would probably give you quite a lot of gas if the gas plants work, but you would still be seriously short of liquid fuels to run vehicles because of slow and imperfect substitution. Even worse, out of all this enormous energy growth over the fifty-year period shown, more than half that growth would never get to the final users because it would be lost first in conversion and distribution before it ever got delivered. Putting billion-dollar blocks of capital into things that take about ten years to build would tend to make inflation worse, utility cash flow unstable, and energy prices obviously much higher. We are talking now about synthetics delivered to say $30 to $60 a barrel, which is a lot higher than OPEC oil, and indeed these energy systems would take so much capital that other sectors would be starved. For every big power station we build, for example, we would directly and indirectly lose the economy somewhere around 4,000 net jobs just by putting disproportionate capital into energy and not having it left to make workplaces elsewhere.

It appears, then, that this approach to the energy problem would make our economic problems worse rather than better. But I think at the same time it would create some serious political problems which may be even more important in the way we actually make energy decisions. For example, just getting these resources into the energy sector, which the market has always been unwilling to do, would require a strong central authority, something like an Energy Mobilization Board and an Energy Security Corporation acting outside the market. Presumably once you built these big complex energy systems, you would need big complex bureaucracies to run them and to say who could have how much energy at what price. Because these systems are centralized, they automatically give the energy and the side effects, or social costs of getting it, to different groups of people at opposite ends of the transmission lines, pipelines, or rail lines, so that the energy goes to Los Angeles and New York, while the side effects go to Colorado, Montana, Alaska, Georges Bank, Appalachia. It's a very old story, except that there are now over 60 so-called "energy wars" going on in this country between, for the most part, politically weak rural people and the "slurbians" at the other end, as represented by the energy siting authorities, because agrarian people do not want to live in a "zone of national sacrifice" for the benefit of somebody several thousands of miles away. They just will not stand for it. And it seems to me the President's recently announced policy will just make that trend worse and put quite a strain on Federalism.

Another disturbing political feature of this sort of future is that it is very vulnerable to disruption, whether by accident or by malice. The electric grids, in particular, and the gas grids can be turned off by just a few people. I have been living in England for the past twelve years, where we're turned off now and then because relying on energy systems like this does basically alter the power balance between large and small groups in society. If you don't like being turned off, you may need stringent social controls. It is also very hard to make democratic decisions about technologies with compulsory perceived hazards that are exotic, disputed, unknown or maybe even unknowable; and governments trying to make decisions like that are very tempted to substitute "we the experts" for "we the people." That makes the experts feel good for a while, but it may also lead to a loss of legitimacy, as we have seen in the nuclear business. Over all of these domestic political problems, which are certainly serious enough, looms a larger threat of nuclear violence and coercion in a world where, we are told, a few decades from now we are supposed to have some tens of thousands of bombs' worth a year of strategic materials like plutonium running around as an item of commerce within the same international community that has never been able to stop the heroin traffic.

Now those are some of the simple, direct side effects of this approach to the energy problem; and if you fiddle with the numbers a bit and you have a little less demand, or a little more of this and that and a little less of something else, it doesn't really make all that much difference to the basic problems I have just outlined. But I do not think our analysis can stop there because these problems, in turn, interact with each other to make new, higher-order side effects which together suggest that the cheap and abundant energy at which this policy is aimed is not cheap at all; we just pay for it everywhere else, in inflation, unemployment, insecurity, and so on. I would like to spin out that argument because I think many of us who should know better tend still to think of energy too much in isolation.

Suppose we think energy ought to be cheap, so we continue to subsidize it to the tune of over $100 billion a year to make it look cheap, and we pay that out of the other pocket, so maybe we don't notice so much. If we think the energy looks cheap, we will continue to use it wastefully and to import lots of oil, which is, of course, bad news for Europe and Japan and disastrous news for the Third World. That much is pretty well known. But then we have to earn the money to pay for all that oil; and traditionally, we have done that in three main ways. One is to run down our domestic stocks of commodities. That is inflationary. It leaves big holes in the ground. It leaves the forest looking sort of moth-eaten. The second way we earn the oil money is to export weapons. That is inflationary, destabilizing and immoral. The third way is to export a lot of products like wheat and soybeans, which turns the midwestern land markets upside down; probably raises our food prices; certainly makes us mine the soil and mine the groundwater. The last I heard there was a dumptruckload of topsoil passing New Orleans every second, an average of 9 tons per acre per year across the country and 25 in parts of the Midwest (Eastern Colorado is not immune). Then we turn around and sell some of the wheat to the Russians and divert some of their investment from agriculture into military activities, so we have to raise our own military budget. That is inflationary. We have to do that anyway to defend the sea lanes to bring in the oil and to defend the Israelis from all those arms we just sold to the Arabs. (I guess if you follow that argument very far, it looks like the best kind of Middle Eastern arms control might be American roof insulation.)

Then, because the wheat and soybeans are looking important to our oil balance of trade, we feel driven to ever more energy, water- and capital-intensive chemical agribusiness. This helps us degrade many natural life-support systems, so we feel driven to use still more fertilizer, pesticides, herbicides, desalination, irrigation—you name it, they are doing it, including mining Pleistocene groundwater in west Kansas at twenty times the recharge rate. Anyway, the upshot of all this is that the soil gradually dries up, blows and washes away—but who cares? At 10 percent discount rates, soil in 50 years isn't worth anything.

Meanwhile, back in the cities where people are not so aware of that problem because the energy looks cheap, we have been substituting it disproportionately for human skills, displacing people with black boxes. The economists call this "increasing productivity"—by which they mean increasing *labor* productivity, and specifically, the labor productivity of the people who have not yet been displaced: the others do not count in that statistic. We are then told that we need energy to fuel the economic growth, that we need to employ the people whom we have just put out of work by this process. In any case, when we displace people with energy-intensive black boxes, we are increasing poverty, inequity, alienation and crime. We then try to spend money on things like crime control and health care, only we cannot because we spent the money already on the energy sector, which is contributing to the unemployment and illness at which those investments are aimed.

At the same time, we gradually drift toward a garrison state at home, trying to protect ourselves from some of these homemade vulnerabilities. Abroad, we are not addressing rational development goals; in fact, we compete with our trading partners to see who can export the most reactors, weapons and inflation to the Third World. These things all encourage international distrust and domestic dissent, which bring on further suspicion and repression. Meanwhile, we are burning fossil fuels, releasing carbon dioxide and other pollutants into the air (synthetics make pollution even worse), and running the risk of destabilizing world climate on which marginal agriculture depends. Meanwhile, we are accelerating the production and export of bombs.

If you start to add up the side-effects and ask: How do they interact with each other? What do the third-order effects look like? What kind of world would this be like to live in?—Then I think it becomes clear that you would not really want to live here; and that, as proponents of this view keep telling us, there is no alternative, then the human prospect is indeed bleak. We might as well all go home right now. I guess the only useful skill to have is knowing how to dig a very deep hole and pull it in after you.

I think there is, however, quite a different way to look at the energy problem; one which makes more sense and leads in a better direction. I will call it a "soft energy path." The British version of it might look something like Figure 3. I will show you the American version later. It has three main technical elements which essentially deal with using the energy we have much more efficiently and, through the intelligent transitional use of fossil fuels, moving to complete reliance on "soft technologies." The two energy paths differ not only in how much energy we use and not only in our choices of equipment, but also, most importantly, in their very different implications for the political structure of our society. I will come back to that point later on. These hard and soft paths also reflect two quite different views of what the energy problem is. In the hard path there is a tacit assumption that the more energy we use, the better off we are, so energy is elevated from a means to an end in itself—as if people want more electricity because they could eat it, rather than because it is nice to have lights and motors to do work. However, in the soft path the amount of energy we use to accomplish our social goals is considered a measure not of our success but of our failure—just as, if you wanted to get to some place, the volume of traffic you had to endure to get there would not measure how well off you are, but it might measure our failure to have a sensible settlement pattern in which you

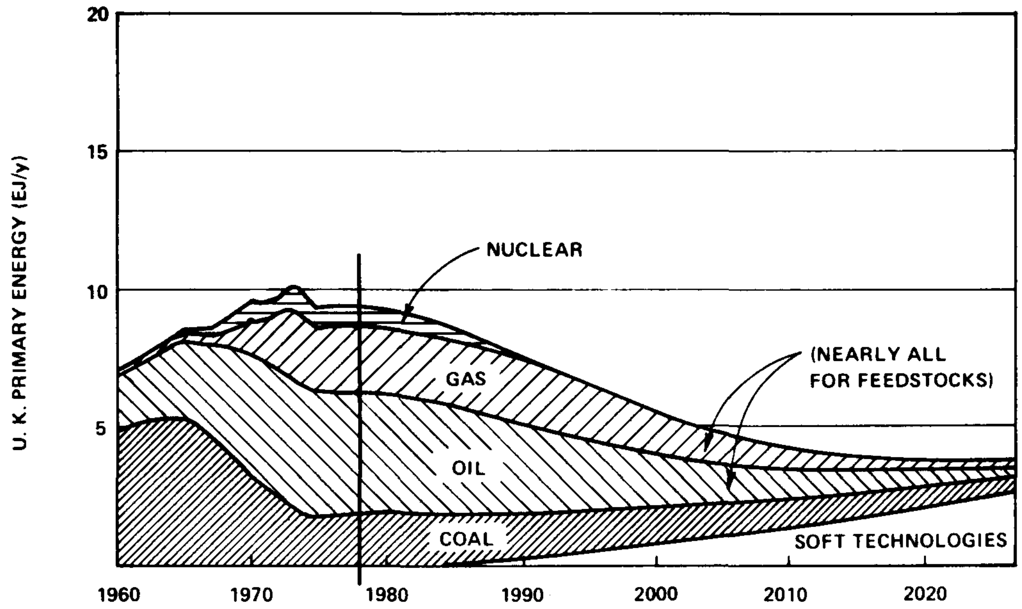

Figure 3. SOFT ENERGY PATH (D. OLIVIER, NOVEMBER 1978, PRELIMINARY)

are already near where you want to be. Therefore, the energy problem that a soft path is addressing is not just to determine where to get more total energy to meet projected demands but to assess the nature of the many different jobs we are trying to use the energy for. That is, we are asking: What are our *heterogeneous* end-use needs? And how can we meet those needs with a minimum supply—or, if you like, an elegant frugality—of energy, supplied in the most effective way *for each task*? This concept really makes use of the criteria of good engineering—economy of means and the right tools for the job—yet, as you will see, it leads to a somewhat unconventional view of what kinds of new energy supply make sense.

Let me take the three elements of the soft path in turn, starting with the question of "end-use efficiency," that is, How much work can we wring from each unit of energy that is delivered to us? Conventional wisdom says that by insulating our houses more effectively, designing more efficient appliances, cars, and machinery in factories, we can save something like 20 to 40 percent of our energy and be just as well off, and indeed, that this is cheaper than new energy supply. However, conventional wisdom is wrong. It comes from not looking quite carefully enough at how great the opportunities are for using energy more efficiently through what are called "technical fixes"—that is, technic-' measures which are now economic by normal criteria, use today's (or quite often, 1870's) technologies, and have no significant effect on lifestyles. These are conventional measures like better insulation, more efficient cars, and the like, except that if you look *very* carefully at the best state-of-the-art right now, you find vastly more opportunities for saving than anybody knew were there. This is something we have learned only within the past year.

One of the first people to look at technical fixes was Gerald Leach, who with his colleagues in England did a study for the Ford Foundation,[1] in which they showed in quite a ratproof way that, if you look carefully at more than 400 sectors of British energy use and you use that energy more efficiently to do the same jobs, using conservation measures that are cheaper than present cheap North Sea gas, you can treble the energy efficiency of the country. You could do three times as much work, have three times the GNP using the same amount of energy as now, or even a little bit less. A colleague of mine has since dug into the numbers even a little more thoroughly. He originally wanted to find out what would happen if you used conservative measures which may not be cheaper than North Sea gas, but nevertheless are cheaper than synthetic gas or new power stations which we would otherwise have to use to replace the North Sea oil and gas that we are going to run out of. He found twice as much saving, a factor of 6. That is actually what is shown in Figure 3.

We have assumed here a trebling of the British Gross Domestic Product. I happen to think that is spherically senseless—that is, it makes no sense no matter which way you look at it—but I am going to assume it anyway to save argument. And yet, at the same time, the total energy used to treble economic activity, in the conventional heavy-industrial sense, drops by half, just through technical fixes. We have since had similar results from a number of other countries, for example, West Germany, which is already considered more energy-efficient than the United States. I think the lesson is that, when we start looking at hundreds of individual small energy uses throughout the economy, the opportunities for saving add up in ways we never expected.

Of course, there has also been very rapid technical progress. We now know, for example, how to make an economically and aesthetically attractive house, in essentially any climate, which doesn't take any energy to heat. We know how to make cars, quite straightforwardly, that are five times as efficient as the average American car, and we can do a lot better than that without pushing technology very hard.

Let me take your refrigerator as my text for a moment because it is a nice graphic example. Around the end of World War II your refrigerator motor was probably 80 or 90 percent efficient and it sat on top. Nowadays the motor is maybe 50 or 60 percent efficient, probably because the price of electricity to your house has dropped severalfold since then; and the motor sits underneath, so the heat goes up into the box. Therefore, your refrigerator probably spends about half of its effort taking away the heat of its own motor. Then the manufacturers have skimped on the insulation. It got thinner and thinner because they tried to make the inside pretty big compared to the outside. (I guess if you gave them a little longer, the inside would be bigger than the outside.) Partly because of the insulation and partly because it is designed so that, when you open the door, all the cold air falls out, it frosts up. So your refrigerator probably has in it a lot of electric space heaters which go on now and then to defrost it. It probably also has electric heaters around the door to keep the gasket from sticking because the manufacturers cannot be bothered to use a Teflon coating. In fact, the heat gets pumped out the back into a kind of radiator, which is usually pressed right into that thin insulation to help the heat re-circulate back inside as fast as possible. Then, to make matters worse, the refrigerator is probably installed next to your stove or dishwasher, so when that goes on, it goes on. It is really hard to think of a better way to waste energy. Now if you design the machine properly, it will keep the same amount of food just as cold and just as conveniently, while using only a sixth as much electricity as now.

(I just had a report from an engineering undergraduate in Santa Barbara who made a refrigerator just for fun that was four times as efficient as the best on the market.)

There is an extra capital cost for the energy savings of one sixth, but you get it back in about three years from your electricity savings and the re-design of your refrigerator becomes highly cost effective. These are the kinds of measures I am talking about—of course, throughout the economy, not just in the household—and they add up to a very large saving, indeed.

You notice that I am not assuming here any significant changes in how we live, where we live, or how we organize our society. I am assuming traditional industrial growth for people who think that conserving energy is a good idea. If you happen to think that today's values or institutions are imperfect, as I am told some people do, then of course, you are welcome to assume some mixture of technical and social change which would make this all easier, but I have not done that. I have tried to keep my personal preferences separate from my analytic assumptions. I suspect that I have even *under*estimated the scope of purely technical savings in energy.

In fact, to nail that down I thought it would be fun to show you a little sociological matrix I made up showing how much total energy various people thought this country would need in the year 2000 (Table 1). It is measured in units called "quads" per year (one quad equals 10^{15} BTU). We now use about 78 quads per year. I have classified these forecasts according to when they were made and who made them. One of the Huxleys said that all knowledge is fated to start as heresy and end as superstition, so I have those categories with "conventional wisdom" in between. I have also included a preheretical phase called "beyond the pale," which means nobody even reads it.

Back in 1972 before the embargo, people like me were suggesting that 125 quads of energy per year was a reasonable estimate of energy demand in the year 2000. (I think John Holdren of Berkeley was down below 100. He was almost unique in that.) The Sierra Club was heretically suggesting 140, but that was unheard of because the Atomic Energy Commission was secure in the conventional wisdom of 160. Other Federal agencies were up around 190 and I think Exxon was around 230. It's all pretty ambitious compared to the present 75 or so. Those were the days when energy planning was done by an army of chimpanzees armed with semi-log paper and rulers.

Then in 1974, of course, we had experience the embargo and the Ford Energy Policy Project, whose 100-quad scenario was not taken very seriously, but the 124 "Technical Fix" was because it was so much lower

TABLE 1.

EVOLUTION OF APPROXIMATE FORECASTS
OF U.S. PRIMARY ENERGY DEMAND IN
THE YEAR 2000[2]
(in Quads/Year = 10^{15} BTU/Year)

(1972-8 Rate: Ca. 75 Q/Y)

YEAR OF FORECAST	SOURCE OF FORECAST			
	Beyond The Pale	Heresy	Conventional Wisdom	Superstition
1972	125	140	160	190
	Lovins	Sierra Club	AEC	BuMines, FPC
1974	100	124	140	160
	EPP (ZEG)	EPP (TF)	ERDA	EEI, EPRI
1976	75	89 - 95	124	140
	Lovins	von Hippel/Lovins & Williams/For.Aff.	ERDA	EEI
1978	33	63 - 77	96 - 101	124
	Steinhart (for 2050)	CONAES Cons. & Dem. Panel (for 2010) (1) (II) (III)	/IEA /(Weinberg)	Lapp

than the Energy Research and Development Administration's or the utilities' estimates.

In 1976 in *Foreign Affairs*, I was suggesting that 95 quads of energy per year would be ample, but in speeches I was already saying that 75 made much better use of the technical fixes which by then we had already discovered. Some Princeton analysts came up with a solid 89 (I think they are now down to 62, but I get ahead of myself). By then ERDA had come down from 120 to 124; they had discovered technical fixes. Edison Electric Institute had dropped down to 140; they had discovered price elasticity. And in 1978, John Steinhart of Wisconsin, for the year 2050, was talking about 33 quads. If you read *Science* magazine, 14 April 1978, you will have seen the very distinguished Demand Panel of the CONAES Study of the National Academy of Sciences giving some scenarios for the year 2010, including 77 and 96 quads, which were pure technical fixes, and 63, which could have been. Alvin Weinberg, the granddaddy of the nuclear business, was by then happy with 101, and even Ralph Lapp was happy with 124. And this matrix even turns out to have some predictive power because about 6 months after I made it, Dr. Schlesinger gave his latest forecast with what now looks like a rather modest oil price of $32 per barrell. He came out with 95 quads; in other words, the estimate which was two years earlier greeted with howls of derision when I put it in *Foreign Affairs* was then the official forecast in 1978; and indeed the low oil price forecast, which I will stick in the right-hand column because they require supernatural intervention, averages to 123, and those numbers are right where they ought to be. Now what I would like you to observe is that this is a diagonal matrix. Every two years you see things are neatly popping down into the next column. We have nowhere hit bottom yet. For example, we just found out that, if we had a really energy-conscious materials policy, just that would roughly treble our national energy efficiency; but we did not know that, so it is not in any of these numbers. And if you take seriously some of the latest European results, very careful results especially from Britain and Germany, and apply them to American conditions, then in about another two rows people ought to be leveling off pretty much at a long-term United States energy need around 10 or 15 quads. I do take that seriously now. I now think that my old forecasts are enormously inflated (looking at Mark Christensen as I say that). Indeed, as I read review drafts of papers people are doing, it seems that the 1980 numbers are going to come out exactly where they ought to according to my little predictions here.

Clearly, if our long-term energy needs are going to level off (see Figure 4) which shows an energy use estimate that is too high but let us use it anyway for the shape) and come down a bit, rather than zooming upward, then we could do much more a lot faster with soft technologies than we used to think we could. I define soft technologies by five specific properties: (1) They are diverse; there are dozens of different kinds, each one used to do what it does best, not trying to be a panacea. (2) They are renewable; they run on sun, wind, water, farm and forestry wastes, not on depletable fuels. (3) Thirdly, they are relatively simple and understandable from the user's point of view—but of course, they can still be technically very sophisticated. This calculator, for example, is a very high-technology gadget. I do not quite know what goes on in there; I do not think I could make one; but what I care about as a user is that to me this is a tool, not a machine. I run it, it does not run me. (At least not very often. I sacrifice a goat to it daily.) It is something I can make up my own mind about. It is not run by a mysterious technological priesthood. It is not some giant lurking over the horizon that is kind of arcane and I am not initiated into its mysteries. So that is the kind of social criterion I have in mind under this third point. (4) They are matched in scale to end-use needs. (5) They are matched in energy quality to end-use needs.

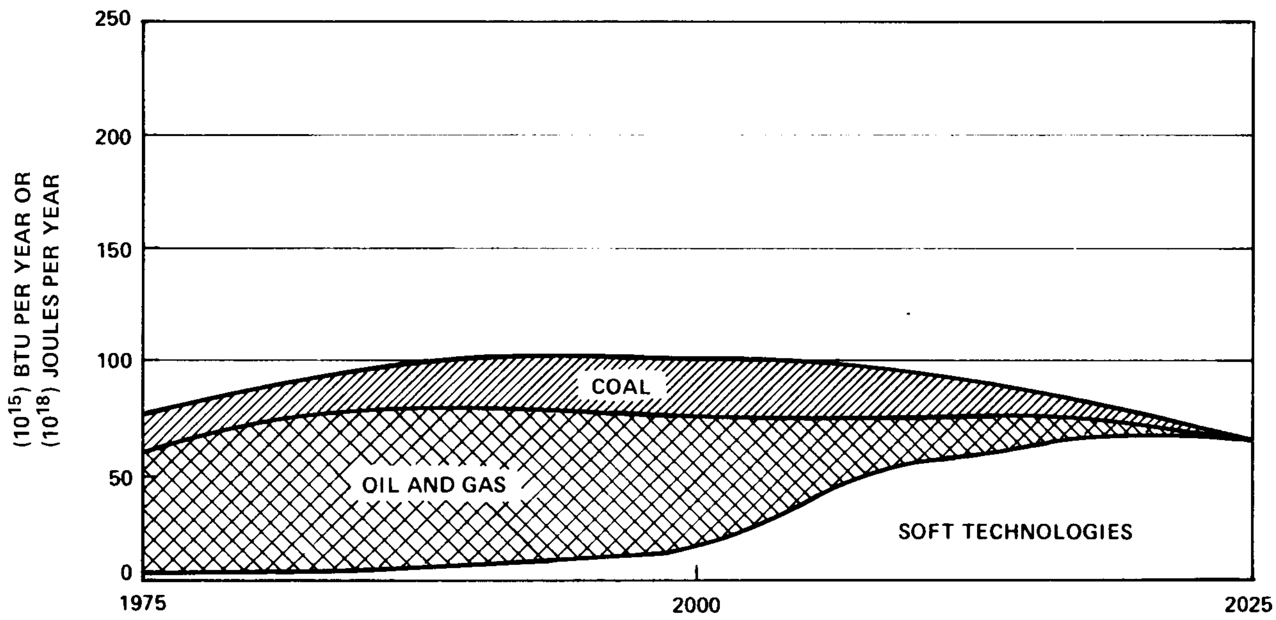

Figure 4. AN ALTERNATE FUTURE FOR U.S. GROSS PRIMARY ENERGY USE

TABLE 2.

DISECONOMIES OF LARGE-SCALE SYSTEMS

1. Cost of Associated Distribution Networks
2. Energy Losses Incurred by Distribution Networks
3. Inability to use Mass-Production Techniques
4. Direct Diseconomies from E.G. Increased Requirement for and Difficulty of Arranging Spinning Reserve
5. Indirect Diseconomies from Long Lead Time (Increased Exposure to Interest and Escalation During Construction, Mistimed Demand Forecasts, Union Wage Pressure, Changes in Political Climate and Regulatory Requirements, etc.)

Plus More Subtle Effects Such As

6. Centrism, Autarchy, Technocracy, and Related Political Issues
7. Vulnerability (Social, Political, Military)
8. Centralization Inequitably Assocates Costs and Benefits to Different Groups
9. Increased Local and Regional Environmental Stress (Siting Problems)
10. Loss of Diversity, Thus Increasing the Likelihood and Consequences of Mistakes and Malfunctions
11. Encourages Oligopoly and Technical Monopoly
12. Reduced Relevance to Needs of Developing Countries
13. Reduced Personal Responsibility in Large Technical Organizations
14. Produces Disproportionately Influential Promotional Constituencies
15. Less Fun to Do and Too Big for Technologists to Play with, So Discouraging Fundamental Innovation

These last two are very important points and I want to amplify them in turn, so let me start with scale.

We have often been told that energy systems must be enormous to be affordable, and there are often some real economies of scale in construction. There are also, however, some real diseconomies of 2 large scale systems which we just have not properly counted before (Table 2). For example, if you make a refinery, gas plant, power plant, or anything else bigger, more centralized, then you have to pay for a bigger and costlier distribution network to spread out the energy to dispersed users. That distribution network can be awfully expensive. It is typically about half the investment in the electric system, for example. If you were an average residential customer for electricity in 1972 or for gas in 1977, then you were paying about 29 cents of your utility-bill dollar to buy energy, and the other 71 cents was paid for getting it delivered to you. That is a diseconomy of centralization. Secondly, some of the energy gets lost along the way. It may not be a big amount, it might be about 5 or 10 percent, but it adds up. Thirdly, we cannot mass produce, say, power stations the way we do cars. If we could, they would cost at least ten times less than they do. They are too big to handle in that way. And also because they are too big, we cannot conveniently use total energy systems—use waste heat and save a lot more money that way. We cannot integrate energy and agricultural systems very well either because they are too big.

Continuing with this argument, some direct diseconomies of scale show up, for example here (Figure 5). This graph shows a sample of half of all the thermal power stations commissioned in the United States in a recent two-year period. You notice that as the plants got bigger, the fraction of the time that they did not work also got bigger: it went up from about 10 to about 35 percent, for very good technical reasons that are not going to go away. But actually it is even worse than that because, if one of these thousand-megawatt stations dies on you, it is embarassing. It is like having an elephant die in the drawing room and you have a thousand-megawatt elephant standing by to haul the carcass away. Now suppose that instead of paying for all that so-called "reserve margin," you built several smaller plants of only a few hundred megawatts each. Because there are several of them, they probably would not all fail at the same time, so you would not need to plan on as much loss of capacity at once, so you do not need as much reserve margin; and in a typical grid, for that reason, if you switched to the smaller plant size, you could do just the same job just as reliably with about a third less new capacity. Congratulations! You just saved $300 million. And if you went to say 10-or 15-megawatt units at the substation, quite dispersed, you could often get by with only a third as much new capacity to do the same job.

So there are some direct diseconomies of scale present in large scale systems in the form of unreliability and reserve requirements. There are also some indirect effects which show up in the lower curve (of Figure 5). This shows how much capital we had to invest in various plant sizes to install a kilowatt of new capacity. According to classical economy-of-scale theories, it should just go straight up to the left: that is, the bigger plant should be cheaper per kilowatt as we have always been told. Except

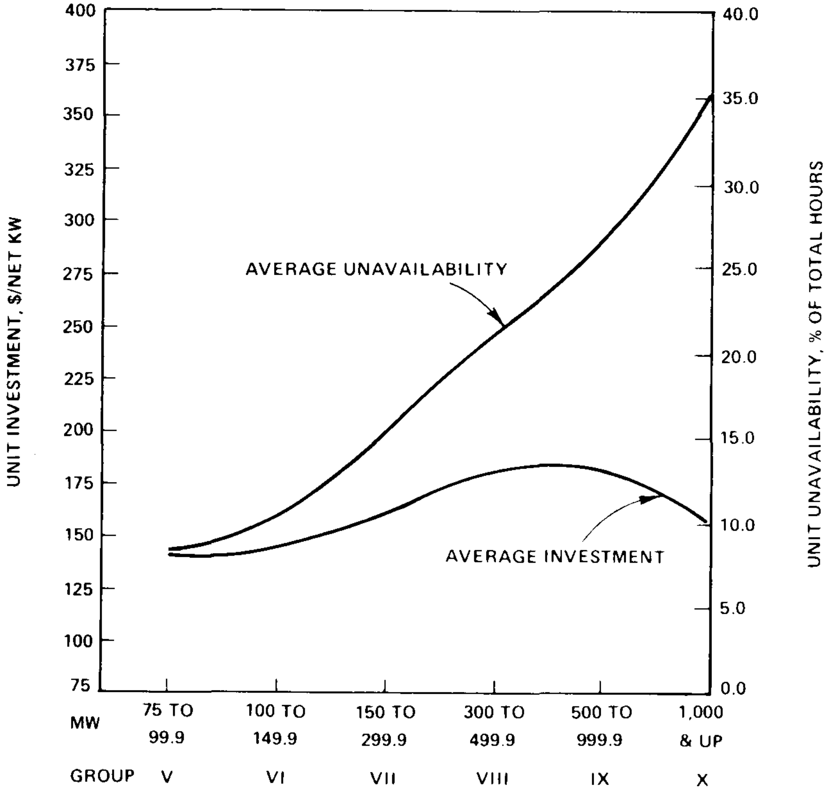

Figure 5. EFFECT OF EXCESSIVE SHUTDOWNS ON OUTPUT OF LARGE UNITS

that there is something funny going on because it is actually costing us less to install the kilowatt in a small plant than in a very big one. I suspect—and there is a lot of evidence emerging on this now—that this is because the small plant is so much *faster* to build that it protects you from cost escalation, interest payments, changes in regulatory requirements during construction, technical changes, and especially the uncertainty in future demand. It is a sad story: in the United States investor-owned utilities forecast demand one year ahead over the past five years—and you would think that one year ahead they would have a pretty good handle on demand. They have actually forecast high with a margin of error that averaged 2½ times the actual load growth, which is not a very good forecasting record. If you do that and you are locked into things that take ten years to build, before you know it, you are bankrupt. You have all these plants sitting around and you cannot sell what they produce, so you are stuck. Then the less people use, the more you have to charge. Whereas, if you have short-lead-time plants, then you have a much lower-inertia investment program that protects you better from uncertainty.

Those are some pretty obvious diseconomies of scale, but then there are some more subtle ones which I think are probably even more important, but they are harder to quantify, so some people do not count them so much. For example, there are all the political side effects I mentioned earlier. I would especially note military vulnerability: there is no point in having an army if a few people can come turn you off. That is called national insecurity. Then there is increased local, social, and environmental stress around the site of a big plant—for example, the boomtown phenomenon becoming well known out here. And that means it is harder to get a site to build the plant, so when the utility, oil company, or coal company can get a license to build that plant, they will probably want to put as much capacity on the site as possible. But that makes the plant a worse neighbor than it would have been, so there is a political reaction to that, and it becomes harder to get the next site, so the transaction costs go up exponentially. We are well into that loop—it is called various siting councils. It then becomes possible to make truly large mistakes. (We call that in the East the "Con Ed Syndrome.") We are encouraging oligopoly because small business cannot make big machines. What we are doing is less relevant to the needs of most of the people in the world. The technologists, themselves, have less personal responsibility and scope for innovation, and policy tends to pass into the hands of big promotional constituencies. Anyway, as Freeman Dyson points out, big technologies are less fun to do and too big to play with, so technologists cannot be as innovative as they would be with smaller, simpler things that a lot of people can tinker with. That is where most of our progress has come from in recent years.

Now I think all of these effects are real and important; but if you like to count only what is easily countable, as I fear many people do, then you will probably want to stick to the first five. Let me just stick to the first two, just the costs and losses of distribution and do a little economics.

I was brought up as a normal, healthy technotwit, and I always assumed that, although soft technologies were nice, they would cost more. But then I started shopping around for the best technologies of every kind; seeing what was actually available, how much it cost, how well it worked, and using these real cost and performance data to calculate how much whole energy systems cost to deliver new energy to final users at a given rate, like a barrel of oil per day. So this is again a measure of capital intensity. You have already seen the steeply rising capital intensity of the hard technologies; and the lower capital intensity of energy-saving measures is pretty well known. But I have found something rather surprising about the soft technologies—it sure surprised me—and that is that actually they are cheaper than hard technologies to do the same jobs.

For example, suppose you have a house. The cheapest, easiest, quickest thing to do with it is retrofit it to the teeth, plug up the square yard of holes in it, insulate it very heavily—what is now called superinsulation—and you have to do it right, but it can certainly be done even to existing houses. Swedes in particular have very good techniques for retrofit. You can even make the house essentially airtight and ventilated through a heat exchanger. You can recover waste heat from your graywater going out of the house and use that to preheat water going into your water heater. It costs money to do all these things. However, it is cheaper than not doing it. Your payback will still be some years, and as energy prices rise, you will be very happy you did it. If you do a really good job, you will not need any heating when you get through because you will be heated by the people, windows, lights, and appliances and that will probably work even in this climate, judging from recent experience in the West. If you still wanted some heat—if perhaps you did not do quite as thorough a job—then as many of you have found out, the cheapest way to add heat is to stick a greenhouse on the south side of your house. That heats better than flat plates and costs a lot less. It is also nice to sit out there amongst your tomatoes in February. If you do not want to do that, you can put in a seasonal-storage active solar heating system, and if you do it for district heating on a neighborhood scale, it is a very good deal—it competes with $8 a barrel oil right now.

If you do not want to do that, you can use a 100 percent active solar heating system just for your house. And yet, if you shop carefully, that fancy solar system, added to an efficient house, will cost you less than half as much capital as you would otherwise have to pay to build a very efficient nuclear-powered heat pump system to heat the same house. And it would probably cost you less capital than a synthetic gas and furnace system. And so on. Whether you are talking about space heating, high temperature heat for industry, making farm and forestry wastes into liquid fuels (alcohol and pyrolysis oil), or making electricity, you find the same answer: that, although the soft technologies are not cheap, they are generally cheaper than not having them. They may or may not be cheaper than present oil and gas—some are, some are not; but what matters is that they are a lot cheaper than what you would *otherwise* have to do to replace present oil and gas (synthetics, for example.)

Now you notice that I am comparing all these alternatives with each other. I do not think you will find any Department of Energy publication that does that. They like to play a little shell game with the costs. The way it works is that they take things they like to build, like different kinds of power stations and synthetic fuel plants, and compare their costs with each other. Then when it comes to the things they have not historically been so excited about, like conservation and solar, they will compare those costs, not with the competing hard technologies, but instead with the historically cheap (and heavily subsidized) oil and gas, which we are running out of and which all of these things are therefore meant to replace. So the Department says oil costs us, depending on where it comes from, say $10 or $20 a barrel, $20-$25 for imports, and we will therefore reject as "uneconomic" the more expensive kinds of soft technology—some kinds of biomass fuels and solar heat which might come in at $20 or $25 a barrel—because they might cost more than the oil. But at the same time, we are asked to put zillions of dollars of our money into subsidies for synthetic fuels at $30 to $60 a barrel, or nuclear electricity at $100 a barrel. That is crazy (or more formally, that leads to a misallocation). Clearly what we ought to be doing is comparing all our investment opportunities *with each other,* not some with each other and some with the cheap oil and gas. And when we do that, we find that the cheapest things to do are the efficiency improvements, then the soft technologies, then (quite a way after that) the synthetic fuels, and worst of all, the central electric systems. Our national energy policy has, of course, taken it in reverse order—worst buys first. We are now in Phase 2; we have gone from power stations to synthetics. We have not yet discovered the relatively cheap ways to do it.

Now I think I ought to go on from here to the more fundamental question not of what class of energy supply system to build—hard or soft—but of what kind of energy to supply with it. If you decide not to build a new power plant like Rifle, or whatever your favorite local turkey is, that does not mean you should go out and look for another way to deliver big blocks of electricity. That is not the point. What you are looking for is how best to do the jobs that you would have done with the oil and gas if you had them in the first place—and it was because they were becoming scarce that your utilities told you you had to build more power plants to use coal and uranium. So what are we really trying to do with the energy? This concerns the fifth and most important part of the definition of soft technologies—that they should supply energy of the right *quality* for each task. In the United States, for example, it turns out that 58 percent of our delivered energy needs are required as heat, mainly at low temperatures. Another 34 percent is portable liquid fuels for vehicles. Only 8 percent is for the premium uses that need electricity and that can give you your money's worth out of it—because it is very special expensive stuff. It is a special kind of energy; it can do difficult kinds of work; and you pay for it accordingly. You will be lucky to get new electricity at less than 6-plus cents per kilowatt-hour delivered. But that is equivalent on a heat basis to oil at over $100 a barrel (about $2.40 a gallon). If you were going to use it to run motors, electronics, lights, smelters, special uses like that that really need electricity, you might be willing to pay that kind of price. But those special uses, which are only 8 percent of all our delivered energy needs, are already filled up—because today we supply not 8 but 13 percent as electricity, with more on the way. Where does the extra 5 percent go? It is already going where more electricity would have to go if we made more; namely to low-temperature heating and cooling. That is a waste of such special energy. You cannot get your money's worth out of it. It is kind of like using a forest fire to fry an egg, or cutting butter with a chainsaw!

Our energy supply problem is thus overwhelmingly—92 percent—a problem of heat and of portable liquid fuels for vehicles. But generating more electricity is too slow and much too expensive to be a rational response to that problem. So arguing about what kind of power station to build, which I am told is still a favorite Colorado pastime, is really missing the point. It is like debating the best buy in mansions when all you need or can afford is a little apartment. (Of course, arguing about what kind of synthetic fuel to use to heat your house is equally the wrong question. You do not need a special fuel that you can carry around with you to do something easy like producing heat at 60 to 70 degrees.)

Now let me give a little example of why it is important to realize exactly what the energy problem is. Many of you have probably seen what is called a "spaghetti chart." It is a gadget used by energy planners to describe the energy flows in a country. You draw a chart which has going into it on the left-hand side all the different primary fuel inputs—oil, gas, coal, etc.—and on the right are listed the different things you use energy for, like making steel, running cars, heating your house, and so on; in between, different kinds of energy flow by various conversion processes to different destinations, so the charts looks like a big tangle of spaghetti. Energy goes every which way.

A few years ago in France, the energy conservation people in the government started at the right-hand end of the chart, and they asked, "What is the best way to heat a house?" They looked at a particular end-use task and they decided the worst way to do that task was with electricity. So they had a big fight with the utility, which they won, and as a result, electricity is to be discouraged and if possible phased out for heating in France because it is such a waste of money and fuel. Meanwhile, down the street the energy supply side of the French Government said, "Here is some oil going into our energy system. We want to replace that oil. Oil is energy. We need another kind of energy. Nukes give us energy. We will build nukes." But they did not ask where it was going to go after that. So they proceeded in opposite directions, and these two conflicting views of the nature of the French energy problem have collided in the middle, because just a few months ago the planners realized that the only way that they can sell most of that planned nuclear electricity is for electric heating, which they had agreed not to do. Our utilities here have been working themselves into just the same position. So when we talk about whether the energy problem means supplying more total energy or meeting end-use needs in the best way for each task, that is not an academic distinction; it has a very concrete meaning for what we actually go out and buy.

Now suppose that the United States were to supply electricity only for the tasks that require it and to do those tasks efficiently. In that case, we could live just as well as we do now, with no significant change in lifestyle, using less than a third as much electricity. If we did that, we would not need *any* thermal power stations; we would do very nicely with present hydro, small scale hydro, and a modest amount of wind. It is an interesting thought experiment because it shows how far out of step we are with the economically efficient ideal of supplying energy in the right quality for the task. But if we did that, we could largely eliminate the costs and losses of converting energy. And if we supplied energy in the right scale for each task, we could largely eliminate the costs and losses of distributing the energy because it would already be where we wanted it. Those two kinds of losses, conversion and distribution, take up most of the growth in the hard energy path. The primary energy (the fuel that you pour into the hopper) zooms up, but the delivered energy that gets to you hardly goes up at all, because the difference is lost in conversion and distribution. Whereas in a soft path, by matching the supply to the need, we gradually squeeze out most of those losses; and meanwhile, because we'd be wringing several times as much work out of each unit of energy that was delivered, the "delivered function," the goods and services, (or, if you like, the GNP) we got out would actually end up a good deal higher than in the hard path even though we were using less energy. We'd be doing more with less.

We've had in recent years extraordinarily rapid technical progress with a wide range of soft technologies. I've shown in some technical papers elsewhere that if you take the best soft technologies now in or entering commercial service—that is, things that are already here and we don't need to wait for them—and if you add them all up and use each one to do what it does best, there are more than enough to meet essentially all long-term energy needs, even for countries like Japan or Denmark (which were the first ones we looked at). I'm not assuming here any cheap solar cells, although I think they'll be here before we know what to do with them. I'm not assuming things that are not on the market. What I'm assuming is the best present technology in passive and active solar heating, solar process heat for industry, converting farm and forestry wastes (not special crops), to liquid fuels to run efficient vehicles, present hydro, the readily available small-scale hydro, and a bit of wind—some for electricity, more of it for water pumping, heat pumping and compressing air to run machines. I think these, used to advantage, add up to more than enough. And yet, even though we've got them, it'll take a long time to put them all in place. It might take about fifty years because it takes that long to do anything in the energy system, since it's so big and sluggish. So, meanwhile, we will certainly need to buy that time by briefly and sparingly using fossil fuels to build a bridge. And we ought to use them in clean ways, as we know how to, in ways that are designed to plug in the soft technologies as they come along. For example, we can have a clean, coal-fired district heating system which is later converted to solar district heat using the same plumbing all over town. I think if we do that, we can squeeze down the oil-and-gas wedge from both sides, with only a modest and temporary expansion of coal-mining, not requiring significant Western stripping. (You notice I'm careful to say "coal mining" rather than "coal production." I wish I knew how to "produce" money out of my bank account or to "develop" my bank account by pulling money out of it.) We would thus be constructing this very different sort of energy future, not by wiping the slate clean, but by starting where we are, and doing different things from now on. We wouldn't be abolishing technologies, but rather saying that they have an important place which they've filled up, and we can take advantage of the ones we've got without multiplying them further. It's not an anti-technology program. It involves very exciting technical challenges—but of a different and to some people an unfamiliar kind, making things that are sophisticated in their simplicity, not in their complexity.

I set up these two paths, you remember, as a vehicle for ideas, and I want quickly to run through some comparisons between them. I've already suggested the soft path is cheaper. It works out to be about three times cheaper in what you finally pay for your energy services. It is also much less demanding of capital, because not only is it less capital intensive, but you turn over your money faster, and hence need less working capital.

The soft energy path is also quicker. That is, for each dollar invested it gives you more energy, money and jobs back faster, because the things you're building take less time to build; they sell spontaneously into a big consumer market, like CB radios or snowmobiles, rather than requiring delivery to a specialized market, like power plants; and there are many different kinds of soft technology, each held back by different problems that are largely independent of the others. Passive solar is held back by the need to retread architects and builders, micro-hydro is held back by regulatory hassles, and so on; and because those are separate problems, these separate, slowly-growing sources can independently add up by strength of numbers to very rapid total growth. It's not the same as putting your bets on monolithic technologies like synthetic fuels and nuclear that have the same problems everywhere at once. For the same reason, the risk of technical failure is much lower when you spread it among dozens of simple things known to work, than when you put all your eggs in a few baskets like big coal-gas plants and oil-shale plants, and breeders which aren't here and may or may not work.

The soft path is environmentally much more benign. It hedges your bets on the climatic problems, like carbon dioxide, by just getting you out of the whole fossil-fuel-burning business as fast as possible. The soft path is also well suited not only to urban and industrial societies but also to modern development concepts.

There's a neat encapsulation of that case in Table 3—some empirical

TABLE 3.

COMPARISON OF TWO METHODS
OF PRODUCING 2.3×10^8 KG OF FIXED NITROGEN PER YEAR
(From: A.K.N. Reddy, Indian Institute of Science, Bangalore)

Characteristic Compared	Western-Style Fertilizer Plant[3]	Indian-Style Village Plant[3]
Number of Plants	1	26,150
Total Capital Cost	$\$140 \times 10^6$	$\$125 \times 10^6$
Foreign Exchange	$-\$70 \times 10^6$	0
Direct Employment	1×10^3	131×10^3
Energy Balance (TWh/y)	-0.1	+6.35

data on two ways to make nitrogen fertilizer in India at a given rate. One way is to build a single western-style fertilizer plant. Another way is to build 26,000-odd village-scale Gobar gas plants. Those turn out to have a lower total capital cost (half that much with Chinese technology), zero foreign exchange drain, create over 100 times more jobs in a country with a labor surplus and a capital shortage, and instead of being a net energy consumer, they are a net producer of so much methane that it can meet essentially all the cooking, lighting, and pumping needs of the villages, and that's half the energy needs of India right now. What's happening now, of course, is that the dung is burned for cooking in open fires. All the nitrogen and most of the heat go up in smoke, which blinds people. Instead, with the Gobar gas plants, you get out a better fertilizer than you started with, plus a clean and efficient fuel; you break the cycle of firewood shortage, deforestation, and erosion. In an Indian context this is clearly an example of a very powerful development tool—which is why China has installed more than 9 million such plants since 1972.

Another important geopolitical side effect of the soft path is that it gives us a very strong political lever for stopping proliferation of nuclear weapons. (We can come back to that point later if you like.) But the last comparison I want to make between the paths, and the one that really defines the difference between them, is politics, because each path entails difficult political problems of very different kinds. In the hard path, problems like centrism, vulnerability, technocracy, inequity prevail and in the soft path, less familiar problems arise, like pluralism—how do we get used to doing with billions of individual choices in a market that we would otherwise do with a few big projects run from Washington or Denver? This concept may be a rather difficult adjustment for central managers, but there is no energy future free of social problems. You have to choose which kinds of problems you want. There's no free lunch; some lunches are just cheaper than others. I think that the social problems of a soft path are a lot more tractable, and get easier as we move ahead rather than harder. In fact, I contend that the social and economic advantages of a soft path are so great that if we let them show themselves, it would largely implement itself through existing market and political processes.

To get that ball rolling, we ought to do three things. The first and most difficult is to clear away, mainly at a state and local level, a long a messy list of what are called "institutional barriers," or in economist's jargon, "market imperfections." That is, silly rules and habits which keep people from using energy in a way that saves money. For example, we have obsolete building codes and mortgage regulations, restrictive utility practices, inequitable access to capital (I think there's a neat answer to that one),[4] architectural fee structures that encourage inefficient buildings, and split incentives (for example, why should your landlord stuff up the cracks around the window if you pay for the heat, or why should a builder make a better house that costs a little more if you're going to pay for the heat later and all the builder wants is to sell a cheap house in the first place?). These are difficult problems. If we're not smart enough to solve them, however, I think we won't be smart enough to solve the much more formidable political problems of a hard energy path.

Secondly, mainly at the Federal level (although the states can do this too), we ought to stop spending about $100 billion a year of our tax money to subsidize conventional fuels and power to make them look cheaper than they really are. That's a very expensive kind of self-deception. We are at the point in California where there's a 55% state solar tax credit that's actually less than the Federal tax subsidies being offered to Alaskan gas. So you start off with solar heat that's cheaper than gas, then you subsidize them both out of your pocket at great expense so that the gas can look cheaper than the solar.

Thirdly, we ought to move gradually and fairly (as I think we can) towards charging ourselves for depletable fuels and whatever it will cost us to replace them in the long run. Not doing that is just a sophisticated way of stealing from our children. (There is also a way in which we can get around that problem by not moving to those prices and yet acting as if we had. We might go into that later on.)

Now, it won't be easy to do any of those three things. But I think it is easier than *not* doing them. And if they're done right, they can have a great political appeal, because unlike the hard path, the soft path has advantages for almost every constituency. It offers, for example, jobs for the unemployed, capital for business-people (otherwise their capital goes to energy and they never see it again), savings for consumers, chances for small business to innovate and for big business to recycle itself, better national security for the military, environmental protection for conservationists, exciting technologies for the secular, a rebirth of spiritual values for the religious, world order and equity for globalists, energy independence for isolationists, traditional values for the old, radical reforms for the young, civil rights for liberals, and states' rights for conservatives. Soft energy doesn't quite make Westinghouse happy, because I think Westinghouse might wrongly see it as a threat rather than an opportunity, but it does cut across the kinds of traditional, ideological disputes that have been stalling energy policy.

We've just spent two years in the Senate saying that before we could even start on an energy policy we have to agree on price versus regulation, capitalism versus socialism, Jefferson versus Hamilton, the future of the oil companies, and the whole shape of our society. We never agreed about any of those things. We never will. Life would be very dull if we did. But if we make these arguments a prerequisite for energy policy, hell will freeze over first—maybe literally. In a soft path those kinds of disputes don't much matter, because if you're an economic traditionalist and you just want to do what's cheapest for you, that's okay: you can go ahead and build your solar collector because it's cheaper than not doing it. If you're a worker, you might want to build it because it gives you more and better jobs than building power stations or synfuel plants. If you're an environmentalist, you might want to build it because it's benign, or if you're a social transformationalist you might want to build it because it's autonomous. So what? It's still the same collector. You don't have to agree, before or after, about why you built it.

We have in this country an overwhelming consensus that energy husbandry and benign renewable sources are a good way to go. We've got no consensus on anything else in energy, and I doubt we ever will. So maybe what we ought to be doing is starting with the consensus we've got and designing an energy policy around it. We've never tried that. But it seems long past the time we should have started.

Yet I think the time left for us to do that is short, because although each of these paths is illustrative and embraces infinite variations on a theme, there is a sense in which they're mutually exclusive. I don't mean by that, as some people have supposed, that hard and soft *technologies are technically incompatible*, because they're not. There's nothing technical to stop you from putting solar panels on top of Fort St. Vrain, it might even help it work better. Indeed, in a soft path you'd start off with a bunch of hard technologies; you'd end up 50 years later with soft technologies; and in between time they'd be coexisting side by side for those fifty years as the mix gradually shifted. But that shift takes place within a social and political context, and it's there, I think, that three kinds of exclusivity arise.

The first one might be called cultural. Each of these worlds just makes the other kind of world harder to imagine. Where we are now is a great example: there are a lot of people around who cannot imagine any approach to the energy problem except what they've been doing for the past thirty years, just because of cultural conditioning. Secondly, each of these paths builds up around itself thick layers of laws, institutions, habits, institutional barriers, which inhibit change—just as today we're surrounded by a lot of old rules, and habits left over from the cheap oil era that are locking us into more of the same rather than something else. Thirdly, and most obviously, the two paths compete for resources. Every bit of work and skill, every dollar, every precious barrel of oil, and every year which we put into these very demanding hard technologies form a resource we cannot also use to do the tasks of the soft path urgently enough so they hang together. I think in that sense, things like the synthetic fuels program are not only unnecessary—they're a positive encumberance whose resource commitment can push this soft technology wedge so far off into the future that before we can get to it our fossil fuel bridge to it has literally been burned.

So we ought, with due deliberate speed, to choose one of these broad patterns before one has foreclosed the other (or before proliferation has foreclosed both). We ought to ask where we could get to in fifty years or so and then work backwards to see how to get there smoothly, rather than just continuing by incremental adhocracy, one plant at a time, not asking where we're going. We ought to be using these relatively cheap fossil fuels, thriftily, to capitalize a transition aimed as nearly as possible straight toward our ultimate energy-income sources, because we won't have another chance to get there.

I haven't been able, in what I had thought would be a briefer talk than this, to do justice to a very rich technical background, and that wasn't actually my intention. But I hope I've left you with the impression that in energy policy the really big, difficult, important, and exciting issues are not at all too complex or too technical for ordinary people to understand—although they may well be too simple and too political for many technical experts to understand.

Notes

1. See *A Low Energy Strategy for the United Kingdom*, 1979, IIED, 10 Percy Street, London W.I, England.

2. Note that this matrix has considerable predictive power. For example, DOE's September, 1978, Domestic Policy Review forecasts for 2000 were 95 q with $32/bbl oil—squarely in the "conventional wisdom" box and identical to Lovins' *Foreign Affairs* number two years earlier—and 114 and 132 q for $25/bbl and $18/bbl oil, respectively, averaging to 123 q and belonging in the "superstition" column, since such low prices presumably require supernatural intervention.

3. The Western-style plant is a coal-fed Fischer-Tropsch plant. Several of these are now operating in India. The Indian-style plant is a Gobar gas plant fed with human and animal wastes and crop residues. Each plant produces 142 m^3 (1500 ft^3) of high-quality methane per day plus 8.8 metric tons of nitrogen in residual fertilizer per year. The capital cost of such a plant is equivalent to about $4825 and the value of the nitrogen output to about $510/T. About 10,000 such plants are installed annually

in India. About 1 million are reportedly operating in the People's Republic of China.

4. Described in *How to Finance the Energy Transition,* available from Friends of the Earth (San Francisco).

Question and Answer Session

Q. *What sort of infrastructure will have to be developed for this transition you are talking about?*

A. I have not assumed significant changes in settlement patterns even though they are happening: as I understand it from the latest census data, people tend to be going away from the suburbs both into the city and out into the country. (The data are a little contradictory, but they make sense if you think about what's going on in both fuel price and quality of life.) I have not assumed those or any other trends. I've assumed that people live in the sorts of places that they do now. Now infrastructure will gradually have to be replaced. After all, I'm talking about 50 years. An awful lot of our cities, and indeed suburban areas, during this 50 years would have to have most of their infrastructure replaced: things like sewers and water systems and transport systems would in any event wear out. The question is, what do we buy after that? I have not tried to go beyond the energy system in analyzing how fast capital stocks turn over. But it's pretty clear that, for example, most of the factories in the country will be replaced over the next 50 years one way or another. In many cases we need to rediscover infrastructure which we are in danger of losing. The most obvious example is that in 1910 you could go from Boston to St. Louis on trolley cars; and the old inter-urban trolleys used to average anywhere from 60 to 85 miles an hour, which beats AMTRAK any day. I wish we still knew how to make trolleys.

Q. *How do we get around the problem that consumers don't see the "real" replacement cost of hard energy sources?*

A. The question is, how do you get around the problem that the consumer is seeing energy prices in which the expense of new plants is rolled in with the cheaper older plants, making the replacement cost of energy seem artificially cheapened, and making the consumer choose not to go to solar because it looks costlier than new oil or gas even when it actually isn't. I think there's a rather neat way around that which has been pioneered de facto (though not in name) by the California Public Utilities Commission. It's a simple principle which I think we can apply to Government spending as well, but let me just use it for utilities. When the utility goes to its state regulatory commission to get permission to build a new plant, suppose that it must show publicly that the plant is the cheapest way to meet your end-use needs, like giving you a comfortable house. If the utility can show that the plant is a good deal and should be built, just to keep the game honest, the utility should be told that the real plant cost that was put in the rate base should not be higher than the cost that was assumed when comparisons were being made between the plant and, say, conservation and solar. But on the other hand, if you can do the same tasks for the end user cheaper *without* building the plant, for example, with conservation and solar, then don't build it; loan out the money instead on equitable terms (I'll get to that in a minute) to do the job in those cheaper ways first. I'm actually leading up to an answer, because we've just solved your problem. The electric utilities have about ¾ of the investment in the energy system; if you count the gas utilities it's even more than that. So with most of the investment going into energy, we're now directly comparing the new power plant or gas plant with conservation and solar; and if the conservation and solar are cheaper than that long-run replacement cost, then they will get built instead, even though the consumer may see all this apparently cheap oil and gas sloshing around. So we are now allocating most of our energy capital as if energy were priced at long-run replacement cost, but *without* having to get to those nasty high prices first.

For utility loans on equitable terms, I think two basic rules ought to apply. One is that you should get money as cheaply as the utility does. They should pass through to you whatever subsidies they get. Secondly, you should repay your loan for your fuel saving investment only as fast as your energy savings save you money. If you borrow $5000 to fix up your house and maybe go solar, and this saves you $500 a year in fuel bills, you should pay back only $500 a year or a little less, so that you don't have to come up with any capital. You're paying the same as if you'd done nothing. But when you've paid off the loan, of course, your bill is lower and meanwhile you're protected from inflation and interruptions. That's a good deal for you, and the utility would only do the financing—it would act like a bank, but it wouldn't install, lease, maintain or specify what you did. You'd just get the money and you'd use it at your own discretion.

Why do utilities do this? First of all, they save a lot of capital. Your investment is cheaper than theirs. Second, they're turning over their money much faster. Your system takes days or weeks or months to build and a few years to pay back. Theirs takes 10 years to build and 30 to pay back. So if they loan you the money instead of building a power plant with it, they turn over their money much faster. They can do more work with it. They improve their effective rate of return (they like that idea). And thirdly, they avoid overbuilding and going bankrupt. That's a good incentive. Utilities invented conservation loans for good economic reasons. We have utilities now in some parts of the country (for example, Pacific Power & Light, Portland, Oregon) which give zero interest conservation loans with a 10 year pay back period. I think they could do even better than that. Some of them will even come in and insulate your electric water heater free because it saves them so much money. You see, kilowatts that are now committed to heating your crawl space can now generate electricity which the utility can turn around and sell to someone else without having to build a new plant to generate it. That's a good deal for them. This kind of system has a number of financing options. It really has a lot to recommend it. It isn't the same, by the way, as what the (Carter) Administration has just proposed. But it has the economic effect that everyone has equitable access to capital, whether you're rich or poor, using hard or soft technology, conservation, or supply. And it has the very important political advantage that it co-opts utilities into the transitional process because then for them it isn't a threat—it's a better business to get into. So, over the next 50 years while they turn into distribution services like the phone company, you give them something to do that they can do well, namely banking and using their present infrastructure—they have a billing relationship with you already, so it doesn't cost much to set up. If you can't lick 'em, make 'em join you.

Q. *What about all the capital equipment the utilities now own?*

A. With gas and indeed with (say) water in Southern California, or electricity in some places, if the utility gets overbuilt, then you can have the problem that the less you use the more they charge you for it. In gas I would be a little surprised if that were a common occurrence because the pipelines, by the time the gas is gone, will be amortized many times over. They have had accelerated depreciation as I understand it. I don't know as much about gas as I do about electricity, but I'm told they have done very well in amortizing pipelines.

I don't think it makes sense to try to fill up pipelines with synthetic gas just to get more use out of the pipelines. The synthetic gas, if the plants work at all, will be extremely expensive. There is some unconventional gas around which at higher prices will come out and that does make sense. But I think in the long run the pipeline grid in this country, unless we find quite different uses for it, like alcohol, may be something of an archaeological artifact rather like the canals have been. Except by then we'll be using the canals again.

Q. *Do we have enough land to supply alcohol for vehicles, and how do we work it into the current gasoline supply system?*

A. Let me start with the use and then with where you get the alcohol. Alcohol is pretty easy to use. Racing drivers have used methanol for many decades. In the 1930's 4 million cars in Europe ran on alcohol blends. Alcohol was something like 18 percent of Europe's motor fuel. There have been recent trials in cold climates—in Sweden and Germany and in the Midwest—of alcohol blends. Neat alcohol works very nicely. The problems have been essentially solved. You have to make a few engineering improvements on the gaskets in your fuel line, having sealing filler spouts on gas pumps so the operator does not get methanol poisoning, etc. Those are, I think, rather straightforward problems. I expect most of you know that you can burn 10-15 percent alcohol blends with no modifications to the car. It is a premium fuel—it makes your car burn clearner and run better. And you can burn straight alcohol in your car if it is somewhat modified—you may need a bigger gas tank; you would certainly need better fuel-line materials, different carburetor, and timing settings. General Motors will quite soon be producing carburetors they have already developed which have a three-way setting for alcohol, gasahol, or gasoline, so you can just flick back and forth to the setting you need. They are pretty straightforward to use and cost only a couple hundred dollars if existing cars need to be modified for their use.

The question then is where do you get the alcohols? We now use something like 16 or 17 quads a year of liquid fuels for transportation. Our average cars are getting, depending on whom you believe, 14 to 17 miles per gallon. A diesel Rabbit gets in the 40s. The turbocharged version, if they designed it for the right engine size, could do 64. VW recently made a hybrid diesel-electric car weighing 3400 pounds, and it did 83 miles a gallon the first time they turned it on. If you combine that kind of engine with light-weight body technology, you are pushing a couple hundred miles a gallon. I do not assume that, but I am just saying that it is within the present art. If we had only vehicles (and I include aircraft, which are rapidly becoming more efficient) that were as efficient as the best European versions now in normal use, we would need not 16 or 17 quads, but 6 quads. That even allows for some growth in traffic. Well, you can get 6 quads out of the farm and forestry wastes in this country as alcohols and pyrolysis oil without growing special crops. I do not find special crops for alcohol very attractive. There are some schemes like coppiced alder that might make sense, but they are rather exceptional. I do not think growing big monocultural biomass plantations for fuel makes any sense at all, ecologically or economically. But there are an awful lot of crop wastes around if we use them effectively. I must stress that the key here is to conserve soil fertility. That is going to take careful management.

Q. *Why are you wary of planting and developing our forests for the purpose of fuel production?*

A. They are very expensive and ecologically unstable. They require large chemical inputs to keep insects from coming in and nibbling them. And if you get into the same game as with present agriculture, it is a mining operation. Now the crop and forestry wastes—forestry wastes are the biggest term—are a very interesting, diverse bunch. For example, the cotton-gin trash in Texas is enough to run every vehicle in Texas, and the distressed grain in Nebraska would run an efficient vehicle fleet in Nebraska. If you start adding up all the little bits around the country, there is an awful lot of the stuff—*if* you use it efficiently. If you burn it in Broncomobiles, nothing makes sense, even gasoline. But the processes by which you convert the waste to alcohol are in very rapid transition. Some of the ways in which we are now making alcohol are excellent, some of them are completely nonsensical and a net energy loss. You really have to use the latest technology if it is going to look attractive for the long run. In particular, we have very efficient ways now of separating alcohol from water; even more efficient ones are working in the laboratory and I think will soon be in commercial operation.

Q. *What innovations do you see coming for more fuel-efficient cars, concepts they have not tried in Detroit yet?*

A. There are a lot of approaches around for super-efficient cars. There are external-combustion engines like Stirling and Ericson. I should explain what a hybrid car is. It is a pretty simple concept. It is not the kind of car that has a battery bank with an electric motor and a separate fuel-fed motor whose design varies with the conditions. What I mean instead is you have a little diesel engine, for example, which runs a generator which charges up a couple of ordinary lead-acid batters, and those run motors on the wheels. The batteries handle the surges of acceleration, so the diesel does not have to be big enough for that. It has to handle only the average load. The diesel can run at constant speed all the time, so you can make it clean and efficient. (If you do not think it is clean enough, you can go to a fuel cell if you like.) Then when the car slows down, you can use the motors as generators and get regenerative breaking. So you now have all the virtues of an electric car without having to lug around a huge battery bank. I think that makes a lot of sense.

Pure electric cars, I don't think, will ever compete with really efficient fueled cars, like hybrids, but I must say opinions differ on that. Dave

Brower used to say, "All those who believe in individual mass transit, raise your right foot!"

Q. *In my town, Holiday Inn wants to build a new Inn. How, given the free enterprise system, do I convince the town council and local bankers to make Holiday Inn build an efficient building?*

A. What free enterprise system?

There was a time when, I think last year, a lot of bankers in the Denver area were not touching solar, whereas in Montana they did it routinely, and they just had not talked to each other. Maybe you need the kind of educational effect we had in Canada. One of the reasons that a decent Federal solar program started there was because Trudeau and his Energy Minister went to open a solar building in the Maritimes on a cloudy day in the winter and the event was broadcast on national television. When Trudeau was being shown the solar plumbing he said, "I suppose you can't get much on a day like this," he grabbed the pipe, and burned his hand. Well, there are ways to get to people. You consider what is in their interest. (Yes, as a gentleman here says, "What? An uninsulated pipe?") Susan Carpenter in ROMCOE got to some bankers around Denver just by projecting a little cash flow for households in which she showed the ratio of the household utility bills to the mortgage payments in future years, with and without conservation and solar. A banker looks at that and just has the heebie-jeebies and says "Uh-oh, these people are going to start defaulting on mortgages. I don't like that."

Now your Holiday Inn architect may have an interesting problem. Architectural fees in most places are split up with the consulting engineers in such a way that, for example, the HVAC engineer would get a fee proportional to the cost of equipment installed. So there is every incentive to put in six blowers where one will do. If the profession, I think, were encouraged a little more—maybe this is already happening—one could come up with a fee structure that would reward the architect for a smart design, and then the engineers that did not have to work so hard would not get so much. Your city comissioners ought to think about the cash flow of that Holiday Inn. If it is built in the usual sieve-like fashion, it will just go broke. There are just no two ways about that. If they do not think that efficient or passive design is feasible, there are an awful lot of places they can go to learn better. You can start, for example, with SERI and the national Solar Heating and Cooling Information Center, or even nowadays with the Department of Energy. Of course, there are many public interest groups—Solar Lobby, Center for Local Self-Reliance, and so forth—with very extensive information.

Q. *What about synthetic fuels for automobiles?*

A. For the cost of many of the synthetics now proposed, you could save oil cheaper by having the Treasury pay anywhere from half to all the cost of giving people free diesel Rabbits on condition that they scrap their Broncomobiles.

There are actually serious proposals—Gary DeLoss at the Environmental Policy Center in Washington is one of the people working on them—along the following lines. One of the things now inhibiting the sale of more efficient cars is that people are, of course, short of money to buy them and cannot get the Blue Book value trading in a gas hog because nobody wants it. They have dropped $1,000 or $2,000; sometimes you cannot sell them at all. It would be definitely worthwhile, I have worked out some numbers on this, for the Treasury to buy gas hogs at Blue Book value and scrap them on receipt of a certificate that the owner has bought a new car that is at least, for example, 10 miles per gallon more efficient than the national average. If you believe, by the way, in an economic stimulus to the car industry to get us out of a recession and so on, you might like that idea too. I have not tried it on the UAW. Those types of ideas are going around, and it is quite clear that we ought to be looking for ways to accelerate the turnover of the car stock if we are really serious about cutting oil imports.

Synthetics are almost the slowest way I can think of to replace imported oil. If you really want to do it fast, you turn over the car stock fast and you fix up the buildings. Those are the big items. In fact, even without much of a legislative toolchest to work with, improved energy efficiency over the past five years has already given us twice as much energy "supply" capacity as synfuels are supposed to in ten years.

Q. *Is there a good source paper on the subsidies we are paying for nonrenewable energy sources?*

A. There are at least two classic papers. One, which has been a little updated, is by Battelle Northwest Labs, and it is called something like "An Analysis of Federal Incentives to Energy Production in the United States." It looks at conventional budget line items—research budgets, cheap money for TVA and the like, depletion allowances, and intangible drilling credits. It has been a while since I have looked at it, but I do not think it counts some of the really big items like the deferred tax liability on overseas revenues for the oil majors and a few things like that. But it still comes to over $200 billion cumulatively. You can get this report from National Technical Information Service, Springfield, Virginia.

The second report, which is more in point, is on the tax subsidies that are given on current account. The Battelle report is on the historic subsidies. But what are we *still* paying each year in investment tax credit, accelerated depreciation allowance, interest deductions, and the like? The best work I know of there is by Duane Chapman, Professor of Agricultural Economics at Cornell, and a simple version of his work for the California Energy Commission is reprinted in a Congressional Joint Economic Committee print, which you can get free from Senator Kennedy's office called, "Creating Jobs Through Energy Policy." (There is a lot of other good stuff in there too.) You can get the full version from the Publications Department of California Energy Commission, 1111 Howe Avenue, Sacramento, California 95825.

There is also a third calculation which I think has not been published and I can see why. It was done by Clark Bullard in the Policy Analysis Section of DOE. He asked a very simple question, answered it using what they call the PIES model, which nobody around there believes very much. The question was, What is the difference, as of last year, between the average energy prices people paid and the more expensive ingredients of that fuel mix—for example, the Alaskan oil, or the Canadian gas that are now coming in, or the recently-commissioned power stations? It turns out that, when you total oil, gas, coal, and electricity, the difference adds up to $67 billion last year. That's a price subsidy through rolled-in pricing and regulated pricing. However, it is not the difference between rolled-in and even short-run *marginal* cost. It is what we are already paying. The marginal cost would be the next unit we were going to buy—for example, if we built another Alaskan gas pipeline of some kind, or ordered a new power plant; and even that is lower than the long-run marginal cost. The bottom line is that the rolled-in price subsidy, very conservatively, was $67 billion last year. It is probably a lot more than that. The tax subsidies are several tens of billions of dollars, which is why I said we are spending about $100 billion each year to make the stuff look cheaper than it is.

Q. *Are there any numbers on how much these subsidies work out to be?*

A. (Supplied later: About $7 per barrel equivalent, or the same order of magnitude as the domestic average price for direct fuels. Most of the subsidies, however, go to electricity, which is priced much higher.)

Q. *Could you distinguish between an equitable way to move toward long run replacement cost pricing for depletable fuels, and just deregulating the stuff?*

A. First of all, there is no energy market. There is kind of a fuel bazaar. I do not think there ever will be an energy market. But let me address your question in a slightly different way. The approach I would prefer—it is describe in my article, "How to Finance the Energy Transition"—is to phase in a Federal tax (formally it would be a severance royalty) charged on all depletable fuels right across the board by energy content and levied as they come out of the ground or into the country. It would be essentially a BTU tax applied at the point of extraction or importation, not to energy in general, but to depletable fuels: oil, gas, coal, uranium, etc. It would gradually rise toward long-run replacement cost which I believe would be set by soft technologies because they are cheaper than hard technologies, so it would not rise very far. You would phase in this tax on an anticipatory schedule so everybody would know quite a few years ahead roughly how the price was going to behave. That is important because, if I think I know the energy price in 1990, I am going to make a lot better decisions than if I still have some hope it is going to be the same then as it is now.

Such a tax is not significantly redistributive, and I ought to explain why. The fraction of income people spend directly *and indirectly* to buy energy is a more or less constant fraction, regardless of income. If you have a high income, you tend to spend more of it on indirect energy purchases, energy embodied in goods and services, and relatively less of it buying direct fuels; whereas, if you are poor, you tend to spend more of your income on direct than on indirect purchases. Yet the total works out very nearly the same, regardless of income. That means that, if energy prices rise through a tax way back at the wellhead end, then that increase works through the economy and gets embodied in all goods and services according to their total direct and indirect energy content, so it hits everybody equally, proportional to income (which I will come back to). The tax would be a fixed-fraction tax of your income if you buy the per capita average amount of energy. Whereas, an excise tax at the end-use end, like on gasoline, hits the poor disporportionately hard. Although the kind of tax I am suggesting would not be significantly redistributive, you can use the revenues redistributively. And that is one option for handling the obvious equity problem that there are poor people that cannot afford to buy things (that's what being poor means), and there are basically two ways to handle that. One way is to subsidize energy so poor people can afford more of it. That also means you give cheap energy to rich people. Then you can make exactly the same argument for food, shelter, education, and everything else, and I do not think it makes very much sense. The other method, which I would prefer, although it takes more political nerve, is directly to make poor people less poor. I hope that helps a bit. I perhaps overcondensed because it is a very difficult issue.

Q. *What do you think of Carter's plan to take part of the windfall profits tax and redistribute it?*

A. Well, that is better than not redistributing it. But I would much prefer to phase in a severance royalty on depletables and also not to handle them one fuel at a time, which makes an awful mess. If you are going to deregulate crude oil, I think it is nuts not to deregulate products. I would prefer, if you are going to do rebates, to do them as part of general tax and welfare reform, particularly welfare. That is another issue and it gets into an entirely separate area which is that we tend to subsidize capital investment and tax employment when we should be doing the reverse. That all needs changing too.

I guess what I least like about the windfall profits tax are the uses Russell Long, and nowadays the Department of Energy, want to put it to. If you are worried about oil at $20 a barrel, it doesn't make much sense to go for synthetics at two or three times that price. Although I have not looked into the details of it, I would prefer, if you are going to spend the money for an energy purpose, the Kennedy approach of spending it on conservation, because you will get an awful lot more energy for your dollars that way.

Q. *What is happening with district heating with renewable energy sources around the world?*

A. I am told there are workshops on that in the next two days. I shoud read my program more carefully. Perhaps you should check with me later because I have some data on it. There are at least three projects in Sweden—one of which is built, one under construction, one in advance planning. I have heard that there is one in the Netherlands, one in Denmark, several in Canada, and several in this country. In the *Annual Review of Energy* last year I described some of the physics of why you cut the costs roughly in half if you go to solar district heating instead of individual solar heating.

We are running short of time. Let me take one more. You have been waiting a long time.

Q. *What about hydrogen as an energy source?*

A. Using hydrogen for space heating seems an awful waste. It is awfully easy to heat buildings, and you do not need to make hydrogen for that. If you make hydrogen out of electricity, it is going to be quite expensive, and you want to reserve it for premium, very high temperature industrial applications, I think.

By the way, back to the pipelines. There are some circumstances in which you can put hydrogen through pipelines. It depends upon what they are made of. There are some projects, I think some even built already, in which wind and microhydro are being use to produce hydrogen. That is a premium product. I have even heard of one recently in upstate New York—a microhydro rig making hydrogen that sells pretty well. I used to think hydrogen was quite dangerous. The last I heard, it looked safer than gasoline if you handle it right. Again, the problem with hydrogen is similar to alcohol: it is an engineering problem which looks to me more straightforward than most. Hydrogen storage looks darned attractive for transport. However, there is so much fuel alcohol and pyrolysis oil available from the wastes that I suspect you would end up using that instead of hydrogen; except perhaps in special applications like in air sheds where you have a particular air quality problem, you might go for hydrogen in the long run.

Now there are two things that could happen that would make hydrogen relatively cheap, and then the energy problem becomes technically trivial. One is really cheap photovoltaics, which there is a good chance we will have. The other is direct photolysis—that is, sunlight directly breaking down water. The Japanese get this to work moderately well in the laboratory. I do not think anybody has scaled it up. Those two possibilities are lurking there. I do not assume them, but they are possible and they would certainly make things much easier.

Section B
Plenary Session I: Overview

August 20, 1979

Plenary Session I: Overview

Speakers

Robert Odland, Conference Chairman
Chief, Community and Consumer Branch
Solar Energy Research Institute (SERI)

Charles J. Bishop
Supervisor, Small Systems Section, Systems Analysis Branch
SERI

Bruce Baccei
Senior Staff Architect and Program Manager, Passive Technology Branch
SERI

Summary

Chairman Odland opened the conference and provided an introduction to the topics to be covered and some of the principles to be applied to community-scale systems.

Messrs. Bishop and Baccei laid the technical groundwork for the conference discussions in the active and passive solar energy systems areas, respectively.

In the question-and-answer session that followed, Amory Lovins, a member of the audience, questioned the contention that there are economies of scale in the manufacture of larger wind energy conversion systems; he argued that electricity can be generated from low-temperature solar processes, as well as high temperature, and pointed out that active solar system costs are very sensitive to the marketing system employed and to system size. Size is dictated to a large extent by the energy conservation techniques which are utilized in conjunction with the system.

Additional points made by other members of the audience included the following:

1. Our balance of payments problem could be alleviated somewhat by competing in the international solar market.
2. A good reason for communities' taking charge of their own energy futures is the fact that many of them (e.g., Crystal City, Texas) have been "ripped off" by energy industries.
3. The Regional Solar Energy Centers should be moving much more aggressively on the promotion of passive solar techniques which are cost effective *now*.

Opening Remarks

Robert Odland
Solar Energy Research Institute
Golden, Colorado

National Energy Goal

President Carter recently set a goal of obtaining twenty percent of the nation's energy needs from solar technologies by the year 2000. Included among these technologies are the solar heating and cooling of buildings, wind systems, biomass production, photovoltaics, industrial process heat, solar thermal systems, ocean thermal energy conversion systems and hydro-electric systems. As a result of the President's message and other recent economic developments, communities throughout the United States are becoming increasingly involved in planning for solar energy.

It has been calculated that for the President's goal to be met, solar installations will be required on one of every two residential and commercial buildings; solar industrial process heat will be required on one of every seven factories; and solar energy will have to produce twenty percent of the nation's electricity. If this is to be accomplished, communities throughout the United States must take action immediately. The President recently acknowledged the need for such involvement when he sent some 6,000 letters to mayors throughout the United States telling them that communities must take an active role in the conservation of energy.

Need for Community Involvement

There are several reasons why communities should become involved in solar energy:

1. Land use controls are exercised at the community level. Land use controls are an important factor because solar energy is land consumptive and many technologies are dependent on direct access to the sun.

2. Building controls in the form of housing codes and building codes are also, for the most part, exercised at the local level.

3. It has been shown that one of the best ways to achieve conservation of energy in the United States is through peer pressure. In other words, one person starts to conserve, a few more do, and soon other people feel they should conserve. The same phenomenon could happen with respect to solar energy.

4. At the local government level, a link can be made between the production and the consumption of energy. A person may, for instance, recognize for the first time that he or she can be a producer of energy as well as a consumer. In this person's mind, energy will be more than just throwing a switch or turning up the thermostat because this person will now realize that energy must be produced.

We might ask ourselves why communities should *not* be involved in energy production as one of their many functions—they certainly have the expertise to get involved in the production of energy since they already manage such operations as waste treatment plants and airports, which can be technically and administratively difficult. They also have the perfect opportunity to become involved in energy production *right now* because solar technologies, for the most part, do not offer any particular economies of scale. In many cases it may no longer be as economical to build a huge plant which would service a state or several states as it would be to build several smaller plants that would service a fewer number of users.

Why should communities be involved? The first reason is that being involved in energy production and conservation promotes community spirit. This fact was confirmed by a SERI survey team that recently went to four locations in the United States: the San Luis Valley, Colorado; New York City; Carbondale, Illinois, and Davis, California. In all instances, the team found that community energy projects promoted a series of activities that bred community cohesion and cooperation. Solar energy was seen as a means to improve the spirit of cooperation and community action because solar-related projects often inspired other projects aimed at providing housing and day-care centers or growth of food. Success builds upon success.

Another reason communities may wish to become involved is that they can move towards energy self-sufficiency. Why is this important? First, it will help a community attract and hold industry. Few things worry industry more than potential energy curtailments. If a community can assure industry that it can provide a reliable source of energy, industry is much more likely to locate or remain in that community. Second, communities can assure supply for their own citizens. No local official likes to represent the people of a community which does not have an adequate supply of energy. Third, solar energy will provide some control over the cost. Once the initial plant is installed, the source of energy, the sun, is free. Obviously, there will be some costs in maintaining and improving the system, however, these factors would be much more under the control of individuals within that commnity than they now are. Finally, moving towards energy self-sufficiency may provide significant psychological benefits. It is often alleged that people feel alienated from various large institutions, including the government. Providing citizens with a technology over which they can exercise some control may thwart this feeling of alienation and permit people to again become involved in community affairs.

Communities may also want to become involved in energy production because they will save money. This is particularly true of lower income and fixed income residents who are being hit very hard by increasing energy bills. Finally, a community may wish to become involved in solar energy because it produces local economic benefits such as additional employment opportunities. Solar energy development industries can provide many opportunities for small and minority businesses, to not only be involved in the manufacture of equipment, but also in the installation and maintenance of that equipment.

The purpose of this conference is to illustrate options to communities—to show communities that they do not necessarily have to do things the way they have been doing them for the past 50 years. Our feeling is that communities may want to have more control over their energy future in the same way that they have control over their education and land use futures.

Encouraging Community Action

From the national perspective there are many reasons why community energy planning should be encouraged. One reason is that it may be necessary for communities to become involved in order to meet national energy goals. It is much easier for communities to take action than for the federal government to do so. A community in Montana does not have to worry about the state of Louisiana when it decides to encourage solar installations within the Montana community. This is not true at the national level where many competing interests must be balanced in order to form a national energy policy.

Community energy planning should also be encouraged because it promotes better end use matching. In other words, the type of energy needed can be provided by a system which is specifically designed to produce that type of energy. It makes no sense to use a very complicated technology to produce electricity which is then sent thousands of miles to a house where this electricity is then used to heat that house. This is an example of poor end use matching in that it is inefficient and very wasteful of resources. If a system can be designed to provide the heat for the house, this system will be much more efficient in the long run for utilization of our resources.

A distinct advantage of community-managed energy systems is that they need not take a long time to move from the planning stage to actual start up. For instance, a community power plant should take a much shorter lead time for the planning, financing, permit requirements, and actual construction than a large-scale power plant. Producing energy at the community level rather than through a large utility may also be cheaper because huge transmission and distribution systems can be avoided. One has to keep in mind that in some cases, the only way that we can meet our energy demands is to use smaller systems.

Still another reason why communities should take charge of their energy future is the psychological effect at the community level. I have already mentioned that solar energy may reduce the sense of alienation that individuals have because it permits them to participate in community activities. The same thing is true of communities themselves. Communities that can build their own systems and produce their own energy are very likely to be healthy communities that will require minimal assistance from state or federal government.

Community Planning Issues

Solar energy produces very interesting linkages that other energy technologies do not. As I've already mentioned, there is a strong link between energy use and energy consumption. The assumption could be made, although it is still unproven, that once consumers realize that this link exists, consumption of energy will go down dramatically. Another link is the one between the production of energy and the adverse affects of production. It is very easy for the people of a city to want to build a coal plant in a remote area because they will not be subjected to any of the adverse affects of that plant. If, however, the production facility is located close to the users of that energy, the users theoretically would think more carefully about what they would like. The overall effect of this type of decision-making should be that nationwide adverse environmental and social impacts from energy production are reduced.

Some of the issues involved in community planning are the following:

- *Employment*
  Does solar energy create more jobs and if so, what types of jobs and at what skill levels?
- *Equity*
  How will solar energy affect poor people, minorities, and women? These issues need further study.
- *Financing*
  It is unclear at this time what the appropriate mechanism should be for the financing of small-scale systems. If systems are to be placed within individual homes, the financing may come from savings & loan associations and other institutions that have traditionally financed the purchase of homes. This, however, from a national viewpoint may not be the optimal system.
- *Land Use*
  For the most part, solar energy consumes more area than conventional energy production does. However, much of this area may be used for other purposes as well. Another factor that has to be addressed in this relationship between density and availability of area in urban areas. In many ways, this relationship determines how effectively solar energy systems can be used.
- *The Role of Utilities*
  The role of utilities is extremely important in community energy planning because utilities are required by law to provide energy to those people within their service area. At present, individual homeowners who are thinking of installing solar energy systems in their homes or who already live in solar homes are still required to use a traditional, utility-based system as a back-up when the sunshine or winds are too weak. The utility must maintain this back-up even though its services are not required most of the time by the individual home, and consequently, it has a tremendous amount of money tied up in the cost of the generating facility, the transmission lines, and the distribution network. This system must be maintained whether energy is being consumed at the individual home level or not. Another issue to be resolved is whether utilities or communities should be involved in the ownership and management of small-scale systems.
- *Intergovernmental Relations*
  We must ask ourselves what constraints will be placed on communities as they go about their energy planning. It is clear that not all communities have always acted in the best interests of society. Discriminatory zoning, large-lot zoning, and discrimina-

tion against minorities are good examples of practices not in line with the public good. What sort of relationships should be established among communities and between communities, states, and regions? What is the role of the federal government in community energy planning?—These are all matters that still need to be addressed.

- *Implementation*
  How do we get from here to there? What changes must be made and what actions must be taken? For the most part, more research is needed in this area.

Implementation Options

We should now ask ourselves what communities can do. I would like to offer a list of things that some communities have already tried and others have considered:

1. Remove regulatory barriers to solar energy. Communities can examine their zoning code and the building code to see if solar energy is prohibited or discouraged.
2. Provide for the proper orientation of buildings. This is especially true in new subdivisions.
3. Require pre-plumbing of new construction. Plumbing will be installed which would accommodate solar energy even though the actual installation of the solar energy system may be some time in the future.
4. Mandate solar swimming pool heating.
5. Mandate residential solar hot water heating. This has recently been undertaken by the County of San Diego in California.
6. Adopt ordinances that provide for solar access.
7. Convert public pools and buildings to solar energy, not only to save money for the community but to act as an example to residents of that community as to what can be done.
8. Provide information to their residents.
9. Hire energy coordinators. These individuals would assist government departments and other elected officials. They would also be available to assist citizens of the community.
10. Provide classes for do-it-yourselfers.
11. Sponsor neighborhood projects where peope would get together and build something (a greenhouse for example).
12. Engage in energy planning. Many communities already engage in

land use, residential, and other types of planning. Energy planning should be incorporated into this system of community planning.

13. Engage in tree-planting programs.
14. Provide local incentives for solar energy. Communities need not wait for the state to provide tax or other incentives. For example, a project which includes solar energy could go through a streamlined permit processing procedure. Also, density bonuses could be given for projects which use solar energy.
15. Consider a solar municipal utility to provide energy to that community.

Suggested Priorities

I would now like to offer several suggestions to communities that are considering energy planning.

1. A community must look at conservation first. In fact, "energy efficiency" may be a better term than "conservation" because conservation has a negative meaning to many people.
2. Passive solar is the second item that communities should consider. Passive technologies are cost effective in every part of the United States. We do not have to wait for any additional research or technological breakthroughs in order to make use of them.
3. Energy planning and management should be done on a community scale. We must go beyond individual buildings. The reason for this is that development patterns, including density and use, affect transportation patterns, and the capability to produce and conserve energy.
4. Communities must look at complete service systems; that is, housing, transportation, waste water treatment, solid waste management, employment, social services, community development, and energy should be planned together.

The fact that energy cannot be considered in isolation from other community needs is perhaps one of the key messages of this conference. We can only echo the words of Mr. Fred Fisher who in the May, 1979 issue of *Public Management*, a publication of the International City Management Association wrote: "Energy planning is a holistic event. It cuts across disciplines, lifestyles, social, and economic systems and reaches into virtually every aspect of community life." The value of community participation in energy is well expressed in Section 101 of the Local Energy Management Act of 1979 which has been introduced by Senator Percy of Illinois:

> "Local units of government are highly appropriate vehicles for the promotion of energy conservation and renewable resource-based technologies, because of their sensitivity to geographic and climatic variations, their ability to make effective use of available human skills and economic resources, their high visibility, and their capacity to accommodate a high degree of citizen involvement in the study, implementation, and demonstration of new programs."

The time is at hand for communities to examine their alternative energy futures and to choose one based on their values and objectives.

Section C
Plenary Session II: Community Experience with Renewable Energy Systems

August 20, 1979

Plenary Session II: Community Experience With Renewable Energy Systems

Moderator

Peggy Wrenn
Colorado Office of Energy Conservation

Speakers

Valerie Pope Ludlam
San Bernardino West Side Community Development Corporation

A. Raymond Moore
Shenandoah Development, Inc.

Mary M. Christianson
Energy Task Force, Inc.

William S. Becker
Wisconsin Energy Extension Service

Gordon A. Marker
Lawrence Hydro Associates

Summary

Practical experience has been gained in several communities, many with no Federal funding support. These local efforts, involving the people they serve, have proven successful in energy conservation, renewable resource use, and land use planning.

One highlight of the session was the question-and-answer period following Ms. Ludlam's presentation:

Q. *Why wasn't there a greater emphasis on combining energy production with food production, for example, through constructing solar greenhouses?*

A. That was tried in San Bernardino, but the residents just were not that interested. It is important that communities be allowed to set their *own* priorities. Moreover, it is far more important to provide employment for poor people so they can afford to purchase the food they need.

Q. *A young woman from a low-income, minority neighborhood in southern New Jersey asked how they could get financial assistance that would help them toward greater self-reliance.*

A. Ludlam's semi-joking response was that you could not go to those "high technology agencies controlled by men and act like a lady"; she then offered to meet with the woman after the session.

The Development and Operation of Successful Neighborhood Solar Energy Projects in San Bernardino, California

Valerie Pope Ludlam, President
San Bernardino West Side
Community Development Corporation
San Bernardino, California

The San Bernardino West Side Community Development Corporation

The San Bernardino West Side Community Development Corporation is a non-profit, minority owned and operated, community based organization. The CDC became involved in solar energy as a result of a variety of things being done in the area of rehabilitation of abandoned homes. During the time when rehabilitation projects were the major thrust of CDC, the energy Crisis became a national priority, and its alleviation is now a national goal. Its effects have been devastating to poor people and senior citizens on fixed incomes.

The CDC recognized that solar energy could be made cost effective for low-income people and could provide an alternate energy source to fossil fuels. The high cost of utilities has continually kept low-income people from benefitting from even the basic comforts of life. The effects of inflation and unemployment, along with high energy cost are becoming more and more difficult for people to deal with. The CDC, which is an outgrowth of the Welfare Rights Organization, was formulated to improve the community living conditions and the quality of formal education being offered by the school system. We, the involved community mothers, wanted to make sure that our children received the proper training so that they would have marketable skills when they reach adulthood.

The San Bernardino westside is primarily populated by low-income minority people. The rehabilitation of two major minority neighborhoods, namely Delmann Heights, and California Gardens, which were rapidly being abandoned, was very low on the priority list for the overall revitalization of the entire City of San Bernardino. As a result, the women of the Welfare Rights Organization decided to look at what means were available to use as tools for doing something about the redevelopment of our communities.

After many years of struggling, protesting, working in election campaigns, and writing grants and proposals, we were able to convince the Veterans Administration (the holders of approximately one-third of the abandoned property) to allow us to try one of their homes as a part of our revitalization program. We eventually rehabilitated 52 residential properties in the California Gardens community for the Veteran's Administration.

Young people who lived on the westside were able to rebuild their own family homes and neighborhood. The CDC employs the talent of an area minority general contractor; who is responsible for instructing the CDC CETA trainees in basic construction skills. Painting, carpentry, plumbing, electrical work, and blueprint reading are just a few of the skills taught to the participants. The rehabilitation work in all the CDC projects has been done by CETA participants.

Prior to the CDC Solar Energy Projects involving 10 homes in Delmann Heights, the CDC performed the following projects using CETA funded trainees:

- *Department of Labor's Old Neighborhood Youth Program*—CDC supplied labor funds for the revitalization of the above mentioned California Gardens sub-community.
- *Senior Citizens Homes Rehabilitation*—Funds provided by the City of San Bernardino's Community Action Agency, and the DOL CETA funds for labor.
- *Summer Youth Projects*—CETA funds used for labor for complete lawn services and weed abatement.
- *Community Crime Awareness Program*—CETA funded participants to man the crime center 24 hours and to serve as an interface between residents and the local police for crime prevention.

It should be emphasized that all of the CDC's programs primarily involve the training and placement of participants in the unsubsidized labor market. Prior to 1976, the thrust of the training was in the traditional low-skilled job categories. Knowledge of such traditional skills is necessary, but to go one giant step further, the CDC realized the potentiality of building a *new* resource of qualified minority people to enter productively into the *Solar Age*. The solar industry can be the major new job-creating industry in the State of California.

In 1976, the CDC expanded its thrust and was a successful bidder in the Housing and Urban Development's Solar Energy Cycle II Research and Demonstration Project. It is significant to note that the CDC was involved in a highly competitive venture with universities, large industrial concerns, private builders and developers in winning a grant to participate in the HUD Cycle II Program.

The Community Services Administration, headquartered in Washington, D.C., has been very instrumental in the success of the CDC. The CSA has provided the necessary administrative and fiscal support needed to continue our efforts. In the case of the HUD Cycle II, HUD only supplied funds for the solar hardware, therefore we had to develop other funding sources in order to qualify for negotiations with HUD. We could not have responded to the RFP if CSA had not provided "front money," i.e., money for negotiations, planning, management and architectural fees. As a result of CSA involvement, we attracted funds from the State Energy Commission, Department of Labor, and the State of California—Governor's Office. The CDC Solar Project was funded by the following agencies:

- *HUD*—Suppliers of solar hardware, construction materials, consulting engineering fees
- *CSA*—Funds for administrative, research and fiscal services
- *State Energy*—Cost of material to weatherstrip and insulate
- *DOL*—Funds for trainee wages
- *State of California*—Governor Brown's 4% Discretionary Funds for trainee wages

The Community Services Administration is the only federal agency mandated to serve our nation's poor. The CSA has been very sensitive to the needs of the poor and has been a constant source of support for the CDC. The CSA has provided funds necessary for planning grants as we seek to determine the feasibility of our programmatic efforts. These funds have helped the CDC negotiate with organizations such as Motorola, JPL, and the Frank Lloyd Wright Institute.

The CDC has planned, designed, developed, assembled, installed, monitored and maintained a centralized solar energy system which supplies space heat and hot water to a block of 10 homes in the Delmann Heights sub-community. The CDC Solar Project now has a greenhouse in which plants and vegetables are grown through hydroponics. The system is an "active system" and utilizes a mechanical heat transfer process. The process transfers heat from the 72 solar panels to the storage unit (a 5,500 gallon capacity buried tank). The system includes equipment for monitoring heat loss, and heat usage.

The Cycle II Solar Energy Project offers an unusual and unique opportunity to demonstrate the use and cost effectiveness of solar energy on existing residential buildings. We believe that solar energy is a viable alternative as a major power source, and that it possesses two highly desirable qualities, abundance and minimal side effects.

The San Bernardino westside is a designated "target area" for redevelopment by the Governor's Office of the State of California. The development of this solar energy system in a low-income area is a reversal of the historical trends with regards to technical advancements. The CDC project addresses itself to providing low cost alternative energy to the segment of the population most affected by increased fuel and energy. Energy conservation techniques and life style modification principles are being introduced to the tenants of the 10 homes and the program will be shared with the school system and other interested persons.

The CDC is further engaged in training young minorities in the mechanical trades. We are operating a sheet metal, solar panel, and machine shop, which is financed by Governor Brown's 4% Discretionary Fund. The shop is producing liquid collectors, solar dhw pre-heaters and is now engaged in the study of other related technologies including photovoltaics.

Through the efforts of organizations such as the CDC, more and more poor people are becoming aware of the use of solar energy as an alternate energy source. Now is the time for involvement of low income people in policy planning. It is highly impossible for policy makers to develop necessary strategies to deal with the poor if they have never lived in a low-income or minority neighborhood. Minority people with solar experience and minority consultants well versed in proposal writing should be included in the decision-making process. The CDC further calls for the involvement of women and minorities in all other aspects of solar energy development such as the development of photovoltaic, heating and cooling and hot water systems; the promotion of greater accessibility to agency decision-making officials; and the promotion of stronger sensitivity to the real needs of people in our society.

Minorities and women have played vital and major roles in the success of the CDC. Women hold major administrative positions in the firm and also played a tremendous part in the mechanical and labor position at CDC. Our Solar Energy Project and varied training programs prove that women and minorities are trainable with minimum effort, if the trainer is sensitive to the needs of the people.

Suggested National Energy Policy Criteria

Neighborhood groups like the CDC are looking for a definitive and clearly worded energy policy. It is our desire to get in step and follow closely with the energy policy; we need to have one and we need to be able to understand how it applies to us. We also realize that an energy plan is a complex and interactive document. Could it not be written in sections or volumes that apply to the various segments of energy producing organizations?

A neighborhood organization is just that, it is an organization whose grassroots reach into the neighborhood. The working people and the poeple in training who form the backbone, are usually the poor and disadvantaged. While we are able to draw outside talent into our organizations, the major need of such firms is for the aid of outsiders with accomplished training and information sharing. We would hope that the energy plan and policy would contain provisions for neighborhood organizations to be able to share the developing information on new and alternated energy sources, especially that of solar. This can only be done by providing sufficient funds to allow those firms and technical research laboratories to transfer a wealth of research and engineering talent to the technical, manufacturing and planning groups of neighborhood organizations.

The Department of Energy need recognize that Neighborhood Organizations such as the CDC *are* applying a great deal of talent and effort toward becoming proficient and competitive in solar energy as it applies to neighborhood development and toward furnishing lower cost energy to the poor and disadvantaged. It is understod that this is a very small part of the responsibility of the DOE but it needs to be made a more important part of the Department's policy. In this, the latter quarter of the 20th century, it is the right and privilege of all people: poor minorities, disadvantaged, handicapped, and elderly, to have the benefits of the basic necessities and comforts of life which are provided through the use and application of various forms of energy. Like everyone else, poor people get cold, and need to keep warm, they suffer in 110 degree heat and need to have relief, and they need to have the option to be entertained with radio, TV, telephones, and other forms of communication. Poor people need to have the right to have a few dollars left over after paying their energy bill to be able to relax on a weekend holiday. The DOE is invited to become sensitive to these needs of the poor and disadvantaged and to include methods for helping them in our nation's basic energy policy.

The DOE is staffed by people who are not necessarily close to or cognizant of the needs and problems of the poor and disadvantaged who have to struggle just to meet a minimum subsistance level in their daily life. We request that in all levels of policymaking and program planning the DOE include CBOs, minorities, women, leaders of grassroots organizations, etc., so that rich and complete planning can be achieved. We would further recommend that the DOE, in conjunction with the Executive Office of the President, HEW, HUD, DOL, and CSA, would arrive at a policy and an easily and readily administered program to provide a subsidy for the payment of rapidly rising energy cost (far and above the rising costs of living that are cranked into various programs for family help and aid), and that these programs be designed so that all people will be able to meet their utility costs in times of severe cold, severe heat, or an arbitrary step increase in the price of gasoline.

As the Research and Development expertise of our nation formulates new programs in solar and alternate energy, we hope that neighborhood groups like the CDC will have the opportunity to contribute to their im plementation as early and as much as possible.

Renewable Energy Systems Planning in Soldiers Grove

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Abstract

The southwestern Wisconsin Village of Soldiers Grove is relocating its entire central business district from its historic floodplain location to escape flooding from the Kickapoo River. The project has inspired a thorough community revitalization effort addressing a range of local problems—faltering economy, poor recreational services, and inadequate commercial services. Part of the effort is the establishment of a neighborhood-scale renewable energy system to serve the new business district.

The villagers plan to make use of passive solar heating and high thermal efficiency design in the 39 business and municipal buildings at the new downtown. Decisions still are being made on a system to supplement passive solar for space heating and cooling. Among the candidates are conventional space conditioning, including heat pumps or conventional furnaces serving clusters of buildings, and renewable fuel systems such as a central woodburning plant or a methane plant producing fuel from wood wastes, garbage, sewage sludge and whey.

The three-year relocation project has just begun. But the village's intensive planning for alternative energy systems already has demonstrated that 1) productive and timely relationships can exist between government institutions and a small community in need of planning help; 2) technical and financial assistance are needed to push projects like that at Soldiers Grove over "planning humps;" and 3) different renewable fuel options may have to compete with one another for economic viability in development projects.

Why the Project Was Undertaken

Soldiers Grove, a village of 524 people, is located on the banks of the Kickapoo River in the wooded, unglaciated terrain of southwest Wisconsin. During the past several decades, the village has suffered from a wide range of problems, including chronic economic deterioration and a loss of population, particularly those of working age. Soldiers Grove has a disproportionately high number of citizens on fixed incomes—72 percent of its residents fall under HUD Section 8 definitions of low-income. These problems have been complicated by devastating floods which have hit the community nine times this century, the last and most serious on July 2, 1978. In 1975, the village proposed complete evacuation of the floodplain, including its entire central business district, and construction of the business district on higher ground. With federal and state assistance spurred by the 1978 flood, the project is now underway. Since the inception of the relocation idea, villagers have talked about making use of the region's rich native, renewable fuels as a major source of energy in the new downtown. There are psychological/social, economic and idealistic reasons for this interest.

Psychological/Social Reasons

The people of the Kickapoo River Valley and the Village of Soldiers Grove are independent, rural folks for the most part unbothered by urban values and urban people until the late 1960's. The Kickapoogians, as they call themselves, are often distrustful of outsiders and uncomfortable at giving up control of their lives to outside influences. Thus, they are receptive to ideas which help them fend for themselves with minimum dependence on outside forces such as fossil fuel prices and supplies. In addition, a substantial number of wood stoves and windpumps still are in use in the area, and the concept of renewable-fuel energy systems is not exotic. Finally, the people of Soldiers Grove have a tradition as innovators of new energy systems. At the turn of the century, the village was the first on the Kickapoo to have electricity, supplied by a small hydroelectric plant on the river.

Economic Reasons

Village businessmen recognized that a renewable fuel energy system would likely hold significant economic benefits. First, businessmen would be taking on new indebtedness to construct their buildings. Since there was no promise of increased business volumes, they had to find ways to reduce their monthly operating costs. Thus they were interested in high energy efficiency and systems making maximum use of low-cost, renewable fuels. In addition, villagers believed that an innovative energy system would draw some tourists to the community and would strengthen the appeal of the relocation project for continued federal and state monetary support.

Idealistic Reasons

A number of villagers felt that the energy demonstration potentials of the relocation project would make the move worth the inconvenience and social trauma unavoidably part of such a project. They felt that if Soldiers Grove could demonstrate not only an innovative approach to flood damage prevention, but also an innovative energy system, the work involved in the project truly would be worthwhile.

Description of Project

The Soldiers Grove project involves 36 business buildings, three municipal structures and 10 homes which will be purchased, razed and rebuilt elsewhere in the community. The 39 business and municipal structures will be rebuilt at a site located on a farm field along U.S. Highway 61, a half-mile from the present downtown area. The site offers building locations on the east and west sides of the highway. Plans call for development of the new retail district on the west, and a small industrial park on the east. The west site is bordered on the south and west by hills which limit insolation, while the east site has unrestricted access to sunlight. While some of the 10 floodplain homes wil be replaced by new construction, others will be replaced by existing vacant housing elsewhere in the village. An additional 12 homes located on the fringe of the flood district will be elevated atop earthen fill and will be "rehabilitated" in the process. A number of the rehabilitations will involve home weatherization.

Surveys have determined that about 3,000 tons per month of wood wastes (sawdust, chips and bark) are generated by lumber mills within a 30-mile radius of Soldiers Grove. Although small quantities of the wastes are used as bedding by farmers, the wood now is largely unutilized. Other potential renewable energy sources in the region include the Kickapoo River itself, whey from a number of small cheese factories scattered throughout the Valley, burnable garbage now deposited at landfill sites, a small amount of sludge from sewage treatment plants in Valley communities, agricultural wastes, solar and wind.

The relocation project, interwoven with the energy system demonstration, is estimated to cost $5.75 million, including $3.25 million in state and federal dollars (primarily for floodplain property acquisition), and

$2.5 million in local government (primarily for development of the new site). Site preparation has been completed, sewer and water lines are installed, two buildings (a new dental clinic and a nursing home) already have been completed, and construction is scheduled to begin on the first 11 business buildings by early fall, 1979. By the time the move is completed, new commercial construction will total between 105,000 and 178,000 square feet.

Project Sponsors and Budget

Soldiers Grove first proposed relocation in 1975. It carried on a frustrating and futile drive for federal support over the next three years, in the meantime committing substantial local resources to the project, including $90,000 in June, 1977, to purchase the new downtown site. After a record flood in July 2, 1978, the village received its first breakthrough in federal funding—a $900,000 grant from the Department of Housing and Urban Development to begin the move. The July flood substantially damaged a number of business buildings and renewed local fears of further floods, and the Village came under substantial pressure from businessmen to start the move immediately. However, local officials recognized that no detailed planning yet had been done on several aspects of the move, including zoning, physical design of the new downtown and potential energy systems. Construction starts consequently were delayed until sufficient planning could be done.

At the request of the village, the University of Wisconsin-Extension (UWEX) formed a speical team to assist in these planning tasks. UWEX divided its work into four areas: creation of a detailed development plan for relocation sites; generation of a zoning ordinance which would guide development; counseling for individual businessmen on the size and type of their new operations; and energy management. The cost to the village of the work provided by UWEX was $10,000, primarily for site development planning.

In the energy component of the studies, the Wisconsin Energy Extension Service (managed by UWEX) was named to coordinate an ad hoc planning team made up of specialists from UWEX Engineering Department, the Wisconsin State Energy Office and Argonne National Laboratory. Between January 1, 1979, and the present, the four agencies have performed planning work at no cost to the village, folding the studies into their ongoing programs.

Another project sponsor has been the Wisconsin Department of Local Affairs and Development, which provided a $4,560 community development grant to Soldiers Grove so that it could hire a private engineering firm to perform a $5,700 "verification study" on the recommendations of the UWEX energy study team. The village provided a 20 percent cash match.

Technologies Involved

On March 1, 1979, the UWEX study team recommended a four-part energy strategy for the new downtown development in Soldiers Grove. The recommendation was that 1) the newly constructed buildings be designed for maximum economical thermal efficiency; 2) passive solar heating design be used throughout the new downtown, and buildings on the east of the highway be designed for retrofit of active solar components; 3) supplemental heating and cooling needs in the downtown be furnished by a central steam boiler system fired with wood wastes; and 4) Soldiers Grove continue investigating other possible uses of renewable fuels throughout the community.

The recommendation for a central wood system utilizing the substantial supply of wastes in the area was developed by Argonne, whose engineers quickly analyzed more than a dozen potential energy systems and sources ranging from the exotic (solar ponds, large-scale wind generation) to the more conventional (oil furnaces, heat pumps, diesel co-generation). By Argonne's calculations, a wood-fired central steam system was the most advantageous.

The Laboratory estimated the system would cost $1,169,100 to install compared to $1,080,500 to furnish the energy equipment necessary if each building was to be heated and cooled with individual heating/air-conditioning units. But because of the low cost of wood (an estimated $10 per ton delivered) compared with oil (50.5¢ per gallon at the time of the study), the extra capital costs would be paid off in about 18 months. Over a 20-year lifetime, all costs associated with the wood system would amount to $6.8 million, compared to $8.7 million for conventional oil-fired furnaces, assuming that oil prices would remain constant. Basically, the wood system would burn sawdust and chips under 1/8" diameter, producing heat and through the use of absorption chillers and a cooling tower, summertime cooling. The system would also provide hot water and process steam for a cheese factory at the new site.[1]

However, it was the passive solar portion of the recommendation which caught the imagination of officials and businessmen in Soldiers Grove. The Village hired Hawkweed Group Ltd. of Chicago, one of the Midwest's best known passive solar architectural firms, to design three municipal buildings—a fire/rescue station, an underground garage and a village office/library building. Hawkweed was also assigned the tasks of defining building performance standards for the downtown and making final refinements to the master development plan. A number of businessmen also have hired Hawkweed for their design work.

It now appears that passive solar will perform so well in the new downtown area that the economics of the wood system recommended by Argonne are jeopardized. Hawkweed estimated that it could design commercial buildings which would obtain 75 percent of their space and water heating needs from the sun. The firm's design included a "thermal shelter" in the attics of the buildings, highly insulated to capture and hold daytime insolation. The design called for a minimum of R-19 insulation in walls and R-76 in ceilings, for U-values of .045 and .012 respectively. Coupled with interior heat gain from people and equipment, off-hour setbacks to 55°, and carefully planned landscaping, including berming and strategic plantings, Hawkweed calculated the new commercial buildings could achieve thermal efficiencies of between 2.5 and 3.8 Btu/sq. ft./degree day. Those figures compare to more than 30 Btu/sq. ft./degree day now characteristic of many Wisconsin commercial buildings. In addition, passive would be a low-tech, nonpolluting system. At the time of this writing, Hawkweed was comparing notes with Brown Engineering Company of Iowa, hired by the Village to verify Argonne's findings regarding the central wood system. Although the size of boilers in the wood system could be tailored for the heat load of a passive solar business district, the costs of installing distribution lines for the heat throughout the downtown was more difficult to adjust, even though they could be minimized by proper siting of the central plant. There were questions whether usage of the central wood system would be sufficient to pay off the system in a reasonable period of time. Other questions surrounding the wood option involved whether sufficient technical know-how existed in the village to maintain the system well and the environmental impact of pollution from the wood plant.

If the wood system proves economical in combination with passive solar, the Village intends to continue exploring other options, both conventional and renewable, to provide supplemental heating and cooling needs. One possibility being encouraged by a local LP gas company was gas-fired heating and cooling systems serving each cluster of buildings in the new downtown, with gas supplied through pipelines from a central storage facility. The installation of that system would allow the immediate heating needs of the village to be provided, but also would permit retrofitting of gas produced in a local methane plant, utilizing the wood wastes, septic sludge, whey, garbage and agricultural wastes in the region as sources of biomass.

Major Problems

Soldiers Grove has encountered a number of major challenges during planning of the energy system, and the village continues working through them. Some are discussed below.

Phased Growth

The Soldiers Grove relocation is being carried out in stages, since federal and state monetary support has not been secured in a one-time grant, but rather in bits and pieces. In considering renewable-fuel energy systems, Soldiers Grove has been forced to give attention only to those options with enough flexibility to fit into the project.

For example, as the winter of 1979 approaches, Soldiers Grove anticipated that 11 business buildings would be completed during the heating season. Those buildings would need immediate sources of heating energy. Planners were forced to consider renewable-fuel systems which would adequately serve individual buildings and small clusters of buildings at the beginning of the project, yet could expand incrementally to serve the needs of the downtown as more buildings were constructed. Systems operating at the level of individual buildings—solar heating, heat pumps, individual furnaces—give maximum flexibility in such an incremental project, while central energy systems tend to be rigid and harder to plan.

As Soldiers Grove pursued Argonne's wood system recommendation, the initial thinking was that all distribution lines would be installed immediately to accommodate future heating needs, but that boilers at the central plant could be installed incrementally. Thus, the central plant would eventually contain several small boilers rather than one large one, a feature which would also result in better operational efficiency.

If passive solar becomes the main heat source for the downtown, it will fit well into the incremental nature of the project. But if it must continue investigating economical options for back-up heating and cooling, Soldiers Grove still will have to choose a system which is flexible enough to provide energy immediately to grow with the business district and to be converted to renewable fuels in the future.

Competition Between Renewable-Fuel Systems

The Soldiers Grove downtown is a small development. Yet in developments of any size, it appears that renewable-fuel energy systems which might make a desirable mix in theory may compete against one another in practice. That has been the case in trying to mix passive solar heating and central wood heating in Soldiers Grove. Reliance on the low-tech, clean technology of passive solar as the primary source of heating energy for the downtown may effectively kill central wood heating as a back-up system by crippling the economics of that option. Engineering studies now underway will determine to what extent the wood system is subverted by passive solar.

However, early estimates by engineers indicate that a passive system operating at near the efficiency projected by Hawkweed would rob the wood system of sufficient business for economic viability. If that is the case, Soldiers Grove may have to settle for individual furnaces or heat pumps operated by conventional fuels, or it will have to continue its search for a renewable-fuel system which can function economically as a supplemental, rather than a primary heating and cooling provider.

Conflicting Values

Planning for passive solar heating in Soldiers Grove has been complicated by the fact that the location selected for the new downtown is bordered by hills which block insolation for a substantial amount of the site during critical winter heating months. Thus, planners and architects have had to be especially creative in pushing building plots out of the shadows and into sunlight, while using the shaded portions of the site productively. The building site chosen by villagers is a small one, and there is little room to waste.

The site was one of three large enough to contain the business district within the existing village limits. While the other two sites had unobstructed insolation, the preferred site was chosen because of its proximity to U.S. Highway 61. That highway used to run through the center of Soldiers Grove, but was moved to bypass the village in the mid-1950's. Businessmen have associated a subsequent loss of business establishments in the village with the loss of the highway. Thus, there was substantial emotional force behind choosing the Highway 61 site, despite its energy drawbacks. The case was one in which economic values competed with solar values, and won. Other strong local values also have come into conflict with energy efficiency. Residents wanted to retain the character of their old downtown with a mix of common-wall and individual structures. Although they agreed upon a mall-type development with a pedestrian-only Main Street, they did not want the mall enclosed, preferring the conventional Main Street feeling of the old business district.

Planners and architects were able to synthesize these conflicting values by designing a new downtown consisting of two east-west rows of commercial buildings, some of them common-wall construction, others not. Shorter buildings will be located on the southern row to minimize the shadowing of the northern row. The buildings will be concentrated on the northern end of the relocation site to stay clear of shadows from hillsides located on the south and west borders of the site. Areas of the site shaded during critical winter months will be used for parking spaces.

Planning Humps

From a planning standpoint, one of the more interesting aspects of energy studies in Soldiers Grove have been "planning humps" in which shots of outside money and expertise were necessary for the project to proceed. The first hump occurred immediately after the Village received federal money to begin the move. The village had no funds for energy studies, and it had no idea how to narrow the range of options into one or two best choices where its limited resources and time could be focused. This first hump was crossed with the help of the UWEX study team, which returned its recommendations to the village in 60 days.

Study team recommendations in hand, the village issued a Request for Proposals to engineering firms qualified in wood systems. It then encountered the second planning hump. Based on a quick look and hastily gathered data, the UWEX study team analysis did not go far enough to allow the village to seek conventional financing for the system. Additional money was needed to hire a firm to conduct a "verification study" which would confirm the UWEX team's recommendations, refine them, build consensus in the village, and churn out sufficient economic data to win financing for system design and construction. The Soldiers Grove community then appealed to the Wisconsin Department of Local Affairs and Development for help, and received a community development grant to contract for the verification work.

The UWEX study and the state grant boosted the planning of renewable-fuel energy systems for Soldiers Grove through critical passages in which local expertise and local financial resources were not sufficient. Because of keen interest and a commitment to the project, the government agencies involved went out of their way to offer input under existing programs at no cost to the village, and to provide their assistance at unusual speed. Despite repeated contacts with the Department of Energy and other potential funders of feasibility studies, the village has been unable to identify a funding program which can furnish the type of help needed in the time-frame demanded by the community's unusual situation.

Controlling Development

The installation of passive solar heating and/or central wood system at the new downtown demands an unusual degree of choreography at the site. How will each building be guaranteed solar access? How will plantings and landscaping be controlled to make best use of the microclimate? How will buildings be arranged to minimize the cost of distribution lines, or to allow for more efficient common-wall construction whenever possible?

In an attempt to simplify this choreography, the Soldiers Grove Community Development Office encouraged businessmen to form their own development corporation, or to hire a single developer to construct the business district. Either option, village officials reasoned, would simplify the coordination involved in 39 separate construction projects. But the businessmen balked at the suggestions, and asked the village government to act as the developer of the relocation site. The municipality thus took charge of ensuring that the development was orderly, attractive and energy efficient. It decided on three actions: education, guidance and enforcement. In the first action, education, the Community Development Office sponsored town meetings dealing with passive solar heating, thermal efficiency and the proposed wood system, stressing the economic benefits of each to businessmen. Second, the village helped guide the business community's selection of architects and contractors by establishing a "construction team" for municipal buildings. The team consisted of a well-known local contractor with interest in renewable-fuel energy systems, and the passive solar architectural firm of Hawkweed Group Ltd. Invited into the village by the municipality, these two firms gained an inside tract on being hired by individual businessmen.

Lastly, with the help of Hawkweed and specialists from UWEX, the village developed a community-wide zoning ordinance which declared the new downtown site a "planned development district." In effect, the ordinance allows the Village to plan the entire development. Under the zoning mechanism, the Community Development Office will draw a master plan for the downtown, including building placement and height, thermal performance, location of plantings, landscaping and other details. The plan will be submitted for approval by a seven-citizen Planning Commission. Once approved, the plan becomes the zoning ordinance—the legally enforceable standard—for the new downtown area. Each businessman wishing to construct at the site will have to apply for zoning and building permits. To qualify for the permit, the construction will have to comply with the plan. While the zoning ordinance does not specifically require passive solar heating, it sets forth thermal performance standards so strict that most, if not all, of the buildings will use passive to meet them. And the plan is being carefully drawn with help from Hawkweed to make sure it meets passive solar criteria. As each building plot is sold to businessmen by the Village, which now owns the land, only the ownership of "footprints" (the actual land underneath the building) will be transferred, leaving the municipality in control of landscaping, vegetation and future development.

Thus, while they did not want to give up control of their building plans to new structures or new groups, the Soldiers Grove businessmen were willing to turn control over to the municipal government which, in such a small town, still was a trusted institution of local people. In doing so, the businessmen in effect turned control of the development over to the entire village.

Citizen and Municipal Official Involvement

Throughout the relocation project and its energy component, the Village government in Soldiers Grove has served as sponsor and lead agency. First through its relocation coordinator, then its Community Development Office, the village has been intimately involved in every facet of project planning, even when planning has been undertaken by outside agencies such as UWEX, the State Energy Office, and Argonne. In coordinating the energy study team, the Wisconsin Energy Extension Service took special care to seek frequent guidance from the Community Development Office, and to check each phase of the work with that office before the study proceeded further.

In turn, it has been the responsibility of the Village Board and Community Development Office to keep in close touch with the citizenry and to stay aware of its wishes. The Village Board kept contact through a Citizen's Advisory Committee appointed shortly after the relocation idea was first proposed in 1975. The Board has consistently followed the committee's advice closely in matters ranging from signing grant applications to hiring specific firms to carry out the project. The Community Development Office runs a regular relocation column in the Village's newspaper, has sponsored dozens of town meetings and workshops, and gives ongoing encouragement to citizens to submit suggestions and complaints on the project to the office.

The Outcome

By August, 1979, Soldiers Grove had received $2 million of the $3.25

million in state and federal funds needed to complete the move. Construction of the first 11 of 36 business buildings was scheduled to be completed by the end of 1979 at the new site.

Four of the first buildings preparing for construction have contracted with Hawkweed for design work. The three municipal buildings planned for the new downtown have been submitted by Hawkweed to the Department of Energy's Passive Solar Commercial Design grant program. Hawkweed has established an office in the village. The new zoning ordinance, critical to guiding development at the site and encouraging energy efficient design, has undergone public hearings and has been adopted by the Village Board. The Village's "planned development standards" are now being drawn and will be in effect by fall, 1979.

Next Steps

Soldiers Grove intends to continue pursuing sufficient state and federal fundings (an additional $1.25 million) to complete the move. Assuming the money is obtained promptly, the move is expected to take two more years. The village is hopeful that all of the first 11 buildings to be constructed will feature passive solar heating, plus back-up heating and cooling equipment which uses renewable fuels or allows for conversion to a renewable-fuel system. The buildings will then serve as demonstrations to other buildings constructed in the future.

Brown Engineering Company intends shortly to produce a "feasibility threshold" the village can use to judge the practicality of the wood-fired plant in the changing conditions at the new site. Brown will also outline the costs of alternative, more conventional options, including furnaces and heat pumps serving groups of three or four buildings in clusters at the site. Soldiers Grove plans to complete the priority work on its zoning ordinance, passive design and provision of a flexible back-up heating system for the first wave of buildings at the new downtown. If necessary, it will then begin studies to find an economically feasible back-up system making use of renewable, native fuels.

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The Lawrence, Massachusetts Community Hydroelectric Project

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I am very pleased to be here on behalf of the six developers who got involved in the Lawrence hydroelectric project thinking that it would be fairly straightforward and not very expensive and found out instead that it was complicated, protractive and expensive. The Army Corps of engineers estimates that there are about 49,000 existing dams in the United States, some of which are capable of being retrofitted. The Lawrence Dam is one of them. It is the furthest downstream dam in the Merrimac River Basin and it had some rather interesting challenges attached to it. Let me just point these out. For one, salmon and shad are returning to the Merrimac River as part of a federal program, and since this is a navigable waterway, it falls under federal licensing and jurisdiction. (And like it or not, anything that can float a log is by definition a navigable waterway, meaning that you have to deal with the federal government.) The only redeeming feature about getting federal approval for a project is that some federal agencies are a lot easier to deal with than state agencies and the Federal Energy Regulatory Commission we had to deal with is one of the easy ones. Let me point out some of the interesting characteristics of the dam from an economic point of view and the problems that the site created for the six developers:

1. The dam is listed on the National Register of Kansas and the gatehouse could very well be eligible for this status.
2. Not only do salmon and shad want to swim up the river and the federal government want them to do so, but no one is willing to pay the freight to allow them to get over the dam.

3. There is an endangered species—a short-nosed sturgeon living in the estuaries at the mouth of the Merrimac River.

Essentially, the problem is: where do you put a power plant that is going to deal with all these issues. We looked at eight different alternatives and they were all either impossibly expensive or environmentally unacceptable even though, as we all know, hydroelectric power itself does not use any energy, it simply uses the weight of the water, and in this case, water falling 28 to 30 feet.

The capacity of the plant is 15 megawatts per hour which is rather large by small-scale hydroelectric plant standards, but still only about 1/80th of the capacity of Seabrook. The total project cost in 1981 dollars including funds used during construction is $24 million dollars. Output is 100 million megawatts per year. The environmental investment required by the federal government was fairly high: 1.3 million dollars for fish facilities. In terms of what that costs every year to the rate payer, this works out to be about 220,000 dollars at conventional financing. We haven't yet calculated what the equivalent is in terms of pounds of fish caught, but we do recognize that the investment was a substantial one and we have some questions about who should have to pay for it.

The Lawrence hydroelectric power plant is one of the first in the country to use American-made and -installed bulk turbine units. They were made by Westinghouse and Allis Chalmers. The energy customer in New England Power Company which is a holding company for a group of industry owned and operated utilities. You might wonder why we didn't consider municipally-owned utilities instead. Actually, we did, but they felt that the project wasn't economical enough. The cost of electricity generated at the plant is a flat 4.4 cents per kilowatt hour on the basis of a 30-year contract. This is about $1,600 per kilowatt capacity in 1981 dollars. I would suggest that Seabrook is going to cost a full penny and a half above this if indeed it ever goes into operation.

To put a project like this together, one needs a certain amount of equity and a certain amount of debt. We were fortunate to find a hard energy investor in EG&G of Idaho Falls, Idaho to build up part of the equity. The Essex company which our group of six developers had to acquire because it owns the dam is the other equity participant. The total debt is $20 million dollars. Because the Lawrence project was our first, we found it very tough to finance. However, we are now working with communities and industry on subsequent projects and various banks we dealt with regarding the Lawrence project are coming to ask when our next project will be.

Finally, and as a brief summary, let me take you through some of the stages we had to go through. First, there was a start-up stage which began in 1974 and took about 1000 hours. This basically involved making and evaluating the business decision. Once we thought that the hydroelectric plant was a good idea, then we had to do a feasibility analysis. We did the feasibility analysis on our own at about 1/5 the cost of the average Department of Energy feasibility study. Next, we prepared options and an application for a FDIC license. The federal licensing procedure itself took from June, 1977 to the first of 1979 which is somewhat of a record in federal energy regulatory processing. Then we went into legal and power contract negotiations, by which time we had put our financial package together as well as some of the preliminary engineering. By the time the negotiations were over the project was at rest at between $800,000 and $900,000. Our project fell apart at about that time because of a slight tax problem that was resolved with the help of the state energy office. Construction of the hydroelectric plant finally began in June 1979. We expect to be on line on July 1, 1981 and if the switch hasn't been thrown by then, the general contractor will have to start paying the penalties.

In closing, I would like to point out that this is just one project out of literally hundreds that are feasible nationwide. Now is the time to get on with them.

Alternative Technology in Low Income New York: Energy Task Force's First Four Years

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Abstract

Energy Task Force is a group of designers, builders and educators which advises low income grassroot organizations on energy matters. Beginning with an experiment at 519 East 11th Street in 1975, ETF has built energy conservation, solar energy and windmill systems to demonstrate the potential of alternative technology for urban communities. In carrying out these projects, ETF has developed technologies and working methods specifically suited for the retrofit of multi-family dwellings.

Efforts to develop, finance and carry out this work have shown that energy projects in low income communities must be integrated into other neighborhood redevelopment plans. Programs should focus on providing direct services to the local population, providing education and job training, as well as installation of energy saving and energy producing equipment. Alternative technologies also require new working attitudes and approaches on the part of technicians, so that residents of buildings receiving energy systems understand their workings and operating techniques.

Alternative energy projects show excellent potential for reducing fuel costs, and when they are planned and carried out in cooperation with community residents they make an important contribution to the restitution and revival on low income neighborhoods.

Introduction

Energy Task Force began in 1975 with three pioneering energy experiments done in cooperation with tenants at 519 East 11th Street in New York City. A grassroots group of co-opers was rehabilitating 519, an abandoned, burned out tenement which had fallen into city management after the landlord failed to pay his taxes. ETF aided the co-opers in securing money to insulate their 13-unit building. Then, with support and assistance from the tenants, ETF designed and constructed the nation's first urban multi-family solar energy system and the first urban windmill on 519's rooftop.

The 519 project was and remains important because it demonstrates how renewable energy sources can reduce dependence on fossil fuels and the contribution they can make to the struggle to rebuild and revitalize low income communities. As one of the first experiments with appropriate technologies in an urban setting, the project concentrated on simply demonstrating that the technologies work in the urban multi-family dwelling context. Overall performance of the systems proves solar and wind energy are viable, abundant energy resources with excellent potential as power producers in densely populated centers like New York City. Equally important, the energy projects were built in conjunction with community organizations on the Lower East Side, showing how engineers and architects, tenant cooperatives, community housing and development groups, city government, federal agencies and federal dollars can all work together to develop comprehensive revitalization programs.

In the four years since the 519 experiment, Energy Task Force has grown from a small group of volunteers into a city-wide technical assistance organization staffed by designers, builders and educators. ETF's approach has been to attack basic energy problems at the neighborhood level, using technologies which are accessible and ready for application now. With the aim of reducing fuel costs for low income co-ops, ETF has conducted conservation retrofit experiments, started an energy audit service and constructed active and passive solar heating systems. The struggle to develop, finance and carry out this work has taught us that appropriate technology must be an integrated part of neighborhood revitalization plans. Energy is a basic survival need, along with nutritious food, decent housing and fulfilling employment. Recognizing this, ETF is committed to showing low income people how the energy crisis contributed to local problems and concrete ways they can use technology as a tool to solve those problems. ETF conducts job training programs to transfer technical skills and is developing a community-based business to employ trainees and serve local needs. Finally, to suggest appropriate development directions, ETF serves as an advocate, communicating the energy concerns of the urban poor to policy makers and the public. Our in-the-field experiences have pointed out problems, issues and potentials for the continuing growth of appropriate energy systems and show that alternative technology has important contributions to make in urban environments.

Energy Conservation, Solar and Wind Energy Design

It is Energy Task Force's conviction that rising fuel costs are a major cause of building abandonment. Since 1968 fuel costs in New York City have risen over 300%, while other building maintenance and operating costs have risen a comparatively low 96%. The effects of this situation have been particularly devastating in low income communities. Unable to maintain a profit, landlords first cut so-called "non-essential" expenses (like taxes and minor repairs) and stop providing heat and hot water. Eventually, they completely abandon their properties, sometimes hastening the process by arson. The result is neighborhoods like the South Bronx where tenants live in crumbling, freezing apartments and where the combination of burned out buildings and vacant land accounts for a vacancy rate of 50%. In the small community of Loisiada, a 50-square-block area in Manhattan, 340 of the remaining tenements are now in Real Estate Management by the fiscally troubled City of New York. These buildings are among the most poorly weatherized in the country. Built strictly for profit during the age of cheap and plentiful fuels, they weren't designed with energy efficiency in mind. Their deteriorated condition allows even more energy waste. Broken window frames and glass let in cold drafts. Crumbling walls, fallen ceilings and total absence of insulation allows heat to escape through walls and roof. These conditions are compounded by broken or poorly operating heating systems.

At 219 East 4th Street on the Lower East Side, ETF instituted a conservation plan—what we call an Occupied Building Energy Retrofit. Before the retrofit, members of this low-income co-op were on the verge of giving up their home because of skyrocketing fuel costs. In keeping with the predictions of ETF's energy audit, fuel consumption was cut by *over 50%* through repair and sealing of windows, addition of insulation, cleaning and upgrading the heating system, installing hot water flow reduction valves and use of other simple techniques. Fuel savings this winter are expected to total 3600 gallons of oil, or about $2880 at 80¢/gallon.

The ETF report "Escalating Fuel Costs of Rent Stabilized Apartments:

the Abandonment Crisis and Its Solution" traces the energy history of six typical New York City apartment buildings. Fuel costs are straining the operating budgets of these buildings, to the point where rent income cannot cover costs. The report discusses how an energy conservation retrofit could reestablish and preserve the economic viability of the properties.

Recognizing energy conservation as an essential part of building rehabilitation and the first step to energy independence, ETF trained 14 community members as energy auditors in 1978. A 20-week course prepared them to advise tenant groups on energy issues, to audit residential buildings for heat loss and to devise energy conservation strategies for retrofits. Unfortunately, funding problems have made it possible for only five auditors to put these skills to use. Two are coordinating weatherization projects on Kelly Street in the South Bronx, two work with the People's Development Corporation's energy team, and one operates an audit service from the ETF office. Despite the overwhelming needs for home energy auditing, weatherization and energy rehabilitation, only a handful of programs have been established to serve low income communities. Often the income eligibility requirements are so stringent that they disqualify people, who, in the real circumstances of New York City, live in real poverty, pay over 25% of their incomes on essential energy needs, and live in the city's cold, most energy inefficient structures. None of the buildings which have taken advantage of ETF's audit service have been able to secure monies for weatherization materials. There simply are no financing mechanisms from local, state, federal or private sources for poor people in red-lined communities. Grant programs are much too limited, too. Grassroots organizations must, therefore, take the initiative and make energy conservation a priority in approaching government agencies and funding sources, in planning rehabilitation projects and in securing skills.

Our efforts to build solar energy systems have also met financial and institutional barriers. After the 519 project and installation of a second, larger system with members of the People's Development Corporation at 1186 Wasington Avenue in the South Bronx, ETF and community groups believed that solar energy systems would enhance funding possibilities for neighborhood housing rehabilitation efforts. This was not the case. Except for the new CSA and HUD demonstration grants and the 12 hot water systems ETF will build for the New York City SUEDE project, no low income solar projects in New York City have secured funding.

In an effort to stretch limited funds, ETF has developed more efficient and cost effective urban solar applications. One problem area has been the expense added to construction projects by city building codes with regard to fire safety, roof structural loads and plumbing. For example, on flat city rooftops, support racks spanning from bearing wall to bearing wall keep the weight of collectors off wooden roof beams, tilt collectors at the proper angle and resist the overturning forces of the wind. Structural and fire codes dictate that the racks be made of steel. ETF first used costly 1/4" steel fabricated by professional iron workers. This expense can be eliminated in two ways: either integrating collectors into the roof structure during rehabilitation, or building racks with light gauge galvanized steel framing systems. These methods are also more appropriate for participatory building, since the materials can be cut and drilled on site by the tenants themselves.

Since old construction practices are not necessarily appropriate for solar applications, the concerns and apprehensions of engineers, builders and owners must be carefully considered. As a local contractor working on the passive solar building being constructed at the Bronx Frontier Development Corporation said, "I've built all kinds of buildings, but this is the *weirdest* one I've ever seen." And design habits which made sense in the age of oil are sometimes hard to change. ETF's approach is to involve people in design and construction to as great a degree as is practicable. This way, ETF is in close touch with available skills and needs. One reason appropriate technology design demands greater attention to problems of builders and operators is that it depends on labor intensive methods and active participation of the operator. The key person in community projects is the construction co-ordinator because he/she must confront mistrust of (or inexperience with) new ideas and techniques on the job and serves as the link between the technicians and the people.

The CUANDO Solar Energy Wall, built during the summer of 1978, was New York City's first passive solar energy system. It demonstrated the potential of south-facing masonry walls for solar retrofit. This variation of the Trombe wall was built by teenaged summer Youth Corps workers and members of CUANDO (Cultural Understanding and Neighborhood Development Organization) and ETF. The 500 sq. ft. system heats the third floor gymnasium of the CUANDO Community Center in the winter and ventilates it during the summer. NCAT (National Center for Appropriate Technology) is monitoring the system to evaluate its performance. Preliminary readings taken at 4:30 P.M. in mid-October showed instantaneous temperatures of 50 degrees F at the collector intake vents and 110 degrees F at the outlet vents eight feet above.

An adaptation of the CUANDO wall is being used in conjunction with active flat plate collectors on two ETF designs for HUD Cycle V projects. One problem associated with passive solar for multi-family dwellings is moving heat from the collection area to isolated zones of the building. Since a passive system also requires active participation of the user, a multi-family design must eliminate controls which depend on a single individual or cannot adjust to the varied habits of a large group of residents. ETF has attacked these two difficulties by tying the passive collectors into the active component's distribution system. The Cycle V buildings will be insulated on the outside, using the 3 inch rigid styrofoam covered with reinforcing fabric and stucco. This permits use of the building's brick walls for thermal storage and eliminates the need for rock bin storage in the basement. This insulation method can also cut costs considerably for the retrofit of already occupied buildings.

On the whole, air space heating systems show more potential for reducing overall building fuel costs than hot water systems. First, since they heat room air directly, there is no efficiency loss through heat exchangers. Second, overall operating temperature is lower—in the range of 65-120 degrees F rather than 90-140 degrees F—a better match for available solar heat. Third, since temperatures are lower the collection period is extended; sunshine can be put to use early in the morning, as soon as the air reaches 65 degrees, rather than waiting for the heat to build up to 90 degrees as with water. During the summer, excess heat can be passed through an air-to-water heat exchanger to make domestic hot water for neighboring buildings.

Excess heat from solar greenhouses can also be used for space and water heating. A 450 sq. ft. rooftop greenhouse designed by ETF for the Renigades of Harlem will also vent waste heat from the boiler to the greenhouse during cold periods. At a cost of $12,000, the return is expected to be $1550 the first year—$175 in heat for the building and $1475 in food. (Again the cost will be higher for this urban multi-family application because structural supports must be added to keep weight off the roof and no flammable materials may be exposed.) Without accounting for escalation of fuel and food, the savings represents a straight payback of less than 7 1/2 years, making solar greenhouses the most cost efficient energy producing technology yet developed. The 519 windmill is a rebuilt Jacobs machine capable of producing 2 KW. To challenge Con Edison's monopoly on electricity production in New York City, the machine was tied into the utility grid with a synchronous inverter which backfeeds excess power. As a result, the New York State Public Service Commission ordered a new tariff establishing the right of windmill owners to back feed power. This is a limited victory, however. The tariff also allows Con Edison to charge windmill owners an alternative monthly bill based on the machines installed capacity ($6.28/KW), rather than on the customer's peak connected demand load. The questionable rationale here is that the utility must maintain standby capacity for the windmill customer, while the windmill owner is given no credit for his/her potential as standby capacity for the utility. At this stage of wind energy development, this policy (which has discouraged interested groups from erecting windmills) does not make sense, since Con Ed's excess capacity above peak system load is 33%. Only through experience with a number of systems can the effect and value of decentralized wind energy conversion systems for utilities be evaluated.

As a follow-up to the 519 experiment, the Bronx Frontier Development Corp. is now installing a 40 KW windmill at its East River compost site. Garbage from the Hunt's Point produce market and leaves from suburban communities are being turned into soil for urban gardens and open space development. Controls and batteries for the windmill will be housed in a passive solar building designed by an ETF staff member which will also serve as an environmental education center, demonstrating a variety of conservation, solar and waste-recycling technologies.

Original impetus behind the Bronx Frontier project was to use a local resource—abundant, free wind energy—to scale up their compost operation and make it a viable commercial effort. This project has grown to address a wide range of technical, economic and policy issues. Its intermediate size is a more appropriate test for community projects than the tiny Jacobs at 519 or NASA's giants. The wind turbine will be monitored using different operational modes (methods of working in concert with utility electricity) to test their economics. Frontier will also investigate consumer protection, siting and zoning, and possible electromagnetic interference problems. The ultimate objective is to test the value of this decentralized energy system as a power producer for a small commercial operation and how it can best be integrated into the existing utility system.

Just as thorough weatherization and insulation must precede use of solar energy, load management and development of decentralized storage capability should be done before installing a wind energy conversion system. A thorough wind site analysis is also an absolute must; no amount of faith will make a windmill economical if winds are poor.

Outreach, Job Training and Economic Development

In carrying out its demonstration projects, Energy Task Force has learned that education is an essential element of community-scale technology. A piece of hardware is not a neutral tool when the people it is meant to serve do not understand its workings or have the skills to put it to use for themselves. New working attitudes on the part of technicians (as described above) and the transfer of knowledge and skills to the community are basic requirements.

ETF's educational work takes two major forms—outreach and job training. Outreach means communicating ideas and issues. Job training means providing the opportunity for local residents to acquire both skills and experience which will enable them to secure meaningful employment. ETF believes these elements are essential to the success of its design and construction projects, but regrettably, funds are often so limited that outreach and training must be severely cut back or eliminated. This situation puts a strain on the relationship between community and technical assistance groups, seriously hampering the development of truly appropriate and effective technical designs. Energy Task Force has therefore adopted a firm policy of insisting that funds for education be an inextricable part of each and every project.

The first outreach priority at ETF is bringing the community information on the energy crisis and how it directly affects them. This requires close attention to people's immediate needs and finding the best ways to communicate. Low income New Yorkers are very conscious of unfair prices and inflated rents, but few link the causes of this situation to the energy crisis.

In teaching people about energy, it is important to use non-technical language and examples from their experience. Saying "weatherstripping stops drafts" communicates better than saying "weatherstripping reduces infiltration." Equal care must be used in developing written materials and technical illustrations. If you never learned about Btus and mathematical equations (or haven't thought about them since high school), a heat loss calculation can look deceptively difficult, even impossible. Blue prints and technical drawings cannot inform people with no experience in reading them. Methods to teach basic concepts must be specifically designed for understanding.

Convincing people to educate themselves is only the first step. Technical assistance groups must also help people develop skills and gain access to technical resources. Otherwise, they have no avenue to participate in solutions. Everyone appreciates a warmer apartment and a lower fuel bill, so ETF first emphasizes energy conservation, beginning with energy auditing. The energy auditor is an important member of ETF's outreach team since he develops a comprehensive picture of a building's energy needs. The auditor goes into each apartment, examining its structure in detail. His close contact with tenants helps us adapt our educational strategy to suit each tenant group. The approach and attitude of the auditor, as the first technician on the scene, can set the tone for all subsequent phases of an energy project. If the auditor is responsive, open and helpful, tenants are encouraged to participate effectively and cooperatively.

Weatherization and insulation are the most critical low-income energy need, and also the best investment. However, teaching tenants the value of insulation and the best way to weatherstrip a window is at best limited when one can't provide materials to put that knowledge to use.

In the New York metropolitan area, Operation Open City, a federally funded weatherization program, has been the only source for materials and experienced crews. Although their record in all five boroughs has been outstanding, the scope of their operation hardly makes a dent in the problem. ETF is therefore working with a coalition of neighborhood energy activists to explore ways of expanding such projects.

Energy Task Force has found it is essential to spend as much time learning as teaching. Participation in community meetings and events keeps technicians aware of neighborhood priorities and helps them develop solutions which provide a direct service. Energy projects are meaningful only when they answer local problems and are integrated into other community development plans. In addition, ETF welcomes and encourages criticisms, questions and suggestions. We depend on the input of grassroots organizations in focusing our efforts.

Another important outreach responsibility is communicating the concerns of low income people to policy makers and the public. If people don't find out about community efforts they cannot support them. ETF writes letters, testifies at hearings and generally keeps in touch with policy makers to help include neighborhood opinions in energy and community redevelopment plans. Considering people's pressing daily needs, devoting resources to public relations sometimes seem too indirect a route. However, no community or technical assistance group can afford to neglect this vital educational effort. Demonstration projects will remain meaningful over the long term only if they are brought to public attention where they can serve as models from which others can work. Also, a group's fundraising success can often be improved by a successful media campaign or public relations event.

Job training has become an ETF priority because unemployment is rampant in low income communities and energy projects need skilled workers. Our training programs are designed to answer very specific community goals, such as transferring skills to complete a construction project or generating energy-related employment for trainees.

Energy Task Force first identifies skills and information to be taught and then develops a curriculum which balances conceptual understanding with hands-on experience. For example, training for SUEDE solar mechanics is emphasizing construction, using installation of equipment as a way of getting at a basic understanding of technical information. The Community Energy Audit Program, on the other hand, relied on classroom instruction to teach skills and concepts and was later augmented with field work to teach working methods and procedures.

Training programs should be designed to accommodate non-traditional learners with diverse backgrounds and levels of education. Many trainees must overcome years of lack of confidence in their abilities, distrust of educational institutions and teachers, and frustration with the learning process. Others are able to progress more quickly and are eager for more advanced technical information. Through teaching in a supportive and non-authoritative manner, ETF attempts to help trainees develop confidence in their abilities to control and change their lives and to make a positive impact on their communities.

Work experience, counseling, formal classroom instruction and in-the-field experience are all important, but no training program is complete without subsequent job placement. The Community Energy Audit Program's success was limited because funds could not be secured for the trainees to work in their communities, as ETF had planned. While energy related businesses (like weatherization and insulation companies, boiler maintenance and repair services, solar installation and energy auditing) show great potential for employing community residents, the market for this work has not been developed. And although the need for such energy services within low income communities is overwhelming, the residents themselves simply don't have the capital to support an unsubsidized business venture. Local economic development is a neighborhood priority, and as grassroots groups have become more determined to explore business ventures, ETF has focused training programs on developing saleable skills. ETF has tried to open the door to the establishment of community-based energy businesses by evaluating the possibilities for economic development when considering new projects. Careful investigation and planning of a strategy for ETF to launch its own commercial auditing service, later expanding to include weatherization, insulation and solar installation, is next on our agenda.

Conclusions

Energy Task Force is a new and developing organization. Looking back over the last four years of struggle to carry out community energy projects, we are excited and encouraged by the new energy consciousness of grassroots groups and their strong support of appropriate technology efforts. However, the local energy problems we identified in 1975 have become far more critical. Arson and building abandonment has become the City of New York's most critical and unmanageable problem. Fuel oil prices continue to escalate at an ever increasing rate, and rumors of shortages expected this winter are already a major concern in low income communities. Tenants wonder if landlords will provide heat and hot water when prices reach the anticipated 95¢/gallon. Weatherization and insulation programs remain severely limited, and funding for locally initiated appropriate technology projects is almost non-existent. Crisis intervention, technical assistance and grant programs which may be available are not the solution, since they offer only temporary relief and few combine monies for materials, staff, administration, outreach and training in one comprehensive program.

Decentralized, community scale energy systems are a promising new approach to meeting energy needs, but they can't be developed with oil age concepts and attitudes. Problems necessarily appear when people are left out of the process. Designing appropriate technology systems has taught ETF that participation of the builders and owners is essential and requires full attention to the needs and resources of each community. The lesson of alternative technology for neighborhood redevelopment is that technology is not neutral, but is a social and political force with a profound influence on every facet of community life.

In designing energy solutions, we can't merely look at dollar signs and barrels of oil saved. The proper perspective is to design strategies that will not only prevent people from freezing this winter, but will also involve local residents in developing long term energy solutions appropriate to the needs and lifestyles of their communities.

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Planning for an Energy-Conserving Community with a Wood-Fired Central Power Plant

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Abstract

A planning team headed by Georgia Tech has completed a 12-month study to design a 235-acre energy conserving community located in Shenandoah, Georgia, approximately 25 miles southwest of Atlanta. The work statement called for the preparation of a conventional land use plan, without energy considerations, which would then be compared to two energy conserving plans: (1) a passive land and building design; and (2) a passive design with some solar options. The passive plan alone produced added building costs of approximately 4%, in return for electric cost savings of approximately 6%, natural gas cost savings of approximately 30%, and land development cost savings of 13%. The second plan recommended four solar options: solar direct gain, attached greenhouses, active water heaters and Trombe walls. If all four devices were installed, the result should be a 62% cost savings in natural gas. Finally, the team will continue to study the feasibility of financing and constructing a 2 to 4 megawatt wood-fired steam turbine to co-generate electric and thermal energy for the community.

Introduction

This conference appears to be dedicated to the proposition that if we simply grind out one energy house at a time, we won't ever get around to air conditioning, much less freezing it over; so, we're trying to discover ways to move up to a community scale and then, hopefully, to complete cities. The U.S. Department of Energy decided in 1977 to encourage that trend, and the Buildings and Community Systems Division of the DOE announced a competition for the planning of an energy-conserving community ranging in size from 50 to 500 acres. Five projects were chosen: The Woodlands near Houston, Texas; Greenbrier near Norfolk, Virginia; Radisson in upstate New York; Burke Centre near Washington; and Shenandoah near Atlanta, Georgia. This presentation will summarize the experience of the Georgia team.

The Team

Shenandoah is located 25 miles southwest of the Atlanta airport, at the Newman exit of Interstate 85. It's a comparatively new community of 7,000 acres, planned for about 42,000 people over a 25-year development period. Energy planning required an interested developer; in this case, Shenandoah Development. So far, its staff has worked toward establishing a one-step demonstration site of many different applications of solar and energy conservation. Among them are the Shenandoah Solar Recreation Center—wrapped by a warm blanket of earth up to its 2nd story level; energy-conserving homes, one of which had a heating and cooling bill in November of less than $9; solar homes for heating and hot water—with both liquid and air systems; a home under construction with passive heating and cooling; and one with solar water heating only. Other homes are planned for photovoltaic applications and one will be cooled with a Rankine cycle turbine.

So, we have the first requirement for a successful project—an interested developer. The second requirement is a capable team. Georgia Tech, less than an hour away from Shenandoah, is involved in most of its energy projects. So Tech engineers and economists were natural choices to manage this effort. Since the design called for heavy emphasis on land planning, the landscape architectural firm of Laubmann & Reed was an important addition. Newcomb & Boyd were the mechanical engineers, furnishing computerized calculations of energy loads. Williams-Russell, a civil engineering firm, provided costs of roads, sewers, and land development. They also examined potential barriers such as building codes and run rights. A building architectural firm, Finch, Alexander, Barnes, Rothchild & Paschal, worked on the energy-conserving construction features.

The Location

The team and the developer chose a 235-acre location—a small part of the first village in Shenandoah—for the planning study. The site is scheduled to receive a variety of buildings—a high school, church, fire station, golf clubhouse, and homes and apartments. And, construction won't begin before late 1980, which allows time for thorough planning.

The Task

The DOE proposal called for the developer to do a conventional land use plan—without any special energy considerations. Then the team would take a year to design an energy-conserving plan—so that savings in fuel and money could be calculated. The Georgia Tech team chose to work on variations of three major alternatives: LEVEL 1: a land use plan that would use passive techniques, such as east/west streets for southern exposure; LEVEL 2: the same passive land use plan but adding energy efficient buildings, plus different forms of passive and active solar systems; and LEVEL 3: a small power plant to produce electricity, heating and cooling for the community.

The Passive Land Use Plan

The landscape architect, Laubmann & Reed, analyzed almost every facet of the site: soils, vegetation, slope of the land, physiography, and the winds. Then the architects plotted a microclimate, differentiating between colder, unprotected areas and warmer, sunnier spots. From all this came a land use plan that will place apartments and townhouses on sunny, protected, gentle slopes and individual homes on the unprotected north slopes. The passive plan calls for streets that run mostly east and west, so that the housing will have a long side facing south to catch the winter sun. But a roof overhang is deep enough to provide summer shade when the sun is overhead. Another benefit includes a narrow west wall to give the hot afternoon sun a smaller target. Some of the housing may be recessed into the earth for coolness and protection from the north winds. Pine trees are used as wind screens on the north side, but hardwood trees on the south side will give shade in the summer and shed their leaves to let in the winter sun. Houses will be set at different distances from the street—to provide better wind circulation.

Compared to the conventional plan, the passive land use plan is calculated to save the developer about $295,000 for streets, roads, water, sewer, etc., and the builders about $64,000 for lot development costs. In summary, it should cost about 13% less to develop the land.

Energy Efficient Buildings

In the actual construction of the homes, the building architects recommended these improvements: wall insulation was increased from R-11 to R-19 and ceilings went from R-19 to R-26. Window glass was sharply reduced on all sides of the house—except for the south side, where it was increased to about 60% of the wall area—in order to permit entry of the winter sun.

The building architects made energy improvements in the other buildings and then measured the increased costs against the savings. Building costs went up about 4%. But, electricity energy savings were about 6%—and natural gas savings almost 30%. all of this results in a savings investment ratio of 1.7. This means that every dollar invested in Shenandoah energy savings package should eventually pay dividends almost twice as high as an investment which might pay a 10% return.

Solar Options

Next the Tech team looked at a variety of energy and solar devices that could be installed on individual houses and buildings. The systems were examined for: *technical feasibility*—that is, would they work dependably in Shenandoah's climate and environment; *cost effectiveness*—measuring costs against savings, including federal tax credits; and *marketability*—would homebuyers find the devices attractive and relatively comfortable. These solar options were rejected: solar heating and cooling, solar window units, insulated shutters, solar attic, photovoltaics or solar cells and solar heat engines.

The recommended systems included solar direct gain (an example might be a solarium window with heat-absorbing tile). Or, a homeowner might prefer a Trombe wall—a thick, concrete mass wall painted black to absorb and radiate heat. Another recommended option would be a greenhouse attached directly to the home. And active solar water heaters are attractive investments, especially if the solar development bank provides low interest loans along with the present federal tax credit.

If all the single family homes in the community chose a combination of a Trombe wall, attached greenhouse and solar water heater, the result should be a 62% saving of natural gas consumption compared with the conventional plan. Electric consumption would still be only about 6% less since no solar cooling would be provided.

Community Advisors

As plans were developed, they were discussed with two outside advisory committees—one committee of marketing specialists and the other of lenders. The marketing director for Kingsberry Homes was doubtful that young couples will pay extra money for insulation because they figure they'll be moving in three years. The marketing committee suggested these strategies: don't talk about total cost and payback, instead, talk about monthly loan payments compared with monthly fuel savings; tax credits will help a little; and low-interest loans are better because they begin help at the moment of purchase. Builders can't get loans for earth-covered houses because they have no history of resale value. If an on-site power plant is built, homebuyers must have a firm guarantee that it will work.

The lenders committee offered these ideas: lenders are more willing to lend money for an energy house—because rising utility bills that are almost equal to mortgage payments are causing more foreclosures than any other single cause; and appraisers depend on the resale price of a house—and there's too little history in our area of resales of low energy homes—and practically no resale history for solar houses. Bankers suggested that a low energy house should get an interest subsidy to provide a loan at ¼ to ½ percent lower than the market rate. Lenders are cautious about an on-site utility plant. They ask, "if it doesn't work, who takes it out and who pays for its failure?" These questions will be examined in an ongoing feasibility study of a central power plant—one that might produce electricity *and* heating and cooling for the community and its surrounding areas.

Central Power Plant

A conventional, large electric plant wastes about 65% of its energy. In other words, the process of converting coal to electricity is only about 35% efficient. However, a power plant that makes electricity *and* captures waste heat for heating and cooling buildings is about 65% efficient—so it might save 30% *more* energy than the conventional plant. Keeping this in mind, the Georgia Tech team explored a number of options for a small central plant for the study area. Those options are ranked in order of their suitability for this site.

Wood-Fired Turbine

The wood-fired turbine appears to be the best choice for a number of reasons. Wood could be burned to produce steam and make electricity. Then, exhaust heat from the turbines can be moved by underground pipes into nearby buildings for both heating and cooling. Wood is a renewable energy source, and Georgia has a great deal of wood waste—wood chips, sawdust, bark. A sizeable amount is within trucking distance of Shenandoah at a reasonable cost. Wood stokers and boilers are neither new nor revolutionary, and they're mechanically reliable. There is comparatively no pollution—no smoke from 40-foot stack, and a fairly simple method is available for collecting fly ash. The plant is not prohibitively expensive to build, and it's not difficult to switch to backup fuels like natural gas or oil.

Central Plant Problems

One major problem inherent in the construction of the central power plant is that a system this small—about 2 to 4 megawatts—is not large enough to take full advantage of economies possible in the average 600 to 1,000 megawatt power plant. The smaller plant needs to be tied in and synchronized with a bigger electric utility—and that interface is not an easy trick. In addition, underground lines for hot and cold water to the buildings are expensive, thermal energy is lost along the lines, and the moisture and heat content of the wood may vary.

The location of a power plant in a predominantly residential community will be a problem. The developer preferred a site in an area of open space where it could be screened on less valuable land. But the plant needed to be located near high-density housing to lessen the cost of thermal distribution lines—and to be centrally located for future construction just outside the eastern boundary of the energy community. So, after getting environmental and aesthetic assurances, the developer yielded.

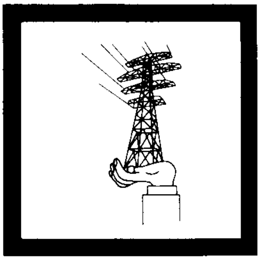
Central Plant Costs

The cost of building a 2 to 4 megawatt electric and thermal plant is estimated at $2.6 million. Operating costs would be about $330 thousand a year. That would mean energy costs to the consumer would be about 4.6 cents a kilowatt hour for electricity—which is close to present rates—and about $10.60 per million Btus for heating and cooling. That's about three times as expensive as natural gas. But, if we assume a rise in the cost of electricity and gas of about 3% a year *above* the inflation rate, the new plant would be economically competitive within a few years.

Conclusions

The energy savings provided by the central plant would be greater than those from any of the options discussed so far. Level 2 (which included solar devices on individual energy-saving buildings) produced a saving of 335 megawatt hours of electricity; the central plant would save 2000 megawatt hours annually. Level 2 would save about 20 billion Btus of natural gas, while the central plant would save 30 billion Btus each year.

It should be emphasized that these are preliminary findings. The George Tech team proposes to continue to work with the Department of Energy and a Georgia electric utility (Ogelthorpe Power Corporation) to refine the preliminary figures and explore possible ways of financing and building a wood-fired central power plant for the community and its surrounding area.



Section D
Role of Local Government in Energy Programs

Luncheon Address
by the Honorable Charles F. Horn
Mayor of Kettering, Ohio
August 20, 1979

Role of Local Government in Energy Programs

Charles F. Horn
Mayor of Kettering, Ohio

I am pleased to have this opportunity to meet with my fellow government officials to discuss a subject that is so important to all of us, not only in our government roles but also to us as individuals. As a farm boy in Ohio using a windmill as our source of water supply, the sun for the drying of crops, and a pony for my personal transportation, I had little vision of the complexities of my life in 1979, and my almost complete dependency on fuels and energy provided and delivered to me by others. The infrequent energy blackouts or brownouts that have temporarily inconvenienced us from time to time have done little to create an awareness and understanding on the part of the American people as to the chaos which would ensue in our society as a result of an extended period of breakdown in our energy delivery system. How well we deal with energy in the next few years will determine the quality of life our grandchildren will experience, not to mention the possibility of strife and war yet in our generation if we should fail. Indeed, the problem of energy to each one of us is very important. It is one that cuts across and impacts on all of our other problems. The solution of our energy dilemma without dramatic effects on our quality of life poses a real test of world leadership. Since we in America are the disproportionately highest energy users (and wasters), it perhaps poses the greatest challenge for leadership in our country. We, in Local Government of course, are part of that leadership. I will direct my remarks to my perception of the role of Local Government in dealing with our energy dilemma.

We, in Local Government, have long complained that we have not had an opportunity for input into the design of Federal and State programs, which affect our delivery of services. The growing Federal bureaucracy consists largely of people who have not had experience in the operation of Local Government but who are designing programs which are mandated upon us. The Department of Energy has adhered to that tradition by closing out Local Government participation in the formulation of Department of Energy Programs. The National League of Cities and the U.S. Conference of Mayors have been continually rebuffed in their efforts to involved the cities in this process.

Local Government is providing services directly to people, is the closest to the people, is most accessible to the people, and is in a position to materially assist in the implementation of the broad-based Energy Program. What then is the role of the Local Government in dealing with our energy dilemma?

We suggest the four following categories:

1. *Leadership:* To gain citizen acceptance of an energy program and to facilitate its implementation.
2. *Planning:* Develop a planning strategy including a planning task force.
3. *Outreach:* Establish a Program for sharing the Local Government resources and expertise with the private sector and with neighboring Local Governments.
4. *Experiment:* Sponsor and encourage experimentation involving new ideas dealing with energy both within City Government staff and within the private sector.

There is much opportunity for Local Government officials to provide the necessary leadership for implementation and acceptance of programs of conservation. In 1973, the City of Kettering embarked upon an Energy Conservation Plan within City facilities and over the ensuing four years, reduced its natural gas consumption by 55% and the electricity consumption by 30%. Such initiative not only encourages other organizations and individuals by example, but offers proof that such progress can be accomplished and lends credibility to a Conservation Program. As Mayor, I drive a manual-shift, four-cylinder sub-compact, not only because I am committed to energy conservation but because I wish to set an example and make some small contribution towards puncturing the highly-advertised tradition of the auto industry that the huge gas-guzzler is the ultimate status symbol.

It disturbs me to hear public figures undermine conservation efforts by suggesting that the energy problem is contrived; that it is temporary and that all we really need to do is to eliminate environmental regulations and allow production to solve all of our problems. Does any intelligent public official really believe that we have an inexhaustible supply of crude oil and natural gas and that our diminishing reserves are not becoming increasingly less available and more costly?

Why don't we as public officials provide the leadership to establish a crash program of conservation which can materially assist in buying the time necessary to research and develop non-depletable sources of energy? Despite all of the rhetoric and hand-wringing coming from the Administration and from the Congress, there appears to be no leadership on the national level willing to ask the American people to make the commitment which they ultimately must make if we are to survive the transition to new energy sources with less than dramatic impact on our quality of life. We must provide leadership among the Local Governments of our region to design responsive and cost-effective public transportation systems and to gain acceptance, support and usage by our citizens. We must provide the leadership in gaining acceptance of new concepts of land use which will help to preserve our food-producing, naturally-irrigated land and which will facilitate energy-efficient but livable patterns of land use.

In the area of planning, we must identify and mobilize resources available to us to cope with the constraints of diminishing sources of cheap energy. We must institutionalize into our management process a method to consider the energy impact of every decision. In Kettering, we have just undertaken, with the help of a consultant, a review of our Zoning Code and Subdivision Regulations to determine those areas where energy is a material impacting factor, in order to make modifications which will facilitate conservation and more efficient use of energy. We are participating in a regional resource recovery planning effort as well as participating in the design of a functional, cost-effective Regional Transportation System. Many of these planning activities involve other jurisdictions which present a very cumbersome procedure. The City of Kettering was instrumental in bringing a group of six cities together into a voluntary Council of Governments not only to administer a common cable television franchise for six cities and five school districts, but also to provide a structure for the planning and implementation of common service-delivery projects which afford great opportunity for the elimination of duplicating functions and for energy conservation.

The City has also initiated a Technology Assistance Program involving regional participation of universities and industries with the cities to bring their expertise to focus upon city problems. By our affiliation with the Urban Technology System, the Great Lakes Innovation Group, Public Technology, Inc., the Federal Labs Consortium, and other technology transfer network sources, the City avails itself of modern technology which assists in the solution of current problems. This information is shared through the local Council of Governments.

In its outreach efforts the City has endeavored to establish an in-house expertise on matters of energy and technology utilization and through various media outlets is making this available to the private sector. Through a Volunteers Program we operate municipal and public access cable television facilities, conducting educational programs and debates, to stimulate energy conservation activities on the part of our citizens. The City also utilizes a quarterly newsletter and maintains a technical library for its own use as well as for the use of action groups in the private sector. The City, through its Technology Agent, provides energy audits for the private sector and is endeavoring to work out common-thrust energy programs with the local utility.

Finally, we must develop an attitude of experimentation and encourage the trying of new techniques. Traditionally, Local Governments have been constrained from experimentation because of political considerations as well as for other reasons. In our City, through the encouragement of City Council, and through the efforts of our Technology Agent, discovery of energy-saving techniques has become a personal objective of our employees. With cheap energy of the past, all cities have facilities which were designed without considerations of energy usage and which offer great opportunity for modifications which will save large amounts of energy. For example, the waste heat from the City ice rink is utilized to warm a nearby swimming pool. Also, through cooperation with a Federal Lab, the City is testing a variety of energy-saving equipment on our vehicle fleet with promise of substantial reduction in gasoline usage.

It is quite common to find heating and air conditioning systems fighting each other within the same building complex. Our Technology Agent discovered that by interconnection of two air conditioning systems the overall efficiency would be improved. Further, the air conditioner's heat output was channeled to the hot water system. Numerous such opportunities abound, not only within the City facilities, but in the private sector.

We, in Local Government, believe that we have a necessary role in the development and implementation of a National Energy Program. Through our efforts on the Intergovernmental Science, Engineering and Technology Advisory Panel, we hope to help open up the Federal agendas for input from the practitioners in Local Government.

I believe that we must immediately concentrate on conservation because it can be done quickly, cheaply, and without threat to health and environment. It is a natural starting point. I believe we must support programs to utilize solar systems for space heating and stop the wasteful practice of using petroleum products and electricity for space heating, thus relieving the projected capital needs of our capital intensive power generation and distribution systems and providing a measure of independence from "break down." I believe that to rush into a massive synfuel program would be an economic disaster, providing only temporary and insufficient relief from our dependency on foreign oil and would divert our resources from the research and development needed to bring about new non-depletable sources of energy. The politicians are only kidding themselves when they say we can develop new sources at the same time as we artificially hold the price of existing energy at unrealistic levels.

It is past time for national commitment to deal with energy. We, in Local Government, must also make a commitment and *use our Public Office to bring about a commitment on the part of our citizens.*

Section E
Concurrent Workshops

August 20, 1979

Workshop on Financing and Ownership Options

August 20, 1979

Workshop on Financing and Ownership Options

Chairman

Stephen G. Lewis
The MITRE Corporation

Panelists

William Fuller
Paine, Webber, Jackson & Curtis

Denis V. Curtin
Citibank, N.A., New York

Gerard Giordano
LeBoeuf, Lamb, Leily, MacRae

Summary

Steve Lewis introduced the panel and summarized some of his thoughts on financing community renewable energy systems. He pointed out that the financing options of choice may differ depending on whether the energy system is "centralized" for the entire community, or "dispersed" consisting of single small customer units; whether public or private financing is available; and, what the system procurement procedures of the community happen to be. For the full text of his remarks, see the accompanying paper in these proceedings.

Mr. Giordano, a bond attorney, then discussed the tax exempt bond mechanism for financing community energy systems. To use this mechanism a community must possess home-rule authority as well as local officials willing to propose the energy system and see it through the financing process. Most states have laws which would authorize communities to pursue relatively large-scale systems (for example, resource recovery plants or alcohol production facilities), but financing of smaller systems (for example greenhouses) may be more difficult. One key aid would be a statute establishing a "solar energy financing authority," which would authorize creation of energy products, contract for sale of these products, and allow business to be conducted on an RFP or request basis rather than exclusively via public bidding.

A key question which communities should be concerned with is, who is going to bear the risk of loss? The bond underwriter will not; the municipality may or may not, depending on its constitution, debt limits or other priorities. The technology promoter may cover the risk through pledging of his assets. The long-term purchasers of the energy product may also be induced to bear some risk.

Thus, the three areas of greatest concern in financing community energy systems through tax exempt bonds are:

- Legal and regulatory authority—are the laws there?
- Will the IRS permit tax exempt bonds in your case?
- Security of the deal—are all the risks covered?

A useful reference is the *Resource Recovery Implementation Guide*, subtitle, "Financing," published by the Environmental Protection Agency, Office of Solid Waste, 201 M St., Washington, D.C.

Following Mr. Giordano, Mr. Curtin described how a bank might evaluate its potential investment in a community renewable energy system. (For the text of his remarks, see his paper published in these Proceedings.) A lively question and answer session followed.

Several questions surrounded the sources of technical advice to which banks turn in evaluating the technical feasibility of renewable energy systems. Many of the larger banks have in-house engineers, including some who work overseas and are thus able to "check out" the feasibility of a foreign-made system. However, these engineers may have been trained in more conventional technologies, so time should be allowed for them to learn new things. Also, banks look at the long-term history of the company proposing the technological innovation, reasoning that large, stable, reputable companies will be able to back up a venture they propose. For the riskier ventures, funds could be sought from venture capitalists who would take an equity position in the project. It was also pointed out that frequently, the upper management of a bank is less "stodgy" than the local branch in evaluating a project.

Mentioned was a legislative bill which would permit commercial banks to underwrite all types of revenue bonds, which might result in their wider distribution. Presently, commercial banks can underwrite general obligation bonds (secured by tax revenue) and some types of revenue bonds (secured by user fees).

An interesting discussion concerned potential competition for funds between large-scale nuclear plants and distributed small-scale energy systems. If the small systems would displace need for large nuclear or coal capacity expansion, they would reduce the economic viability of the large project. A bank might therefore not be interested in both types of projects. But it was generally agreed that there was no shortage of capital—the problem is the high price one has to pay for it.

Mr. Fuller then spoke about some of the institutional realities in financing systems through large private organizations. He pointed out that many corporate executives have trouble understanding the public official's need to conduct all his business in the public eye, not "at the country club," for example. Also, institutional investors tend to be "cold-blooded," they generally follow investment guidelines set down by investment committees, generally want to see "tried and true" technologies, and generally want "company," i.e., other like-minded investors participating in the deal.

He pointed out that tax exempt instruments are open to small projects and small towns, whereas a project has to be fairly large to attract the public markets. Also, the definition of "public purpose" is constantly being expanded, thus making it possible for more and more projects to be undertaken with tax exempt financing. Fuller added that it sometimes takes years to develop the financing for a municipal system. For example, the Saugus, Massachusetts resource recovery facility took five years to finance.

The balance of the workshop was occupied by an active question-and-answer session. These questions and answers are paraphrased below.

Q. *Could there be a municipal trust fund or some other financing mechanism that does not involve the profit motive?*

A. There's no reason a municipality couldn't issue a general obligation bond, in small denominations, with a yield higher than passbook savings. Eventually, the town would have to raise the taxes to pay it back, and there would need to be legal interpretation of public purpose. In the revenue bond case, there is the possibility of lawsuit if the bonds don't pay off.

Q. *Are banks concerned about utilities borrowing money from them and loaning it out for energy projects?*

A. They don't appear to be.

Q. *Is there a "rumor mill" in the financial community about which energy systems work and which ones don't?*
A. Yes! When there is a failure, many people investigate it so they can explain it to the investors.

Q. *Is there a publication on how to set up and finance a municipal solar utility?*
A. A publication on "Bond Financing of Municipal Solar Utilities" is available from the California Energy Commission, Attn: Sharon White, c/o Commissioner Ron Doctor.

Q. *What is the effect of the new investment tax credits?*
A. Tax exempt financing will save 20-25%.

Q. *How is it determined if the test of public purpose has been passed?*
A. By the courts. "Overriding public purpose is used for such health, safety, and welfare projects as garbage disposal and parking garages. It can be developed for energy projects but will probably have to be approved by the courts."

Q. *Is there information on community-based cooperative banks?*
A. The "National Consumer Cooperative Bank Act" has been operational for 3 months and a board has been nominated. This is a complex, public/private bank. The federal government guarantees $100 million per year over a 3 year period, specifically 90% for consumer co-ops, 10% for producer co-ops. In the first two years or so, we can expect a very conservative philosophy to prevail, with loans going to established co-ops. For small towns where the producers are the consumers, a co-op should probably check the regulations and declare itself a consumer co-op. Further information is available from Michael Freedberg, Conference on Alternative State and Local Policies, Q Street, Washington, D.C.

Q. *Banks and financial institutions are composed of human beings. People are getting really concerned about their policies. Will they keep backing the companies that pollute the air and water, or will they start getting behind better things?*
A. Bankers will get on board if you get legislation passed and issue general obligation bonds. In one case, several banks created a $3 million pool of funds for low interest loans for rehabilitation. In North Dakota, several banks pool funds to share the risk of financing an industry which the State Economic Development Department brings in. Regional banks are deeply involved with their communities. Also, there apparently is a not-for-profit financial institution that works closely with the community. Stan Hallet at the Center for Urban Affairs, North-

western University, 2040 Sheridan Rd., Evanston, IL 60201, has information on this.

Q. *The Public Utility Regulatory Policies Act and Title II of the National Energy Conservation Policy Act require new utility rate designs and financing arrangements. Is the financial community preparing for this?*

A. A municipality could probably set up a utility for a small district. Also a recent Business Week article explained Southern California Edison's philosophy that the best way to add capacity is to invest in conservation.

Financing and Ownership Options For Renewable Energy Systems: An Overview

Stephen G. Lewis
MITRE Corporation/Metrek Division
Bedford, Massachusetts

Abstract

This workshop discussion is concerned with the financing of community-scale renewable energy systems. The panelists, from the financial community, will explain some of the criteria that the community views as important prerequisites to financing projects.

Remarks and Introduction

This workshop is concerned with *financing and ownership options* for community renewable energy systems. I can't imagine an issue more important in a renewable energy systems project than to determine how the money is to be raised to pay for it, what institutions will put up the money, and what security they demand to assure themselves that they will get their money back. This is what we intend to cover in this workshop.

- What makes a project financable?
- What financial options are available to you?
- At what point in the project do you start to concern yourself with how it is to be financed?
- Should you seek the Department of Energy grant, or should you finance the project by properly supported debt financing?

- What are some of the important legal and legislative issues affecting various financing methods?

In this workshop, we are going to discuss these and many other critical questions about financing community renewable energy systems, and I believe we have the right people here to help you do it.

- William Fuller, Director and Senior Vice President, Paine Webber, Jackson and Curtis, an investment banking firm
- Gerard Giordano, Partner in the law firm of LeBoeuf, Lamb, Leiby and MacRae
- Denis Curtin, Assistant Vice President, Public Finance Department, Citibank

These three people have vast experience in financing both complex projects and home-based systems. In fact, they represent the people you must approach when you are seeking financing.

After my opening remarks, which will take no longer than 5-7 minutes, our procedure in the workshop will be to have each of our three panelists talk for about 15 minutes. All together, this will take about an hour, giving us over an hour for questions and discussion.

The subject of financing community renewable energy systems is a complex one indeed. To help us I want to try to organize some of these complexities. One of the complexities is that we are considering a wide variety of systems. To help us deal with them, we can group them into two categories:

- Centralized systems such as hydro, wood combustion for steam or power, waste to energy facilities, central wind or solar, etc.
- Small individual units serving a single home, industry, or commercial establishment, such as a home-based solar or wind unit.

The financing options and issues differ considerably for centralized systems and small single customer units.

- Financing centralized systems usually involves a combination of debt and equity financing and the marketing of bonds. It can, however, also involve grants.
- The financing options for small single customer units can involve rehabilitation loans, second mortgages or refinancing of the home or establishment. It also can involve grants. Some of you here to-

day are interested in centralized systems, some home or plant based units.

Another complicating dimension is that we must consider both public and private financing schemes—and they can be vastly different indeed. This morning we heard from Gordon Marker who described the Lawrence, Massachusetts low head hydro project. This was financed by traditional private means to obtain construction financing from institutions such as *Chase Manhattan Bank* and *R.I. Hospital Association*; mortgaging financing from *Mutual of New York* with security provided by private equity, equipment performance guarantees from the contractor and long-term energy purchase contracts. This private scheme is quite different from public general obligation backed financing where the security for the bonds may come primarily from the tax base of a public entity. We must also deal with such joint public-private schemes as Industrial Development Financing and Pollution Control Revenue Bond Financing.

A third and final complicating factor concerns the relationships between the financing method, the ownership and operating responsibilities for the facility, and the procedures that are used to plan and develop the facility. If the project is a totally private one, then this is not really an issue. If, however, a unit of government is assuming responsibility for planning or financing the project, then this is a very important issue. State and local government laws and procedures concerning procurement of equipment and services, and concerning financing were not originally developed with projects of this type in mind. Rather, they were developed for "off-the-shelf" hardware that would be used in the normal functions of government, such as fire engines or school buildings. Energy systems are vastly different. Most of my personal experience over the past eight years has been in waste-to-energy systems, helping government units to plan for, procure, and negotiate contracts with utilities and industry so that these systems can be financed.

Some of the relationships between financing and ownership and operation are quite limiting. For example, one city we worked with wanted to competitively select a so-called full service contractor to design, construct and operate the facility on a long-term contract basis with the city. A contractor selection of this type, and the contracts involved, are very complex. Such complexity means that the contract terms probably must be negotiated rather than decided on a strict low bid basis. But the laws governing procurement in that city prohibited such negotiation. The solution in that case involved writing new state laws and developing unique procurement procedures that would match the needs of the project. These same complexities will be found in many alternative energy system projects.

In conclusion, I believe it is important for you to keep these three dimensions in mind as we conduct the workshop, namely:

- Centralized systems versus single customer or "distributed" systems
- Public versus private financing
- Relationships between the financing methods used and how the system is implemented for public sponsored systems

I now want to introduce our speakers.

Financing Community Energy Systems Through Tax Exempt Bonds

Gerard Giordano
LeBoeuf, Lamb, Leiby and MacRae
New York

The search for a solution to the increasing cost of oil during the decade of the 1970's and the search for alternate energy sources has focused greater attention on solar energy systems. Solar energy systems in whatever form are, however, highly capital intensive. If there is to be serious competition or a realistic alternative to the use of oil, reduction of capital costs is a necessity. Clearly, hard construction costs will not decrease. With inflation at a rate of 18% to 23% a year the anticipation of reduced costs would not be realistic. If the cost of investment capital can be controlled at an acceptable level when compared to conventional financing costs a major advantage can be achieved.

One answer to the problem of controlling financing costs is that of being able to raise investment capital by the use of tax exempt bonds. These are bonds issued by States or political subdivisions for the purpose of financing specific solar energy systems. Among the major considerations involved in such tax exempt financing are (a) applicable State constitutional and statute law; (b) the application of the pertinent provisions of the Internal Revenue Code and the regulations thereunder; and (c) assuming the above two have been satisfactorily answered, the kind of security offered to bondholders.

State Law Considerations

Assuming that the State constitution does not prohibit the type of financing in question there must, in most cases, be State legislation providing for financing by the State or a political subdivision of the project. In addition, there must be a willingness on the part of State or local officials to implement the statutory authorization and to carry the financing into effect.

Broadly speaking, there are in many jurisdictions statutes on the books which allow for financing by political subdivisions of energy systems. These for the most part are geared to electric power projects but may not necessarily be limited to the production of electric power. A review of the specific language in a law which defines the purposes for which financings are authorized would determine whether or not energy systems based on solar energy could be financed without major legislative revision. Specifically, a hydroelectric facility, a windmill farm, or a solar power tower may be within presently existing statutory authorizations.

In another area, statutes have been adopted providing for tax exempt financing of solid waste disposal facilities. Such laws, with perhaps minimal revision could provide a basis for the authorization of projects for the conversion of biomass to gas or some other synthetic fuel. Such statutes have been used to date principally for the generation of electricity or steam which is then used to generate electricity.

While solid waste disposal authorities may provide a temporary answer, the thrust in those statutes is aimed at the disposal of waste matter rather than a creation of an energy source. I would think that a statute aimed at the creation of energy should contain broader language aimed at the production and delivery function as opposed to disposal.

The financing of individual solar facilities presents a somewhat different set of problems. It might be possible to accomplish the purposes desired under existing financing programs providing for loans to homeowners for rehabilitation. Some negative aspects to this approach would be the need for the definition of the public purpose by the highest Court of the State in question and the problem of existing constitutional prohibitions regarding the lending of credit to private individuals.

Internal Revenue Code Considerations

The principal problem to be faced under the Internal Revenue Code is whether the bonds to be issued for the solar energy system would be considered industrial development bonds and, if they are, whether an exemption is available under the Code. Briefly, if the proceeds of bonds are used in the trade or business of a non-exempt person, interest on the bonds would not be tax exempt unless the project falls within one of these specific exemptions found in 103(b) (4). The exception for solid waste facilities is very helpful but questions as to market value of the waste itself may still exist (since the date of this presentation, the Crude

Oil Windfall Profits Tax Act of 1980 Sec. 241 through 244 has been adopted which broadens the ability to issue tax exempt bonds for solid waste, hydroelectric facilities and renewable energy facilities).

Credit Considerations

Once the statutory and tax hurdles have been overcome, the next and most important consideration is that of security for the bonds to be issued.

The key issue here is who will bear the risk of loss when technologies are in many respects unproven and capital costs are difficult to lock in and are steadily increasing. It is safe to say that the investor will not assume the risk in most cases and where bonds are sold on a publicly underwritten basis, underwriters would not be willing to market obligations which place an unreasonable risk on their customers. The second interested party, the municipality issuing bonds, may similarly not wish to assume the risk. However, if the product is socially or politically desirable there may be enough force behind the idea for the issuer to pledge its faith and credit, that is, to provide for the financing by the issuance of general obligation bonds.

Assuming that there will be no general obligation bond financing, the risk then must be imposed upon those who benefit from the use and operation of the facility. In general, there may be a multitude of credit arrangements which, packaged together, would provide adequate security in the eyes of investors. The arrangements would include long term contracts with municipalities supported either by its general taxing power or revenues received from systems such as garbage collection systems or electric distribution systems under its control. There could also be contracts with private corporations for the sale of recovered products and, more importantly, for the sale of power generated by the solar system. Such contracts can take a variety of forms the key to each being the bargaining power of the parties and the idea being to get as much of the corporate credit behind the bonds as possible.

At the present time there appears to be a patch-work system available in many jurisdictions which can provide a basis for tax exempt financing of solar energy systems. Each case, however, may have its legislative problems which could make it more difficult to put together the kind of financing package which would be most effective. During the next decade the need may be recognized for the formation of State financing agencies dealing specifically with the financing of solar facilities and having powers broad enough to cover alternative financing mechanisms and to control the raw material needed to produce the energy product.

Financing Options and Outlook for Community Renewable Energy Systems

Denis V. Curtin
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Abstract

During the past decade a rapid succession of events has thrust energy to the very top of the national agenda and subsequently the development of renewable energy systems has been identified as a top priority. For a variety of reasons, renewable energy systems should enjoy an increase in both the amount of financing and the number of financing options available from both private and public sources.

As a national priority renewable energy systems will surely be the recipient of increased government funding under President Carter's energy program. In addition, a number of current developments and trends in the energy field should make renewable energy systems increasingly attractive to private investment sources. For example, as the costs of energy from fossil fuels continue to rise and difficulties continue to surround nuclear energy, renewable energy systems should become more economical on a relative basis. The "proving" of both certain renewable energy technologies and the equipment necessary to exploit these technologies should also increase the availability of financing and the financing options open to the sponsors of community renewable energy systems.

Introduction

During the past decade the United States has experienced a succession of developments which have, and will continue to affect the economics of and the outlook for the energy requirements of the nation. Among these developments are:

- the escalation of oil prices by the members of OPEC;
- the growing concern with and cost of the environmental problems connected with the use of fossil fuels;
- the accident at Three Mile Island which has clouded the future of nuclear energy in the United States;
- the growing public awareness of the exhaustibility of the world's supply of fossil fuels; and
- the growing public awareness of the dependence of our way of life on the availability of a supply of energy which is both inexpensive and reliable.

These developments and others, have transformed energy from something that was taken for granted by many, into something given the status of a top national priority. Energy departments and agencies have been established at all levels of government. Indeed, the nation has declared war on the energy problem and is currently in the process of mobilizing. Clearly, in the campaign for energy self-sufficiency, one of the most important fronts on which the nation must advance is that of the development of renewable energy systems which utilize energy derived from wood, wind, water, and the sun.

Greater Financing Options

It is apparent from the variety of both the case histories presented this morning and those I anticipate we will discuss during the course of this workshop, that community renewable energy systems include projects of widely different scope and origin. A wide variety also exists among the available financing options for renewable systems. For example, systems utilizing hydro power, a conventional, proven technology, generally enjoy a greater number of financing options than systems using technologies whose operation and practicality are not so well-established.

The overall financing outlook for renewable energy systems should become brighter because in our mixed economy and under our federal system of government, matters of top national priority usually enjoy a broad spectrum of financing opportunities. Housing and education are examples of such priorities and energy-related endeavors seem to be moving into this category. President Carter's proposed energy program is ample evidence of this. On the one end of the spectrum of potential financing is private investment capital, from individuals and private sector institutions, including bank loans and the issuance of debt, either taxable or tax-exempt, and equity. In the middle of the spectrum lie various combinations of private investment capital and grants with federal, state and local government funding programs. On the opposite end of the spectrum from private investment capital is funding through use of government funds only. Naturally, where along this spectrum the financing opportunities for a particular energy system can be found would depend largely upon the individual characteristics of that energy system.

Because I am from a private financial intermediary, Citibank, and also because opportunities for government grants and funding are the subject of another Conference workshop, I will limit my discussion to financing which involves the use of capital from private sources—commercial banks, individuals, and institutional investors. What I propose to do during these opening remarks is, rather than to address any specific financing vehicles or the financing merits of any particular renewable energy system (since I am sure that such discussion will dominate the question and answer period), to instead first briefly review what in essence is involved in the financing process and what in general determines whether a project or energy system is capable of attracting financing. Second, I will, again briefly, mention the major short-comings, as viewed from a financing point of view, of some community renewable energy systems, and then finally I will touch on how recent developments and trends should work to alleviate these shortcomings. My hope is that a review of this basic information will provide useful background for the discussion of the financing options for specific renewable energy systems during the give and take of the workshop.

General Financing Criteria

What determines whether an individual or an institutional investor will invest in a particular project or whether a bank will give a loan for a particular endeavor? To attract financing the project or system to be financed must fulfill two major requirements. First, it must be clear that somehow the capital (principal of a loan or bond principal) will be paid back; and second, a rate of return on the investment of capital must be offered which is not only commensurate with the risk involved, but also appropriate in light of the length of time the capital is committed and the interest rate climate in the money markets at the time of the commitment.

Interest rates are generally determined by the cost of money prevailing at the time plus a premium for the risk involved in a particular financing. Determining repayment capability is more involved. When evaluating a particular financing opportunity, private investors, commercial banks and other lenders generally require that repayment be capable of coming from at least two of the following sources:

- *The project itself*—In order for repayment to come from revenues generated by the project itself, it must be feasible from an economic standpoint. In the case of energy systems such as electric utilities, economic feasibility is usually evidenced by a comprehensive feasibility study performed by a consulting engineering firm. For the equipment used in an energy system, there should be adequate evidence that the equipment actually works. Often manufacturers will certify and guaranty that this is the case. It is extremely helpful if both the technology and the equipment employed in a system have a proven track record. Proof of adequate demand for the energy produced is also critical. Power sales contracts are often used to prove that both the demand and the revenues will be there.
- *The principal utility,* individuals, or other sponsors of the project (energy system)—If the projected revenues generated by the project or system cannot be proven an adequate source of repayment, then the creditworthiness and income generating ability of the sponsors, whether they be corporate or government entities, or individuals, must suffice. Thus the overall financial condition, earning capacity, and debt repayment history of the borrowing entity or individuals are the key considerations. (Thus a community renewable energy system may have to rely on the "full faith and credit" backing of the community in order to obtain financing.)
- *The assets being financed* (i.e. collateral)—Because there is always a chance, no matter how slight, that a borrower will not be able to repay from either project or system revenues, general income, or other sources, lenders and investors like to have, as a source of payment of last resort, a pledge of assets of sufficient value and marketability to, upon liquidation of the assets, be able to repay the loan or investment in full. Thus it is helpful if the assets are readily marketable, readily assignable and of sufficient value to cover the loan.

When community renewable energy systems are evaluated using these financing criteria, it becomes readily apparent that many systems possess common characteristics that often make financing from private sources difficult to obtain. The major stumbling blocks seem to be unproven technology and equipment, and lack of economic feasibility, however, each case must be judged on its own merits.

Financing Outlook for the Future

As time goes on, renewable energy systems should become stronger credits and therefore should enjoy greater access to financing from private sources. This should result from a number of developments and trends, some of which are interrelated:

- First, as energy from fossil fuels grows more expensive, energy from renewable sources should become less expensive on a relative basis. Thus the economic feasibility of renewable energy systems will be enhanced.
- Second, as renewable energy technologies become proven, perhaps through pilot projects funded by government, private investment capital will be more readily attracted.
- Third, as demand for the equipment required for renewable energy systems grows, economies of scale should impact the production of such equipment making it less expensive and therefore more economical to utilize. In turn, the economic feasibility of the systems should be enhanced.
- Finally, as different renewable energy systems develop an operational and financial track record, financing will be more easily attracted to similar systems. It would be beneficial if there existed a clearinghouse for information about different systems which are successful and even about those that are not so successful. Conferences such as the First Conference on Community Renewable Energy Systems help to serve that purpose.

Workshop on Technologies and Economics

August 20, 1979

Workshop on Technologies and Economics

Chairman

Henry C. Kelly
Office of Technology Assessment

Panelists

Fred S. Dubin, P.E.
Dubin-Bloome Associates, P.C.

John Huetter Jr.
Energy Research and Applications, Inc.

E. Lawrence Klein
Tennessee Valley Authority

Alvin Duskin
U.S. Windpower

Edward E. Johanson
JBF Scientific Corporation

Amory B. Lovins
Friends of the Earth

Summary

In this workshop the key questions, "Does it work?" and "How much will it cost?" were addressed for several renewable-resource energy systems.

Chairman Kelly opened the workshop by pointing out that not all the technical issues of integration between conventional and renewable energy systems have been solved, nor have the economics of all systems been tested. Market imperfections, societal costs, replacement versus delivered energy costs, etc., are still not completely quantified. "Solar economics is a case of shooting at a moving target."

Fred Dubin pointed out that an integrated, systems approach is required to integrate various energy systems and that energy conservation is the first step in any project. This is followed by passive solar heating and cooling, active systems, solar ponds, etc. "Energy should be a major design input to the architectural process."

Alvin Duskin described recent wind energy system projects, one of which is anticipated to produce electricity for pumping water at 3.5 cents per kwh. Based on the relatively lower expense in consumer goods over capital goods, his company is focusing on mass-production techniques, in smaller capacities.

John Huetter pointed out that we, as individuals and as a nation, have lost control of our energy systems. With smaller-scale systems, people can influence energy decisions, utilizing proven (i.e., hydro, wind, solar) systems, at costs competitive with conventional systems. "The problems are institutional, not economic or technical."

Edward Johanson stated that the time for renewable energy has arrived. Many analyses, he contended, have been too conservative in predicting effects of inflation and oil price rises, thus prejudicing some decisions against renewable energy systems.

E. Lawrence Klein described TVA's biomass-for-energy program, early results of which indicate that 20% of the Valley's energy needs would be met with biomass. The present barriers are the economic and environmental effects of whole-tree harvesting for energy (current forestry uses leave 40-50% of the tree in the forest).

Amory Lovins* used the example of an operating solar/conservation house in Saskatchewan (*Soft Energy Notes*, May, 1979) to make the following points on system economics:

1. Quantify end-use needs and match the system accordingly.
2. Do not consider energy supply and demand separately—take advantage of synergisms presented.
3. Optimum sizes for systems are likely climate- and site-specific.

*Refer to Amory Lovins' public address in Section A.

Solar Technologies and Economics

Henry C. Kelly
Office of Technology Assessment
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The theme of this session deals with the technical and economic feasibility of solar energy. It is certainly not going to be possible to deal with this subject to a satisfying level of detail within the short time we have allotted to us so what I'll try to do for an introduction is to sketch out the basic framework for analyzing these issues and the other speakers will talk about specific technologies in greater detail.

The first question I am going to pose is whether the basic solar source is adequate to support contemporary energy requirements and energy systems as sophisticated as we find in the United States. Now the answer to this question is clearly, "Yes." By my calculation, solar energy can be converted to useful forms with roughly half the efficiency with which conventional energy sources are converted. U.S. energy requirements can be met if we find room for 130 square meters of unshaded collector per capita, assuming the current energy-guzzling aspects of the American lifestyle. If we can imagine energy consumption reduced to the level of Europe, or perhaps below that, we can talk about getting by with perhaps 50 to 60 square meters of unshaded collector area per capita. To put this into some kind of perspective, the average floor area in residences in the United States is about 40 square meters, so we are talking about a collector area that is 50% larger than the living area of most houses. The technical feasibility of solar energy needs to be addressed further but I think that there is empirical evidence right now that shows beyond any question that solar energy can be converted into all of the useful forms that we need: heat, chemical, and electrical energy.

The really important question and the one upon which most of the attention is going to be focused is whether we can afford solar technology. There are two key aspects to this: one is whether the investment of solar technology is the most efficient use of labor and capital for individuals, and the other is whether the investment is efficient from the point of view of society where an inefficient allocation of capital and labor leads to retarded economic growth, inflation, and a host of other problems. Now these are independent issues for a number of reasons and I am prepared to give five:

1. Society must measure values which aren't reflected in conventional economic terms—values like environmental quality and national security. In many cases these values do have a directly calculable economic effect. For example, if you say that you have 60,000 premature deaths in coal burning, and calculate the direct hospitalization costs, you can come up with a number like ⅓ of a cent per kilowatt hour if that's how you choose to measure the societal value of this sort of thing. In general, this has to be a political decision.
2. We all know that the delivered price of energy to customers is in many cases much below the replacement cost of that energy. It is the replacement cost that society must consider when comparative investment decisions are being made.
3. There is a complex tangle of subsidies, tax laws, regulations and other problems which distort and disguise the optimum economic choice made by individual decision-makers. Somehow we have to find a way to fight our way through these complications to find out what the real optimum investment looks like. It's not an easy job and I hope that this issue is one that some of the speakers will address later.
4. There is frequently a lack of institutional infrastructure for making suitable investments in the real economic environment. For example, you might find that large blocks of capital are available for centralized generating equipment, but that no retail distribution center exists for this type of investment.
5. There is a slight difference between the way society and individuals may measure the risks of future energy choices. For instance, there may be different perspectives about the credibility of different energy price forecasts and there may be different views about how to discount the future.

The question of discounting the future becomes very important in evaluating the economics of solar energy. With the exception of most biomass investments, virtually all solar investments involve an initial cost estimate which yields a fairly constant and predictable capital cost. The way you compare future costs with present costs becomes very crucial to the economic analysis. To give you a specific example, imagine that heating oil this winter may be $1.00 per gallon. What you should *not* do is to compare solar energy to the cost of fuel at $1.00 a gallon. Instead, you should assume that the investment will last for 20 years and you should try to find the lowest cycle of cost to pay $1.00 per year. If you take into account that the price of oil goes up with inflation and you count the future at 10%, the future estimate of fuel costs comes out to $1.62 per gallon. However, if you do the same calculation over a 30-year period, assuming that all prices go up at 2% above inflation, you end up with a value of $2.50 a gallon for comparative analysis. So you can see there is a very colorful influence built into the techniques that you can use to discount the future.

The straightforward task of evaluating the economic work of the solar investment in conventional economic terms also turns out to be a very tricky one. For example, the technical problem of optimizing the system to a particular climate or pattern of energy demand has never been fully resolved. It becomes particularly complicated when we try to integrate solar equipment with conventional sources of energy supply. The most complicated source of energy turns out to be the electrical utility. Basically, you have two options to consider when optimizing the economics of your system: you can provide all of your backup from a small on-site electric generating unit or you can try to integrate yourself with an electric utility. Another point that must be considered is how worthwhile it is for us to maintain certain aspects of our lifestyle and industrial processing techniques that evolved at a time when the cost and quality of energy were not very closely correlated. For example, we have to decide how much reliability is worth; how much it means to us to totally ignore the weather outside and not to react in any way to the external environment; and also to be independent of fluctuating future energy costs.

Another complication that exists when we want to evaluate solar investments in conventional economic terms is the fact that the cost of conventional fuels such as oil and gas is changing very radically. The technology for processing these fuels is also changing very dramatically. When fairly rapid progress is being made in heat pump technology, hot water heaters, and other advanced industrial techniques are being developed, it is very difficult to know precisely what the point of comparison for solar equipment turns out to be. And finally, even though I come from Washington, D.C., I have to admit that government economic and energy policies regulating all of these things keep fluctuating, making it even more difficult for us to evaluate solar investments.

When discussing the economics of solar technologies, I think it is important to distinguish between those that are available right now to communities who are making investment decisions and those that are somewhat more speculative. For the purposes of this session, the technologies that I consider to be in the near term category would include direct heat from biomass (not the advanced conversion processes), solar space and hot water heating for domestic use, hydroelectricity, electricity from biomass, and perhaps in some very specialized instances electricity from wind. Now, there are a few points that I think we need to discuss when we are reviewing biomass technologies, one of them being what the net resource is going to be. I think that while biomass may be an extremely inexpensive source of energy, a realistic forecast of its ultimate potential by the year 2000 without considering offshore oil drilling is about equal to the amount of energy we consume in gasoline today. Another problem that we have to consider is why we should use biomass instead of coal to meet our energy needs. Coal is clearly a good competitor in terms of convenience and cost to the consumer. The housing industry will, I think, benefit greatly from biomass technology when we start to build buildings that are more energy efficient than the ones currently on the market.

The technologies that I would put further into the future are photovoltaics, solar thermal electricity, and large-scale wind power generation, all of which may well begin to play a promising role in energy projection about the middle of the 1980's. We might also look to photochemical conversion processes for producing liquid fuels directly from sunlight. The details of many of these technologies will be examined in greater detail by the following speakers.

Community Solar Energy Systems

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Abstract

This paper examines the numerous options for decentralized active and passive solar energy systems and other alternative energy systems suitable and fully developed for community use. The capital costs in all cases can be amortized in energy savings to make the investment very attractive. Five community projects in which Dubin-Bloome Associates is active are described.

Options

There are many options available for us to utilize energy-effective and cost-effective community-based solar energy systems in combination with other components of an energy management program. Even though the solar thermal power tower for central generation of heat and/or electricity has its proponents, the smaller decentralized systems approach, I believe, can yield quicker returns at less cost for a new or existing community. For instance, a network of larger cluster installations serving multiple buildings can radically change the energy consumption of an entire community when that network is coupled with community software programs, such as tax incentives, grants, zoning and sun rights legislation and energy budget requirements to enhance a more rapid growth of solar hot water, space heating, process, or cooling systems in individual buildings. The community may be as small as a few buildings, or as large as New York City.

For community solar energy systems to be successful, there is, and will be, a continuing need to develop more efficient solar energy hardware and integrated systems, a larger pool of trained professionals and vocational workers, more innovative and realistic financing programs, and more industry participation to reduce production costs. We already have the available solar hardware, design know-how, system designs and a concerned population to implement community systems which are cost-effective alternatives to building more central utility power plants. We therefore already have a viable alternative to consuming huge quantities of non-renewable resources such as oil, coal, and gas.

The thermal and financial success of any alternative energy system, i.e., active or passive solar, wind, and biomass depends upon first reducing the load by energy conservation measures. Briefly, these include the following:

> *Buildings*—reduce heat loss and heat gain by treatment of the envelope—wall, roof and basement or slab insulation and thermal mass; double or triple glazing; solar heat gain control; wind control; planting for sun and wind shading; movable insulation; and, in the case of new buildings, orientation.
>
> *Domestic and process hot water*—reduce flow rate and utilization and storage temperature; pipe and tank insulation.
>
> *Make-up air and exhaust systems*—more efficient exhaust hoods; reduced air flow; heat recovery; direct supply air to hoods.

After we have reduced the thermal and electric loads in new construction or retrofitted existing buildings, passive solar heating is the next line of defense. Passive solar heating for individual buildings is cost-effective in all areas of the United States. Direct and indirect gain systems, trombe and water walls, sun spaces within individual buildings, and hybrid systems are rapidly escalating and individual buildings using one or more of these passive techniques are dotting the countryside. For larger community systems, central greenhouses can grow food in cold climates and provide heat to adjacent community buildings. A greenhouse with sufficient thermal mass and night insulated shutters or shades can collect more heat than it requires; the excess heat can be distributed to community buildings with a warm water network (water walls in the greenhouse can provide collection and storage). An acre of greenhouse can supply about 50% of the winter heating requirements of more than 100 homes in Denver, in addition to growing cash crops.

A mixed-use development of homes, stores, factories, and commercial buildings can utilize passive solar heating very effectively if the buildings are close coupled in an attractive cluster design. The heat stored in passive storage walls in the commercial and day-time occupied buildings can be transferred to residential structures for night use. The transfer of waste heat from industrial processes or, in some cases, commercial buildings, is often in excess of the quantity needed to heat those buildings at night and can be redistributed to the residential sector where night heating is required.

Active systems using solar collectors and thermal storage can also serve multiple buildings in a community. Solar collectors in a mixed-use development can supply heating in the winter to those buildings which have the greater heat loss per square foot, such as residential apartments versus supermarkets, factories or high-use buildings, and in the summer the same collectors can be used for cooling the buildings which have a high internal load and little need for winter heat, since the dwelling units often require little or no air conditioning in many climates when properly designed with natural ventilation, and sun shading. Evaporative cooling is being used with increasing frequency in buildings with light internal loads, resulting in little expenditure for electrical energy.

The use of solar energy systems to temper make-up air for community hospitals, laboratories, industrial processes or malls is very cost-effective, since the collectors can be simple and inexpensive—they need only produce temperatures 15° above ambient, and ambient temperatures are low. Often no storage systems are needed.

Solar ponds can be used for community systems in all sections of the United States. A solar pond provides annual or near-annual heat storage for direct heating, or combined with heat pumps it can boost the temperature for multiple buildings. In fact, the larger the system, the more efficient since the capital costs and thermal losses are inversely proportional to size. There are solar ponds in operation in such diverse locations as Israel, Ohio, and Iowa. In making an analysis for a solar pond for the projected permanent headquarters facilities for SERI in Golden, Colorado, a three-acre pond three meters deep can provide approximately five billion Btus per year for heating—enough to heat and cool (with absorption refrigeration) more than 100 homes in Denver or New York; or, with the same size ponds, 250 dwelling units in Arkansas. The cost of such a solar pond installation is about $600,000. We were planning such an installation to heat 500 homes in a new town in Iran before the revolution.

Other solar applications on a community scale include crop drying with solar air heaters, solar pumps for irrigation, and combination wind/furnace solar heating for space and hot water heating.

One of the most cost-effective solar energy systems for large projects is to pre-heat heavy oil stored in tanks above grade directly with solar energy. The tanks, of course, become the storage systems as well as the collection system. They can be painted black and encircled with a single layer of fiberglass to create a very effective and low-cost passive solar installation. Pre-heating the heavy oil reduces the energy cost of electric or steam pre-heaters and increases the efficiency of combustion with the pre-heated oil. Another very cost-effective solar energy system has been installed in Maine, to process sewage. Solar energy is used to dry the sewage sludge.

Blacktopped tennis courts and street surfaces make very effective solar collectors. Coils imbedded under ground could provide hot water and sizable community installations at a cost less than $3 per square foot, not including the cost of the surface which would already be in place.

The use of sawdust and wood chips is becoming an increasingly popular method of generating heat and electricity in many regions of the country. For the proposed SERI headquarters, preliminary plans include a two megawatt installation using wood chips and a gasifier to produce heat and electrical energy for a major portion of the installation. Depending upon other climatic variables, such as wind and sun which follow unpredictable cycles, there are however often many periods where available energy does not coincide with a simultaneous requirement for the energy. Two ways of dealing with this problem are: first, use energy storage systems to collect and store the energy for use at later periods; and, second, install cogeneration systems wherein the energy produced from sun and wind during periods when there is not sufficient demand in some buildings can be sold back to the utility company.

A few examples of solar and alternative energy systems which we have designed or studied for communities around the world are briefly described below:

Crete: A proposed new community using biomass, with olive pits as an energy source, for generating electricity and heat; 700,000 square meters of greenhouse for growing seedlings and for heat to adjacent buildings, and passive solar heating of dwelling and commercial structures, using native materials for thermal storage and the great sun for all it's worth!

Iran: The solar ponds, passive heating for buildings, and evaporative cooling for a new town for 100,000 people.

Anagoda, BWI: A new community involving 2,000 homes, a 500 room hotel, and supporting facilities, depending solely upon wind and sun for electricity, cooling, hot water heating and refrigeration.

Washington, D.C. & Boston, Massachusetts: A study for a 2,000,000 square foot development for Pennsylvania Avenue, Washington, D.C. performed for the Pennsylvania Avenue Development Corporation and financed by D.O.E. and the Argonne National Laboratory for a seasonal storage system, using ice-maker heat pumps for heating and producing ice at the same time. Ice is stored in concrete bunkers and ice and ice water are used the following summer for cooling without electric refrigeration. In cold climates, solar energy is used to melt excess ice generated during the long winter season. These systems appear to have a ten-year payback in 1978 dollars, and conventional fuels are already much higher.

St. Paul, Minnesota: A preliminary study using warm sewage flow to provide a heat source for community heat pumps along the sewer distribution system appears very favorable.

In conclusion, we have reached the 5 "C's" of the ABC's of solar energy—Community, Configuration, Cogeneration, Coordination, and most important, Cooperation.

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An Introduction to United States Wind Power

Alvin Duskin
U.S. Wind Power
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Using high-technology windmills, electricity generated from wind is currently 3.5 cents a kilowatt hour. Our company, U.S. Wind Power, has a contract with the Department of Water Resources in California to deliver electricity at 3.5 cents a kilowatt hour to power the pumps of the California aqueduct. That contract is for 400 million kilowatt hours a year. In order to fulfill the contract we have to install a generator capacity of 100 megawatts—slightly larger than if you were trying to get 400 million kilowatt hours a year from a hydro or thermal power plant, but that's how much you need from a windmill array because the wind doesn't blow all the time.

Actually, because of the peculiar situation in California, i.e. the thermal wind resulting from hot air rising over the central valley and cold air rushing in through the passes, the energy available from the wind peaks at the hottest part of the hottest day of the year. This exactly matches the peak load in California—the air conditioning load. So what will probably happen is that the Department of Water Resources will continue to buy bulk power during off-peak hours because they can pump water any time of the day or night. As our power comes out of the line, they'll probably sell it to utilities as peak power. So at 3.5 cents per kilowatt hour, they could come out very well.

Our goal is not to prove that you can get electricity from the wind, nor to do demonstration projects around the country to acquaint people with what is going on, but simply to get into mass production of modern wind turbines. There are two steps to this goal: one is to fully develop the technology by gearing it for the techniques of mass production, and the other is to develop a market.

We are doing prototype development and with the California and other contracts we have a market for 7,000 windmills which we are going to make in the next five years.

The reason our windmills are cost effective, whereas the big windmills that you hear about are not, is due to economies of scale. We figure if we produce 30,000 units a year we are in mass production.

DOE assumes that their cost-effective windmill is going to be the MOD II—the 2,500 kilowatt Boeing machine. It seems pretty astounding that this 2500 kilowatt machine is less cost-effective than our little 50 kilowatt machine. With a wind speed of 20 miles per hour you need 20 of our machines to equal one of theirs. But if our machine costs $37,000 and you get 20 of them, you end up paying $740,000. And those of you who know anything about Boeing machines know it's going to be a lot more than $740,000.

The reason that Boeing appears to be cost-effective is that DOE assumes a high price for land. But, when you put our machines on an open range you use about one percent of the agricultural land. So, if you only use one percent of the land the cost becomes infinitesimal.

In conclusion, we feel that ultimately, wind energy is the answer to using nuclear power and coal to generate electricity. In the years ahead you are going to see the price of windmills dropping as the price of fossil and nuclear fuels continue to rise.

Small-Scale Hydroelectric Power: The Community-Size Renewable Energy Source

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"The U.S. must develop its own sources of energy to replace foreign imports so that we can have control over our own destiny."

Jimmy Carter, President, U.S.A.
July 1979

Abstract

Increasing and largely undesirable dependence on foreign fossil fuel sources has resulted in a loss of control over energy supply at the individual and community level. Small-scale hydroelectric power is a renewable energy resource that fits in well at the community level both in implementation and requirement for the power produced. Small hydropower technology is highly developed, well-proven and available *right now.* The basic resource is widely distributed regionally. In addition to more conventional site development featuring equipment retrofit at existing dams, there are many other structures including irrigation canals, aqueducts, and municipal water systems that can be engineered to generate hydroelectric power.

Economically, small hydropower makes good sense for the community. Additional funding sources and financing options are becoming available. Legal, regulatory and institutional blocks constitute the most serious set of problems in resource development. Small hydropower is relatively benign environmentally and aesthetically non-disruptive. The problems associated with development are largely known, quantifiable and, therefore, solvable. Communities can exercise increased control

over their energy needs using existing technology applied to a renewable resource that is often overlooked yet usually nearby.

Hydropower for Community Use

Americans are, finally, rightfully concerned about the precariousness of international oil supplies and capriciousness of those who control the sources. We have become petroleum product addicts without an assured supplier. The frustration is that we can't directly affect the amounts or prices of petroleum supplies. Individuals and communities of individuals have unintentionally relinquished control over their sources of power. But this is not a necessary condition. Communities can gain a greater degree of control, if not complete control, over electric power—often from overlooked energy supplies literally in the backyard. People can have some influence over their own energy supply production and use, and their own future. Small-scale hydropower can be the key to regaining control.

Small hydroelectric generation facilities commonly and legally defined as under 15 MWe, can be developed at existing structures and impoundments in every region throughout the U.S. Existing solar power technologies are best adapted to use at individual structures, primarily for heating and cooling. It's not clear yet how or at what scale biomass can be optimally employed—aside from wood-burning home stoves. Wind power matches farm or homestead requirements fairly well.

Small-scale hydropower seems to be the existing renewable resource technology best suited to community level development and use. The installed power capacity and economics/financing pictures are usually too big to be handled by an individual. Conversely, the same site is too small for utility interest: utilities are not geared to develop under 15 MW power sources. Small hydropower is just right for a community both in level of effort required by a project and the level of power produced: assuming 1-2 kilowatts (KW) per person as a reasonable planning number for electric power developments.

Status of the Technology

The technology of a hydropower unit is straightforward, non-esoteric, and simple to understand. There is no Research & Development required to make immediate, practical use of this renewable resource. There are minimal additional safety problems in power generation at an existing structure and no pollution of air, earth or water to contend with. Hydropower units retrofitted to existing structures blend well with overall surroundings. The industrial scene of smokestacks, cooling towers, etc. is not present. The technology can bring electric power production back to the community level and the people who use the power. They gain a real sense and knowledge of where their electric power is coming from—or at least a portion of it. The power is essentially free so that future electric power costs can be controlled. Hydropower is an inflation-proof energy source. Investment is made in present dollars to be repaid in future fuel savings. It offers the capacity for community-control over electric energy costs.

Nature of the Resource

Hydropower is environmentally benign and the aesthetics do not clash with the community environment. (E.g., totally hidden sites built in Germany during WWII to avoid bombardment now continue to operate, hidden and totally or partially submerged.) The old water wheel vs. a central fuel-burning plant image for the community offers an easy symbolic choice that has real-world impact.

Still, the intent is not to present small hydropower as the lesser of two evils. It is an indigenous American resource which is constantly overlooked. Four-color ads in national magazines argue the extent and availability of coal, another native resource. No one: no agency; no corporation is promoting the widely distributed hydropower resource for which the infrastructure is largely in place, i.e., electric transmission and distribution lines. Large corporations do not generally benefit.

The sites are not owned by conglomerates. Ownership and water rights are usually vested in individuals or communities. (A common occurrence has been sale of abandoned sites by a utility to the political entity in which the site is located for a nominal sum, or outright donation to avoid property taxes. Such an arrangement can be especially advantageous to the utility when equipment has been fully depreciated.)

Some may feel that they do not have any potential for hydraulic energy recovery simply because their community does not have an existing dam on a river. This perceived lack of hydropower potential is often a lack of imagination and innovative engineering. For instance, in New England and the Southeast, there are thousands of mill sites with sluiceways, weirs or similar diversion structures already in place. In the 18th and 19th centuries, these mills were the community's agricultural focus for grain grinding. These sites were originally largely rural, so that the smaller community's electric power needs can often be met by the power potential that can be developed. One Tennessee mill we've investigated, which incidentally is a national historic site, could be retrofitted to generate the power needs of the immediate community without compromising its architectural integrity.

In the West, where flowing water is a very precious commodity in its own right, potential for hydropower development exists in irrigation canals and aqueducts. This type of retrofit is already underway in some irrigation districts, under consideration by others, and in the case of the Imperial Valley, California district has been done for years.

Small hydropower development possibilities can also be found in municipal water systems and sewage treatment plant outfalls. Another attractive aspect of these forms of small hydro is that conduit-based systems can be exempt from Federal Energy Regulatory Commission licensing requirements.

The Los Angeles area's Metropolitan Water District is already proceeding to replace check valves in its pipelines with turbine-generator sets at approximately 14 locations. Every size community can and should explore its local potential. A small town of 15,000 in upstate New York retrofitted the municipal water distribution system and applied the resulting power to operation of the city's pumping stations and street lights.

Where water systems are municipally-owned, there is not only the opportunity for hydroelectric development but an administrative and engineering staff already existing and in place. A management infrastructure and water rights may already exist.

Finances and Funding

The question that should be on everybody's mind is: How much does it cost? In actual experience, the cost per installed kilowatt of *feasible* sites has been \$350-\$1,200. A median figure around \$700/KW installed capacity keeps emerging in our analyses. This compares favorably to other existing technologies even as a first cost. A coal-fired plant can easily top \$800/KW for construction only plus the fuel cost to operate the plant (currently, about \$25/ton) plus the energy costs for extracting, processing, transporting and controlling pollutants in the coal.

A more realistic approach to considering the economics of small-scale hydropower is life cycle costing. This better accounts for the non-fuel dependent nature of this electric power source. In a recent economic analysis of small-scale ($\leqslant$15MW) hydropower sites for the Tennessee Valley Authority a life cycle cost of 7 mils to 55 mils per kilowatt-hour was determined for various combinations of site ownership, operator and end use of the power. The higher costs were associated with facilities to be used for peaking power. Incidentally, those hydroelectric peak power costs, even at these relatively small sites, are about the same as fuel costs alone for oil and gas-fired peaking turbines.

The really attractive aspect of this and other renewable energy systems suitable for community development is that they are very nearly inflation-proof. A small hydropower site can be developed by a community with 100% debt financing through bond issue, low cost government loan, or similar method for amortization over 30-35 years. Annual operation and maintenance costs are a very small component of the system cost due to the lack of a fuel element and partial or total automatic operation of the site with existing solid state controls.

Many municipalities are experiencing cash flow problems. If they're currently paying an outside entity (such as a regional utility) for power, a small-scale hydroelectric site can be a very sound investment as well as a measure of energy independence. Other benefits include an assured, highly realizable source of power, mitigating the effects of brownouts or blackouts. There are various financing sources available to communities that need assistance, for example, the Rural Electric Initiative, announced by President Carter last May, which is basically a small-scale hydropower financing program.

Individuals and communities can have sites nominated for feasibility determination through the following agencies: Rural Electrification Administration, HUD, Farmers' Home Administration, Community Services Administration, and the Economic Development Administration. You can see the initiative is not strictly rural. These agencies have hundreds of millions of dollars already appropriated by Congress that can be made available for small-scale hydropower development. Again, it takes the resources and interests of a community to survive through the funding cycle. An individual usually can't do it. Utilities, except for rural co-ops who are excellent candidates for this program, probably wouldn't get involved for these small increments of capacity, anyway.

What are the problems in realizing the benefits of this power? In the aggregate, there is a limited capacity as defined by a finite number of existing sites that have feasible retrofit potential. Of course, more sites become economically feasible according to the popularly accepted yardstick of oil price every time OPEC meets. Still, at any cost, there are probably no more than 30,000 MW of small-scale hydropower available from existing impoundments nationally. The key is that communities do not need thousands of megawatts of power. Ten to 20 MW may just satisfy local demand and be physically and economically attainable at the local level.

There are a number of serious institutional problems which are only now being addressed. There is no place established for 500-25,000 KW units in existing electric generation schemes except for fuel-fired standby units. Federal Regulations that apply were designed for big hydro-power projects. They become both unwieldy and cost-prohibitive when applied to small-scale projects. And, as already mentioned, utilities have a big power increment mentality which evolves, in part, from the fact that innovative or creative development has been regulated out of them with restricted rates of return, modes of doing business, and so on. Some of these factors, particularly the burdensome Federal licensing process, are changing but institutional changes are seldom wrought overnight in a democratic society. Attitudes must evolve before laws and regulations can be modified to better suit the energy needs of a changed world.

Finally, there is not a whole lot of current expertise in small-scale hydroelectric power. In DOE's first funded round of feasibility studies for $\leqslant$15MW sites, the average age of the engineers involved was 56. An entire generation of engineering capability has been schooled in high technology applications. On top of that, the major concerns, especially in retrofit of existing sites for power generation, are usually not technical. Legal, social, environmental and economic factors tend to dominate. Expertise in these areas has only recently been applied positively to renewable resource use.

The positive aspect of these problems is that they are predictable, definable, and therefore solvable at a known cost and level of complexity. The technology itself is well-proven, highly reliable, and very long-lived. Fifty year-old installations are still operable and producing power. There are minimal technical problems in the implementation of this particular decentralized, low-impact electricity source.

Do Something Reasonable

Finally, one of the better things about small-scale hydropower installations is that they can be designed and implemented very quickly compared to other power sources of equivalent size. An analysis, design, procurement and installation cycle can be routinely executed in less than two years at an existing structure. This means that if your community has facilities that have been abandoned or any diversion structure for retrofit of generating equipment, in as little as a year's time, you could have your own small-scale hydropower site generating electricity. It is a very positive step toward regaining control of our energy future.

Some Thoughts on the Economics of Renewable Energy Systems

Edward E. Johanson
JBF Scientific Corporation
Wilmington, Massachusetts

I've been asked to say something interesting and informative—in only five minutes—and that's a real challenge, for me. My comments will be directed toward the economics, or non-economics, of dispersed and centralized solar and wind systems.

Today, solar systems are not economic, for the majority of applications in the United States. There are exceptions. Solar heating, in competition with electric heat, is cost effective in some parts of the country. Small wind systems are cost effective for customers that are not served by a utility grid, under moderate wind conditions. Direct combustion of biomass is cost effective for utilities, or industrial users, that have a ready supply of biomass.

JBF has been doing renewable energy economics for three years now and the picture that emerges is very clear. Based upon today's "guesstimates" of what tomorrow will bring, the following picture emerges in the Northeast:

- solar heating—early-to-mid 1980's
- residential wind and photovoltaics—late 1980's
- industrial/commercial wind—mid 1980's
- industrial/commercial PV—mid 1990's
- utility wind—about 1990
- utility PV—about 2000
- utility solar thermal electric—questionable in the Northeast

Solar advocates think this picture is too conservative and some utilities think it is too optimistic. Our first analysis for utility wind systems was in 1976 and we used a 4%/year inflation and *no* escalation of fuel prices above inflation! In 1977 we used a modest fuel escalation that would cause fuel prices to rise to $20-$30/barrel in the late 1980's. In 1978 we used a 6% inflation and 3% fuel escalation and many thought this too high. We've learned to speak parametrically because we no longer know how to predict, only how to do sensitivity analyses. Analytically, we live in a "one significant digit" world. There's nothing wrong with our ability to do economic analysis, the problem is in trying to obtain the input data, since the energy picture is deteriorating so fast. The present energy system has evolved over the past 50 years and was optimized for an environment that no longer exists. The fundamental problem is that renewables are being evaluated within a conventional source economic system that was optimized when fuels were inexpensive and in a system that provides incentives to conventional sources far in excess of those available to renewables. Because of that, renewables appear to be five to fifteen years away from economic viability. However, measured with a different yardstick, the time for renewables has arrived.

Our economic studies say that renewable energy systems are not cost effective because they do not have a payback period of 3-5 years. What other purchase do any of us make that must pay for itself in 3-5 years (excluding perhaps the industrial sector)? Perhaps we need a new economics—the economics of the 80's. In the 50's and 60's and early 70's our economics were growth oriented—bigger is better. Perhaps the economics of the 1980's should be called "crisis economics." In the summer of 1976 there was a great water shortage in California. People's perception of the value of water changed drastically. Entrepreneurs peddled water at unbelievable prices and no one asked whether a purchase would reach breakeven in 3-5 years.

The winter of 1976 brought us the natural gas shortage. JBF did a study of the impact of this in South Carolina and found 9,000 textile mill workers temporarily unemployed, $2.5 million of wages lost, 28 textile firms suffered production losses, 9 textile firms moved, numerous social and civil institutions were forced to close, etc. That was only textiles and South Carolina. Solar industrial process heat would have prevented some of those discontinuities, if we can be as callous as to call them that, but the payback period for solar was more than 3-5 years. We submit that perhaps a different kind of economics should be applied, one that recognizes the value of renewables not only to the textile mill owner, but also to the city, county, state, region, and nation, and translates that *value* into incentives that make it happen.

The spring of 1979 will be remembered as the time in which the joy of driving an automobile died. It seems only a few years ago we paid

$.39/gallon. In June, in Massachusetts we sat in line for 45 minutes, paid $.95/gallon and berated the attendant because he would *only* let us have five dollars worth. Stealing of gasoline has become an epidemic. The new millionaires are the manufacturers of red "Jerry" cans. Crisis economics.

And now the winter of 1979 is coming. We have 2.4 million homes in New England that burn #2 fuel oil. Not too long ago we paid $.15/gallon. Lawns are being ripped up at a spectacular rate so that 2000 gallon tanks can be installed. People used to occasionally use large tanks because the fuel oil was inexpensive in the summer. They now use them because there may not be any fuel oil in the winter. When the oil burner stops, the tank is empty, and it is 20 below zero outside, will we warm ourselves by calculating the breakeven time for residential solar and wind systems? Crisis economics.

We find ourselves on the horns of a dilemma—we can't afford to go on with our present energy system and can't seem to afford to change it. I'd like to leave you with the following thoughts.

1. Schumacher tells us that "small is beautiful" but the utilities and oil companies tell us "bigger is better." What we really need to do is to take the best from both of these. Let's change the ground rules so that we have the advantages of central energy systems as well as those of dispersed systems. We've got plenty of incentive money, we're just not spending it properly.
2. Let's recognize that a national energy policy is essential but perhaps implementing it requires far more regional involvement. Would anyone dispute that, for the textile mill case sited earlier, the state of South Carolina, the counties the mills are in, the municipalities they are part of, the owners of the mills, the employees that work there, and the community in which their earnings are spent—should have a strong input into solving the problem? Involvement is a double-edged sword and implies doing more than passing on federal funds. It means changing the economic fabric of the total infrastructure that we are dealing with.
3. We need creativity and a fracturing of the status quo. As an example, in the winter of 1979 we are talking about giving money to low income families in the Northeast (and elsewhere) so they can buy oil to heat their homes! At the same time, many of the small business solar and wind manufacturing companies are going out of business due to the slow emergence of a solar market. Why not "give" solar and wind systems to low income families instead of paying ransom to OPEC? This would achieve several things, such

as generating an immediate market for solar and wind systems, could be a large part of the Department of Energy demonstration programs, would save lots of oil, and would put solar and wind systems into the grass roots of this country.

We find ourselves setting incentives (tax credits and low interest loans) that are not adequate to create viable economics for those that *can* afford to buy solar while at the same time giving money to low income families to buy fuels that we are running out of. It is ironic that foreign oil from the Mexico oil spill is staining our Gulf Coast beaches and smothering the marine and tourist business in that region, while at the same time foreign oil from OPEC is staining our life style and smothering our economic vitality. We have as little control over the Mexican oil spill as we do over OPEC oil. It is time to do something about that and we can't wait another five to ten years.

The Tennessee Valley Authority Solar Program

E. Lawrence Klein
Tennessee Valley Authority
Norris, Tennessee

Everybody here today has been talking about solar. We think of wood as stored solar energy, and I also think of wood as young coal. It's very young coal, or oil, or gas. We're just going to use it a couple million years before someone else does. Most of our fossil fuels come from biomass plants and we feel that we can use many of these plants to save a lot of the other fossil fuels for special applications. Wood can play a major role along with the other solar technologies, however, it's more of a regional importance than a national one because in the southwest and in deserts, for instance, you're not going to have any trees or biomass. But in certain areas of the country it can have a significant impact. In fact, our calculations show that in the Tennessee Valley we can meet at least 20 percent of the region's energy needs using wood—not the other agricultural biomass sources but just the wood biomass without disrupting our forest-based industries.

The present commercial barrier to large-scale wood use is harvesting. We just don't have a handle on the cost of harvesting large-scale volumes of biomass, not only from an economics standpoint but from an environmental one as well. Of course, the standard wood-fired boiler has been around for many years and the industries using wood have used it for years because it is a very simple, proven system—the technology is there—you can call up any one of a couple dozen companies and get them to install you a boiler. They usually talk in terms of 5,000 lbs. of steam per hour and above and you want to talk in terms of $20.00 a pound for your steam—the cost of the boiler installation.

But more important are some new developments that look very promising. The first one is in the area of gasification. It's not really new but it's a very good system for retrofitting present oil and gas-fired boilers. Another system that we've got is a portable pyrolysis system. This is one system that we have purchased and are actually testing in the Tennessee Valley. We are going to use it to heat a small college. The college has 546,000 square feet of space, and they are presently using about 240,000 gallons of No. 2 oil and 18 million cubic feet of natural gas per year. We can reduce that fuel consumption with this small portable pyrolysis unit. The gas and oil generated by pyrolysis can be used to heat the college and the charcoal can be sold by the college. Hopefully, they will make a profit on heating the campus instead of a deficit. This is a developing technology that can be used for industries, hospitals, and community buildings. With pyrolysis you can take the charcoal and use it in solid fuel boilers and coal burners. If you have a pollution problem burning coal, you can blend charcoal with it to reduce your sulfur emissions without having to spend a lot of money on scrubbers to clean up the emissions. Charcoal is a very good blend, not only with coal but as a slurry with oil. If you are going to burn a high sulfur oil you can blend charcoal with it and make the oil go farther, and at the same time reduce your sulfur.

Another system we are testing in a Northern Georgia vocational school is one developed by Dr. John Riley of the University of Maine. The system is a small wood chip-fired system that runs between 200,000 and 500,000 Btus per hour. It's built on site. In fact, the kids in the vocational school built it to heat their building. To start it up you turn the thermostat, the furnace downstairs starts feeding wood chips and a little oil starter comes on and burns for about 30 seconds. It gets the temperature in the firebox up to 500 degrees (F). Then it burns at 1500 to 1800 degrees where you get 100 percent combustion—you have no pollution, no smoke. It is a very simple little system. You have a wood chip bin that contains about three to four weeks' supply of wood chips. The total cost of this system, including the chip bin, furnace and the controls, is about $20,000.

But in this electrically-heated vocational school, they haven't finished working out the economics. The kids are still in the process of building the furnace. We're working with Dr. Riley to develop the complete set of very detailed drawings and plans that he can give to people that would like to build their own system, whether for use in a school, small community building, or small industry.

It's my feeling that at the TVA we've got to think small, too. TVA has a big wood stove program geared toward heating homes. We've shown an average reduction of 50 percent in kilowatt hours of electricity used in the homes in Tennessee Valley that were heated electrically. But we also went over to the Cherokee Indians in North Carolina where they have craft shops abundant with wood waste. They were putting this waste in a truck, hauling it to the dump and paying for its disposal. We went over one day and said, "Hey, come over and see what we can do with this stuff." We talked to one gentleman who bought three wood stoves, put them in a couple of his buildings, and by this spring he had not only paid for the three stoves, and for their installation, but he had made over $3,000 profit as well. Now he is trying to figure out how he can heat the whole complex with a central wood furnace or some more of these smaller stoves. So depending on the situation, there are a lot of little things you can do that don't take a lot of money and can be very effective.

In summary, there's plenty of used plant waste that goes to the dump that can be used by small industries and communities. I think you can do a lot of good with these small systems in your communities and it doesn't take much time to install them.

Workshop On Legal Strategies for Local Governments

August 20, 1979

Workshop On Legal Strategies for Local Governments

Chairman

William C. Osborn
Consultant to the MITRE Corporation

Panelists

Roger Hedgecock
San Diego County Board of Supervisors

Larry L. Levin
California Office, Western Solar Utilization Network

Charles Vidich
Central Naugatuck Valley Regional Planning Agency

Martin Jaffe
American Planning Association

Thomas J. Tomasi, Mayor
Davis, California

Arnold Wallenstein
Northeast Solar Energy Center

Summary

A poll of those in attendance, taken by Mr. Osborn, indicated that state and local governments were heavily represented, as they are keenly interested in methods to remove barriers to renewable energy systems development.

Traditionally, state and local governments have responsibility for building codes, land use plans, and space management, all of which impact energy use. In some localities, the involvement of community governments has gone beyond barrier removal to incentives and mandatory measures.

Arnold Wallenstein described NESEC's activities at the local government level in four Northeast states, activities which have paved the way for renewable energy systems through land use regulations, historic district planning, zoning changes for wind energy systems, and zoning variances.

Charles Vidich described solar access issues studied in Connecticut, involving lot size and orientation, setback, etc. A number of institutional barriers were addressed in Central Naugatuck's study.

Martin Jaffe pointed out that the first priority for all communities is an energy plan or, at very least, a solar access policy. This is necessary to focus local attention on the energy issue and provide a public forum for discussion. "Protecting Solar Access for Residential Development," an APA handbook published with HUD assistance, is recommended reading.

Thomas Tomasi described Davis' highly successful program, begun in 1973 with a general city-wide energy plan. Since then, several zoning and building code modifications, bicycle path construction projects, and public forums have reduced energy use and heightened public awareness and participation.

Roger Hedgecock described San Diego County's energy program, one undertaken in an area of extremely rapid growth. The County has used its legal abilities to control growth. One catalyst for debate over solar energy in San Diego was a referendum on the Sun Desert nuclear power plant. Since then, several communities, even some considered conservative, have begun distributed energy systems planning.

Larry Levin discussed Western SUN's approach to community assistance, which stresses transferability between communities and a field orientation. "Capturing the Sun's Energy," a Western SUN publication, is a recommended guidebook for local governments.

Introduction

William C. Osborn
Consultant to the MITRE Corporation
Bedford, Massachusetts

This workshop will focus on the ways in which local officials can use their legal powers to encourage the development of solar and other renewable energy projects. We will be looking at how local government can remove existing legal barriers to renewable energy systems, such as problems in building codes and zoning ordinances. We will also be discussing how communities can go further than this and actively promote the use of alternative energy through innovative new laws and ordinances.

The power of local government to influence renewable energy development is significant. Most community-scale solar, wood, wind and hydro projects are dispersed and small. Numerous installations are required to equal the output, for instance, of even a small conventional power plant. Therefore, whether a community succeeds in meeting a large portion of its energy demands with renewables depends on whether it can encourage hundreds, even thousands of projects within its boundaries.

Of course, to get a large number of small systems installed, or even a few large systems, requires favorable economics and workable technologies. But once the technical and cost questions have been answered, there often remains for the individual or business thinking about installing a solar, wind or wood energy system, a plethora of legal and regulatory issues to be resolved. Many, if not most, of these issues arise from local laws and regulations which apply to local building activity. And because these laws affect the decision-making of all builders and building owners in the area, a change in them can have a major impact on the speed with which a community adopts new renewable energy technologies.

What are some of the local legal obstacles facing developers of renewable projects? Lack of protection for continued access to sunlight is one. Will trees or new building shade the solar system in five or ten years? Can this be protected against? Will the bank financing the system want to see some sort of legal solar access protection before they deliver the money? The same type questions can be asked for a wind turbine, which needs clear access to the wind to operate properly. Other legal snags lurk in local building and plumbing codes. Is the plastic glazing material proposed for use on the solar collectors an approved roofing material under the building code? Are plans to use roof rafters 24 inch on center rather than 16 inch on center so as to incorporate solar panels going to run awry of the loading specifications in the code?

Zoning and aesthetic considerations comprise another set of problems that have beset community solar and wind developments. Are solar collectors or wind machines a permitted use? What about the glare and reflection from the solar collectors or the tendency of the windmill blades to make noise or interfere with nearby TV reception? And what about smoke from 100 wood stoves on a stagnant winter day? Are these reason enough to justify a restriction or ban on these systems?

I list these questions not to suggest that every energy project will always face every problem, but to illustrate the kind of tough non-economic and non-technical issues facing local developers of renewable energy. Fortunately, these are the type of issues that are within the traditional jurisdiction of local government. The regulation of land use and building activity offer a major opportunity, as we shall see this afternoon, to local government to encourage renewable energy projects. And it is my firm belief that unless this opportunity is exploited by local officials, it will be a long time before we see significant headway in the mass installation of dispersed, small-scale renewable systems.

We have today a group of people well-experienced in dealing with these types of issues. They come from local governments which have pioneered new initiatives and from organizations which are sponsoring or funding local government projects in the area of legal strategies. If it seems that we are top-heavy with Californians, it is true, and it is intentional: local government in California has generally done more and gone further than in the rest of the country in terms of developing innovative strategies to push solar and other renewables. Other communities can learn a great deal from places like Davis and San Diego, California.

I have asked our speakers not only to describe their projects, but also to tell us something about the political and legal process which resulted in the new laws and initiatives. For example, what types of plans or studies were conducted before passage of the particular initiative to justify it? How did the leaders of the particular effort obtain political support for the measure, especially support from groups affected by the new changes, such as non-solar property owners, builders and local code officials? Local officials and groups interested in following the example of some of the communities we will hear from today, will want to know the answer to these types of questions. It is my hope that you will leave this workshop with both new ideas for local renewable energy initiatives and a sense of how to start something in your own community. To this end, I have asked each of the speakers to limit their remarks to twenty minutes so that we may have a good question period at the end. I should add that the speakers will all be available for further questions and informal discussion at the end of the workshop.

Protecting Solar Access

Martin Jaffe
American Planning Association
Chicago, Illinois

Let me give you a brief overview of two planning guidebooks which I have been working on and which I think will be of interest to many communities. The books were initiated when the Solar Energy Office of the U.S. Department of Housing and Urban Development, which was interested in residential solar energy use, contracted with the American Planning Association (an organization of planners, planning commissioners, and general public interested in land use planning) to develop a series of free solar access manuals. The first manual,[1] *Protecting Solar Access for Residential Development,* has already been published. It is a guidebook for planners which goes over all of the techniques that the gentleman for Naugatuck (Charles Vidich) mentioned in terms of barriers, zoning changes, tables, and how to figure out shadow lengths and shadow directions in various slopes and radiance. It is all covered in there, and I won't be talking about that.

The second guidebook[2] is a book on site planning for solar access. The audience for that second book is primarily developers and site planners, but it will also be useful to planners who have to review subdivision maps. I focus on orientation and a number of techniques that can be used. Currently in the works is the third and final book under this contract which deals with architectural regulations, design review controls and historic preservation regulations. It essentially suggests design standards for the installation of solar energy systems using these types of regulations, and discusses ways in which these regulations can be modified—in legal language—to accommodate solar energy use. This book may be out around the end of the year.

The first manual is available free of charge from the National Solar Heating and Cooling Information Center in Rockville, Maryland (Telehpone: (800)523-2929—Continental U.S., excluding Pennsylvania;

(800)462-4983—Pennsylvania only; (800)523-4700—Alaska and Hawaii). I think it presents a fairly useful overview of legal and land use techniques which can be considered for solar access protection.

Essentially, what I wanted to talk about here is not so much the specific techniques already covered in detail in the guidebooks (this was discussed in some detail by the previous speakers); rather, I want to discuss how to develop a solar access program using these techniques. Where do you put your effort, and where do you put your money first?

The types of techniques which can be considered for protecting solar access include: (1) zoning, both for removing barriers and for changing dimensional requirements to correspond with solar angles to minimize shading; (2) subdivision review regulations for those larger orientation guidelines; (3) environmental assessments, including analysis of shadow patterns on existing and proposed features in subdivision maps; (4) vegetation controls, including exaction or landscaping requirements for new developments, perimeter plantings around mobile home parks, public street tree requirements, and subdivision regulations; (5) covenants and restrictions. (Presently, California is the only state which has passed a Solar Rights Act allowing communities to mandate solar easements in tentative subdivisions under review.) However, these are largely private instruments. Solar access priorities which you should consider will depend on whether your community is developing rapidly or whether it is already built up. The first priority for all types of communities—from small town to big city—is some type of energy planning. If you don't have a comprehensive plan, you should consider at least some type of solar energy policy which may comprise of anything that indicates a public objective to protect solar access and promote the use of solar energy systems.

There are three reasons why you should start with a solar energy element in a comprehensive plan. The first reason is it makes you look at the issues and determine the alternatives. For instance, if your community is suburban and zoned for large lots, you may find that there is no solar access problem—that's the end of your solar access program. Just ignore it and you go on to other development issues. If you can identify some problems, then you have a starting off point in terms of coming up with objectives.

Another reason for comprehensive planning of solar energy policies is that you have to bring it out into a public forum. This strategy gives you a platform from which to educate your own communities and your own local officials. It also gives you a platform by which you can receive information from the community. You can identify people who have an interest in solar energy with whom you can consult for technical expertise.

Finally, it will give you an idea of the political realities of pushing forward with the solar energy program. If nobody shows up at the hearings, then there isn't that much solar interest in your community.

The last reason for solar planning is legal. If you have solar policies or something in your comprehensive plan, then your solar regulations become more legally defensible. When you get challenged in court (which happens from time to time) the judge will look at these policies. The policies will help support a presumption of legislative validity for the regulations. So, on a pragmatic level, it is good to start with some type of solar energy plan or policy.

However, don't kill yourself with studies—don't study yourself to death. Don't spend all of your time doing a comprehensive energy audit if all you are worried about is solar access protection. What you should do is, essentially, to work backward. Decide what you want and then decide what type of studies you need to support what you want.

The second priority (after you have your policy and after you have some technical objective) will depend on the type of community. If your community is already mature, your second objective should be removing barriers, such as exempting solar equipment from height lot coverage, yard projection, and many other issues. Removing barriers could easily take care of 90% of your solar installations—which are likely to be retrofit installations.

For high-growth communities, the second priority should not necessarily be removing barriers, but modifications to subdivision regulations. You want to get buildings oriented to face 22-½ degrees either side of south. (A few communities, like Sacramento County, already have such regulations in effect.) However, the communities which have this orientation guideline are beginning to rethink it after it has been in effect for a few months. They are finding out that merely orienting the lots and orienting walls does not necessarily mean that the buildings will get oriented properly.

In your subdivision regulations there is usually a requirement that the sides of the buildings have to be parallel to the lot lines; if you regulate the lots, you will be regulating the building. So that is something to consider. After the subdivision regulations are changed for high-growth communities, those communities can consider removing barriers. Because subdivision regulations are so easy to change and can have enormous effect on solar access and energy conservation, they are usually the easiest thing to do.

The third priority is considering changes to zoning ordinances. This is likely to be a hot issue only in rapidly growing urban and suburban communities because, in most rural communities (once you've removed legal barriers and have orientation guidelines in your subdivision), the lot sizes are going to be so large that you won't have to worry about adjacent neighbors shading collector locations. If your community is large and has a large planning staff, you can start to think about very sophisticated zoning techniques such as building envelopes, incentive or negotiated zoning controls. Performance standards require a great deal of administration and technical support. For rapidly growing smaller communities, I suggest changing the prescriptive standards in height and setback and yard area requirements.

Your fourth priority is vegetation control. This strategy will be tricky and very politically volatile, but very important for solar access. This involves changing street tree and landscaping requirements. It gets tricky because you also have to regulate both deciduous vegetation as well as evergreen (initial studies have found that up to 80% of available solar radiation can be blocked by deciduous twigs and branches during the winter months) and could involve running around with a light meter to determine how much winter radiation is being blocked by deciduous trees. However, I don't think it is politically feasible to start cutting down or trimming existing trees and it would be administratively impossible in small towns and larger cities. This strategy probably is feasible only for large, rapidly growing suburbs.

The fifth priority is environmental assessment. This strategy is only valuable for high-growth communities because it takes a lot of manpower. It's a considerable administrative burden to check shadow patterns on each lot for each subdivision submitted. There are techniques whereby you can shift that burden onto the developer, but the cost also goes up.

A few quick conclusions: First, work backward. Decide what you want to do, then put your efforts and time into studies to support what you want to do. Don't use a shopping approach, studying everything to death. Rather, you should do the minimum amount of studies necessary and make sure that you get good press coverage (because solar energy makes good press). Secondly, don't strive for complete technical accuracy. Don't develop an ingenue mentality about protecting 100% of all houses 100% of the time so that every conceivable solar energy system can have access to sunlight. If you get ⅔ of the houses in your locale entered in the right direction you're way ahead of the game. I think that you should set a reasonable, achievable goal. Finally, solar is a spinoff of over-engineering your regulations. When your regulations get challenged, the courts are not going to be challenging the technical data which supports your regulation, all they are going to look at is a reasonable relationship. And if you do decent homework by using studies which already exist showing cost effectiveness and various other things, you can probably sustain your regulations.

Notes

1. *Protecting Solar Access for Residential Development: A Guidebook for Planning Officials.* Martin Jaffe and Duncan Erley; Chicago, IL: American Planning Association. Prepared for the U.S. Housing and Urban Development in cooperation with the U.S. Department of Energy; May, 1979; Report no. HUD-PDR445. 154 pp., $4.75.

2. *Site Planning for Solar Access: A Guidebook for Residential Developers and Site Planners.* Duncan Erley and Martin Jaffe; Chicago, IL: American Planning Association. Prepared for the U.S. Department of Housing and Urban Development in cooperation with the U.S. Department of Energy; September, 1979; Report no. HUD—PDR481. 149 pp., $4.75.

A Strategy for Local Government to Implement Use of Alternative Energy Sources

Thomas J. Tomasi
Mayor, City of Davis, California

Abstract

A brief history of the City of Davis' programs and accomplishments in the area of energy conservation and alternative energy use is presented. The processes and mechanisms used by a local community to promote alternative energy use are examined. It is concluded that local governments have the necessary tools to implement alternative energy use.

Authorization and Action

The California State Constitution empowers local governments to adopt ordinances to promote and protect public health, safety and welfare. On the other hand, the state preempts and restricts local government in specific areas. These conditions still provide a great degree of flexibility for local agencies to take action in the realm of alternative energy utilization.

In the early 1970's, local governments were mandated by the state to adopt certain elements within their general plans. These elements included land use, circulation, open space, housing, and conservation. The state subsequently expanded the list of mandatory elements. Through this compulsory process local communities were given the opportunity to seriously consider conservation along with other aspects that would determine their social, economic and physical configuration.

The City of Davis seized this opportunity to write a farsighted, comprehensive general plan. This was the turning point in the city's destiny. In contrast to the past, when a laissez-faire attitude prevailed, local control of the city's future, in the early 1970's, became the central focus of community effort. A strong growth control program was implemented to provide the quality and quantity of growth desired. Further, an exhaustive conservation element was drafted including water, soil, biological, mineral, energy, climatic, cultural, scenic and recycling conservation objectives.

Once the general plan was formally adopted in 1973 many action plans, ordinances, and zoning changes were implemented, thus bringing the city into compliance with its newly adopted general plan. The basis for almost every ordinance, regulation, or criteria adopted by the city since 1973 can be found in specific objectives or policies within the general plan. These changes cover a very broad spectrum—from an historical and landmark ordinance to a newspaper recycling ordinance, from a requirement of economic mix within each planning area to the provision of a permanent senior citizen facility.

Implementation of the conservation element of the general plan required a multitude of actions to be taken. Presented here is a list of ten such actions.

1. Bicycle use was provided for in an integrated circulation street and path system.
2. Intra and intercity transportation was funded.
3. Recycling of newspaper was implemented, with glass and cans being voluntary using curb-side pickup by the franchised waste disposal company.
4. Water conservation programs were instituted.
5. Shading requirements of parking lots were adopted.
6. Solar dryer ordinance was enacted.
7. Solar pool heaters were required in multiple and commercial installations.
8. Street widths were modified.
9. Vehicle size was reduced.
10. Most significant, an energy conservation building code ordinance was adopted in October, 1975.

Accomplishments

When built under the energy conserving building code, new homes have attained a 50 per cent reduction in energy consumption. This is accomplished through orientation, increased insulation, and reduced glazing. From 1973 to 1978 the per customer reduction in electrical use was 18%, the reduction in natural gas consumption was 37%, and it is estimated that 25% of in-city miles traveled are by bicycle. These reductions of energy use cannot be accounted for on the basis of mandatory programs alone. Therefore, the voluntary efforts of a concerned and aware public must have contributed significantly.

Through the growth control process of yearly allocations of housing units, the city has had a significant impact in not only promoting alternative energy use, but also in providing better planned neighborhoods. Further, since the adoption of the general plan, a policy of zoning all residential lands as planned development zones has been followed. This creates greater flexibility for the developer and the city, while maintaining even greater control by the city. Planned development zoning allows for greater flexibility in density shifts, fencing, setbacks, parking, drainage systems, street widths and other aspects which have successfully provided for solar access rights, provision of open space, reduced energy consumption and more pleasant neighborhoods.

As part of the allocation system, ten criteria were developed by which each development was rated and judged as to its merits in meeting the criteria. Innovative energy conserving developments would generally receive greater allocations than standard subdivisions given that all other factors were comparable. Since the inception of the allocation process in 1974, the allocation number has diminished and the competition has become keener. Also in the 1977 and 1978 allocation, as a condition of approval, all units were required to have solar water heaters stubbed in; and in the 1979 allocation it is contemplated that it will be a condition of approval to provide the bread box type solar water heaters.

At present, a retrofit ordinance is pending action. The retrofit ordinance would require homes built prior to the adoption of the energy conserving building code to be made more energy efficient at time of resale. Further back in the wings, though presently being investigated by an alternative land use committe, is a revolutionary concept of land use I have labeled self-reliance zoning. Under this type of land use large parcels would be annexed to the city conditioned upon deeding to the city 75% of the land for the provision of small scale farms and wood lots, which could also serve as a windbreak. Obviously, this concept will require lengthy, in-depth study. More programs will be forthcoming as they become more cost effective.

Conclusions

The degree of control that a local community desires to exercise, not the legal restrictions, is the limiting factor as to how much a local community can promote alternative energy use. The state and federal governments (along with financial institutions) have placed certain limitations on local government. But, given the will to change our present energy consuming attitudes, a community still has the necessary tools available to it to bring about that change. Using the standard tools of a general plan, zoning, and the conditions of approval through the planned development process, the local community is in the driver's seat. Energy conserving building codes and other mandated programs have their positive impacts. Most important, however, is an aware, concerned citizenry that supports cost effective, environmentally sound alternatives.

The process by which local government considers new ideas and eventually adopts some of them can be the determining factor in a successful program. How local government conducts public hearings, receives public input and communicates with the media and the community can lead to a success or failure. In a nutshell, local government must govern in a fashion that the public can become part of the process and part of the solution. General consciousness and awareness will be increased and an atmosphere conducive to change can be cultivated. These kinds of considerations should be uppermost in the minds of people who want to bring about changes to promote renewable energy projects.

Local Leadership for Solar Energy in San Diego County

Roger Hedgecock
San Diego County Supervisor
San Diego, California

The County of San Diego originally became involved with energy management and planning as a result of the Oil Embargo of 1973–1974, as did many other local jurisdictions. Subsequently, in response to the lack of a coherent energy policy from the federal and to some extent the state governments, the County Board of Supervisors made the decision to provide what leadership they could in local energy planning.

Energy Conservation Policy

The first step the County Board of Supervisors took was to establish a policy dictating the use of energy within County-owned facilities. This policy, Board Policy G-8 (Energy Conservation in County Buildings), specifically established procedures for realizing maximum conservation of energy in County facilities through application of energy conserving systems and practices including solar technologies. In a letter dated November 16, 1977, from the Department of General Services to the Board of Supervisors, the results of implementing this policy were outlined. Between fiscal year 1974 and fiscal year 1976, the County had reduced the energy consumption in existing facilities by 58%.

One of the msot innovative programs developed from these early conservation efforts was that of developing a central monitoring and control system to regulate energy utilization within County facilities. A feasibility study was authorized by the Board of Supervisors on August 7, 1973. The study concluded that such a system would have a return on investment of approximately 4.7 years and reduce energy consumption by approximately 14,000,000 kilowatt hours annually. It also concluded that such a system would optimize equipment performance and manpower utilization and provide real time preventive maintenance scheduling.

The Central Monitoring and Control System is currently installed and operating. Work remains to be completed on specific applications programs tailored to County requirements. It appears that expectations on the system will be met.

Energy Element

During implementation of Policy G-8, the County Board of Supervisors recognized the need for a more comprehensive energy planning process which would not only include energy management within County facilities, but also provide direction to the unincorporated areas as a whole. In late 1975, consequently, the Board directed that an *Energy Element* be prepared for inclusion into the *County's General Plan.* Work on this Element was completed in late 1977 and subsequently adopted by the Board on November 15, 1977.

The Energy Element contains policy statements and corresponding action programs which provide direction for County planning processes, decision makers and community planning groups. It also specifies goals and objectives for the County to meet in implementing its energy policy. During the 1977–1978 fiscal year budgetary process, the Board directed that implementation of the Energy Element be carried out by appropriate County agencies according to implementation schedules drawn up by each.

Energy Office

On August 30, 1977, the Board of Supervisors established an Energy Office within the administrative framework of its long-range planning office, the Department of Planning and Land Use. This office was specifically established to act as the focal point for County energy planning and to oversee the implementation of the Energy Element. The office itself was authorized one full-time position with additional help made available through Comprehensive Employment Training Act workers, student workers, and, when possible, through grant monies available for consultant work.

A prime example of the function of the Energy Office as it relates to the implementation of the Energy Element occurred with the adoption by the Board of Supervisors of an ordinance which will require solar water heating in new residential construction. The Energy Office was given primary responsibility for implementing this particular action program by Board directive.

The Energy Office submitted a Solar Ordinance Feasibility Analysis and draft ordinance to the Board of Supervisors on November 21, 1978. Subsequently, the Board adopted the ordinance on December 12, 1978, which became the first such ordinance in the nation.

Although the passage of Proposition 13 has hindered many of the County departments from maintaining their implementation schedules of Energy Element action programs, the County does anticipate achieving substantial implementation within the next two years. For example, this next year's work program for the Energy Office includes work on incentives or ordinances which will promote the use of passive solar design techniques, utility rate restructuring, and residential energy performance standards.

The County of San Diego has financed its entire energy program from its own funds and for the most part with its own staff. Several reasons for this include the problem of finding competent consultants with expertise in the energy field as it relates to local planning matters, the lack of grant funds from the federal and state governments, and the fact that the County is moving fast enough with its energy program that often grant monies are too slow in coming or for programs no longer valid to the County's program. The County of San Diego will continue to have a viable and progressive energy program, however, because it is self-supported and not dependent on other agencies for its survival.

Solar Ordinance

The solar water heating ordinance was a Board of Supervisors' initiative arising out of public interest group suggestions during hearings on the County Energy Element. In 1977, concurrently with hearings on and following the adoption of the Element, the County took an aggressive role in opposing construction of the San Diego Gas and Electric Company's Sundesert nuclear power plant. The rationale for such a position was staff and Board concerns about the costs of the proposed project, the safety of nuclear plants and their nuclear wastes, and the necessity of constructing the plant when conservation, power pooling, and alternative energy technologies could supply the necessary power within the same time frame. With the ultimate demise of the project, the Board used the momentum generated around alternative approaches to providing adequate future energy supplies to begin vigorously implementing an alternative energy program. One result was the solar ordinance.

The solar ordinance requires that after October 1, 1979, new residential construction involving those lots for which solar access has been determined to be feasible and which occur in areas not served by natural gas shall have a solar heater as the primary means of heating water. This requirement extends to all other areas of the County after October 1, 1979.

Preparation of the *Solar Ordinance Feasibility Analysis* by the County Energy Office served as the focal point for participation by persons or organizations having an interest in the solar ordinance. The feasibility analysis provided the back-up data, such as the economics of solar water heating and the impact of mandating, necessary to allow the Board to make a well-informed decision. The final result of the analysis and participation by interested parties, both for and against, was a document with figures everyone agreed upon. That left one major philosophic point of discussion for the public hearings: Was it appropriate for a local government to mandate a specific technology? The answer was a unanimous yes from the County Board of Supervisors.

The major opposition to the ordinance came from the construction industry which philosophically disagreed with the Board's approach to solar water heating. The industry argued that the free market would satisfactorily integrate solar and other alternatives into the housing market. The Board disagreed contending that the market would probably not integrate alternative energy sources into the energy supply plan rapidly enough to make a significant contribution as soon as needed. Furthermore, the Board was not convinced that the construction industry was as sensitive to consumer requirements, such as reducing energy operating costs of a home, as they thought themselves to be. To their credit, the construction industry responded to the passage of the ordinance by constructively offering to assist in implementing it properly.

Implementation

Following the adoption of the solar ordinance, the County Energy Office took responsibility for developing the component parts necessary for successful implementation of the ordinance. Most recently, the Energy Office, with the assistance of the local construction industry, developed a solar access ordinance. The Board approved this ordinance which requires reservation of a minimum of one-hundred square feet in a plane ten feet above the buildable area of each lot in a subdivision which has access to sunlight. Lots which have this access and lots not having it are noticed on the final map. At the building permit stage, residential construction on lots having access must have solar water heating. A solar swimming pool ordinance is being considered now also.

Standards for solar equipment will be presented to the Board prior to October 1, 1979. To date, these include materials usage and installation standards and sizing standards. So far, equipment performance standards may also be included. The County has been hampered in developing these standards by the slow response by the Federal and State governments in developing and releasing solar equipment testing procedures and results.

Future Developments

San Diego County views the solar water heating ordinance as only one step in a long process of moving the County through the current transition to renewable energy alternatives. The County has recently been awarded a grant by the Department of Energy to conduct a passive solar design project which will eventually culminate specific design and performance data for use by architects and engineers. The County intends to tie alternative energy technologies, conservation technologies, and alternative planning and design standards together into specific performance codes. Different building types will have to conform to energy budgets which will be designed to allow flexibility in design solutions for meeting the energy budgets. The County is also starting on specific planning strategies for assuring energy efficient communities in the future.

We in San Diego County feel that local governments have a responsibility which is uniquely theirs in meeting the crisis of energy transition. Our County has taken initiative in a few of these areas of responsibility. It has thus far been successful. Local governments can and must exert leadership successfully in addressing this serious national problem.

Workshop on Citizen Participation in Renewable Energy Planning and Implementation

August 20, 1979

Workshop on Citizen Participation in Renewable Energy Planning and Implementation

Chairman

Richard J. Munson
The Solar Lobby

Panelists

Paul Bujak
Albany County (Wyoming) Energy Council

Kye Cochran
Montana Alternative Energy Resources Organization

James Welch
Wyoming Community Grants Program

Peggy Wrenn
Colorado Office of Energy Conservation

Summary

James Welch of the Wyoming Community Grants Council outlined ways in which communities may participate in the Grants program, and noted the importance of acquiring a cross section of the population to serve on the Council. Funding for these grants comes from the Energy Policy and Conservation Act, i.e., the Federal government. Using these funds as a catalyst, local business, utilities and citizen groups have provided additional support. These funds are used only for planning purposes, not for any actual construction of energy systems.

Paul Bujak, of the Laramie (Wyoming) Energy Technology Center, described the "Energy Town Meetings," to involve small communities in their energy solutions. He also noted how the success of these endeavors depends on the "right season," and involving those who may oppose you. Through the Institute for Cultural Affairs, neighborhood energy meetings were held in the local schools, to determine and clarify the issues, and establish a contact person to coordinate organizational efforts. These meetings have produced much enthusiasm, and good local conservation programs.

Kye Cochrane of the Montana Alternative Energy Resources Organization, then reported how they were able to use the CETA program to get people to work on energy programs (they have seven people and one coordinator). They organized an energy fair with entertainment, exhibits, workshops and discussions in the evening. Kye introduced some of her co-workers who had accompanied her to the conference, and showed some slides of their projects throughout the state.

Peggy Wrenn, of the Colorado Office of Energy Conservation, emphasized decentralization of energy. She told of "The New West Energy Show" which travels from town to town combining theatre with hardware. They exhibit wind mills, solar collectors, etc., with "hands-on" workshops, educational workshops, and they encourage other people to bring in their energy-related hardware. This program is produced by The Institute of Cultural Affairs in Denver. She also listed other sources of information through which the communities can institute their own programs, such as: individual state Energy Extension Services; the Center for Renewable Resources, 1001 Connecticut Avenue, Washington, D.C.; Wyoming Energy Handbook; and the Institute for Participatory Planning, Laramie, Wyoming. SERI is also putting out a book on citizen participation.

It was evident that there was much enthusiasm among the panelists and the audience for establishing worthwhile programs on the local level.

Grassroots Energy Planning: The Wyoming Community Grants Program

Jim Welch
Consultant to Wyoming Energy Conservation Office
Ft. Collins, Colorado

Abstract

As part of a state-wide energy conservation plan, the State of Wyoming Energy Conservation Office has completed the first year of a program to fund community-based energy conservation and renewable energy projects. Each participating community is asked to form an energy council which is responsible for developing a first year energy program that meets the specific need of the community. Grants of up to $10,000 are available for funding these programs.

To date, twenty Wyoming communities have energy councils. Their diverse programs include demonstrations, workshops, seminars, feasibility studies, and other ways of implementing energy conservation and renewable energy sources at the community level. The program has been successful in soliciting broad citizen support. The long term goal is to have these councils continue to initiate and coordinate energy planning in their communities after the program funding ends in December 1979.

Introduction

Community energy programs are effective means by which states and local governments can encourage energy conservation and the use of renewable energy sources. Communities such as Davis, California, have shown that they can save substantial amounts of energy and in the process assume the lead in resolving the nation's energy crisis. Unlike most federal programs, grassroots energy planning depends upon broad citizen support and involvement for its success.

The Wyoming Community Grants Program

Recognizing this, the Wyoming Energy Conservation Office initiated a program, the Wyoming Community Grants Program, to fund community energy councils, citizen advisory boards on energy. Grants of up to $10,000 are available to communities which establish energy councils and develop an energy program addressing community priorities. The objective of the Wyoming Community Grants Program is to promote community efforts to conserve energy and utilize renewable energy resources by encouraging participation and support from members of the community. The long-term goal is to establish energy councils that will continue to coordinate community energy decisions after the funding for the program ends in December of 1979.

The Wyoming Community Grants Program is one part of a state-wide energy conservation plan designed and implemented by the Wyoming Energy Conservation Office. Funding for this state plan was authorized by the Federal Government in bills passed by Congress in 1975 and 1976. These bills are the Energy Policy and Conservation Act of 1975 (EPCA) and the Energy Conservation and Production Act of 1976 (ECPA).

Establishing Community Energy Programs

Wyoming communities interested in participating in the Community Grants Program are asked to follow a step by step process for developing proposals for funding. A handbook explaining this process is available from the Energy Conservation Office. The requirements for funding are:

1. *Establish a Community Energy Council.* The community energy council consists of 6 to 12 people representing the various interest of the community. Either interested citizens or a community organization can assume the responsibility for organizing a public meeting and selecting a council; or a council can be appointed by an arm of the community government, such as the mayor or the city council. In order to receive federal funds, a council has to incorporate as a non-profit corporation or affiliate with an existing non-profit group such as the Chamber of Commerce or the Rotary Club.

2. *Submit a Request for Start-up Funds.* Before an energy program is developed, the needs and interests of the community must be determined. Start-up funds of up to $1000.00 are available to energy councils from the Energy Conservation Office. These funds are used to develop a proposal for the community's first year energy program.

3. *Develop Community Support for the Community Energy Program.*

After submitting a Request for Start-up Funds, an energy council is asked to develop a broad base of support for its activities. The council surveys the community to determine the energy related programs already existing in the community and the types of energy programs and projects that are important to the community in the future. Community objectives are determined. An energy program is developed to meet the objectives.

4. *Submit a Final Program Proposal.* A council's final proposal consists of a description of their first year energy program, a plan of action, and a budget summary. Grants of up to $10,000 are available to energy councils whose programs are approved by the Energy Conservation Office. The program provides funds for planning, consultants, salaries, travel, education, and administration, but not for construction materials.

Community Energy Programs Funded

Since initiating the Community Grants Program a year ago, twenty energy councils have been funded in the State of Wyoming. The communities with councils vary in size from small rural towns of less than 1000 peple to the larger Wyoming cities with over 50,000 inhabitants.

The energy programs of the twenty energy councils are diverse and varied. The principal objective of most of the councils' programs is to increase community energy awareness. Other priorities are energy planning, recycling, and alternative transportation. A sampling of some of the councils' successful projects follow.

Energy Education. Workshops on the use of appropriate technologies such as underground architecture, passive solar design, solar domestic hot water heating and solar greenhouses, seminars for tax supported institutions on energy conservation, supplements on energy in local newspapers, energy resource sections in local libraries, community solar greenhouses, solar heating municipal swimming pools, information dissemination, solar tours, energy theatre, and energy fairs, active and passive solar demonstrations.

Energy Audit Programs. Energy audits of homes and local businesses, programs to audit and weatherize mobile homes.

Energy Planning. Tree planting programs for natural windbreaks, bikeway planning, studies of low head hydro and wind power for generating electricity, a town project to pump municipal water with wind power, investigations of using waste heat from power plants, town government energy management programs, establishment of city energy coordinators, town meetings on energy, biomass conversion for gasohol, firewood management programs, and carpooling.

Recycling. Projects to recover and recycle cans, bottles, oil, etc., wood waste recovery from local sawmills for firewood and fuel.

Results

The Wyoming Community Grants Program has been successful in establishing energy councils and in developing local community energy programs. Wyomingites have a strong grassroots interest in energy self-reliance and the use of renewable energy resources. The successful elements of this program are:

Community Involvement and Support. Hundreds of Wyomingites have volunteered large amounts of time to serve on the councils and to plan and administer their energy programs. These people are becoming the leaders in the energy area in their communities and will be a great resource to the State in the future. Many of the councils have been sponsored by local service clubs such as the Rotary, Chamber of Commerce, and Audubon Society. Others have been officially recognized by their local governments.

Communities Planning Their Own Energy Futures. The councils are taking the first steps to secure a sound energy future for their communities. In the process, they are becoming less dependent on state and federal planning efforts to solve their local problems.

Establishment of a State-wide Network of Energy Councils. There now exists a state-wide network of energy councils in Wyoming. These councils have the tools to bring in other state, federal, and private energy programs identified as needed for their communities. Conversely, the Energy Conservation Office is better able to implement its programs by using the councils to administer them on the community level.

Diversity of Energy Projects. By funding local energy efforts, a great diversity of energy projects are generated. As a result, the options available to the State of Wyoming for using renewable energies and conserving energy are increased.

Community Fund Raising. By drawing on local resources, the community energy councils can augment their state grants with local assistance. Many Wyoming businesses, utilities, industries, and civic groups have provided support for their local energy programs. As a result, many of the councils have spent very little of their grant monies to date.

Grassroots Technology Transfer. Local energy problems are best solved by using technologies appropriate to the community needs. By supporting community energy conservation-renewable energy projects, we are able to get new technologies to where people can use them.

The problems encountered by energy councils in implementing their energy programs are those which plague all citizen groups. Some councils have had trouble sustaining interest among council members because of the large amounts of time needed to serve on a council. Councils also have had difficulties finding effective leaders, skilled community members who can design and administer programs. The effectiveness of other councils has been impaired by the lack of recognition and assistance from local governments. On the whole, what leadership and legitimacy the councils have lacked has been made up for by the willingness of Wyomingites to get involved with community affairs and to contribute to the nation's efforts to solve the energy crisis.

The Future of the Wyoming Community Grants Program

The Wyoming Community Grants Program is scheduled to end on December 31, 1979. If continued funding from D.O.E. is made available to the Energy Conservation Office, the Office will be able to continue to support the existing energy councils and possibly fund more Wyoming communities. If federal support is not forthcoming, the energy councils should continue to be an important voice for energy conservation and alternate energy at the community and state level. Already, many are adept at raising money for their own projects. Others have an association with their local governments and can expect support from them in the future.

Acknowledgments

The original concept of funding local energy councils in Wyoming was conceived by Ms. Lynn Dickey and Ms. Lorna Wilkes, past director and assistant director of the Wyoming Energy Conservation Office. Myself and Ken Olson of the Roaring Fork Resource Center in Aspen, Colorado were hired as consultants to develop and implement the Community Grants Program. Ken's assistance was invaluable in helping to generate the initial enthusiasm among Wyoming communities for energy self-reliance. The present director of the Energy Conservation Office, Ms. Pam Abel, should also be acknowledged for her continued support of this program.

An Energy-Oriented Citizen Mobilization Effort in a Small Western Community

Paul C. Bujak, Chairperson
Albany County Energy Council
Laramie, Wyoming

We had no idea what we were getting ourselves into. We had underestimated the amount of effort necessary and over-estimated the amount of support we would receive. The best of intentions interrupted and unnecessarily lengthened many meetings. Personalities and wills clashed. We would never have guessed where some of our best support came from. None of us realized that we could reach our limits and find more to give. We didn't expect that quiet and intense satisfaction as we realized "We did it." It really was true, the average person who cares enough to attend a public meeting with his or her neighbors, can respond creatively and realistically to complex, goal-oriented situations.

—Albany County Energy Council

Abstract

A small number of concerned citizens in Laramie, Wyoming recently coordinated a set of neighborhood problem-solving meetings on energy-related concerns. The Albany County Energy Council was a young, DOE funded volunteer group who, together with The Institute for Cultural Affairs conducted fourteen "Town Meetings on Energy" over a two week period in Spring 1979. Following a final county-wide assembly, several continuing energy action groups were created. These, along with the parent organization continue to address recycling, energy information, transportation, and other energy-related city and county issues.

Background Information

Environment

Albany County is located in southeast Wyoming and is home for an estimated 30,200 people, 26,500 of whom live in Laramie, an old railroad town and present location of the state's only four-year university. It's large by some standards—4,374 square miles (about the size of Connecticut). It's high—with elevations ranging from 6,700 feet to 10,300 feet. It's dry—11.1 inches of rainfall annually, 1.4 inches above being officially classified as a desert. Some tourists and newcomers claim it's cold and windy.

County Energy Office

The Wyoming State Energy Conservation Office, with DOE funds, has been coordinating a series of Community grants—up to $10,000 in size—for towns in Wyoming. Laramie became involved with the State Office after three organizational meetings of concerned citizens brought an eight-member, Albany County Energy Council into being. Early plans for community energy-consciousness-raising efforts included: school energy reduction contests, an energy and the arts publication, establishment of a speakers bureau, etc. Solar greenhouse and bikepath proposals were discussed, but the group's first real efforts were directed at resurrecting and supporting a recently scuttled recycling program.

As the council struggled with the details of just this preliminary project, it soon realized that in spite of initial interest from several dozen people, not much more than some lip service and a few familiar faces remained—a coalition of the overcommitted.

Why the Project Was Undertaken

We needed to expand our base of support. We wanted to mobilize the community, or at least raise the level of awareness about energy and conservation matters as they related to our town and our county. This community-involvement effort was begun back when energy problems were less evident than today—or at least less publicized. Few people were convinced there was a serious problem; gas lines were still located between the fuel pump and the carburetor.

We also wanted to investigate perspectives not always discussed in existing "energy education" efforts: blind growth, the finite nature of fossil energy, conservation ethics, etc. Our intent was to sponsor a community-wide event, letting everyone know what everyone else was doing or planning. We wanted to avoid wheel re-invention and other inefficient uses of that most valuable resource—our time.

We needed to involve others and discover on-going programs; to convince our fellow residents that:

- there really was a set of serious growing problems with the way we were using energy;
- there were specific, practical steps that the community could take, at the city and county level, to solve these problems or at least lessen their impact;
- the average man and woman had an important contribution in determining these practical steps.

The Council membership realized as well, that implementing any truly effective measures to save energy were likely to be at least partially controversial. Consequently, we felt that it was important to involve as many of those diverse factions and interests in generating the solutions that would affect them all.

What It Involved

One of our members had been involved with "Town Meeting 76," a bicentennial project initiated and developed by the Institute for Cultural Affairs (ICA). The Institute is an international teaching and social demonstration order dedicated to human development. Since 1976 they have conducted more than 4,000 town meetings, at least one in every county in the nation. A "town meeting" as managed by ICA, is a citizen participation technique called a "charette," a highly structured, yet open-ended brain storming session designed to determine issues, define problems, and schedule specific courses of action to solve them.

The council agreed to contact ICA and investigate the possibility of channeling their more open structure towards energy-related concerns. A contract was negotiated and a set of thirteen neighborhood meetings were scheduled in Albany County over a two week period in March and April, 1979. A final county-wide assembly would tie the whole effort together on Saturday, April 7th.

What follows is the text from a portion of ICA's proposal to Albany County:

"The ultimate goal is to engage a broad cross-section of citizens of Albany County in a process to:

- determine comprehensively the major arenas of energy issues facing the county in the matter of energy conservation and alternate sources.

- determine systematically the broad proposals required to deal with energy conservation matters and alternate sources at the local level.
- develop a group mechanism for implementing the necessary actions during the next one to two years to accomplish these proposals.

[this would be carried out by:]

- holding a series of community meetings intentionally including geographical, social, economic, and cultural cross-sections of the entire county,
- pulling together the issues and proposals from each meeting at one overall community assembly and publish the consensed-upon actions for the county,
- determining when and how each action will be done and what persons or groups will be responsible for doing them."

Implementing this proposal involved some planning steps unique to ICA's specific approach to citizen participation. Other steps taken may be necessary, or at least helpful, in many other kinds of citizen participation efforts. The remainder of this paper will attempt to outline these and draw some preliminary conclusions from the process and the product.

Mobilizing the Community

Neighborhood Identification

With some estimating and other more obvious situations, the Council subdivided Albany County into twelve neighborhood areas within Laramie city limits, in the surrounding developments and subdivisions, and in the ranching communities further out. Because the non-Laramie, county population is widely dispersed, it might have been advantageous to have a larger number of neighborhoods identified, but more neighborhoods meant more meetings, and more staff to run them. We could have used more help.

Determining twelve subdivisions of our county using geographical criteria was only a part of our community-identification-in-an-energy-context method. Using non-geographic criteria, we isolated:

- the business community
- the Senior Citizens
- The University
- Spanish-American residents
- contractors, and others in building, planning, design, construction or maintenance
- realtors and others with property-oriented interests
- truckers and those otherwise involved in local transportation systems.

Our list was site-specific to Laramie, and is likely to need modification if used elsewhere. Although we would have liked to target each of these groups with a specific town meeting, we limited ourselves to the geographically defined neighborhood meetings and a senior citizen meeting.

Scheduling

Most neighborhood energy meetings were scheduled for the auditoriums or cafeterias of elementary and secondary schools throughout the community (see flier reproduction at end of text). Other town metings were held at the public-use facility nearest each defined neighborhood—a neighborhood center, armory, or conference hall. In some cases months of advance notice was required. It was essential that the locations used not cancel out. Last minute changes in times or locations with this kind of meeting could easily send more than half the attendees back to their homes. Residents were free to attend any meeting, not just the one for their neighborhood.

Selection of Contacts

Once the county was segregated, the Council members and others concerned spent two meetings brainstorming the names of individuals who could act as contact persons in their respective neighborhoods and met any one or more of these criteria:

- they had recently expressed an interest in community energy conservation matters
- they had a history of such involvement
- they had been constructively involved in other community mobilization efforts
- their position, trade, or other circumstances, associated them with energy or conservation-related issues.

When an individual had agreed to act as contact person for that neighborhood, he or she was asked to work with us to find others in their neighborhood who could help get out the troops or coordinate other organizational efforts.

Each town meeting, as first planned, would be led by one ICA staff member and a specially trained community volunteer from each respective neighborhood. This individual may or may not have been the contact person. When the meetings were finally held, ACEC members were needed more than twice. The duties of community volunteers included coordinating the phone calling, double-checking the facility arrangements, and providing coffee, tea and cookies. Final efforts included attending a model meeting and training the community leaders. The training sessions—part of ICA's contract with us—were unexpectedly difficult. Schedule conflicts of the participants and other seemingly preventable problems postponed some sessions and reduced attendance at others.

Support

Local media were cooperative when approached, but our own publicity efforts were sketchy due to efforts directed elsewhere, holding things together. Local county, city and other officials, church and community leaders, were cooperative in contributing to a large news story developed from small head-and-shoulders portraits interspersed with their statements of support.

Problems Gave Way to Success

The model meeting was an event that the Council had been counting on. It was hoped that from the 62 individuals who had said yes to personal invitations, we could work with an expanded team and support the town meetings at the level we had originally expected. Instead, by the end of the evening, the entire project had all but collapsed. Of the 62 community leaders who accepted our invitations, 30 showed up, 10 left in frustration within the first half hour, 14 more left before the end of the evening. The reason for this was that ICA had innocently kept their broad-based problem solving format and simply placed issues in an energy context. The Council had emphasized to those invited that this meeting was going to deal specifically with energy issues as they relate to Albany County. There had been a classic failure to establish an adequate level of communication in a cooperative effort.

We picked up the pieces, contacted those who had left in confused frustration, and recovered some of our support. But our continuing in-

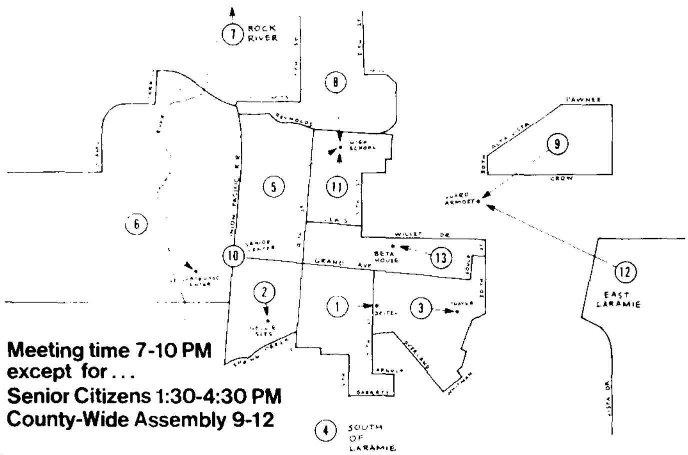
Town Meetings On Energy

ENERGY CONSERVATION

YES, A NECESSITY!

CITIZEN ACTION

Join your neighbors for a Town Meeting on Energy being held near you.



Meeting time 7-10 PM except for...
Senior Citizens 1:30-4:30 PM
County-Wide Assembly 9-12

Schedule

MARCH	MON 26	TUE 27	WED 28	THU 29	APRIL	MON 2	TUE 3	WED 4	THU 5	FRI 6	SAT 7
NEIGHBORHOOD NUMBER	1	3	5	6	NEIGHBORHOOD NUMBER	8	10	11	12		COUNTY WIDE ASSEMBLY AT HIGH SCHOOL
MEETING LOCATION	BEITEL	THAYER	HIGH SCHOOL	NEIGHBORHOOD CENTER	MEETING LOCATION	HIGH SCHOOL	SENIOR CENTER	HIGH SCHOOL	GUARD ARMORY		
NEIGHBORHOOD NUMBER	2	4		7	NEIGHBORHOOD NUMBER	9			13		
MEETING LOCATION	NELLIE ISLES	FAIRGROUNDS NEW 4-H BLDG.		ROCK RIVER SCHOOL	MEETING LOCATION	GUARD ARMORY			BETA HOUSE		

Figure 1. TOWN MEETINGS ON ENERGY (layout for newspaper notice, posters, and fliers)

TOWN MEETINGS ON ENERGY
Attend One or More

WHAT-- 13 Neighborhood Town Meetings on ENERGY
1 Final Assembly

WHERE-- See Map Inside

WHEN-- March 26 - April 7

WHO-- All Citizens of Albany County

WHY-- 1) To share your concerns about energy
- o High cost and availability of energy
- o What of the future?
- o Life styles

2) To find the challenges to action
- o What actions do we need to take?
- o What is keeping us from taking action?

3) To generate ideas, set goals and make plans to meet the challenges
- o Come up with specific ideas
- o Identify necessary resources
- o Develop plans of action and take responsibility for their success

Remember-- What we, the people of Albany County do to help ourselves, will also help the people of our State and Nation. By demonstrating effective action, others will follow and that will help us!

Town Meetings on Energy are sponsored by the Albany County Energy Council, a local citizens group. The Town Meetings are partially funded by a grant from the State Energy Conservation Office. A.C.E.C. is assisted by the Denver Regional Office of the Institute for Cultural Affairs, a research, training, and demonstration organization. Co-sponsors include the Laramie Women's Club and the Men's Club, United Methodist Church.

ENERGY ISSUES

Are any of your concerns listed below ?

- Heating Costs
- Gasoline Shortage
- Balance Of Payments
- Food Costs
- Recycle Dump
- Solar Green Houses
- Food Supply Vulnerability
- Conservation
- Solar Legislation
- Renewable Sources
- Fuel Reserves
- Transportation
- Co-operative Effort

SOMETHING CAN BE DONE !

Join your neighbors at a Town Meeting on Energy.

Figure 2. TOWN MEETINGS ON ENERGY (layout for outside cover of flier)

ability to effectively multiply the size of our working team meant we had to reduce the number of town meetings from an original sixteen to twelve, and each of the original project team members had to be more personally involved than they had ever dreamed would be necessary.

And the meetings came off without a hitch. In our supposedly apathetic, definitely over-committed community, a full one percent of Albany County's population attended at least one of the fourteen events. We had hoped for more, but it could have been considerably worse. Few past community involvement efforts in Laramie had ever been as successful. Many eyes were opened. In fact, some participants were surprised that so many people in Laramie would "turn out for something like this." Others were amazed that, given the immediacy of the problems, there were so few.

The enthusiasm and animated atmosphere during and after the meetings was a beautiful surprise. There had been some initial concern that the highly structured and tightly scheduled format would put people off or stifle creativity. It did neither. Typical comments included: "It's nice to take part in a meeting where something gets *accomplished* for a change"; or "So many good ideas tonight; can't we do at least *one* of 'em?" and "I didn't think anyone cared about my ideas anymore."

Present and Future goals

Literally dozens of good suggestions regarding specific energy wasting situations were outlined and documented. Those who attended covered the widest imaginable range of ages, personality types, and value systems. They were employed by federal, state, county, and municipal governments. The business community, the homemakers, academia and unemployed were represented. The specific issues and suggestions developed from each small cross-section at each meeting meant that when it came to energy wastage in Albany County there were very few secrets.

One of the stated goals of the town meeting series had been to "develop a group mechanism" to implement the suggested and detailed projects. Presently, four months after the final assembly, some of the well-intentioned projects have fallen by the wayside; others have continued and are gaining momentum. The new established Community Recycling program and the Albany County Energy Newsletter are good examples. Each of these programs are being sustained by community residents who were not active in conservation efforts a year ago. Some Albany County Energy Council members are active in these and other continuing energy-related efforts, but the base of support has been expanded; "mobilization" has begun.

Colorado Community Solar Action

Peggy Wrenn
Director, Solar and Renewable Resources
Colorado Office of Energy Conservation
Denver, Colorado

Abstract

Acknowledging a long, successful history of private and community solar development in Colorado, the State has endeavored to support existing efforts of citizens and businesses. State solar policy and programs are currently in early stages of development. State solar planning has involved a wide range of citizens and solar experts with diverse professional, socio-economic, and geographic affiliations.

This paper reports on a program of the Colorado Office of Energy Conservation to encourage and support community solar planning by awarding small grants to principal investigators representing non-profit solar energy associations or community groups. The program has already shown that limited resources can produce significant results when broad-based local participation is combined with flexible funding requirements.

Colorado Solar Action Plan

Immediately upon its creation in August, 1977, the Colorado Office of Energy Conservation (COEC) began a year-long planning effort to identify appropriate state government roles to accelerate the use of solar and renewable energy. A Solar Advisory Group was appointed, composed of 35 citizens and professionals with expertise in solar, wind, and bio-fuel technologies. The group represented a wide variety of citizens from around the state, including lenders, builders, architects, solar advocates, lawyers, businesspeople, utility representatives, farmers, educators, and others. Each member took on assignments, which often involved consulting with their colleagues and neighbors.

Chaired by Joe Zettel, the Governor's appointee to the Board of Directors of the Western Solar Utilization Network (WSUN), the Solar Advisory Group provided reports, conclusions, suggestions, and criticisms to a team of principal investigators who wrote the *Colorado Solar Action Plan*, a five-year plan for solar commercialization. The writing team included representatives of COEC, Colorado Energy Research Institute and contractors from Denver Research Institute, Foundation for Urban and Neighborhood Development, the State Climatologist's office, and local Solar Energy Associations from around the state. The effort was funded with $20,000 from Department of Energy (DOE) through WSUN.

The *Solar Action Plan* identified four major areas the state government should address, with dozens of specific programs and budgets. Critical areas included Legislation (incentives and policy); Technical Assistance to Local Governments; and Data Collection and Evaluation. Studies were conducted for the planning effort: (1) projecting five year energy cost esclations in Colorado; (2) identifying local resources and existing solar efforts.

Overwhelming consensus of the Solar Advisory Group directed programs to accelerate the use of solar to be implemented by existing local and community groups in cooperation with private sector solar businesses. The over-riding principle of the *Action Plan* was to decentralize resources, information, and programs to the greatest extent possible. The plan proposed a series of Solar Energy Resource Centers (SOURCE Centers) around the state to cover five regions with different climates, cultural mixes, and economic/industrial interests.

Community Solar Planning Grants

Although the *Solar Action Plan* has not been funded in its entirety, state solar planning funds have been made available from WSUN and allocated to community solar planning efforts, through a "SOURCE Center Planning" program. (The nomenclature derives from the perception that local, community-based efforts in concert with private business and educators have been the *source* of solar development in Colorado.)

COEC has historically relied on Community Energy Conservation Centers for local outreach and information programs. Located in strategic Colorado communities, the Community Centers have been seed-funded with annual budgets of under $10,000 from COEC base budget authorized in the National Energy Conservation and Production Act (1976) and administered by DOE. Although Colorado was not awarded a pilot Energy Extension Service program, COEC took a similar approach with available funding by existing groups ranging from local solar energy associations to city offices to university extension agents. One Center is operated by the Durango League of Women Voters.

When $11,000 of WSUN state solar planning funds became available in November, 1978, $5,000 was allocated to the SOURCE Center Planning program. The program was designed to support existing community solar efforts, both in the five COEC Community Centers and in four other communities that lacked Centers due to lack of adequate funding. Contractors were identified in the four un-funded communities by consulting with Solar Advisory Group members from those communities, and each community was awarded $1,000 for solar planning. Existing COEC Centers were awarded $100 solar "mini-grants."

The $100 solar grants for existing Centers were extremely flexible, with task descriptions derived on a case-by-case basis. The minimum deliverable for the $100 grants was a directory of solar resource people (or potential key groups), including various combinations of solar businesspeople, solar homeowners, lenders, builders, local government officials, and energy-related organizations.

The $1,000 solar grants, awarded to contractors in the four un-funded communities who represented local non-profit solar energy associations or educational groups, were directed by the following task description:

1. meet with COEC representatives, local city and county officials, solar associations, solar business people, educators, bankers, appraisers, land-use planners, legislators, utility company representatives, university officials, extension agents and other appropriate individuals to discuss their perceived roles in a community Solar Action Plan, their willingness to serve on a Community Solar Advisory Committee, their priorities, and possibilities for local funding sources;
2. keep an annotated log of persons contacted along with notes on their priorities and perceived roles in solar action programs;
3. explore possible local funding sources for either funds or in-kind services for a SOURCE Center; and
4. prepare and submit to COEC a final report including information secured above and a proposed set of prioritized community solar action programs with information on time and funding requirements for each program and what matching funds or services might be available in the community.

The SOURCE Center Planning program was approved by the Solar Advisory Group in March 1978, and most of the contracts have terminated as of this writing in August 1978. The contacts and activities initiated during the contract period are still yielding amazing demonstrations of the "multiplier effect." These small grants enabled local people to mobilize in-place resources and institutions to plan for solar/renewable energy supplies in many Colorado communities. In fact, it's very difficult to ascertain how much of current activity results from SOURCE Center grants and how much might have happened anyway from the rising momentum of widespread public interest in local, decentralized, renewable energy supplies. Some of the intermediate, apparent results are summarized below.

$100 Mini-Grants to Existing Community Conservation Centers

Alamosa/San Luis Valley

The San Luis Valley Energy Conservation Center, seed-funded by the COEC, has provided a new home for the well-established San Luis Valley Solar Energy Association. The Center is using it's $100 mini-grant to complete, update, and publish the Solar Directory begun as a volunteer project by association members. The directory will list solar businesses, contractors, and homeowners in the five-county rural area of the San Luis Valley, which is not nationally known for its 250 (at last count) low-cost solar greenhouses and site-built air collectors.

Boulder

The Boulder Energy Conservation Center will use its mini-grant to produce a solar directcry for the area in cooperation with the Boulder Solar Energy Society. The two organizations have initiated a close working relationship, providing solar tours, information, and contact with City of Boulder planners involved in the Community Energy Management grant awarded last year to the City by DOE.

Durango

The Durango Community Energy Conservation Center, seed-funded by COEC and operated by the local League of Women Voters, has published a directory of solar homes and businesses with their solar mini-grant. The annotated directory has already been extremely useful, facilitating tours and enabling prospective solar buyers to talk to experienced solar users.

Grand Junction

The Grand Junction Public Energy Information Office is using the solar mini-grant for a directory of solar homeowners, lenders, and businesses. The Grand Junction office has already established close connections with the City, receiving in-kind office space and support for their solar energy association, which was largely responsible for a Grand Junction legislator's successful sponsorship of a bill to defer property taxation on solar equipment until 1990. They have sponsored several solar greenhouse workshops, and are responsible for regular Public Service Announcements and media articles on solar and energy conservation, in addition to providing invaluable local information and coordination on solar funding, services, equipment, demonstrations, etc.

$1,000 Solar Planning Grants to Key Communities

Denver

Although Denver has a Community Energy Conservation Center, it is funded at the same minimal level as other Centers in much less populated areas, so Denver was awarded one of four $1,000 solar planning grants. (Denver Metro area has 50% of the State's population.) A contractor from the Colorado Solar Energy Association used the solar planning grant to contact 55 individuals in five counties, including solar businesses; municipal, county, and state officials; architects, builders, and developers; neighborhood associations, extension agents, and educators; appraisers and bankers. A Metro Denver Solar Resource Center Plan resulted, assessing level of interest and priorities of a broad group of key organizations. In the process of developing the plan, the contractor put model solar ordinances and zoning information in the hands of city and county officials, as well as sparks of solar interest in the heads of many key individuals and groups. A directory of individuals and interviews is included in the plan, which will be used by the Denver Energy Conservation Center to followup and implement planned programs.

Colorado Springs

Solar Advisory Group members from Colorado Springs, where there is no COEC Community Center, identified the Wright-Ingraham Institute as a prime contractor for their solar planning grant. The Institute is a non-profit educational facility that's well established and respected in the community. They used the solar planning grant to investigate all the agencies, individuals, and community groups who are involved, or could be involved, in solar development in the area. A directory of these groups came out of an initial meeting conducted by the contractor. A Steering Committee was appointed, and are in the process of actually creating a Conservation/Solar information center, using local resources and in-kind donations. Key groups like the Homebuilders Association, the Pikes Peak Solar Energy Association, and city officials are now represented on the steering committee, which continues to meet and provide direction.

Pueblo

The Pueblo Energy Commission, established by the City of Pueblo, received and directed the Solar Planning grant for their area, which also lacks an energy conservation center. A retired long-time solar advocate was hired to conduct the investigation and planning for a Pueblo Solar Resource Center. Still in progress, the planning activity already promises to connect many key individuals and solar homeowners in Pueblo.

Fort Collins/Greeley

Solar Energy Association of Northeastern Colorado (SEANEC), one of Colorado's most active local solar energy associations, was awarded the solar planning grant for a multi-county area encompassing Loveland, Berthoud, Fort Collins, and Greeley. The principal investigator who was hired for the solar planning job is an experienced solar engineer. He conducted a long series of interviews and meetings with local officials, builders, and Colorado State University personnel. He produced a short plan indicating consensus priorities for community solar activities, along with a directory of key individuals and groups. By-products of his work include a project by the University Extension Office to provide solar/energy conservation information and a project by SEANEC to approach the City Council of Greeley to authorize increased authority for the zoning board to grant variances in favor of solar projects (authorized in a recently-enacted Colorado state law). This effort is in direct response to a citizen of Greeley who could not obtain a setback variance for his proposed solar greenhouse.

Conclusions

The level of solar activity in Colorado attests to the potency of community solar action. Thirteen volunteer, citizen Solar Energy Associations are alive and well throughout the state, and solar applications are in evidence almost everywhere, even though the state government has never made a significant policy or revenue commitment to solar and renewable energy.

Because solar needs and solutions are so specific to different climatic regions within the state, it appears that the most effective way to promote solar use is on the local, community level. When people become aware of solar activities in their own neighborhoods, it seems to activate them, whether they're architects, city planners, housewives, or businesspeople.

The critical ingredient that's always been lacking from these solar community activities is *money*. They've all been started with volunteer energy and local donations. Collectively, Colorado's neighborhood and community solar groups have conducted over 200 hands-on solar workshops, and inspired hundreds of people to get active in promoting the use of solar energy. Given a small amount of money and some local discretion about how to use it, these organizations can make incredible use of small amounts of funding.

Although there are no immediate sources of non-local funding for Solar Resource Centers in Colorado, the solar planning and directories are immediately useful in several ways. First, the planning accomplished the preliminary coordination necessary for communities to respond effectively to opportunities for funding such as the upcoming Energy Extension Service and WSUN community programs.

Also, the planning in all cases identified local resources (people, funding, and in-kind donations) that can be mobilized to promote the use of renewable energy. In some cases, the planning effort actually mobilized some of these resources, and initiated local support for a Solar Resource Center function.

The community plans and directors put people in touch with each other and with state government resources. People-to-people contact generated by this effort stimulated individuals to look into solar in their daily jobs (i.e., lenders, city planners, builders, etc.) Finally, the community planning and directories are very valuable to the State solar staff for purposes of seeking additional community funding, clearinghouse information functions, and knowing who to alert RFP's and funding opportunities.

Workshop on Community Energy Planning Methods

August 20 and 21, 1979

Workshop on Community Energy Planning Methods

Chairman

James E. Quinn
U.S. Department of Energy

Panelists

Stephen M. Dell
North Central Pennsylvania Regional Planning
& Development Commission

Ann M. Jones
City of Columbus, Ohio

Clara G. Miller
Southern Tier Regional Planning Board

Robert Tanenhaus
International Energy Agency

Marion Hemphill
City of Portland, Oregon

Donald Megathlin, Jr.
Portland (Maine) City Planning Director

John Mullin
University of Massachusetts, Amherst

Gaming Session Coordinators

Dorothy A. Lacher
U. S. Department of Energy

Yale M. Schiffman
MITRE Corporation

Carol J. Madsen
Applied Resource Integration, Ltd.

Summary

This workshop, which was a combination of panel presentations and an energy planning simulation, met for two consecutive days, for 2½ hours each day.

Below is a brief synopsis of remarks made by the first day's panelists:

Clara Miller, Southern Tier Regional Planning Board, Corning, N.Y.—The economic impacts of natural gas curtailments on the area's glass industry prompted Miller and the Regional Planning Agency to take a hard look at locally available, renewable energy resources. Residents from the surrounding communities were recruited to serve on volunteer task groups and were presented with a hypothetical energy emergency which called for displacing 20% of the region's energy imports the first year, and 5% per year for each of the next six years. Using previously compiled resource inventories they produced a renewable resource/sustained yield plan for the region. They then recombined into three county-based groups which sought consensus on immediate actions (e.g., revolving loan fund and volunteer training programs) that could be implemented in each county.

John Mullin, University of Massachusetts (Amherst)—Mullin served as a consultant to a consortium of citizen groups representing a heavily low-income and minority group section of Springfield, Mass. His task was to assist in the development of an energy conservation plan and program that would mitigate the impact of rising energy costs and scarcities on low-income tenants and home owners. Some of the major problems encountered were:

1. An unwillingness to understand or adapt energy conserving measures;
2. Resistance to home energy audits; and
3. A general reluctance to take other necessary action.

Some recommendations included:

1. Treating the energy problem as a real crisis;
2. Launching massive energy education efforts;

3. Coordinating all efforts at the local level; and
4. Getting involved in local politics and the local power base.

Steve Dell, North Central Pennsylvania Regional Planning and Development Commission—Dell described a Regional Energy Flow Model developed as a planning tool to be used in the creation of a six county energy plan in this coal exporting part of Appalachia.

After the above presentations the group of approximately 90 participants was divided into nine teams for the first part of the simulation. These teams played the role of "energy planning staffs" to the "Mayor" and "City Council" of a mythical city of 40,000 people which received the following message:

> The following is a closed circuit television broadcast brought to you by the United States Government closed circuit broadcasting network, Executive Office of the President, Washington, D.C.
>
> Good Evening. This is an emergency report. For national security reasons, it is necessary that we as a nation severely curtail our use of energy, for a period beginning now and continuing indefinitely, the curtailment will mean the following:
>
> > 20 percent of the fuel you now use will no longer be available, immediately.
> >
> > 20 percent of the electric power you use will no longer be available, immediately.
>
> Your energy imports must be decreased by five percent during each year after 1979, until they reach 50 percent of their current rate.
>
> The following conditions will apply to the distribution and use of fuel:
>
> > Imported fuel and electricity that is replaced through the development of local energy resources can be designated for other local purposes, and will not be "lost" to the community.
> >
> > The energy systems you are directed to emphasize in your plan are distributed or decentralized energy systems that use renewable energy resources. These are defined as systems that can be built and operated with local capital and expertise, that are built at or near the site the energy is consumed, and that can be fueled indefinitely by a locally-produced fuel source.
>
> You, as elected officials and public agency staff, will have responsibility for the formulation of a short-range plan to compensate for the loss of 20% of your energy imported from outside the immediate area. You will also have to develop a plan to ameliorate the impacts of continuing cuts until your area imports are only 50% of its current level.

> Your task for the first session will be to review your locality's resources and determine which should be used to meet the immediate and long-range energy shortfall. Data on the community, its energy resources, and renewable energy technologies will be provided to help you match up needs and resources.
>
> During the second session, you will develop an implementation strategy to be used in achieving the goals outlined earlier.

The teams were then provided with (1) bibliographies, (2) resource maps and (3) a series of tables with data on the following: characteristics, energy demand, biomass resources and systems, wind resources and solar systems pertinent to the study community. They were also given a breakdown of current fuel use by sector (residential, commercial and industrial) and by type (gas, oil and electricity).

Because of a lack of time, the teams were not able to quantify their chosen alternative fuels by sector and end use, they merely listed some of the options chosen. These included: home wood burning, methane digesters, wood fired electrical generation, photovoltaics, WECS, solar thermal, passive solar retrofits, etc. They also cited the need for public education and formation of various citizen committees.

Below is a brief synopsis of remarks made by panelists on the second day of the workshop.

Don Megathlin, Jr., Portland, Me.—Megathlin cited a number of problems, including a heavy dependence on imported oil and delays in the development of tidal power, hydropower, refinery siting and offshore drilling, which led Portland to adopt a number of energy conserving techniques. These included energy audits, zoning, home insulation programs, improved mass transit and changes in street lighting.

Ann Jones, Columbus, Ohio—Jones described a three-part energy program adopted by the city which involved (1) information flow (e.g., serving as a clearinghouse on Federal energy programs and responding to enquiries from inventors, business people and homeowners, (2) energy management planning (e.g., holding a seminar for the mayor and the city council members, evaluating seven different energy audit methodologies) and (3) energy conservation actions within city government (e.g., car pooling for city employees, evaluating transportation/vehicle policies and plans, auditing public buildings). In the future they are looking toward greater emphasis on energy management, e.g. through the use of cable TV, computer control of traffic signals, computer conferencing.

Robert Tanenhaus, International Energy Agency—Tanenhaus described a building rehabilitation program with which he had been associated in New York City. It was a collaborative effort that involved (1) neighborhood groups, (2) private sector/financial community and (3) city and Federal officials. One of its purposes was to train low-income people in design and rehabilitation of structures incorporating energy conservation and solar energy technologies.

Marion Hemphill, Portland, Oregon*—Hemphill emphasized the citizen participation aspect of Portland's energy program and cited the importance of building a strong and knowledgeable constituency for community energy programs. The Portland city government created a blue ribbon Energy Policy Steering Committee composed of (1) "movers and shakers," (2) technical people and (3) neighborhood representatives. The public education campaign involved 40 community workshops; 8 different public service spot announcements that ran 35 times a day for 3 months and full page ads which addressed the most controversial aspects of proposed policies (e.g., mandatory weatherization of buildings prior to resale). After almost two years of review, evaluation, feedback and revision, a comprehensive city ordinance was adopted with broad-based citizen support.

After the panel presentations the 14 participants divided into 3 task groups to decide upon strategies for implementing the fuel substitutions mandated the previous day. In addition to previously cited actions they recommended: A $5 million bond issue, neighborhood block parties, conversion of south facing porches to greenhouses, initiation of forest management and organic gardening programs, and the suspension of selected building code provisions to allow for energy conserving or producing modifications.

*Marion Hemphill's paper, "The Portland Energy Conservation Policy," is printed under Plenary Session III, in which he also participated.

Local Energy Planning Through Community Level Technology Assessment in the Southern Tier Central Region of New York State

Clara G. Miller
Southern Tier Central Regional Planning and Development Board
Corning, New York

Abstract

Regional planners, volunteers and public officials in the Southern Tier Central Region of New York State (STC—Chemung, Schuyler and Steuben Counties) recently completed a year-long project to create a local policy for energy conservation and the development of renewable energy resources. The project, a Community Technology Assessment, was designed and carried out by the Southern Tier Central Regional Planning and Development Board of Corning, New York under the sponsorship of the U.S. Department of Energy through Oak Ridge National Laboratory. It is the first of several Community Level Technology Assessments which will be carried out nationally under the same sponsorship.

This paper summarizes the project's background, the policy making and technology assessment process followed by the project participants, the development policies created by the participants, and the implementation activities planned in the STC region as a result of the project.

Background

Setting

The Southern Tier Central Region of New York State is comprised of

Chemung, Schuyler and Steuben Counties. Its major population centers are Elmira, Corning, Hornell and Watkins Glen. Wine, agricultural products, manufactured goods and glass are important local exports.

In the winter of 1975, the region experienced severe natural gas curtailments. Natural gas is an important fuel in the region both for home heating and for industry, since certain glass manufacturing processes require this fuel. During the fuel cutbacks, planners and planning board members at the Southern Tier Central Regional Planning and Development Board (STC) saw how vulnerable the local economy and communities were to fluctuations in energy supply, and this realization was the impetus for starting work on an energy conservation and development policy. Local industrialists, labor leaders and elected officials backed this effort because they thought that local energy development and conservation could help stabilize energy supplies, retain or create jobs and revitalize the region's economy.

Goals

The energy policy-making project had three main goals:

- To explore the potential for renewable energy resource development and energy conservation;
- To anticipate the social, environmental and economic consequences of developing such resources in order to create a sound local policy for their development;
- To use the expertise and energy of citizens to plan for the development of these resources and to carry out such plans.

Sponsor

The project, called a "Community Level Technology Assessment" was carried out by STC under the sponsorship of the U.S. Department of Energy through Oak Ridge National Laboratory. This project is the first of several Community Level Technology Assessments which are being carried out throughout the United States.

The Project

Background Material

In the first four months of the project, the STC staff compiled background information for use by program participants and others throughout the region. The information was printed in three volumes.

The first volume is a resource inventory which contains information on the quantity and quality of renewable energy resources in the region. The inventory also contains maps of these resources, so that the resources' relationship to existing physical infrastructure (utility lines, roads, subdivisions, etc.) and to each other is evident to citizens and public officials. These maps can be used as a planning tool alone or in overlay combinations. Information for the resource inventory was obtained from such sources as local personal accounts, airport weather stations, air pollution monitoring stations, climatological and topographical maps, animal population counts, air photos and the Land Use and Natural Resources computer printouts (New York State).

The second volume produced by the staff is a handbook on renewable energy technology, which describes the workings of a variety of renewable energy technologies in an easy-to-understand style. The books contain numerous pictures and examples of existing local renewable energy installations. Among such installations are a methane producing manure digestor on a local dairy farm; several solar hot water heaters; a wind turbine; innumerable wood stoves and a ground water heat pump system.

The third volume is the *Energy Technology Assessment Workbook.* It was designed to guide program participants in a process by which they would plan for renewable energy development, then refine their policies by considering the consequences of such development. This process was the technology assessment component of the project.

The Process

When energy shortages first appeared in the STC region during the natural gas curtailments of 1975, no government official mentioned the possibility of developing local solutions. For the most part, people watched TV, listened to the radio, read the papers, and hoped for the best. Even when the possibility of local energy development was raised by the staff and regional planning board, pessimism prevailed. Citizens were paralyzed by attitudes like, "solar just isn't feasible"; "we can only get 2% of our energy from those kinds of things, anyway"; or "the utilities won't let you do it." National media articles and advertising generally reinforced these attitudes by creating an image of an inaccessible societal energy system in which citizens may *conserve* but the "pros" and the research scientists *develop.* The citizens' and local governments' role seemed narrow and optionless. In the words of Lee Younge, later a citizen participant in the program, "when people aren't offered any alternatives, all they can do is listen and suffer and pay."

The "Emergency" Scenario

The approach the staff took therefore emphasized the possible rather than the usual. Forty volunteers from the region's three counties met in four interest groups. The interests represented included: I. Environment, Agriculture, Natural Resources; II. Industry, Commerce, Finance, Labor; III. Disadvantaged, Educational, Legal, Religious, Medical; IV. Building Community, Transportation, Land Use and Housing.

The interest groups started work under the following hypothetical fact situation:

> You were chosen to hear this broadcast because we as a nation are entering a period of national emergency. You have agreed to help visualize and carry out plans for action on energy problems in Chemung, Schuyler and Steuben Counties. The President extends his gratitude to you for your service.
>
> For national security reasons, it is necessary that we as a nation severely curtail our use of energy, for a period beginning now and continuing indefinitely. The curtailment will mean the following to the three counties:
>
> 20 percent of the fuel you now use will no longer be available, immediately; 20 percent of the electric power you use will no longer be available, immediately.
>
> Your energy imports to the region must be decreased by five percent during each year after 1979, until they reach 50 percent of their current rate.
>
> The following conditions will apply to the distribution and use of fuel in your region:
>
> Imported fuel and electricity that is replaced through the development of local energy resources can be designated for other local purposes, and will not be lost to the community.
>
> The energy systems you are directed to emphasize in your plan are distributed or decentralized energy sytems that use renewable energy resources. These are defined as systems that can be built and operated with local capital and expertise, that are built at or near the site the energy is consumed, and that can be fueled indefinitely by a locally-produced fuel source.

Each group responded by creating an "emergency" scenario—an extreme case of what could be accomplished by local action if all questions but those of technical and physical feasibility were temporarily shelved. Rather than getting bogged down in disagreements over short-term economics or political viability, the groups let their imaginations inspire them to a view of "what we *can* do." The groups were aided in formulating these scenarios by the background material produced by the staff.

The results were remarkable. For example, the group representing the utilities, business and industry came up with the 50% cutback of imported energy on schedule (6 years) with a mix of conservation and development actions on the local level, and predicted an increase in the supply of locally-produced energy beyond that point. Therefore, citizens could generate the non-emergency, present-day case for planning purposes with a shared sense of the possible firmly in mind.

The "Planned" Scenario: Technology Assessment

After creating the emergency case scenario, the citizens started to work on a planned case scenario. To produce this scenario, they carried out a technology assessment of actions called for in the emergency scenario by imagining and recording the social, environmental and economic future of their community in light of the technological changes they suggested. They then modified their emergency case scenario to mitigate the bad effects of hasty development.

The participants used the technology assessment process to educate themselves about the relationship between different renewable energy technologies in the same system. They also found that no technology —renewable energy technologies included—operate in a social vacuum or are a cure-all for social ills.

The technology assessment also provided an opportunity for the STC staff and the citizen participant to plan in the ideal, theoretical sense. Most often "planning" occurs in response to a bad situation which can no longer be ignored. By assessing the effects of their own solutions which were hastily made in the face of an emergency, the citizens could predict conditions which rapid resource development could precipitate. Thus, the groups were able to suggest anticipatory actions—plans—to avert the crisis around which most *post-facto* planning occurs.

Because the increased decentralization of energy technology can have a great effect on the lives of individuals and a cumulative, profound effect on society as a whole, citizens are especially suited to assess its social impacts. This is because citizens are closest to the actual widespread effects of this change in technology, and can thus characterize in detail how it might be used. Often, the most important parts of such an assessment are the parts that are left out—that no one thinks are important or that the professionals are too "well-trained" to be able to see. In this effort, citizens helped make up for the deficiences of experts.

The Pragmatic Scenario

After the planned case assessment was completed, the citizens reorganized into groups formed by county of residence rather than by interest groups. After some preliminary meetings at which the citizens synthesized a sketch county plan from the four regional plans, each group met with local public officials and community leaders to get advice on how some of their ideas might be put into action. The comments and ideas of the public officials became the third form of technology assessment and created the final "pragmatic case" which became the basis for three county's energy action plans. The four planned case scenarios were synthesized into a regional energy plan.

Implementation

The volunteers, planners and public officials that have worked on creating a skeleton energy development policy for the region have now turned their attention to two jobs: 1) getting more people involved in the process of energy policy making and 2) implementing their ideas. Below is a list of some volunteer and governmental projects planned for next year.

Revolving Loan Fund/Regional Energy Enterprise Development Authority

The STC staff is working to establish a capital base and an organizational framework for a three-county vehicle for funding local renewable energy development. This authority would:

- Loan money for research and development for new products in renewable energy.
- Loan money to leverage capital for new manufacturing ventures in the renewable energy industry.
- Provide special case energy conservation loans for small- and medium size industries.
- Provide special technical assistance in development of manufacturing of renewable energy systems.

Volunteer Training Conference

The STC staff has worked with staff from Elmira College Volunteer Center to organize a consortium of government and community groups to sponsor a conference "to facilitate local involvement in energy conservation and use of renewable resources through education and community action."

Co-sponsors include the League of Women Voters of Chemung, Schuyler and Steuben Counties, the Corning Volunteer Center and the Counties' Cooperative Extension Offices. Preliminary objectives of the conference are itemized below.

- Share information and project outcomes on STC's Community Level Technology Assessment.
- Present information on specific renewable resources and their

potential for meeting local needs (supply, technology for use, cost, appropriateness).

- Offer task training for local energy conservation and development activities most effectively handled by volunteers as individuals, as families and in groups.
- Provide initial and ongoing assistance for energy resource conservation and development projects identified by conference participants and potentially operated by volunteers. An organized team consisting of a member from each co-sponsoring group will provide educational, organizational and legislative assistance.

The activities described above are intended to stimulate energy development activities at a regional/commercial scale as well as at a community/individual scale. Because both these activities were sparked through volunteers working with Southern Tier Central, the STC staff and citizens' groups will work to structure them so they blend the "grassroots" and the "governmental" aspects of the program. Specific examples of this synthesis are:

- The Board of the Regional Energy Enterprise Development Authority will contain a majority from STC's and other citizen and volunteer groups.
- The instructors and speakers at the Elmira Conference will be local volunteers from the STC group as well as trained volunteers from other parts of the community.
- The co-sponsors of the volunteer conference will work with STC to continue a volunteer energy policy-making group which will use community-level technology assessment to reformulate local energy policy annually.

Smaller scale community projects include:

- A group of volunteers from the program plan to make a half-hour videotape on local installations of renewable energy technology;
- A volunteer group will form a "watchdog" network to advocate the use of renewables and strict energy conservation standards throughout the counties;
- Two counties will establish an office for an energy coordinator to begin to act on the group's recommendations;
- One county will do a feasibility study on the phased merging of the county school district bussing and mass transit systems;
- A group of volunteers will investigate and pursue the possibility of a commercial alcohol production venture.

Individual projects include:

- Building a windmill in an all-electric suburban development;
- Retrofitting a home with a solar greenhouse;
- Solarizing a mobile home.

The Problems of Developing Energy Planning Approaches in Low Income Sections of Cities: A Case Study of the North End, Springfield, Massachusetts

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The ability to develop meaningful, energy planning approaches at the local level will represent one of the most critical tests of the municipal planner in the decade ahead. With little knowledge of the parameters of the task, conflicting information and a recalcitrant public, the planner must develop programs that will aid in insuring supply, reducing usage and developing new energy sources. Programs concerning the provision of supplies and the reduction of demand are now on-going and have been mainstreamed into the political process. Programs related to the development of renewable energy systems have not been developed to the same extent and, perhaps more importantly, have not been politically mainstreamed. Herein lies a critical problem and a major weakness in terms of our quest for safe, sure, inexpensive and long-term energy sources. In particular, how do we gain the popular and local political support necessary to develop programs that will be supportive of implementing renewable energy concepts? The answer to this question is difficult and, at this stage, it may be impossible. Until renewable energy programs are politically mainstreamed, until the average citizen sees the gains from them, and until both the public and politicians see them as necessary and viable alternatives, little will be done. While the Davises, the Franklin Counties and the 11th Streets will continue to serve as models, the key job for renewable energy supporters remains: transferring the information about these sources and the skills necessary to apply them to the people, planners and politicians of our cities.

The problem is further compounded by the fact that the impact of energy costs is not spread evenly over the entire economic spectrum. The rich can pay regardless of cost. The middle classes will "pull in their belt," make their homes more energy efficient and even partially convert to renewable energy systems—while taking advantage of various tax incentives. The lower middle classes will be colder, sicker and more bitter. With little savings, increasingly severe inflation, no tax advantages and little opportunity to take advantage of conversion to alternate systems, this group will experience extensive hardships. At the bottom, the lower income groups will freeze, abandon their unheated homes and increasingly become wards of the state. It is this last group that has been the most ignored by energy planners of all types. It is also the group most in need of assistance.

This paper focuses upon the energy conservation problems of this group. It is a case study of the problems of developing energy conservation programs in the North End of Springfield, Massachusetts. The North End is composed of lower-income Black, Spanish-surnamed, and White people. It suffers from disinvestment, high unemployment, abandonment, a high crime-rate and a falling population base (mainly due to white flight). It has also been "short-changed" by the city in terms of the various federally-sponsored, city-distributed, revitalization grants.

The paper is divided into three parts: Part One is a discussion of the key problems related to energy conservation in the North End. Part Two focuses upon an approach that could help resolve the energy problems in the North End. This approach centers upon both the overall energy problem and problems related to the application of renewable energy. Part Three attempts to explain the implications of this case study for planners in other cities. Hopefully the findings will contribute to the planners' efforts to come one step closer to reducing the problems of energy scarcity among poorer groups in urban areas.

The Problems

Energy experts state that all solutions to the problems of decreasing residential consumption must start with 1) a willingness of the citizenry to conserve, 2) an understanding of what energy conservation is, 3) the undertaking of an energy audit to determine what is needed to make a home ready for a proper heating system and, ultimately, 4) the making of the necessary adjustments. Based on the experiences of the North End, some progress has been made in implementing these measures. However, the record is, at best, mixed. This can become clear by a more detailed examination of the initial factors noted above.

A key element of the ideology of appropriate technology (and its sub-element "renewable energy") is self-sufficiency—the weaning of residents from dependency on the oil companies, the utilities and the federal government. Self sufficiency implies, on a personal basis, that the resident is willing to take on increased responsibility for one's own life style and behavior. This willingness, when translated into an action mode, means simply a reduction in consumption and a shift to renewable energy sources. It also means, on a collective level, that the resident will pay the necessary costs to see that this effort is carried out.

Alas, stripping away the rhetoric, the will has not been present in the North End. In effect, energy programs are treated as no different than any other government program. In fact, it is clear that energy conservation programs, renewable and non-renewable alike, are not unique, are not part of a crusade and are not part of a spiritual separation from big institutions. They are part of the *System's* attempt to aid those who are at the lowest end of the economic spectrum. Energy programs are different in only one way from such programs as Urban Renewal, OEO, Model Cities, or other social experiments: They are designed to prevent direct physical harm. This distinction is important. And yet, it is not being emphasized. Low income people are not aware of the severity of the problem. Further, as has happened before, they believe that the government will provide for them.

Given the lack of awareness and given the severity of the problem, continuous governmental emergency assistance does appear likely. This, in turn, will not lead to change. The assistance will be designed to feed the existing fuel systems. It stands to reason that, as needs due to rising fuel costs increase, the assistance efforts will expand and funds for other energy programs may suffer. Thus, it becomes clear that efforts to resist institutional dependency will have to be a critical component of any localized energy planning effort.

Efforts to develop an understanding of the nature of the energy problem have resulted in mixed reactions. Attempts to portray the severity of the crisis to residents have been effective. Interestingly, this success has not been due to the media or governmental actions. Rather, it has come from the neighborhood's realization that increased abandonment has occurred (the North End's abandonment problems peak in September, when landlord's have to start heating, and January, the period when heating costs are at their highest). More recently, the phenomena of rent raises in the summer, in anticipation of increased heating costs, and the insistence of oil distributors of cash on delivery have begun to make an influence.

While residents are now aware of the problems, the understanding of what energy conservation means is unclear. The Energy Crisis of 1973 left a bitter memory among the residents of the North End. There was a feeling that they suffered inordinately in the sense that, despite the fact that they had already been conserving, energy resources were denied to them. In essence, from that experience emerged a feeling that energy conservation means energy restriction. To people who already were receiving minimal supplies, perceived increased restriction was difficult to understand. This feeling still remains.

Given this feeling, it is easy to see why there is little interest in energy conservation in the community. The programs of the city or state energy agencies in the North End have excited no one. While there is knowledge of the low income loan programs, free energy audit program and the emergency repair programs neither the residents nor the landlords have participated to any great extent.

If one has to sum up the attitude of the residents today it would be "let's wait and see." The media has been predicting a disastrous winter for lower income people all summer. And yet, the North End residents are not organizing in any form to take action. Part of the "wait and see" attitude is tied to the belief that no one has been able to determine how disastrous the winter will be. Therefore, being typically American, they ask "why plan?"

Concerning alternative energy approaches, there is little knowledge among the North End residents of what can be done. For example, proposals for a state sponsored Solar Green House Demonstration Project were widely disseminated across the entire city. Not one lower income group or resident so much as requested information about the project. Perhaps the extent of the problem will become more clearly realized when it is noted that a community-based, community-owned cooperative food store, the most inexpensive food store in the North End, failed due to lack of participation. Clearly, as with the need to reduce dependency, large scale educational and organizing efforts will have to be undertaken if alternative energy approaches are to be considered.

A key device necessary to stimulate corrective measures is the home energy audit. The Western Massachusetts area has had an extensive and successful audit program that has provided this service to thousands of families. Yet, it has not reached the North End. There are several reasons for this. First, there is an extensive back log of several months—this will be further exacerbated by staff cuts in the coming months. Secondly, the audit has to be requested by the resident. While this is easy for people who have had successful dealings with government agencies, it is difficult for those who feel victimized. Thirdly, there is extensive fear that an energy audit is associated with code enforcement. Given that the homes are, at best, marginally meeting the building code, there is a feeling that opening one's home to an inspector will ultimately cost the tenant money or a day in court. For this reason alone, there is resistance to inviting an audit.

Lastly, there is the problem of making the repairs. If there is understanding of the problems, awareness of the alternatives and a desire to make improvements, what then? There are several approaches, none of which has been overly effective. The Weatherization Loan Program cuts three percent off the existing loan rate. With the current loan rate of 13%, 10% loan money on already marginal housing has not had many takers. The Springfield Community Action Program has over $150,000 for low income weatherization (of up to $450 per unit). It will not be able to make these improvements because its repair crew staff has been cut from 60 people to 4 people! Springfield Action also has $600,000 for emergency fuel supplies but no guarantee of fuel availability. The most likely source for energy planning is the Community Development Block Grant Program (CDBG). And yet, Springfield planners have not expressed any interest in re-adjusting their priorities to focus upon these needs (the North End is now having sidewalks installed with CDBG funds). In sum, there has been no effort to tie together the means of assisting in repairs beyond providing information. This knowledge is crucial but without training assistance, the availability to tools and a means for the inexpensive purchase of materials, little will be done.

A Recommended Approach: The Pursuit of Moderation

There are three community organization groups within the North End who have an interest in energy conservation. Within the city of Springfield there is the CAP agency, the Housing Assistance Agency, the City Planning Office and the Mayor's Committee on Energy Conservation. There is also a liaison to the State Department of Energy and the University of Massachusetts Energy Conservation Cooperative Extension auditing team working in the city. There is very little coordination among these agencies. Each has different goals and each has different constituencies. Herein lies one of the most important problems: the lack of coordination and support among the various agencies. It has become clear that nothing will be done until the participants are mainstreamed in a coordinative fashion into the political process. For this reason, it is recommended that an energy coordination program be developed at the city level.

The city level appears to be the best place for this effort due to several reasons: It is the conduit for state and local assistance, the distribution point for federal loans and grants in aid and the place where the greatest amount of experts are housed. Given the problems of staffing and organization that occur at the community level in Springfield, it has become clear that community based efforts lack technical knowledge, the support of citizens, the political support and the expertise to carry out the tasks. Furthermore, regional agencies do not have the clout to impose decisions on the various cities and towns. Therefore, little would be accomplished.

This approach, to many people, will reflect a "business as usual" conceptualization. They will be correct. Decentralization, community power and self reliance will suffer. There will also be little change in the short term toward alternative energy solutions. However, again in the short term, the most important aspect of the effort to maintain adequate energy supplies for lower income residents will be to coordinate all organizations such that desired ends can be immediately reached. In Springfield, this cannot be accomplished at any other level.

There are extensive benefits that could result from this approach for advocates of renewable energy. Foremost is the fact that they will be able to pinpoint the people responsible for energy policy at the local level. Secondly, they will be able to work without the tension of knowing that they will be competing for time and attention with those people who are in need of next week's heat. Thirdly, the renewable energy people will have the time to create the neighborhood support base that is necessary for the implementation of renewable energy programs.

The creation of a new city based agency will not be a panacea. However, it will prevent the worst hardships and endeavor to employ resources where they are most required.

The Implications

Several key points emerge from this case study that may be of benefit to energy planners, community organizers and politicians in cities across the United States. They are:

1. That the energy problem is not being treated as a crisis by lower incomed residents. There is, in essence, a "wait and see" attitude.
2. That there is still need to educate and provide direct "face to face" assistance to lower incomed residents.
3. That all efforts to resolve the energy problems must be coordinated at the local level. In Springfield, the city level appears to be best.
4. That decentralized approaches to the energy problem cannot be

developed in urban areas until the emergency problems are addressed.

5. That energy conservation efforts to date have been largely ineffective.
6. That, in order to be effective, advocates of renewable energy approaches must develop political power at both the neighborhood and the city level.

Summary

One case study does not make a universe. However, what has been happening in Springfield may be happening in another city tomorrow. We think that there is a need to focus upon the experiences that have occurred so that all cities will be able to more effectively respond to the needs of their citizens. Hopefully, this example will contribute to that end.

Regional Energy Flow Model

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Abstract

The North Central Pennsylvania Regional Planning and Development Commission prepared a Regional Energy Policies Plan using HUD 701 funds. A key element of the Plan was a regional energy flow model. The model illustrates the forms of energy in the region and the associated processes in converting that energy resource into a usable form. Although coal is the most obvious existing energy resource in the region, any resource (including wood and solar) can be described by the model.

Each step in the energy flow system is comprised of four components. This provides a consistent format for investigating each energy resource. The four components are: Forms, Processes, Investments and By-Products. Together, these components comprise a standard core element, and each energy resource passes through eight, generalized stages from existing reserves through development to eventual utilization.

Introduction

The North Central Pennsylvania Regional Planning and Development Commission (NCPRPDC) represents the counties of Cameron, Clearfield, Elk, Jefferson, McKean, and Potter. These six contiguous counties lie in the mountainous Allegheny Plateau of northern Pennsylvania. The region is part of a larger, sparsely populated area which is the only extensive "open" area remaining in the urbanized northeastern United States.

The region is characterized by a generally rugged, heavily wooded landscape. Moderate to steep slopes are found on the many hills in the region which have been formed because of the erosion of the Allegheny Plateau by the many mountain streams. Valleys are generally small in length and width, and are often quite irregularly shaped. Local relief averages approximately 400 feet, with the high plateau summits reaching 2,500 feet, and base level in the major streams at approximately 800-1,200 feet above sea level.

The total area of the region is 5,083 square miles, or 3,257,100 acres which represents approximately eleven percent (11%) of the area of Pennsylvania. Nearly ninety percent (90%) of this area is forested, with large tracts of forest land owned by the federal government (Allegheny National Forest), state government (game lands and forest lands) and private landowners.

The population of the North Central Region in 1970 was 231,490, or approximately two percent (2%) of the state total. There was a 5.2 percent decline in population between 1960 and 1970, and population decline has been a general characteristic of the region since 1920. An exception was the 1930-1940 decade when the region increased in population by 4.8 percent. This decade, marked by a severe worldwide economic depression, was characterized by population gains in many rural areas throughout the U.S.

The region is rural non-farm and small town in character. There are numerous communities having populations in excess of 1,000, however, only thirty-six percent (36%) of the total population resides in the fifteen (15) larger (population of 2,500 or more) urban centers of the region. Bradford (12,672) and DuBois (10,112) are the only chartered cities, as well as the largest population centers.

Major economic activities in the North Central Region include coal and clay mining, agriculture, forestry and timber production, oil and gas production, retail and personal services, and manufacturing. Declines in the extractive industries and reliance on below average growth industries have caused severe economic problems in the region, especially when the national economy is troubled.

Poverty, housing shortages, high dependency ratios, low wages, low tax assessments, and a lack of retail outlets and personal services are all problems currently experienced in the region. These problems are not unique, but characteristic of many areas in Appalachia.

Study Rationale

As with the rest of Appalachia, coal is a major resource which has been exported over the years while energy in more usable forms (i.e., electricity) has been imported into the region. This creates another drain on our area which is already economically stagnate. In addition, proposals have been made in the past to locate huge "energy parks" in the area. The concept was to build 10-20 electrical generating plants at one location, minimizing permitting problems. The proposed energy park for north central Pennsylvania would have consumed 15 square miles and generated 10,000 MW-20,000 MW. Needless to say, the damage to the quality of life in the area would have been enormous if this proposal had been implemented. Thirdly, the lack of public transit and the dependence on the private automobile in rural areas has been well documented. The oil price increases by OPEC and other energy problems have left rural America (including north central Pennsylvania) even more vulnerable than ever. Given these problems, citizens and local elected officials were groping for facts and for a method to determine a rational policy response to these problems.

Consequently, the regional planning commission staff began to collect and analyze data on energy resources, energy production and energy consumption in the six county area. The aim of the two-year effort was to establish a basis for drafting proposed policies for consideration by the Commission's Board of Directors (i.e., county commissioners). This effort was supported with 701 Comprehensive Planning Grants from the Department of Housing and Urban Development, as administered by the Pennsylvania Department of Community Affairs and was completed in June, 1979.

Flow Model

As a major element of this study, existing research and methodologies were utilized to develop a systematic and organized model for investigating energy resources on a regional scale. The Regional Energy Flow Model (Figure 3) follows and defines energy forms and processes from discovery of an energy reserve, through transportation and processing of the raw materials, to the delivery of a usable power commodity such as coal, gas or electricity. Each step in the energy flow system is comprised of four components, which provide a consistent focus for investigating each energy resource. These four components are: Forms, Processes, Investments, and By-Products. These four components are: Forms, Processes, Investments, and By-Products. Together, the components comprise a *standard core element* (Figure 4) consisting of all available data and information relating to a particular resource at a specific point in its development or utilization. This element may be divided into two major segments, connected by a process. First, the input segment represents the resource available along with any investments required to activate the process. Processing of the resource involves those technologies and activities necessary to transform, transport, or convert

Figure 3. NCPRPDC REGIONAL ENERGY FLOW MODEL

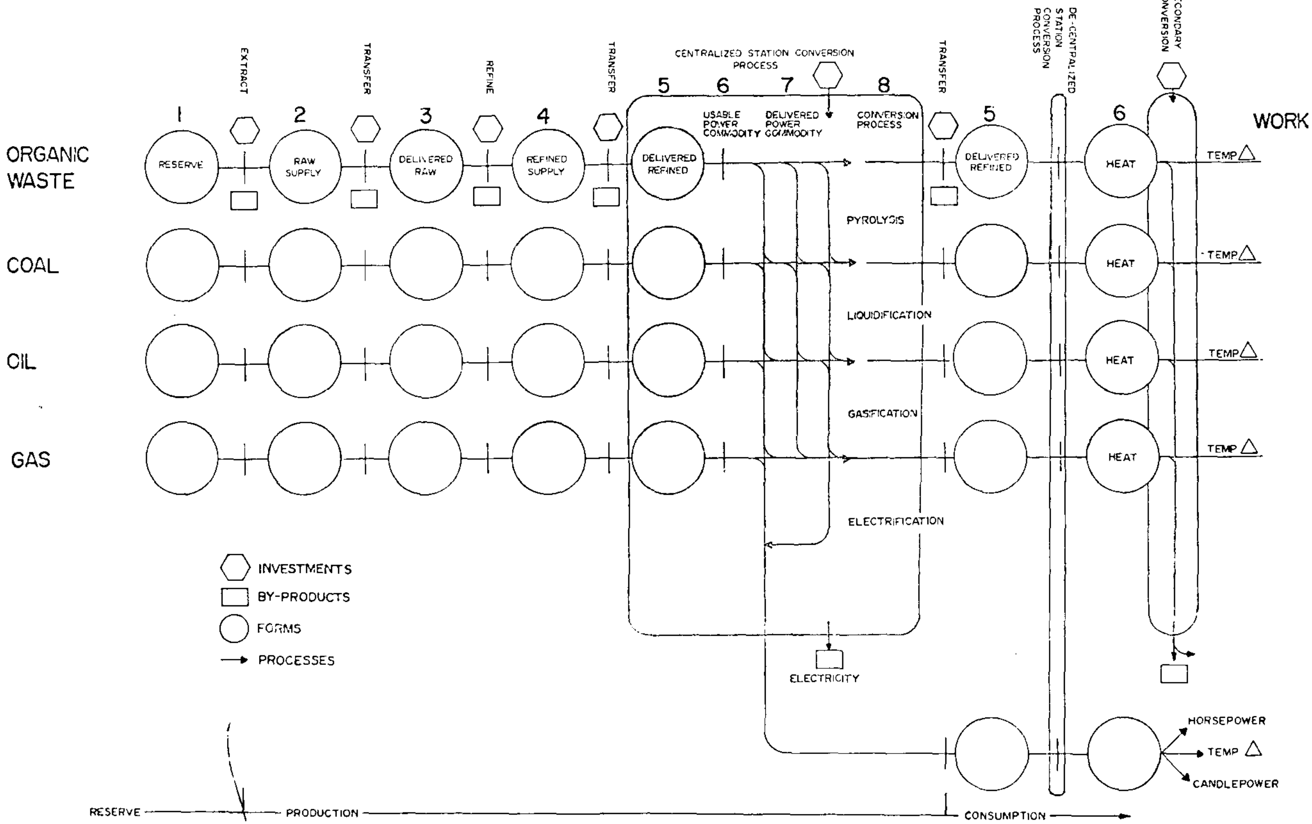
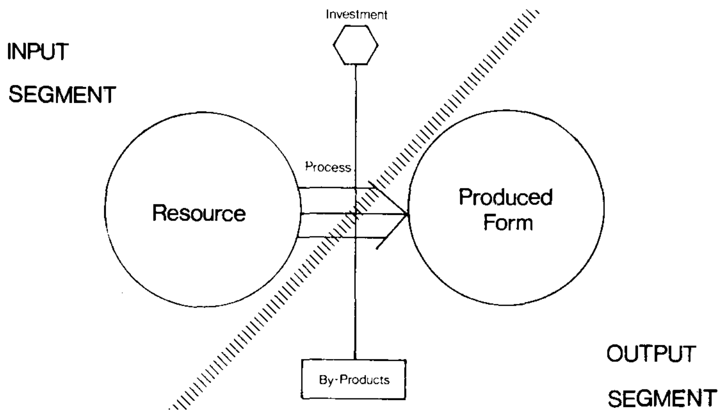


Figure 4. STANDARD CORE ELEMENT OF THE NCPRPDC REGIONAL ENERGY FLOW MODEL



a resource from one state or form to another. This second segment, or output, represents a produced energy form and attendant by-products. The produced form of energy is then considered as the input for the next core element.

Although eight core elements are contained in the North Central Regional Energy Flow Model, variations on the basic model result from the diversity inherent in different energy resources. Each resource (coal, oil, gas, organic waste, and alternative resources) follows the basic path from existing reserves through development to eventual utilization. Some resources, particularly organic waste and alternative resources, require flexibility in application to the model, since they are in a different stage of development or constitute new approaches to energy utilization.

Black Box Conversions

Note also, the two shaded sections of the model, labeled "Central Station Conversion" and "De-centralized Station Conversion," represent "black boxes" within which various conversion processes are employed in the consumption of a fuel resource to produce energy. On the one hand, central-station conversion may involve such processes as pyrolysis, liquefaction, gasification, and electrification. As a general rule, especially in the North Central Region, large central station conversion (where a resource is converted to a usable power commodity and then transported to decentralized markets for consumption) occurs only for electricity. For this reason, the section dealing with electricity is the only example of central station conversion contained in the study.

Pyrolysis, liquefaction, and gasification processes are discussed in various resource sections as decentralized station conversions. These processes are generally used by industries or individuals on site and in combination with an alternate power supply.

Finally, the process labeled Secondary Conversion involves modifications to the delivered power commodity in order to produce variations in end use. In this instance, for example, the electricity entering an individual home may be applied to space heating and lighting, and to drive a mechanical device, such as a water pump. These three measures (Temperature change, Candlepower, and Horsepower) constitute the final end use indicators of energy consumption. It is within this area, and using these measures, that conservation practices are most often employed to reduce consumption and increase energy efficiency. The section of this study dealing with conservation addresses practices and techniques that may be applied in end use consumption of an energy resource.

Uses

Beyond the ability to collect and analyze data, we hope to use the model to graphically depict to the general public the region's energy perspective in a clear, understandable manner. If successful, energy consumers should be able to understand the complicated systems that supply them with usable energy, and should be able to discover methods of affecting future energy policies.

Planning For Renewable Energy Systems in Maine

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Abstract

Maine is more dependent on foreign oil than probably any state in the country. This has tremendouus negative social and economic impacts upon the State. Unfortunately Maine is behind the rest of the nation in diversifying its sources of energy, however the state *does* enjoy many natural energy sources which have not yet been developed.

The impetus for reversing Maine's trend of increasing oil dependence must come from State and local government. The two strategies that must be marshalled include energy conservation and alternate energy development. Portland has taken significant steps in promoting energy conservation measures such as insulation and lighting projects, fuel and vehicle management programs, and car pooling programs. The introduction of alternate energy systems such as wood and solar has resulted in increased reliance on these energy sources.

Maine Energy Situation

Supply

Maine is overwhelmingly dependent on oil. Oil dependency means extreme vulnerability and substantially higher prices than the national average. The sources of energy in Maine today include: oil, 81.8% (79% of which is imported from foreign countries); nuclear, 9.5%; hydro, 7.2%; fuelwood, coal and miscellaneous, 1%; and natural gas, 0.9%. Nationally, the figures are approximately: oil, 28.8%; natural gas, 36.4%; coal, 26.4%; nuclear 3%; and hydro 4.9%.

Clearly, Maine is enormously behind the rest of the country in diversifying its sources of energy, and it is dangerously and expensively dependent upon foreign oil. Maine is more dependent on oil as an energy source than any other state in the nation. What makes this dependence on foreign oil even more dramatic, is that it's increasing. In 1973, the year of the Arab oil embargo, the American's dependence was 75%. In 1979, the year of the OPEC price increases, it is up to 79%. This trend will have tremendous socioeconomic impacts in Maine, if it is permitted to continue.

Maine lacks large reserves of fossil fuels and has a remote geographic location. The energy sources which Maine does enjoy in relative abundance: wood, hydroelectric, solar, solid waste, and wind have not benefited from massive government financial incentives which have been extended to fossil fuels and nuclear power.

Consumption and Demand

Maine's consumption patterns are also quite different from that of the nation as a whole. Residential and transportation are higher and commercial and industrial are lower in terms of consumption. The overall demand rate projected for the next 7 years is a 1.5% increase annually.

Strategies to Address the Energy Crisis: A Two Pronged Effort—Conservation and Alternate Energy Development

Reducing the State's overwhelming dependence on imported oil is the major objective. While oil is and will continue to be the largest source of energy, it can be reduced significantly from 80% to 50%. Achieving this level will require a major public and private effort. All of the State and local governments and private efforts must be marshalled immediately to find ways to conserve energy and to find energy alternatives to expensive imported oil.

Energy Conservation is the Most Sensible and Cost Effective Short Term Strategy for Addressing the Current Energy Dilemma. Energy Conservation is an Absolute Necessity.

A list of the more important conservation measures which have been adopted by the State and/or the lists of Portland are as follows: These programs will contribute to reducing the impact of the energy crisis in Maine.

1. Passage of an "Energy Efficiency Building Performance Act" by the State. This Act establishes energy performance standards for new buildings.

2. Passage of a State Bond Issue in 1976 for $10 million for Energy Conservation Improvements to local public schools. To improve the energy efficiency of Portland's 30 plus schools—$280,000 was expended from the City's Capital Budget. In 1978 the school department saved more than $85,000 dollars through reduced energy consumption. The $280,000 will be recouped in 3 years. Similar experiences have occurred for other school districts throughout the State.
3. The City of Portland's zoning ordinance now supports the development of work places in residential areas, thus encouraging energy conservation. Home occupations are allowed for uses which do not occupy more than 25% of the total floor area. The increased use of home occupations reduce the amount of driving. There are now some 30 home occupations listed in the zoning ordinance.

   The City Council also has before it another zoning amendment to allow clustered housing in low density residential zones, which is energy efficient.
4. Bikeways have gained in popularity in the Portland Area. For the first time, funds have been set aside for the development of a bikeway system in Greater Portland and the construction of the first component is slated for 1980 by the regional transportation agency (PACTS).
5. The MDOT was allocated $400,000 by the Legislature to assist in the growing need for regional and intercity public transportation, particularly regarding low income, elderly and handicapped residents.
6. Portland's recently adopted subdivision ordinance reduces the street widths on local streets from 32 ft. to 28 ft. saving additional asphalt required for wider streets.
7. The PACTS in conjunction with the Planning Department and Transit District have recently completed a contract with OER to encourage greater use of buses in Portland to conserve energy. Marketing measures have been developed to include ridership booklets, transit system and route maps, route schedules, media advertising, including radio and television commercials, and provision of a public information booth and display racks.
8. Portland has established an Energy Conservation CETA crew. This crew is insulating municipal buildings. Four buildings have been completed with a 40% reduction in heating costs already realized. Four additional buildings are scheduled to be insulated before Fall. The Energy Crew has also completed a lighting reduction project for 7 municipal buildings. Approximately 30% of the

lights were eliminated as unnecessary with a reduction of 165,000 watts.

9. The City of Portland has reduced its gasoline consumption during the past few months through implementation of a Fuel and Vehicle Fleet Management Program. The City now has a computerized fuel dispensing system which monitors fuel consumption for every municipal vehicle.
10. Portland has initiated a project to convert street lights from mercury vapor to the more energy efficient sodium vapor. Sodium vapor utilizes approximately 33% less energy. To date 500 fixtures have been relamped and all future replacements and installation will be sodium vapor.
11. Portland's Energy Conservation Office has implemented a monthly energy use monitoring system for all municipal buildings. For the first time, the City knows exactly how much energy each municipal building is consuming. The monitoring and subsequent management of energy consumption has proven to be an effective conservation tool—in 1978 energy expenses rose only 3% over 1977 costs. Municipal expenditures for energy in 1978 were $1.3 million.
12. Detailed computer energy audits of Portland's 50 plus municipal buildings will begin this fall by a specially trained auditor. The purpose of the audit is to identify the more cost effective energy conservation improvements for the building. Some of the critical areas of investigation are air tightness, maintenance procedures, heating and cooling equipment and lighting levels.
13. In late 1978, the City passed a tree ordinance dealing with tree planting, shade, maintenance, and preservation of trees in public places. The ordinance also provides guidance on trees on private property regarding wind buffering.
14. The City has applied to the Department of Energy to obtain a small fleet of 15 electric vehicles. These vehicles would be utilized for a variety of purposes by five municipal departments (passenger cars, vans, and pick-up trucks would be purchased). The electrics would utilize off peak power for recharging of batters.
15. The Maine Office of Energy Resources (OER) is offering free audits for homeowners. This service was instituted this past July. According to the OER office, the response has been excellent. Over 100 requests for energy audit a day are being received by the Energy Office. Maine has approximately 225,000 homeowners.
16. The Legislature passed a bill authorizing a bond issue in an

amount of $2.5 million for energy conservation improvements for local government buildings. This proposal will go to the voters in November for 50% matching money to local governments.

The Development and Utilization on a Significant Scale of Alternate Energy Resources Is Necessary If Maine and New England Are Ever Going to Break The Stranglehold of Foreign Imports.

Maine is beginning to make progress in developing its own natural resources for energy production. State and local governments have, in partnership as well as separately, promoted alternate energy projects. Typical of the independent nature of Maine people, the private sector has not waited for government action and subsidy to develop alternate energy resources. Both private industry and government have a number of wood and solar energy projects in operation. Solar energy is growing in Maine. Almost 1% of all Maine residents are now using some form of solar energy. By the year 2000 it is estimated there will be 43,000 solar installations in Maine.

Both Maine residents and Maine industry are utilizing wood more extensively. Over ½ million cords of wood are used for residents amounting to 6% of total energy consumption for residences. Nearly half of Maine's homes use wood stoves. There will be increasing reliance by industry on wood waste and bark as fuel.

Solar

1. The Brewer Housing Authority sponsored a Solar Greenhouse Project for a new elderly housing project of about 50 units.
2. The Town of Sanford is in the process of retrofitting its Municipal Garage for passive solar utilization. The town has obtained the services of local vocational technical institute students for the design and construction phase of the project.
3. A firestation in Searsmont will be retrofitted utilizing a passive/active solar system.
4. The State Legislature passed an act to provide grants to homeowners for the purpose of installing solar water heaters. The 50 grants which were awarded ($400.00 each) to homeowners were selected through a lottery procedure. All 50 solar water heating projects are in operation.
5. The Governor's House—the Blaine Mansion—had a solar water heating system installed earlier this year.
6. In 1975, the Maine Audubon Society's solar and wood heated headquarters became the first building in Maine to make use of solar heating, and the first building in New England—perhaps

even the country—to meld solar collection, storage and back up heat into a single sophisticated system. The 5,500 square foot building receives about 60-75% of its heating needs from the solar collectors with the balance from the wood furnace.

7. The Maine Organic Farmers and Gardeners Association and Northeast Carry (another local non-profit group) are working together on a project designed to optimize the utilization of solar greenhouses for commercial farmers. The solar greenhouse is already constructed. The primary focus of the project is on developing improvements to the solar greenhouse and for developing greenhouse planting schedules. The purpose of the project is to develop a method to effectively extend the growing season for Maine farmers.
8. The City of Portland is seeking funds to place between 50-70 solar collectors on the roof on one of the school's swimming pools. The cost of the project is $40,000. The solar collectors would save about 4,200 gallons of fuel oil. The purpose of the project is to provide a highly visible successful solar energy demonstration project.
9. Two Maine communities—Ellsworth and Wilton—are utilizing solar energy for their waste water treatment plants.
10. The Portland Regional Vocational Technical Center offers a "hands-on" solar course for high school students. Last year 32 eleventh and twelfth grade students participated in the course. As part of the solar course, students and staff undertook the design and construction of demonstration solar projects which were sold to the public. A solar greenhouse is now in the process of being completed.
11. The Legislature established a minimum warranty for all solar energy equipment sold and installed in the State. OER has the responsibility for establishing the minimum warranty period for the sale and installation of solar energy equipment in Maine. There is also a certification program for solar inspectors.
12. The City of Portland is now developing energy policies for its comprehensive plan dealing with land use, transportation, community facilities and building design. The last Legislature passed a bill to encourage the efficient use of solar energy, particularly regarding the orientation of buildings. This bill authorizes communities to adopt ordinances protecting direct access to sunlight for solar energy. The Planning Board is considering amending the subdivision ordinance and zoning ordinance as outlined below: that buildings, lots and streets be assured of direct sunlight for

solar orientation; that residential subdivisions are buffered from prevailing winds; and that natural materials are utilized for heat storage; that a flexible street layout allows for a reduction in street lengths and use of cul-de-sacs, pedestrian walkways in middle of large blocks, bike paths, and reduction of street widths; and that setback waivers allow placement of solar collectors.

Wood

1. A local non-profit organization—Coastal Enterprises—is designing and constructing a fuel wood processor which would have the capability of handling large volumes of cull hardwood. This will enable wood cutters to optimize their use of wood.
2. Great Northern Paper Company will cut its use of oil by 413,000 barrels a year by building a $34 million boiler to burn 460,000 tons of waste tree bark annually. It will cut by approximately 20% Great Northern Paper's dependence on imported oil and help solve a solid waste problem. It allows Great Northern Paper to incorporate a boiler using bark into a system providing electricity and steam for the paper making process. Other large paper companies in Maine such as Georgia Pacific and Scott Paper have undertaken similar projects.
3. A Portland neighborhood group has received funding from ACTION, the federal VISTA agency, to start up a wood co-op in Portland. One cord of seasoned hardwood is the equivalent to 200 gallons of heating oil. The aim of the project is to provide some 2,000 cords of hardwood to area residents. This would amount to about a 400,000 reduction in oil consumption.
4. The City of Portland has contracted to purchase a wood stove for one of its greenhouses. The wood stove will be in operation before the heating season. The City's Parks Department has already built up an inventory of over 300 cords of hardwood. This hardwood was obtained through the City's dead and diseased tree removal program and through selective pruning of City forests.
5. In an effort to further promote renewable energy systems, the Maine Legislature established an income tax credit of 20% or $100, whichever is less, for the purchase and installation of a renewable energy system—solar, wood, wind, etc. The new tax incentive coupled with 90 cent a gallon heating oil is expected to increase utilization of wood for heating purposes.
6. The expected increase in use of wood stoves spurred the Portland City Council to establish minimum standards for the installation of wood burning stoves. Portland was the first city in the State to

establish such standards. The new standards will minimize the fire safety problems associated with the burning of wood. In January 1979 there were 13 fires directly attributable to poorly installed wood burning stoves.

Other Energy Resources

1. The Isle Au Haut Electric Power Company is involved in a cogeneration project where waste heat produced from electrical generation is utilized for space heating of offices, heating of water for laundry and showers, heating of a greenhouse, and drying of seaweed. The local non profit company is located in a fishing community off the coast of Deer Isle, Maine.
2. A man in Easton, Maine has received federal funds to improve and upgrade his existing wind power system. The purpose of the project is to demonstrate the fairly low cost of wind generation for rural areas. The wind system will generate approximately 12 volts of electricity—enough to meet all his power needs.
3. The Research Team at the University of Maine at Orono is conducting a study with the paper industry on the possibility of methane generation from paper sludge. The project is designed not only to develop alternate energy—methane gas—but also to solve a waste problem—paper sludge.

Local Government Role in Energy Management

As previously stated, the key to increase efficiency of energy utilization and development of alternate energy is the active support and involvement of local governments. Local governments can provide a major focal point for community energy management.

There has been an increased awareness by Portland's City Council that Portland's energy problems must be evaluated within a comprehensive planning framework. Approximately one year ago, the City Council's Energy Conservation Committee submitted a proposal to the Department of Energy to participate in a pilot demonstration project entitled Comprehensive Community Energy Management. Portland was one of only 17 communities selected nationwide to participate in the $3.5 million program: Portland's grant is $163,000. The Energy Conservation Committee consists of 30 persons and is represented by persons from suppliers, consumers, labor unions, community groups, transportation, housing, residential, public and industry representatives. There are 5 sub-committees including public awareness, supply, demand, alternate energy, and economics and financing. There is a staff of four (two of whom are from the Planning Department). The overall objective of the project is the development of a comprehensive community energy action plan. The Action Plan will be designed to have a positive impact on the present and future (1985) energy supply and demand patterns of the City. Through a series of tasks the project staff will, over a two year period, develop a detailed energy management plan for all sectors within the community—public and private. The City Council's Energy Conservation Committee and project staff will work with many community groups throughout the project to get their input and involvement. The Energy Action Plan will be in draft form by summer of 1980. After a period of review and comment, a final Action Plan will be presented to the City Council and community in the fall of 1980.

Aside from sponsoring a comprehensive energy management program, local governments can also lead through example. Portland, as previously noted, has taken significant steps to reducing its municipal energy consumption. Insulation and lighting reduction projects, fuel and vehicle management programs, installation of alternate energy systems such as wood and solar for municipal buildings, incorporation of solar energy courses into high school curriculum, and sponsoring of car pooling programs have already been undertaken by the City. Not only have Portland's conservation actions saved energy, it has also saved tax dollars and this is particularly important during this period of inflation and "no increase" budgets.

Confusion and Uncertainty Regarding Energy Policy

For years, the energy policy of this country has been in disarray. There is general uncertainty and confusion regarding energy policies. Efforts to research and develop alternate energy sources at the national level have been somewhat feeble and uncoordinated. As a result, the State must take a leadership role in reducing the dependence on imported oil.

Lease sales of prospective OCS oil plots of 728,000 acres have been delayed because of actions of the fishing industry and jurisdictional problems. An injunction issued in January 1978 was lifted by an Appellate Court only a short time ago. A proposal to develop a petroleum reserve of 20-30 million barrels for New England is still awaiting Federal government action and approval. In 1973 a $350 million oil refinery was proposed by Pittson Company for Eastport, Maine. The project has been stymied for 6 years now and the projected cost has ballooned to $700 million. Environmental objections and government red tape have been responsible for the delay.

In March of this year, Maine Yankee—a 600,000 Kilowatt Nuclear

Power Plant which provides 38% of Maine's electrical energy—was shut down by the NRC for "possible" safety problems. After several months of intensive analysis, it was determined that no safety problems existed and Maine Yankee was allowed to reopen. In the interim, however, some extra oil was consumed in order to generate enough electricity to meet the demand.

A 1,000 megawatt hydro electric project—Dickey Lincoln—is no closer to a construction date today than it was years ago when it was first proposed. The cost of construction has escalated to more than $1 billion. Maine's largest power company—Central Maine Power—says it will need 350 megawatts of additional power capacity by 1986. Yet CMP's large coal fired plant proposal at Searsport has met delay after delay and is opposed by the Office of Energy Resources. Tidal power, which is a uniquely New England resource, has been considered for 50 years and yet only a study for a portion of the Passamaquoddy Project has been approved. Maine has 18 foot tides which are ideal for tidal projects. Congress recently approved $100,000 of engineering funds for a small segment called Cobscook Bay, which if constructed for $13 million, would supply 5 megawatts in electrical energy.

There are about 470 dams in Maine. However, it is unlikely many would be reactivated. They have a generating capacity of 850 megawatts. The Corps of Engineers has said that the dams could not serve as an alternative to Dickey-Lincoln. Proposals to buy additional power from New Brunswick or Quebec depend on certain approval of respective provincial and federal governments in addition to construction of transmission lines. Local government leadership in developing alternative energy sources and in conserving existing energy resources will be essential in Maine. Any solutions from the federal government to the energy crisis presently facing Maine will be long term.

Energy Management in Columbus, Ohio

Ann M. Jones
Department of Energy and Telecommunication
City of Columbus, Ohio

Abstract

Although energy-related projects have been conducted by various City of Columbus agencies in recent years, actual energy management is a very recent addition to the City government structure. The Department of Energy and Telecommunication was created in early 1979 and two staff members for energy programs were hired in June.

Our activities tend to fall into three categories:

1. Information Dissemination: We provide information to other City agencies, businesses, and citizens on energy issues such as carpooling, federal building temperature standards, new energy products, available grants for energy projects, etc.
2. Current Energy Programs: Our past or current energy programs focus on energy conservation in City buildings; a fuel contingency plan for City vehicles; an energy questionnaire for City employees; an energy seminar for the Mayor, Cabinet and City Council members; and a carpooling program.
3. Energy Management Planning: The need for an energy management planning process culminating in the implementation of a coordinated series of energy programs has been identified. The first step, an energy audit of the entire community, is now beginning.

To date, the development of current energy programs has received the most staff attention. However, this emphasis is now changing so that energy management planning will receive top priority in the future.

Department Designation

Designation of a separate department for energy management is recommended for other cities based on our experience, as it provides two primary benefits. First, its separate designation creates awareness of the importance of energy management and insures that inquiries and suggestions from the public and from government agencies are directed properly. A separate department also provides cabinet level status which can be important in influencing other City agencies to carry out energy programs. Neither of these benefits accrues if the energy management function is placed within an existing department, which happens in many cities.

Functions

Information Dissemination

This function evolves naturally to a great extent. Inquiries and suggestions come from citizens and other officials. Major federal policies or laws such as the recent building temperature requirements generate questions from all sectors of the City plus require that detailed information be provided to other City agencies. Federal (or other) programs which fund energy-related projects are directed to the appropriate agency and an application prepared jointly where appropriate. New energy products are constantly referred to us which are evaluated and made available to other agencies.

Current Energy Programs

For a city newly involved in energy management, there is no problem in identifying many things that need to be done, only in knowing what to do first. In beginning our energy program, we felt that many energy projects should be undertaken within the City of Columbus government structure itself. This would allow us to save energy and tax dollars and would also help us make sure our "own house is in order" before asking other sectors to undertake energy programs.

One of our first actions was to provide an energy seminar for the Mayor, Cabinet and Council members which was conducted by several Columbus groups recognized nationally for their energy expertise. The seminar began with an overview of the international, national, and state energy situations and then focused on energy consumption, issues, options and activities in Columbus. It ended with "Where does the City go from here?" This seminar was enthusiastically received and appeared to make an important contribution to a beginning energy program.

Two other projects have focused on City buildings and vehicles. Energy consumption and general construction information was collected over the past year including submission of Preliminary Energy Audits under the Schools, Hospitals, and Local Public Buildings audit program. Funding has been approved under that program for energy audits for virtually all City buildings which will be completed this fall. In addition, arrangements were made for Columbia Gas to do a walk-through review of all buildings and to produce subsequent conservation recommendations that could be distributed to building operators for their information and implementation where possible.

A fuel contingency plan has been developed for City vehicles which outlines how each City agency will reduce its gasoline consumption by 20 or 40 percent if necessary. From this review, a conservation plan outlining steps to be taken immediately to reduce consumption is being developed, and related actions needing further investigation have been identified and are currently being researched. A similar plan will be developed for diesel fuel use.

Another outcome of our energy planning program, was the development and distribution of an energy questionnaire for City employees. Over 60 percent of whom responded. This questionnaire identified the extent of current conservation measures and evaluated employee interest in carpooling and vanpooling and the feasibility of electric vehicle usage. Largely because of the success of the questionnaire, a carpooling program is currently being developed. Future plans call for appointment of an energy committee of City government representatives and for further building and vehicle conservation measures to be taken.

Energy Management Planning

Columbus is currently beginning an energy audit of the sources and uses of all forms of energy in the community. As a first step in this process, energy audit procedures in 6 or 7 other cities are being reviewed and evaluated. From this an appropriate methodology for Columbus will be developed and implemented.

The information developed in the audit will be used to project future energy supply and demand and to set objectives for an energy program which insures an adequate energy supply. Alternative programs to conserve energy or develop alternate energy sources will be developed, evaluated, and implemented. Community representatives will be involved in this process from the outset to insure their input, consensus, and support for the programs developed.

Throughout our program we are attempting to study the successful energy efforts of other cities and to transfer the programs we are developing to other jurisdictions. We would recommend that cities beginning energy programs also take maximum advantage of the experience gained in other cities.

Pioneering New York City's Solar and Conservation Program

Robert Tanenhaus,[1] *Principal Administrator*
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Paris, France

Abstract

In 1974–75, the New York City government, neighborhood groups and banks formed a complementary structural partnership, based on a balance of power, and adopted two city financial incentives to successfully pioneer the use of solar energy and energy conservation in urban housing, using existing programs. Since then, one of the incentives was adopted by New York State and the other was incorporated into the recently-enacted National Energy Act.

History

The project began with several events. First, an architect who had been studying solar energy and energy conservation techniques in the Southwest, returned to New York to see if some of the techniques could be applied to housing in the City, where energy costs are among the highest in the United States. One interesting aspect is that the architect borrowed some techniques that Indians in the Southwest had been using for centuries.

At the same time, poor tenants in the city began to organize into neighborhood groups and to buy their own apartment buildings through two city government programs which provided financial assistance to people rehabilitating their own homes. The first incentive offered government-subsidized, low-interest mortgages to home-owners who did the work themselves, and who followed a fixed schedule for completion.

The second incentive waives property taxes for nine to twenty years on the increase in assessed value of the dwellings due to rehabilitation. The city encourages solar energy and energy conservation measures by including them—piggy back—in the rehabilitation activities permitted under the two laws.

The first building was completed in 1975. It houses 26 people on five floors. Based on the first year's operation, analysts expect the solar hot water system to cost no more, and perhaps even less, than a conventional system. Under the city's mortgage-subsidy program, and conservatively assuming ten per cent annual fuel price increases, the conservation measures will probably pay for themselves in less than five years and the solar measures in twelve years. In twenty years, each apartment would reduce costs by about $1700 due to conservation efforts and $100 due to solar energy devices.

When the city government, squeezed by a financial crisis, had to abandon part of the program, the participating neighborhood groups convinced the federal government to pick it up from whence it was incorporated into the recently-enacted National Energy Act. Thus the program was part city, part federal and largely privately funded.

Reason for Success

When the three groups—the architect and the citizen housing organizations, the city and federal governments and the banks (representing the private sector)—began to work together, success came quickly. The three groups formed a complementary structural partnership based on a balance of power. Each group has responsibility and authority for an aspect of the program relating directly to its own interest, and within its own competence. The working relationship between the groups, including "checks and balances," is established in the administrative framework. In addition, the economic incentives are designed to mould the market, not to supersede it.

The approach taken by the city administration was to make use of existing financial assistance programs for housing, rather than establish new programs specifically to encourage solar energy and energy conservation. Given the normal legislative and administrative process, such programs would have required at least three years to enact and set up. The New York City approach also integrated solar and conservation measures into the established operation of regular government programs, rather than treating them as separate activities. The programs aimed at the most active housing market—renovation of old buildings.

Other Advantages

Other advantages of the project included its secondary effects. As mentioned, the concept was adapted into the National Energy Act. But almost as importantly, the people who developed the project expanded their activities. The architect joined a new loan program by the Tennessee Valley Authority to encourage solar energy devices. This project may eventually place solar hot water heaters in thousands of homes. I, who was one of the city administrators, am serving many industrialized countries through work at the International Energy Agency in Paris. The leaders of the citizen housing group are providing technical expertise to other neighbourhood groups conducting similar projects in poverty areas throughout New York City.

When I last checked, about half a dozen of these projects in some of the worst poverty areas had been able to attract federal funds. Other projects are financing solar and conservation measures themselves.

In addition, technicians and labourers from the poverty areas have been and continue to be trained and employed in solar energy and conservation through these projects. These people are active in building design and construction and equipment installation, maintenance and sales. Some of them have joined existing firms or formed small businesses and appear ready to assist wider efforts. When I left, it appeared that a small industry was developing in New York, drawing personnel from the poor, providing on-the-job training and serving the national need for skilled labour in conservation and solar energy programs.

Accelerating Government Support

To accelerate the use of solar and other renewables, let me mention just one barrier that will have to be faced early and suggest some solutions. If governments, be they national, state or local, are to actively support renewables, they must first be convinced of the value of renewables to themselves and be confident of their control of any activities for which they may be responsible. This will require continued education and training of the government specialists involved, such as this conference provides. As gathered here today, in pioneering states and cities, government expertise in the various roles required to accelerate renewables use does exist. To disseminate it quickly let me suggest two government-to-government programs: (1) the exchange or loan of these experts to appropriate government levels and (2) the creation of advisory teams for larger jobs. In addition, the problems thus identified and solved might contribute to training seminars. Once confident in their own competence in their areas of responsibility, governments will be more willing to support renewables.

Note

1. Adapted from the author's article, "Deux Projets Pilotes New-Yorkais sur la Conservation de l'Energie et l'Utilisation de l'Energie Solaire" (Paris: International·Communication Agency, U.S. Embassy), No. 3, March, 1979, French original. Copyright U.S. government.

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Section F
Informal Presentations and Discussions

August 20, 1979

Informal Presentations and Discussions: The Neighborhood Energy Audit

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District of Columbia

Washington, D.C., is in a unique position because of its location and government organization. Of every energy dollar spent in the District, fully 85 cents leaves the local area, so that no multiplier effect can boost the local economy.

The City Planning and Development Agency and the Institute for Local Self-Reliance teamed up to keep energy dollars in the local economy. By training local people, energy audits were performed on the District housing stock, audits which have led to cost-effective conservation and solar retrofits. More than 150 Class A audits have been performed since April 1979, with 350 more being planned for the near future. Through such community-based projects, local self-reliance and cooperation have increased, credibility is maintained with the members of the community, and funds remain within the local economy.

Institutional Development of the Solar Pond at the Community Level

Robert W. Gilmer
Institute for Energy Analysis
Oak Ridge, Tennessee

Summary

Robert Gilmer's presentation entitled, "Institutional Development of the Solar Pond at the Community Level," centered on the scale economies of solar ponds for meeting residential space-heating needs and the potential for ownership and management by neighborhood cooperatives. Three management institutions—the private utility, municipal utility, and neighborhood cooperative—were compared in terms of management goals, information transfer, and client control (direct or indirect). Mr. Gilmer began with a conceptual and technical description of the nonconvecting solar pond and concluded by developing a case for local cooperative ownership and management of this energy system.

Scale economies were assumed to exist for construction of a community pond serving 25, 50, or 100 homes, though Mr. Gilmer emphasized that cost estimates were for illustrative purposes only. He maintained that city control was most appropriate for matters of zoning, insurance, and safety; whereas, local-level institutions (neighborhood cooperatives) would be best for minimizing costs, improving information transfer, and responding to problems.

Weak, moderate, and strong decentralization strategies were defined in the presentation, with utility institutions considered capable of only weak and moderate decentralization. Weak decentralization included improved public relations and establishment of a formal grievance mechanism. Moderate decentralization involved increased information flow from energy producer to neighborhood residents and administration of physical facilities by neighborhood cooperatives.

Strong decentralization was considered possible only with alternative

ownership patterns in which both physical and political control was transferred to neighborhood cooperatives. Client control would be improved and response to problems would be quicker. Mr. Gilmer concluded his presentation by suggesting the potential for service firms maintaining neighborhood energy systems, operating as small competitive organizations similar to lawn or pool care services. Out-of-pocket costs as well as costs of organizational control were considered lowest for a strongly decentralized system.

Scale Economies in Solar Ponds and Seasonal Reliability

The first section of this paper describes the solar pond as a simple technology capable of fitting into community energy planning at the local level. Some scale economies are exhibited in the construction (and perhaps in the operation) of these ponds, but they can be captured at the block or neighborhood level of operation. Operation of the pond as an energy generator requires joint suppy arrangements among neighbors, and a local cooperative organization may be the best means of arranging this supply.

A nonconvecting solar pond[1] can provide heat up to 90°C for industrial or commercial applications or for residential space heating. It can provide heat for continuous processes or for electricity (especially in summer when the heat might otherwise be lost), but its best application may be for mass storage and as a means of achieving high solar fractions for space heating. Other alternative energy technologies fit applications at the block level, e.g., wind generators, community methane, even solar towerlets have been proposed.[2] These may complement the solar pond or compete with it for some applications.

Description of Pond

The basic conception of the nonconvecting solar pond is simple: a shallow pool of water (1-3 m) is divided into two zones, a lower layer with a salt concentration gradient and an upper layer of lighter fresh water.[3] The pond acts as a heat trap as the salt gradient prevents the convection process that would normally bring trapped solar energy to the surface as the pond heats up. The upper layer of fresh water serves as a transparent insulator.

The details of constructing such a pond have varied widely among the few existing ponds. Some procedures commonly used are:

- Earth is moved to create a large shallow depression that is covered with a plastic liner capable of withstanding the heat and salt. The edges of the liner are placed in trenches cut into the earth around the pond and buried by backfilling the trenches. The depression is then filled with water.

- The shallow depression has been cemented over in some cases, but the plastic liner is still required to protect the cement from heat and salt.
- A large carbon steel tank, placed above ground or partly below ground, is used to hold the water.
- A plywood frame hung on center posts is constructed above or partly below ground, and the plastic liner is draped on the frame.

The choice of design will be affected by circumstances at the site of the pond. Ponds constructed above ground require insulation on the sides if ambient air temperatures are low. Those constructed below ground level have a limited need for side insulation, but if moving ground water is present it can carry off significant amounts of heat. Ponds need not be covered even in the north central United States. The insulating layer of water remains effective under ice and snow, and a cover may induce transmission losses that offset any value it might have as an insulator. Dust and leaves settle out rapidly, and the wind is not a problem unless the pond is large enough to form waves. In some arid regions, a cover might be desirable to prevent water losses through evaporation.

Despite the conceptual and technical simplicity of the ponds, they remain in the research and development stage. The formation and maintenance of the salt gradient remain something of an art, and little is known about how the temperature of the solar pond behaves as heat is extracted. Detecting and fixing leaks are problems, especially since emptying a pond designed for seasonal storage can render it useless for a year. Salt pollution from leaks or from routine maintenance could pose environmental hazards.

Costs of Ponds

The cost of energy from a solar pond can vary significantly depending not only on its design but also on its location. Insolation at the site determines the energy input, of course; and ambient temperatures will affect not only heat losses in the pond, but also the demand for space heating from the pond. In this section, a simple design for a solar pond and some associated costs are considered.[4] These costs are strictly for illustrative purposes, with the uncertainty surrounding them too large for predictive purposes or use as a basis for policy conclusions. They do suggest how the design and location of the pond determine the cost of energy from the pond, and how scale effects in construction and operation influence these costs.

The pond is assumed to be excavated from the earth with dirt from the depression forming banked dikes, and the bottom of the pond compacted and covered with several inches of sand. A 30 mil plastic liner is laid in the depression with backfilling over its edges to hold it in place. The cost of excavation, backfilling, and compaction falls rapidly as the size of the pond approaches 1000 m^3, but levels off at about \$0.80/m^3 for volumes greater than 1000 m^3. The cost of a plastic liner capable of withstanding the stalt and heat is about \$10/m^2.

The pond is assumed to be 3 m deep. The top insulating layer is 1½ m, and contains 150 kg/m^3 of salt in a uniform gradient; the bottom convective layer contains 150 kg/m^3 of salt. If a delivered price of \$1.50 per 100 lb of salt is assumed, the cost of salt will be \$11.15/m^2 of surface area. The costs of piping, pumps, valves, heat exchangers, etc. are assumed to be \$3000 plus an additional \$10/m^2 of surface area. The pond is fenced with an 8-foot high chain length fence that costs \$8/foot. Operations and maintenance are assumed to take 8 hours per month plus 1 hour per month for each 1000 m^2. Labor is valued at \$15/hour. Not included here are the costs of land and water, essentially because they can vary so widely in value from site to site. Also excluded is the cost of insurance for the value of physical plant and for liability on the property.

The fixed charge rate for the consumer is taken to be 11 percent. This low value (compared to that used for business) stems from the inability of a private person to depreciate capital against personal income, and from the fact that interest expense is the only operating expense that can be written off of income to achieve tax advantages. A ten year life is assumed for the pond, and straight-line depreciation applied. The cost of money is 6 percent. Current dollars are used, but the analysis abstracts from general price level changes. The tax rate (state + local) is 50 percent.

The pond is assumed to provide heat to a group of houses located in Boston (alternately 5, 10, or 25 houses in the example below), each having 1500 ft^2 of floor space and a conductance of .05 kWh/m^2 – °C-day. Efficiency of the pond is assumed to be 30 percent. Insolation values and the solar fraction are calculated using algorithms described in David Boyd's work,[5] and are based on a record of 5662 days.

Table 1 shows the results of combining the above listed data and assumptions and gives the cost of constructing and operating a solar pond for five houses in Boston. The area of the pond and the cost of building and operating a pond of that size are given in the first three col-

TABLE 1. COST OF CONSTRUCTING AND OPERATING A SOLAR POND FOR FIVE HOUSES IN BOSTON

Area of Pond (m^2)	Construction Costs ($)	Operations & Maintenance ($/day)	% Load Carried By Pond (%)	Energy Cost (¢/kWh)
80	6,550	2.08	8.6	19.1
125	8,024	2.12	11.4	16.1
200	10,863	2.20	16.8	13.2
500	23,273	2.50	35.0	10.1
800	31,399	2.82	52.0	9.3
1500	58,111	3.62	94.9	9.0

TABLE 2. COST OF CONSTRUCTING AND OPERATING A SOLAR POND FOR TEN HOUSES IN BOSTON

Area of Pond (m^2)	Construction Costs ($)	Operations & Maintenance ($/day)	% Load Carried By Pond (%)	Energy Cost (¢/kWh)
160	9,452	2.08	8.6	11.6
250	12,301	2.13	11.4	10.4
400	17,758	2.20	16.8	9.1
1000	38,032	2.25	35.0	7.9
1600	58,361	2.80	52.0	7.9
3000	104,115	3.50	94.9	7.4

umns. Column 4 gives the percentage of the space heating load the solar pond can carry given its size. The last column shows the cost of energy from the pond in cents per kilowatt hour of heat. Tables 2 and 3 show the same results for groups of 10 and 25 houses.

Table 4 draws together the data from the earlier tables relevant to scale economies. As the pond grows—whether it is due to a quest for a higher solar fraction or due to a greater heating load from more houses—the price of energy per kilowatt hour tends to fall. These scale economies are built into the cost assumptions made above about piping and controls, fencing, earth moving, and operations and maintenance. It is possible that some further economies may exist in large ponds due to smaller edge losses, i.e., efficiency may rise with volume, though it is not included in these calculations.

The scale economies in Table 4 diminish as more houses are added or as a greater solar fraction is attained. Small groups of homes can effectively capture scale effects if they rely heavily on the pond for heating; larger groups of homes are necessary if the pond simply supplements other heat sources. Even for small solar fractions, groups of 25-50 homes would capture the scale advantages of the pond considered in this paper. The economies are not so large or pervasive that a small, cooperative institution cannot capture them.

Institutional Form and Decentralization

This section of the paper examines three alternative institutional forms as potential managers of an energy generator (such as a solar pond) that might be shared by a neighborhood-sized group of individual homes. A private utility, a municipal utility, and a neighborhood cooperative are all considered for this management role. It is argued that the cooperative form eliminates unnecessary central energy management, that the costs of organizational control to meet client needs are lower than the utility alternatives, and that it can achieve strong decentralized control of the energy resource.

This paper assumes that scale economies exist in the creation of solar pond capacity, and that several households pool resources to capture scale economies that none can capture by acting alone. Given scale economies in the pond and given the cost of managing and controlling a group of individuals to achieve a common goal, it is possible to solve simultaneously for both the number of households that share the energy generator and the energy needs of each member. In principle, both types of utilities and the cooperative are capable of carrying out these calculations and of achieving minimum cost energy delivery. The

TABLE 3. COST OF CONSTRUCTING AND OPERATING A SOLAR POND FOR 25 HOUSES IN BOSTON

Area of Pond (m^2)	Construction Costs ($)	Operations & Maintenance ($/day)	% Load Carried By Pond (%)	Energy Cost (¢/kWh)
400	17,758	2.20	8.6	7.1
600	24,584	2.30	11.4	6.9
1000	38,032	2.50	16.8	6.9
2500	87,707	3.25	35.0	6.9
4000	133,058	4.00	52.0	6.9
7500	250,776	5.75	94.9	6.8

TABLE 4. COST OF SPACE HEAT FROM NONCONVECTING SOLAR POND (¢/kWh)

% Load Carried By Pond	Number of Houses on Pond		
	5	10	25
8.6	19.1	11.6	7.1
11.4	16.1	10.4	6.9
16.8	13.2	9.1	6.9
35.0	10.1	7.9	6.9
52.0	9.3	7.9	6.9
94.9	9.0	7.4	6.8

difficulty lies in the difference that may arise between the potential and the performance of these institutions once organized. This difference can depend on many factors independent of the institution, e.g., the skill and personality of the manager, but some factors specific to institutional choice per se can be important. This paper is concerned only with these institutional characteristics and the incentives to performance offered by the institution.

Alternative Institutions

An energy institution is defined by four characteristics: (i) property rights in the capital stock; (ii) property rights in the energy created; (iii) the means of policing and controlling the property rights in the energy and capital; and (iv) the operational control of the energy generator exercised on a day-to-day basis. The three institutional forms considered here—private utility, public ownership, and neighborhood cooperative—are defined by these four characteristics in Table 5. Each institution is discussed below.

Private Utility

The utility assumes ownership and operational control of a number of solar ponds located throughout the city. It may or may not operate other energy delivery systems such as natural gas or electricity.[6] Ownership of the capital is vested in utility stockholders. Ownership of the energy is

TABLE 5. DEFINITION OF ALTERNATIVE ENERGY INSTITUTIONS

	Private Utility	Municipal Ownership	Cooperative
Property Rights			
Capital	Stockholder	City	Membership
Energy	Utility	City	Cooperative
Operational Control	Utility	City	Cooperative
Policing			
Capital	Public Utility Commission	City	Cooperative Rules
Energy	Metering, Billing	Metering, Billing	Metering, Billing

vested in the utility as a corporate person; and once created, the heat is metered and transferred to the consumer, and the consumer is billed. The rates for the heat are set by a public utility commission using standard cost-plus procedures. The property rights of the stockholders are protected by a rate high enough to cover operating cost plus a fair rate of return on invested capital. Property rights in both energy and capital are ultimately backed by the power of the courts.

Municipal Operation

Ownership and operational responsibilities are vested in the city, with pricing and policies determined by a municipal bureau, board, or commission. In principle, its pricing policies should not differ from those of the private utility; it will bill its customers for operating expenses plus a capital charge to cover project financing.

Cooperative

Ownership of capital is vested in the members of the cooperative. Ownership of energy and operational control is assumed by the cooperative, and pricing and policing of property rights are according to rules set by the cooperative charter. Prices of energy are set by the cooperative at a level high enough to cover continuing costs; any excess funds collected will be rebated to the members in proportion to their purchases of energy from the cooperative. Capital costs may be recovered as part of the energy charges or recovered as a membership fee.

Management of the Energy System

The private and municipal utility arrangements result in the responsibility for building and operating the energy source being assumed by a party outside the neighborhood. Although the physical facilities are geographically dispersed, the property rights and the power to run the system remain under centralized control. This gives rise to several problems that can affect the efficiency of the system in meeting the needs of the neighborhood. These are problems that the decentralization strategies discussed later in this paper must handle adequately.

Incentives to Perform

Those homeowners served by a municipal or private utility want the energy system to meet certain specifications for reliability and maintenance; but once the service standards are met, the cost of service is to be minimized. The private or municipal utility is a second party in the energy delivery system, and the question arises as to whether the objectives of the utility coincide with the minimum cost goals of the neighborhood clients. Although controversial and dealing with unresolved issues, there is a substantial literature that suggests a perverse incentive structure might be at work for both private and municipal utilities.

The municipal utility is part of city government and presumably operates on a nonprofit basis, i.e., the employees of the organization do not appropriate any of the difference between the cost of energy delivered and revenues. The revenues may derive completely from energy sales, or tax revenue may subsidize this part of the city operation. Profit maximization is clearly *not* a goal of the utility, and perhaps neither is cost minimization a goal. The municipal utility is staffed by civil servants, and many theories of the maximand or objective function of the bureaucrat have been offered.[7] These theories generally deal with the means of personal advancement in bureaucracy and the use of public resources to promote this advancement, e.g., maximizing the budget or staff. Virtually all of the writers recognize the inherent conflict between the personal goals of the civil servant and the goals of those he presumably serves. The cost minimization goals of the neighborhood energy client perhaps run the risk of being subsumed by bureaucratic objectives.

Similar problems may exist between the objectives of the regulated firm and the energy client. The objective of the unregulated, private firm is assumed to be profit maximization (and, simultaneously, cost minimization). The objectives of the behavior of the regulated firm, because its profits are bound by a regulatory limit, are more controversial. The well-known Averch-Johnson hypothesis[8] argues that the regulated firm will expand its use of capital to levels unjustified by minimum cost considerations, largely as a response to having profits tied to the size of the capital stock. Whether or not the Averch-Johnson effect is operative, regulation does create a confrontation between two groups with potentially conflicting objectives—utility customers and stockholders. High profits channel large amounts of money from consumers to stockholders, and low profits reverse this flow. Regulatory hearings are adversary proceedings with the utility and the commission caught between conflicting goals and demands. The interests of all parties within the private utility will not work in parallel.

Information Transfer

A large utility, operating many energy generators, whether private or public, must draw on a wide range of technical, financial, and administrative expertise. To assure effective social control of the utility, to assure that it works toward goals coincident with those of its clients, the complex operations of the utility must be continually examined by its regulators. This examination requires a transfer of information from the utility to the regulator about its continuing operations, a transfer that is difficult and complicated by several factors.[9]

The first complication is the complexity of the business. A wide range of expertise is required to keep a utility running, and an assessment of how well its functions are carried out for the public requires a high level of expertise and a continuing involvement in the planning process. Unfortunately, this extensive, day-to-day involvement is difficult for the typical regulator to undertake. Regulatory staffs are small, the number of affected utilities is often large, and the time available to probe the inner workings of the utility is limited. Efforts to check on the utility or to achieve control tend to be limited to routine reports and formal hearings with limited objectives.

Second, there is the problem that much of the information required to carry out a successful regulatory program is the property of the regulated industry. Even with a deep, continuing commitment by regulators to keep utility operations in parallel with client needs, the regulator remains an outsider.

> The reason why outsiders are not on a parity with insiders is usually because outsiders lack firm-specific, task-specific, or transaction-specific experience. Such experience is a valuable resource and can be used in strategic ways by those who have acquired it.[10]

Thus possible conflicts in the goals of the utility and its clients can lead to a need for information to keep the goals coincident. The fact that the utility holds these facts makes the transfer of information potentially difficult and raises the possibility of the data being manipulated or distorted to advance utility goals.

Indirect Client Control

Should differences between the objectives of the utility and the client become apparent, the client typically finds that the regulatory process can be influenced only indirectly and through remote agencies. For example, the regulated private utility is often under the authority of a state-level commission, a remote location for most consumers. The state-wide authority of the regulator may deter any one consumer from complaining on the assumption that one consumer cannot influence the course of events. And the individual complaints of those few consumers who do come forward may indeed seem like isolated incidents to a board or commission operating hundreds of miles away. The municipal utility is more accessible geographically, but individual complaints may still seem insignificant or become lost in seemingly bigger issues. The rise of consumer and environmental groups in recent years, and their introduction into the regulatory process as intervenors in formal hearings, has gone some of the way toward giving the consumer a better voice in remote proceedings. And, of course, there is the ultimate recourse of the ballot box. The means of achieving recourse remains indirect, remote, impersonal, and probably slow in every case.

Institutions and Decentralization

Decentralization strategies can be defined as being weak, moderate, or strong.[11] The utility institutions are capable of carrying out weak or moderate strategies, but strong decentralization efforts must be carried out by alternative ownership patterns such as the neighborhood cooperative.

Weak Decentralization

The weak decentralization strategies relate to the transfer of information from the energy producer to the client. Examples of these strategies would be improved public and community relations or the establishment of a formal grievance mechanism. The fact of physical deployment of energy production facilities at the neighborhood level serves this informational need. These weak strategies do not affect the form or substance of the utilities as defined in Table 1. Property rights, operational control, and the methods of policing property rights remain in place.

Moderate Decentralization

These strategies result in the utility giving up some operational control to neighborhood residents. The administration of physical facilities, the employment of neighborhood residents, and the use of neighborhood institutions to carry out some management functions all fit this moderate category. Inherent in the moderate strategy is a greater flow of information from the energy producer to neighborhood residents, so certain informational goals are also carried out. In Table 1 moderate strategies by private utilities or municipalities result in operational control shifting to neighborhood groups. All property rights (and thus the police mechanisms to protect these rights) remain vested in the utility.

Strong Decentralization

This is a transfer of political and physical control of property rights in the energy generator to the neighborhood. Because municipal and private utility structures are defined by their pattern of property ownership, neither is capable of achieving strong decentralization. Weak and moderate decentralization strategies are captured within strong decentralization. All information is transferred to the neighborhood, and operational control moves to the neighborhood level.

The advantage of the local, neighborhood cooperative is its ability to achieve strong decentralization strategies, moving control of energy to the local level. Club-like structures move property rights and policing of these rights through cooperative rules to the local level. The potential importance of strong decentralization has been pointed out by a survey of 215 studies that considered decentralization of urban services.[12] They were not energy-related studies, but encompassed public safety, health, education, economic development, and multi-service programs. The programs showed indications of increased or improved services at fairly high levels for all strategies—55 percent of programs applying weak strategies showed improved services, 66 percent of programs applying moderate strategies, and 74 percent of programs applying strong strategies. Increased client control, however, was a more unusual outcome of the decentralization efforts, and it was very closely tied to the use of strong decentralization strategies. Only 5 percent of the case studies where weak or moderate strategies were applied resulted in greater client control; the use of strong strategies resulted in greater control in 45 percent of the cases where they were applied.

Once strong decentralization is achieved, it may offer the interesting possibility of giving up some forms of intermediate control. In particular, some of the more time consuming aspects of operational control and maintenance can be assigned to an outside party. This may be important in relieving the neighborhood of some of the heavier burdens of the energy business. Again referring to the studies of decentralized urban service, the following quote is revealing.

> . . . those who have been participants in the decentralization process, whether servers or served, generally feel that decentralization has been a failure. Their judgment is based on an implicit benefit-to-cost calculus: The personal or collective benefits from decentralization have failed to justify the heavy personal "costs" of participation—that is, the endless hours, emotions, and conflicts and frustrations that all of us have experienced in participating in any community affair . . .[13]

If the neighborhood finds it a bother to maintain the energy system, service firms should develop to serve these neighborhood institutions. These firms can operate as small, competitive organizations analogous to lawn and pool care services, termite inspection services, or appliance repair shops. The simple fact that a dozen alternate firms can perform these chores gives each firm an incentive to please the customer. And if the goals of neighborhood and service firm do not coincide, the neighborhood has clear alternatives. Any loss of control can always be reasserted.

Conclusions

This paper has developed a case for local cooperatives or other forms of decentralized ownership and management of energy generators capable of physical, territorial, or geographical dispersion throughout the community. It avoids the necessity of centralized management, and cooperative, club-like structures can coalesce around the dispersed technology. No centralized planning mechanism or grandiose schemes to redirect lifestyles are necessary.[14] Further, the local ownership pattern is consistent with strong decentralization measures, measures which have been found most successful in increasing client control of the services decentralized.

The costs, both out-of-pocket and otherwise, of operating a strongly decentralized system may be lower than the utility structure. First, the cost minimization goal of the energy consumer is shared by all parties to the energy production process. There is no problem of conflicting goals among the participants. Second, the energy cooperative is an efficient means of transferring data from the energy producer to neighborhood residents. Finally, once strong decentralization measures are adopted, some weak and moderate forms of decentralized control may be given up, e.g., operational control turned over to a private manager. Strong decentralization assures that other forms of control can be reasserted at any time if necessary.

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Notes

1. Only nonconvecting ponds are described in this paper though other possible designs certainly exist. For example, T. B. Taylor Associates', "A Preliminary Assessment of Prospects for Worldwide Use of Solar Energy," preliminary draft of a report to the Rockefeller Foundation dated February 10, 1978, speculates on an alternative design. A. B. Casamajor and R. E. Parsons, "Design Guide for Shallow Solar Ponds," UCRL-52385 (Livermore, Calif.: Lawrence Livermore Laboratory, 1979) presents designs more appropriate to continuous process heat applications.

2. Lee Johnson, "Neighborhood Energy: Designing for Democracy in the 1980's, in L. de Moll and G. Coe (eds.) *Stepping Stones: Appropriate Technology and Beyond* (to be published by Schocken Books).

3. A. Rabl and C. E. Nielsen, "Solar Ponds for Space Heating," *Solar Energy*, 17 (1975), pp. 1–12.

4. The cost is roughly \$50 $C_3{}^{-0.6}$ where C is the volume of earth moved, and C is less than 1000 m^3. Office of Technology Assessment, "Application of Solar Technology to Today's Energy Needs," draft dated June 1977, pp. XIV 71-XIV74.

5. David A. Boyd, "The Stochastic Sun: Identifying the Recoverable Resource," to be published by the Institute for Energy Analysis. Draft dated March 1979.

6. For the argument that these heat utilities should be independent of other energy utilities, see R. W. Gilmer and R. E. Meunier, "Solar Energy and Electric Utilities: The Service Contract in a New Social Context," *Mercer Law Review* (March 1979).

7. Anthony Downs, *Inside Bureaucracy* (Boston: Little, Brown & Co., 1957); Gordon Tullock, *The Politics of Bureaucracy* (Washington, D.C.: Public Affairs Press, 1967); W. A. Niskanen, *Bureaucracy and Representative Government* (Chicago, Ill.: Aldine, 1971).

8. H. Averch and L. Johnson, "Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, 52 (December 1962), pp.

1053–1069. For extensions of the original formulation, see E. E. Baily, *Economic Theory of Regulatory Constraint,* (Lexington, Mass.: Lexington Books, 1973).

9. The difficulties have been pointed out by O. E. Williamson, *Markets and Hierarchies: Analysis and Antitrust Implications,* (New York: Free Press, 1975).

10. Williamson, *op. cit.*

11. Robert K. Yin and Douglas Yates, *Street-Level Governments* (Lexington, Mass.: Lexington Books, 1975).

12. Yin and Yates, *op. cit.*

13. Yin and Yates, *op. cit.*

14. If backup is required for the system from centralized sources such as electricity, some rate design may be required. The pond could be charged off-peak at reduced rates reflecting marginal operating cost, however. See Gilmer and Meunier, *op. cit.*

Philadelphia Solar Planning Project

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Abstract

The Philadelphia Solar Planning Project (PSPP) is designed to speed the implementation of solar technologies in the city of Philadelphia. The city government is enthusiastically participating for a second reason as well, to gain benefits for the local economy. The project has four major aspects:

1. & 2. Studying the application of solar techniques to the buildings of Philadelphia by developing (1) a building type/energy use inventory and then (2) a set of probable solar technologies (with products including handbooks that help households).

3. Assessing the impacts of various scenarios, including both the effects of reduced demand on the present energy industry and the benefits in the job market for making the transition.

4. Implementation which includes helping shape city-wide policy to overcome barriers and provide incentives, starting a system of grass roots neighborhood groups to apply solar techniques, and promoting a range of specified projects.

This work began in the spring of 1979. The present contract is from the National Endowment for the Arts, with funds provided by the Office of Conservation and Solar Applications of the Department of the Environment (Frank de Serio, project manager). The work is being carried

ried out by several subcontractors under the direction of Charles Burnette and is located at the University City Science Center of Philadelphia.

This contract will expire before January, 1980. By that time, the planning model will be complete for several residential and commercial applications and be set up for other building types as well. In addition, data from the study will have been used to influence a city-wide energy policy plan and several specific implementations are likely to be underway. A final hoped-for effect is that the Project can be a pilot one: a key part of the final report will be to extrapolate from this experience planning procedures for use in many other large cities and their neighborhoods.

Studying Applications

There are two parts to the problem of projecting the application of solar techniques to the building stock of a city—first, finding out what the building inventory is (its quantity and energy characteristics) and, second, what potential applications might be. This study will cover only a few building types, but will do so through setting up a model applicable to other categories as well. We will start with, and complete, several housing types (which however cover perhaps 80% of the city's residential buildings). Then we will proceed to treat two other examples, most likely one commercial and one industrial building. Some policy projections, specific implementation programs, and organizations will emerge as well from the activity of the project staff.

Building Type/Energy Use Inventory

At first, it seemed a hopeless task to find a small enough number of categories of housing types to handle each in enough detail to study the effectiveness of the more likely solar techniques. However, after a number of searches, three key sources of information have been located to do the task. The Board of Revision of Taxes (BRT) has given us a geocoded, computer-based description of great value; it includes data on location, house type by 28 categories, number of floors, floor area, and rough descriptions of construction. A first tabulation from this indicates that 78% of the private residential structures are row houses, a fact which makes our task more manageable.

To gauge the actual kind of construction, particularly with respect to energy efficiency, we are compiling a Building Type/Energy Use Inventory, based on drawings of actual houses done by University of Pennsylvania students. These historically different residential types are being cross-referenced with a series of maps showing the growth of neighborhoods provided by the City Planning Commission. For example, row houses located in an area of growth of a certain era will be coded as having construction typical of that time. This historical data will be combined with the BRT data, which is geocoded. We will be able to check our counts against aerial photographs to give us fairly accurate estimates of the utility of certain solar applications. As a result, we will know how many systems and what types are possible in a single neighborhood.

We are also conducting (through the Comprehensive Community Energy Management Project and the Philadelphia Gas Works) energy audits of 750 houses by mail and about 250 by direct visits. These audits will give us information on the degree to which houses have been weatherized, data enabling us to complete our model of building types. Also as a check, we will compare our estimated fuel consumption derived from the historical drawings with the utility company records for structures of each type.

Solar Applications

The kinds of applications of energy savings we are considering for this project are passive, active and conservation measures. Each of them is being handled separately by a different subcontractor.

Don Prowler of South Street Design is examining the effectiveness of six passive designs on the two most predominant residential and commercial building types. For the residential applications, the passive designs are trombe walls, water walls, and direct gain, all with and without night insulation. For each housing type, Prowler is running through calculations considering the effects of passive designs combined with three differing degrees of weatherization. A first result is showing that a simple trombe wall, consisting of single glazing over the south facing wall of a mid block brick row house will save 13% to 28% of the annual heating load, and 31% to 55% of its load if applied to a south facing end wall. This will help to pinpoint the most probable economic applications in Philadelphia. In order to study the economic effects of these applications, all materials and labor types used in each application are being tabulated; to be exact about impacts on fuel distribution, we will be calculating the energy saved, including data on diurnal and annual cycles. Also, as part of the calculations, we will be charting the efficiency of the applications in solar fractions.

The other applications to be studied are conservation measures and active techniques. The conservation measures are listed in the audit survey mentioned above and include insulation, weatherstripping, storm windows, and equipment improvements. The active techniques, being studied by Dick Voith of the Energy Center (working with Don Prowler) are domestic hot water, heat pumps, electric power generation, photovoltaics and other active applications.

At this point, we are trying to develop the model to be as detailed as possible rather than comprehensive for all buildings. We expect to understand what data is most useful in the next phases of the project—studying the impacts of various solar applications and promoting their implementation.

Impacts

Assessment of the outputs of the above scenarios will also address two kinds of impacts—those on the existing fuel industry and those stemming from the development of a solar industry. The first set of impacts will be derived from tracing the effects of present energy uses that might be displaced. We expect to know from the audits which fuels can be potentially displaced by the applications mentioned above. The impacts on the electric industry, The Philadelphia Electric Company in particular, will be analyzed by developing load curves for each solar system and introducing these data into the electric company's computer model. This study is being conductetd by the Energy Center of the University of Pennsylvania.

A more complex study will have to be made to understand the impact of reduced consumption of fossil fuels. Dan Sims of the UCSC is constructing a model of the fossil fuel industry, describing how the various suppliers (PGW, larger oil suppliers, small distributors), supply fuel. This will help us understand the implications of using solar techniques in various areas of the city's fossil fuel industry. A major hope is that developing a solar industry will help the Philadelphia economy. This study will help locate the places for potential gain and help devise a citywide implementation strategy. This will be done by aggregating the specific materials needed both in first costs and life cycle costs for each of the studied applications. This aggregation of costs will be done by Sid Shore of Department of Civil and Urban Engineering (University of Pennsylvania) based on the data coming from Don Prowler and from the building inventory. In turn, Sid Shore's output will be taken by Bob Coughlin of the Regional Science Research Institute and fit into the existing input/output model of the city's economy to understand the gains in each sector (by Standard Industrial Classification).

A key piece of information necessary to judge the impacts of various application scenarios will be to understand how fast an application will come about, that is, its market penetration. Estimates initially will be made in the form of solar application scenarios; however, a critical element of this task will be to understand how to improve the rates of implementation. Don Overly of UCSC will be directing a study of barriers and incentives to pave the way for improving the rate of adoption of solar technologies. These will be presented in the form of recommendations to the larger energy planning efforts to which this project is linked.

Implementation

It is the strong prejudice of the staff to skew all efforts of constructing the planning model toward promoting implementation. As a consequence, there are many connections with on-going implementation efforts and spin-off products to help us initiate some solar applications. The key on-going effort that the project is related to is the CCEMP (Comprehensive Community Energy Management Project) of the city. It was organized by Tony DiTomaso and is now directed by Lucien Calhoun housed in the Office of the Director of Commerce. The CCEMP program will have the task of coordinating all energy projects of the city, including recommending policies to the Major and Council. Being partly composed of City employees and outsiders (chaired by the executive director of the Philadelphia Gas Works), it will attempt to make policy agreeable to all groups and help the City implement measures in coordination with private interests.

In order to get the needed political support for solar applications and particularly to utilize the grass-roots outreach mechanisms of the city, we used our resources to help the CCEMP leaders (before they had staff) to organize the Energy Management Council (EMC). We helped organize and run its early meetings so that the broadly representative group could give direction to the planning efforts. Our notion was that people should not plan for solar alone, but rather for all energy issues. This led us to look toward having solar planning done in a group with this larger charter. It has paid an unexpected, though logical dividend. When the ecologically oriented people of the EMC wanted to take an anti-nuclear stance, the electric company threatened to withdraw: the compromise reached was that the EMC could only make available information on issues not able to be settled nationally (such as nuclear ones), and hence the group would primarily concentrate on *promoting alternatives* to traditional energy sources such as solar energy.

The CCEMP staff, the utility groups represented on the EMC, and other City agencies involved have been very cooperative (for example, by helping solar consideration to become part of the audits). The resulting plan will be a framework for the solar policies which emerge from the PSPP. CCEMP goals will be compiled by next September for city-wide adoption. Its format will be goals, policies, and programs charted by supply expansion and demand reduction in five areas: industry, residences, commerce, institutions, and transportation. The PSPP will organize its information and policies about barriers and incentives to solar implementation into these categories in order to insert them into the overall energy plan. In addition, we are in the process of working with the City Planning Commission, citizen groups on the EMC, and local branches of the Office of Housing and Community Development to organize grass-roots planning and implementation efforts at the neighborhood level. The development of a Neighborhood Planning Aid Kit is, in part, a response to the discovery that people are not as interested in being involved in planning through such efforts as audits, as they are in receiving direct technical assistance.

Other implementation efforts include spin-off products and pilot projects which are being generated by PSPP staff.

The following proposals have been developed:

1. A Trombe Wall Application for a Two-story Row House
2. A Plenum Collector for Flat Roofs
3. Directed Daylighting for the Atrium Office Building
4. A Window Furnace for a Municipal Auto Shop
5. Passive Principles Applied to Urban Design—Broad Street
6. The Philadelphia Solar Cities Assistance Program (A cooperative effort between Philadelphia, Camden, Chester, and Wilmington)
7. A Solar Access Mapping Technology

We find that the existence of this project and its staff can be a useful conduit for city support and a catalyst to help the formation of a growing number of efforts.

Selected Questions

In the discussion period which followed Mr. Krauss' presentation, there were several questions about the make-up of the Board of Overseers of the Philadelphia Project, and whether the Board was properly representative of the community interest to be served by the project. Several questioners thought that the Board should have greater neighborhood and community representation. Since community people would be the ultimate solar users, it was felt that they should be given a stronger role in planning the project. Not doing this might mean that implementation of the solar energy strategy proposed in the plan would later fail. It was thought that the concentration on the Board of utility, banking and conventional energy representatives could threaten the success of the project, and particularly its acceptance at the local level. In defense of the make-up of the Board, Mr. Krauss said it was imperative to involve those institutions which have the money and the power in the energy field, i.e., the big energy companies, the banks, and the utilities. If these groups did not participate, then there was little hope of moving those who make energy policy in the community away from traditional depletable energy patterns, and toward the future based on renewable resources. At the end of the session, the issue remained unresolved.

The Evolution of Montana's Renewable Energy Programs: Policy and Implementation

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This presentation highlighted Montana's Alternative Renewable Energy Sources Grants Program administered by the Department of Natural Resources and Conservation and the proposed Montana Renewable Energy Viability Project, also to be administered by the Department. These programs underscore Montana's commitment to tapping renewable energy sources and reflect an increasing interest in formulating energy policy geared to achieve a transition to renewable energy systems.

In 1975, the Legislature passed a bill creating the Alternative Renewable Energy Sources Grants Program to "stimulate research, development and demonstration of energy sources which are harmonious with ecological stability by being renewable, thereby to lessen that reliance on nonrenewable energy sources which conflicts with the goal of long range ecological stability . . ." The Legislature authorized funding of the Program from revenue derived from the coal severance tax. At present, the Program receives about $750,000 per fiscal year. Through November, 1978, the Program had distributed nearly $1.7 million to 124 renewable energy projects. Grants to these projects ranged from $1,000 to $100,000. Grant projects cover all the renewable energy sources, although the majority of projects have been solar.

During the first two years of the Program, requests for grants have been largely unsolicited and have come from a broad range of Montana citizens. Each grant not only increases information about renewable energy, but also increases the pool of expertise in the use of renewables.

Many of the projects thus far funded have just completed their first season of use. As reliable performance data become available, the infor-

The projects funded by the grants program have been successful as demonstration projects. Since all projects must be made available to public viewing, many Montanans have had a first hand opportunity to judge the feasibility of tapping renewable energy sources. Demonstration of renewable energy application has raised public consciousness about the viability of solar, wind, hydro, biomass and geothermal energy sources in Montana.

Raising public consciousness is a necessary condition for the commercialization of renewable energy. In January, 1979, the staff adopted a new program plan. This program plan de-emphasizes unsolicited grant proposals in favor of requests for proposals (RFP's) and sole source contracts for projects in areas that have not received adequate attention. These areas are those in which the commercialization and widespread implementation of renewable energy systems will eventually be achieved. The majority of projects to be funded under the current program plan will probably require a greater level of expertise than those projects previously funded. Consequently, many of the projects will be contracted to universities, consultants and private research organizations.

Although the Alternative Renewable Energy Grants Program will contract for projects to overcome technical, social, legal, economic and political barriers to the use of renewable energy in order to increase the use of that energy, it will not provide systematic information regarding the degree to which a transition to renewable energy sources and conservation in Montana is possible. Developing this information is the goal of the Montana Renewable Energy Viability (REV) Project.

The work plan for the Viability Project has been completed by the contractor and is currently under review by the Department. Once the Department has approved the design study, it will be submitted to various agencies as a proposal for funding the REV Project.

The proposed project is essential to determine whether renewable energy should be commercialized in all energy use sectors of Montana. Currently, energy decision makers lack the information and analyses to determine what type and scale of systems are appropriate to the various geographical regions of Montana. The project will gather information statewide as well as on a local level. The project will assess the extent to which conservation measures and renewable energy can be implemented within the next twenty years. Results of the study would be used to direct the division's Alternative Renewable Energy Sources Program and to assist education and outreach activities, forecasting, and major facility siting duties. After consultation with the Legislature, the project results could be incorporated in the planning process of many state agencies. The private sector could be expected to make use of a well devised plan for implementing alternative energy strategies, and the study should also prove useful to other states.

Electrical Energy Self-Sufficiency for Hawaii by 1990

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Abstract

Hawaii is in a unique position of having an extreme dependence on imported oil and an abundance of renewable natural energy resources (wind, solar, biomass, geothermal, ocean thermal). It thus has not only the need but the means to attain energy self-sufficiency. The State has a choice. With an active State role in alternate renewable energy R&D, not only can energy self-sufficiency be realized relatively soon, but the State's economic well-being will be greatly enhanced by (1) elimination of the outflow of hundreds of millions of dollars to purchase oil and (2) the creation of new jobs and new industries. Finally, Hawaii can be assured of its needed energy supply independent of foreign politics and the tremendously rising costs of the world's dwindling supply of oil. The cost to the State is small compared with the significant benefits that will be achieved from this proposed program; furthermore, much of the cost can be recovered from the value of the energy generated.

The Goal for Hawaii

On July 1, 1979, President Jimmy Carter said: "I would like to see the State of Hawaii become completely energy independent by the year 1990. And if all of us continue to work together with the same spirit and dedication which we've shown so far, we have an excellent chance to do that."

Senator Spark Matsunaga has stressed that a reasonable goal for Hawaii would be electrical energy self-sufficiency by 1990. Governor

Ariyoshi has affirmed his belief that Hawaii will be the first state in the United States to achieve energy self-sufficiency.

Clearly, it is widely recognized that Hawaii is in a unique position in several respects: not only does the State have the highest dependence on imported petroleum caused by geographic isolation and lack of fossil fuels, which creates a threatening situation of extreme vulnerability, but Hawaii has the greatest potential of any state in the nation to achieve energy self-sufficiency because it possesses an abundance of natural energy resources.

Research, development and demonstration (RD&D) includes all of those activities that are required before full commercialization can take place. Much of the work in energy being undertaken in Hawaii is applied research—that is, activities that have a near-term goal of making a contribution to the energy supply in Hawaii. Because of the extremely favorable conditions in Hawaii (strong, steady tradewinds, high rate of insolation, rapid growing conditions for biomass, very high geothermal temperatures, and tropical oceans with good temperature differentials close to shore), the state should be a leader in applied research in many of the natural energy technologies (wind, direct solar, biomass, geothermal, and OTEC). Hawaii is the ideal place to carry out applied RD&D activities and to prove the technical and economic viability of the natural energy systems. The other RD&D activities involve basic research in those technologies that have a longer range potential contribution. These include areas that hold great promise as future energy sources for Hawaii but are not currently receiving adequate funding support or the desired priorities at the Federal level or in the private sector.

If Hawaii accepts the goal of electrical energy self-sufficiency by 1990 and adds a commitment to a major movement toward energy self-sufficiency for ground transportation by 1990, even though the objective of total energy self-sufficiency may not be achieved until 1995 or 2000 or later, the State must provide its own impetus. Thus the question before the State of Hawaii now is: "What research, development and demonstration programs should be funded and undertaken by Hawaii to help achieve this goal?"

A bold ten-year program is needed. It is recognized that certain programs or efforts will not move forward as anticipated, while others possibly will be accelerated. And we will learn not only from our successes and breakthroughs, but from our mistakes as well. The emphasis is upon RD&D, with some thrust in the application or demonstration of technologies that are near commercialization but need State financial support in order to help "close the gap" and get them on-line, to produce energy.

In short, the State's role is to accelerate the process of tapping our abundant renewable energy resources and make alternate energy systems work to contribute to our energy supply. Strong State support will enable natural energy systems to become economically and technologically viable sooner.

Hawaii's Renewable Energy Assets

Hawaii possesses a unique combination of outstanding natural resources that can be integrated to achieve State energy self-sufficiency. A brief description of those resources and their potential follows.

Wind Energy

Wind Power currently represents the most promising potential near term source of electrical generation in Hawaii. Measurements taken by the University of Hawaii at Manoa, Department of Meteorology show that in over 600 mi^2 of area, the tradewinds blow from 60 to 20 mph over 70 to 80 percent of the time and above 9 mph 80 to 90 percent of the time; this could generate 800 to 1800 w/m^2 of power.

Direct Solar Energy

Hawaii has the highest insolation in the United States, with an average of approximately 250 w/m^2. Solar hot water heating is already widespread and cost effective.

Biomass Energy

The excellent growing conditions in Hawaii make the use of biomass to produce electricity attractive today and the provision of liquid fuels very promising for the future. Bagasse, or sugar cane waste, has contributed to the State's electricity generation for years. Currently over 600 million kWh of power is generated from bagasse both for running sugar mills and feeding into the electrical grid. Sugar cane molasses has the potential of producing 22 million gallons of ethanol per year for gasohol. Wood chips can also be burned in power generators, and current studies on various types of trees indicate that the giant Koa haole will grow 50 ft. in a 4-year period, which would make it an excellent source of fuel. Pineapple waste, hay power, cassava, and many other energy crops also have potential.

Ocean Thermal Energy

Hawii's OTEC potential is excellent, with a 36° to 40°F temperature differential between the surface water at a depth of 2000 ft. only one mile offshore. Current OTEC programs include Mini-OTEC the first operational OTEC demonstration system in the world producing net energy which is currently in operation; the Seacoast Test Facility, an onshore facility for OTEC RD&D; and OTEC-1, a 1 MW floating OTEC system planned for 1980.

Geothermal Energy

The Big Island of Hawaii possesses the hottest geothermal well in the country, with a temperature of 680°F. The Puna reservoir has been estimated to have a power potential of 500 MW for 100 years.

Hydroelectric Energy

Though only 20 MW of hydroelectric power is currently on line in the State, this could be expanded to possibly three to four times this amount. One interesting future possibility is the use of pump-storage-hydro systems for energy storage.

Other Energy Resources

Hawaii has ideal climate and driving conditions for electric and hybrid vehicles. A goal for the year 2000 is for transportation to consist of 60 percent electric vehicles, 30 percent hybrid, and 10 percent ethanol- and hydrogen-powered vehicles. Currently the University of Hawaii at Manoa has a demonstration program of 15 EV's, and Hawaiian Telephone is proposing a fleet of 25 demonstration EV's.

Other studies and programs to supplement the current natural energy technologies include studies of underwater cables, liquid fuels from algae, aquaculture programs, biofouling and corrosions, environmental quality studies, and others.

Assumptions

If the goal of electrical energy self-sufficiency is going to be achieved by 1990, a great many things must come to pass. Following are some of the basic assumptions to be made in order that this goal may be achieved.

1. The goal of electrical energy self-sufficiency by 1990 is accepted by appropriate decision makers in both the public and private sectors, and they are committed to achieve this goal.

2. Existing utility generating systems will be used as backup systems, with oil as the primary storage medium, and the debt service on these existing systems will be met. A sub-goal is that no new systems using nonrenewable sources of energy will be installed.

3. The utilities will be able to deliver the needed energy, on demand, with no brownouts or losses of power; and the stockholders' return on their investment will be equitable as determined by the Public Utilities Commission.

4. The needed RD&D programs to accelerate the closing of the gap for commercialization of renewable energy systems will be funded and expedited, and reliable systems will be brought on line.

5. Submarine cable technology will be sufficiently well developed and costs will be viable enough to enable a Maui-Molokai cable to be installed by 1982. A Maui-Oahu 100 MW cable, operating at 50 percent of capacity, would transmit 4 billion kWh a year, and a 1-mil (1/10 of a cent) charge would generate $4 million of revenue to help repay the cost of the cable, assuming the State would fund such a project.

6. Capital financing for these projects would be available, either from the private sector or from various Federal, State or county programs such as President Carter's proposed energy development fund from excess profit tax, or from the proposed Hawaii Alternate Energy Development Fund of the "utility bond" program.

7. Adequate, technologically sound, and cost-effective storage systems, both for short-term and for longer periods, will be available for those times when intermittent alternative energy sources are not generating electricity.

8. By 1990, the ethanol-from-molasses project will be providing its maximum potential of about 22 million gallons a year for gasohol or 100 percent alcohol-powered vehicles. The needed RD&D on full sugar crops (which possibly could provide up to 150 million gallons a year of liquid fuel) and other promising crops will be carried out, and appropriate programs will be implemented where feasible.

9. A shift to electric and hybrid vehicles will be well underway by 1990 and completed by the year 2000. (The exception would be those vehicles requiring 100 percent alcohol fuels.)

Benefits of a 1990 Electrical Energy Self-Sufficiency Program

1. Electrical energy self-sufficiency for Hawaii will eliminate the need for more than 30 million barrels of oil imported per year, which cost in excess of $800 million today and are due to increase rapidly in the years ahead.

2. Hawaii ESS Program will ensure that Hawaii's future energy needs will be supplied, independent of world politics and supplies; thus the fear of brownouts or total loss of electric power caused by a lack of fuel oil will be eliminated.

3. The money that is currently spent to import petroleum will no longer be sent out of the State but will remain in the State and contribute to the health of the economy, not only in the form of dollar savings but as wages and taxes.

4. New industries will be developed, which will result in the creation of jobs in both technical and nontechnical areas; the result of this will be to diversify and strengthen Hawaii's economy.

Achieving the Goal

The key to achieving the goal of energy-self-sufficiency by 1990, using all of these current and future technologies, is a strong foundation of energy conservation. Hawii's goal is 10 to 20 percent savings through convervation by 1990.

In addition to a strong conservation program, the State of Hawaii has a number of activities planned. The Hawaii State Senate is holding a workshop in November to evaluate the state of the art efforts in Hawaii and the RD&D that will be needed to bring energy technologies to commercialization by 1990. This effort is aided by citizens and community groups who are involved in planning for island, county, and State efforts toward energy self-sufficiency. Technical committes are developing goals and plans for needed RD&D and funding levels.

In summary, the energy self-sufficiency plans for Hawaii are a joint effort of the State, counties, islands, University, private industry, the utilities, and communities. Only with such a cooperative effort can Hawaii's goal be achieved.

General Assumptions of Statewide 1990 Demand and Supply Projections

The goal is to achieve 100% electrical energy self-sufficiency for Hawaii by 1990. The following are preliminary projections to meet the projected demand. Specific details are given for each island. The assumptions on which these projections are based are as follows (see Table 6.).

1. Oahu's deficit in supply will be fulfilled by importing surplus wind energy from Molokai and geothermal energy from the Big Island of Hawaii; this assumes the installation of submarine cables ($3{,}700 \times 10^6$ kWh at 1 mill would generate $3,700,000 annually for the cost of the cable transmission). Lanai's surplus energy will be transmitted via submarine cable to Maui at 1 mill = $42,000 value).

2. Biomass energy will make a more significant contribution through increased efficiency from the sugar industry, pineapple waste recovery,

TABLE 6. HAWAII ALTERNATE ENERGY SUPPLY PROJECTIONS FOR 1990
(ELECTRICAL ENERGY)

	Molokai	Lanai	Maui	Kauai	Hawaii	Oahu	TOTAL
POPULATION	9,624	2,467	99,560	46,500	133,400	917,300	1,208,851
DEMAND ($kwhx10^6$)							
Projections (Grid Only)	69	7.4	1,053	375	688	7,858	10,050.4
Conservation Savings (Grid Only)	-7	-.7	-105	-37	-69	-786	-1,004.7
Sugar Plantations (1975 data)	-	-	215	100	100	141	556.0
Net Demand	62	6.7	1,163	438	719	7,213	9,601.7
ELECTRICAL SUPPLY ($kwhx10^6$)							
Biomass							
Bagasse	-	-	225	131	299	182	837
Pineapple Waste Recover	7	28	15	-	-	6	56
Wood Chips	10	10	18	9	74	-	121
Solid Waste	4	-	40	18	44	362	468
Other Fuels	12	-	-	-	-	-	12
Geothermal	18	-	153	-	1,349	-	1,520
Wind (includes 6 hours storage)	3,020	0.9	600	150	600	3,000	7,370.9
Solar							
Water Heating	3	0.6	25	10	30	230	298.6
Air Conditioning	-	-	10	5	10	-	25
Photovoltaic	10	10	10	2	10	10	52
Thermal	10	-	20	40	15	10	95
OTEC	-	-	-	-	66	66	132
Hydroelectric	1.0	-	51	179	6	-	237
Other	-	-	-	-	-	-	-
TOTAL PROJECTED SUPPLY (Alternative Sources)	3,095	49.1	1,167	544	2,453	3,876	11,184.1
BALANCE	3,033	42.4	4	106	1,734	-3,337	1,582.4
PETROLEUM DEMAND (bbls)							
Electrical Generation from Oil (to meet projections)	110,000	12,000	2,062,000	777,000	1,275,000	12,789,000	17,025,000
Potential from Alternate Sources	5,468,000	87,000	2,069,000	902,000	4,349,000	4,213,000	17,088,000
Balance	5,358,000	75,000	7,000	125,000	3,074,000	-8,576	63,000

wood chips and other crops, as well as solid waste recovery. Further, molasses and eventually other crops will help provide liquid fuels for ground transportation (which will be covered in another section).

3. 220 MW of geothermal power have been projected by 1990 on the Big Island along with modest amounts in Maui and Molokai. This could be the best "firm power" resource, and even Oahu might secure an estimated 200 MW of power by the 1990's if projected explorations are successful.

4. Wind energy projections are based primarily on the calculations of Boeing engineers who indicate that the Boeing MOD 2 wind turbine generators will provide 15 million kWh a year in an 18 mph wind regime. Other systems, both vertical and horizontal axis, are scheduled to be in production in the near future with projections that are also economically viable.

5. The solar water heating projection of 59,535 systems statewide is very conservative. The year 2000 goal includes 100% of the single family residential units and a percentage for apartments and hotel units. Solar air conditioning, photovoltaic, thermal electric, and process heat technologies represent demonstration projects and a few early commercialized projects. These technologies could possibly provide a substantial amount of power in the future; some scientific breakthroughs are needed, however.

6. OTEC assumes only two 10-MW demonstration plants on line by 1990, although an optimistic projection could include a 100-MW plant on line by the early 1990's.

7. Hawaii's hydroelectric power potential is limited; however, the current contribution of 20 MW could be increased by 20 to 30 MW by 1990. Pump-storage-hydroelectric systems could provide an important energy storage medium, with the first project planned for Molokai.

Practical Advice on Developing A Local Government Energy Program

Moderator

Dorothy A. Lacher,
Policy Analyst, Office of Policy and Evaluation
U.S. Department of Energy

Speakers

Edward Holt
Seattle, Washington

Robert Kleinman
Southern Tier Central Regional Planning & Development Board
Corning, New York

Ann Cline
Director, City Energy Program
Richmond, Indiana

Richard Mounts
National League of Cities

Ann Jones
Columbus, Ohio

Thomas Tomasi
Mayor, City of Davis
Davis, California

Don Megathlin
Portland, Maine

Summary

Theoretical and idealized energy planning programs are only the starting point for a workable and effective system. Through practical experience, these panelists have gained invaluable knowledge on how to go about actually implementing a program. Their experiences and suggestions are contained in their various papers, to which the reader is referred:

- Clara Miller—Section E—Workshop on Community Energy Planning Methods
- Thomas Tomasi—Section E—Workshop on Legal Strategies
- Edward Holt—Section G—Plenary Session III

- Ann Cline—Section G—Plenary Session III
- Marion Hemphill—Section G—Plenary Session III
- Donald Megathlin—Section E—Workshop on Community Energy Planning Methods
- Ann Jones—Section E—Workshop on Community Energy Planning Methods

This informal session focused on the first-hand experiences of energy planners and officials and sought to generate some rules of thumb for local initiatives.

An overview of local energy activities was presented by Dorothy Lacher. Some of the main problems cited at the local level were: 1) lack of data; 2) lack of experienced personnel; 3) inability to cope with range of unanticipated problems and crises.

The Community Education and Training Act (CETA) and the Community Services Administration Weatherization programs supplied a high percentage of funds for local programs.

The involvement of a core group of committed people was the key to most local efforts.

Brief presentations were given by panelists outlining the positive and negative aspects of their respective experiences.

Seattle, Washington: Edward Holt

The focus of energy efforts was on conservation, working in conjunction with a local municipally owned utility.

Problems: 1) broad community participation was not maintained; 2) no empirical evaluation mechanism was set up; 3) lacked coordination with local government offices; 4) did not integrate energy and land use plans.

Corning, New York: Robert Kleinman

Insights: 1) the maintenance of interest and enthusiasm of support volunteers is important; 2) if energy planners are a regional agency, time must be allotted to coordinate various local governments; 3) energy planning staff should be large enough to allow for inter-group support.

Richmond, Indiana: Ann Cline

Insights: 1) plans must be made to educate those sectors of the community assessed to be against energy alternatives; 2) an assessment of local "tools" available for implementing the energy plan should be carried out early.

Columbus, Ohio: Ann Jones

Insights: 1) where possible utilize resources from other cities in implementing as thorough an energy audit as possible; 2) look for opportunities to retrofit energy planning groups into the appropriate branch of local government; 3) gain support of city government by sponsoring seminars, lectures, etc. tailored for city officials.

Richard Mounts

Insights: Energy plan should be integrated into the local electoral process. Local politicians should be encouraged to make commitments to the implementation of the energy plan.

City of Davis: Thomas Tomasi

Insights: 1) political strategies should be developed to utilize election years and political platforms to insure support; 2) energy policies can and should become increasingly progressive.

Panel presentations were followed by questions and answers:

Q: *Who are the primary support groups in the communities? Banks? Citizens?*

A. Answers to energy issues must come from the community people, but prevailing wasteful lifestyles must be drastically altered.

Q: *Why should local governments make expenditures when the state and federal governments have the dollars and mechanisms to implement energy programs?*

A. Local independence in making energy initiatives is important. Local governmental activity can have the effect of stabilizing the community.

Q: *What happens when local government mandates particular technologies?*

A: Davis has had good results from just setting minimum standards.

Q: *What are local governments looking for with regards to state and federal assistance?*

A: A wholehearted attempt by states to involve local expertise is often lacking. Localities should have a hand in planning and implementation.

Q: *How do energy plans relate to utilities?*

A: Utilities must be convinced that it is in their financial interest to change to conservation or renewable energy. Most locals represented were involved with municipally owned utilities.

Q: *How has implementation of energy policies changed attitudes of citizens?*

A: The Davis experience has shown that people become energy conservation competitors. Who can save the most energy on the block?

The County Energy Plan Project

Jim Benson
Institute for Ecological Policies (IEP)
Fairfax, Virginia

The purpose of this work group was to distribute and explain the *County Energy Plan Guidebook* recently published (July 1979) by the IEP. As described by Jim Benson, the *Guidebook* is a comprehensive, step-by-step method for energy planning at the local level. Following a set of simple procedures, a citizens group can create the nucleus of an organized effort to conserve energy sources. Benson stressed that the process of developing the "plan" was in fact more important than the final document which might be produced. By involving local citizens, utility representatives, bankers, and other members of the community, the effort broadens its resources and creates the necessary political constituency to support the finished plan.

The IEP has distributed its initial printing of the *Guidebook* and with the assistance of several national and state organizations is in the process of distributing a second printing. The League of Women Voters and the Michigan Energy Extension Service are currently involved in this effort. Benson indicated that, when a substantial number of the energy plans had been completed, he hoped to organize a national convention to call attention to what would, in effect, be a grass-roots, national energy plan.

Several participants asked whether any financial support is available to local groups for these plans. Benson suggested that the methodology was designed for a volunteer effort. It is possible, however, that federal, state, and private institutions would be interested in supporting these projects.

The following discussion focused on possible sources of information for completing the *Guidebook* plan. Although many possibilities were discussed, Benson emphasized that each planning group would probably have to adopt its own unique source of data and that the most effective method would be to include in the group a contact with experience and good access to information.

Riverside, California: A Forerunner of Comprehensive Community Energy Planning

Allen L. White, Northern Energy Corporation
Northeast Solar Energy Center
Cambridge, Massachusetts

David A. Ball, John R. Hagley, Sherwood Talbert
Battelle Columbus Laboratories
Columbus, Ohio

Robert Zweig, M.D., Chairperson
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Riverside, California

Overview

The City of Riverside, California, located adjacent to Los Angeles, is perhaps one of the smoggiest cities in the country. In addition to the smog's obvious environmental and health costs, it has been estimated that the financial costs of smog in the South Coast basin is approximately $2 billion per year.

These unusually severe conditions led the city to look at fossil fuel energy conservation as a means of reducing local air pollution. An independent contractor was retained to (1) conduct an energy audit, (2) compile an energy-demand profile, (3) select and evaluate energy and energy conservation options, and (4) present the results. Some of the outputs included (1) an energy use map of the city; (2) an energy use matrix which broke out residential, commercial, and industrial uses for each region of the city; and (3) identification of energy-conserving opportunities controllable directly by the city government, e.g., code enforcement, car and van pooling, purchase of fuel-efficient cars, land use policies, solar-based zoning ordinances, performance standards for new residential units, and street light replacement.

The contractor developed various strategies for implementation, analyzed their feasibility, revised the strategies, and made final recommendations to a citizen advisory committee. The committee, in turn, presented its report to the city council, which accepted it and requested a multi-year implementation plan. This plan was produced and is now being costed out by the city manager's office.

Abstract

Local governments are adopting an increasingly activist role in planning for their energy futures. Extreme dependency on oil and natural gas and environmental degradation prompted one such effort in the City of Riverside, California. In close coordination with a community-based Advisory Committee, a research team developed a planning model for evaluating local conservation/supply alternatives composed of the following: baseline data compilation, formulation of three population growth scenarios; calculation of "business-as-usual" demand projections by fuel and by sector; assessment of conservation opportunities; revision of demand forecasts; and evaluation of supply alternatives. In addition, for each conservation/supply package, a feasibility analysis and assessment of secondary outcomes were undertaken. Application of the methodology to Riverside suggests that an intensive local effort based on conservation and alternative fuels can reduce oil and natural gas consumption in the year 2000 by as much as 76 percent when compared to a "business-as-usual" scenario. This can be achieved while significantly reducing the levels of primary emissions and enhancing the community's overall quality of life.

Summary

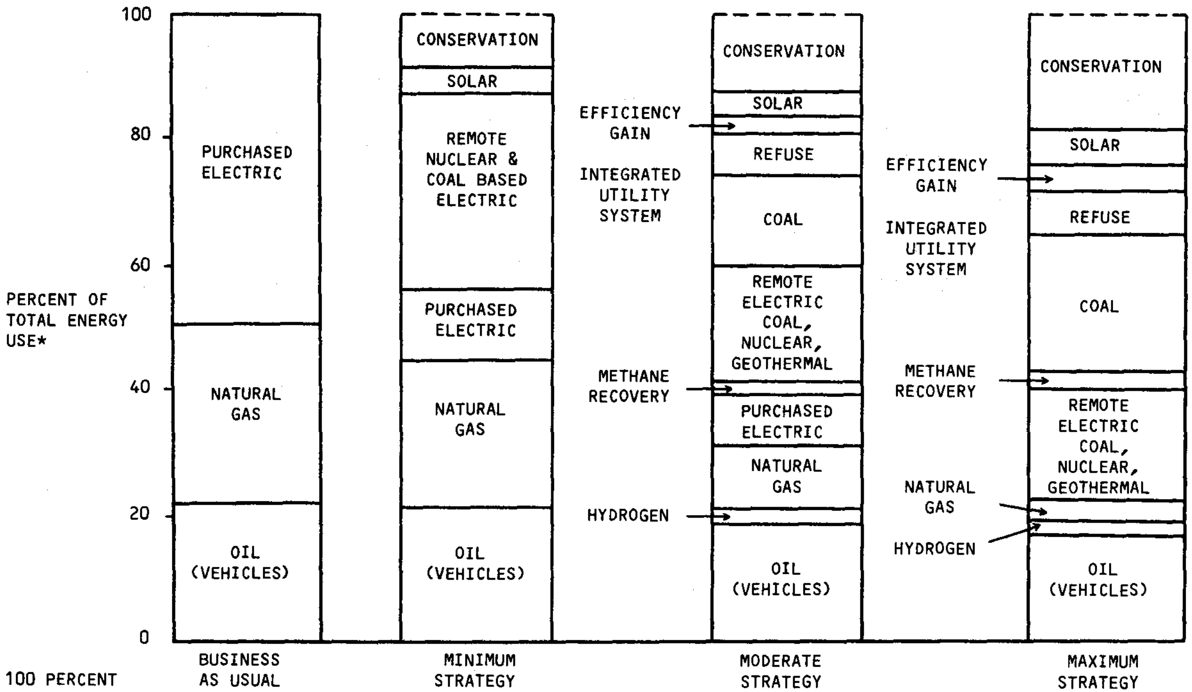
The concept of local participation in planning a secure energy future has achieved widespread acceptance across all levels of government. The number of local initiatives aimed at reducing the nation's dependence on oil and natural gas has proliferated during the last five years, and the backlog of such experiences has proven to policy-makers that local energy needs are too urgent and local resources too diverse for municipalities and counties to remain secondary actors in the energy planning process.

One example of a local planning program with national implications was recently completed in the City of Riverside, California. Under contract with the U.S. Department of Energy, and in close collaboration with a community-based Advisory Committee, a multi-disciplinary research team attempted to formulate a planning methodology and program which could be replicated throughout the South Coast Air Basin, and thereafter, to other communities across the country. The mandate from DOE was to develop a planning model which any locality could readily adopt and apply to its specific socio-economic, environmental and institutional setting to arrive at a set of strategy options from which decision-makers could choose. The key criterion that all such options must meet was that local actors—the municipal government, the municipal electric utility, builders, contractors, individual homeowners, manufacturers and business people, etc.—control most or all of the resources to proceed with implementation of the recommended projects and programs developed in the study. Riverside appeared to offer a particularly appropriate setting for such an experiment for four reasons: (1) the community is extremely (90 percent) dependent on oil and natural gas; (2) severe air pollution, stemming from its location in the eastern extreme of the South Coast Air Basin, has long been a major public health hazard; (3) a municipal utlity exists and could serve as a vehicle for program implementation; and (4) a manageable population size, 163,000, would permit appreciable results before the year 2000.

After an intensive 18-month assessment of a variety of conservation and supply packages, the study team concluded that Riverside, operating primarily within the constraints of its own resources and legal authority, is capable of implementing a set of cost-effective alternative energy measures which collectively can drastically reduce its reliance on oil and natural gas. Defined within the context of three strategies reflecting varying levels of effort, we estimate that Riverside can reduce its forecasted consumption of oil and natural gas for the year 2000 by 40 to 76 percent (Figure 1). A minimum strategy relies primarily on sizable reductions in the substitution of Riverside-financed remote coal-based and nuclear electric generation in combination with a variety of conservation measures and some solar hot water heating.

A moderate strategy adds remote geothermal electrical generation, new and more intensive conservation programs, increased use of solar hot water systems, methane recovery from feedlot manure and refuse, and an integrated utility system (IUS) based on refuse and coal which provides steam and chilled water for a portion of Riverside's core area and 30 percent of the city's electric needs. The IUS also achieves a measurable efficiency gain as a result of the cogeneration of steam and electricity.

Finally, a maximum strategy builds upon the moderate strategy



*THE 100 PERCENT FIGURE IS APPROXIMATELY EQUIVALENT TO 43 x 10^{12} BTU/YEAR OR 7.2 x 10^{6} BARRELS OF OIL PER YEAR.

Figure 1. EFFECT OF IMPLEMENTING SELECTED ENERGY SUPPLY AND CONSERVATION OPTIONS ON RIVERSIDE ENERGY USE IN THE YEAR 2000

measures with a more extensive conservation program, additional solar hot water (now 70 percent in existing residences and 100 percent in new residences) and extension of the IUS to include the Central Business District, the University area and major commercial and industrial consumers. This strategy also includes the use of hydrogen produced by electrolysis for the entire municipal vehicular fleet. A maximum strategy reduces Riverside's oil and natural gas energy requirement in the year 2000 to less than half that consumed in 1976 and totally eliminates the need for purchasing electricity from non-Riverside suppliers.

Methodology

In addition to our findings concerning the achievable reduction in scarce fossil fuel consumption, an equally important contribution of the Riverside project is the analytical framework which evolved during the 18-month study period (Figure 2). We discovered early in the research program that while the separate components of such a framework had been developed by other researchers, there existed no systematic integration of these components into a comprehensive methodology generally applicable to any community-level energy analysis. Although the degree to which any component of Figure 2 is evaluated may vary according to available community resources, we strongly recommend that all be addressed to some degree to insure that a systems viewpoint is maintained.

As indicated on the far left of Figure 2, the study was initiated with the compilation of baseline data on Riverside's socio-economic, institutional and energy characteristics. This baseline information was essential to determine the kinds of energy, human and institutional resources available to the community, and the degree to which these resources are utilized in the existing energy supply system, conservation and planning programs. Our sources of data included the Riverside Planning Department, Public Utilities Department, Chamber of Commerce, City Manager and other municipal officials; Southern California Edison and Southern California Gas; local architects, builders, manufacturers and other business people; and the State Energy Commission, Air Pollution Control Board, and Public Utilities Commission. Specifically, information was compiled for the following:

- historical and present energy use, by fuel type end use and census tracts;
- historical and current environmental conditions, especially the types, sources and distribution of air pollutants;
- energy resources actually or potentially within the community's

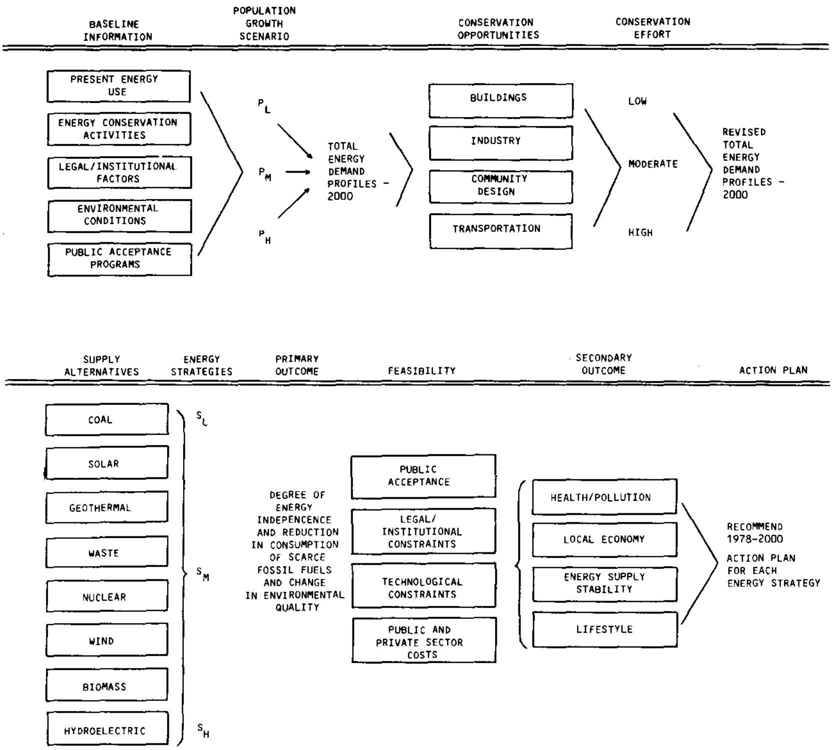


Figure 2. A MODEL FOR COMPREHENSIVE COMMUNITY ENERGY PLANNING

control (though not necessarily within its physical boundaries), including coal, solar, geothermal, municipal solid waste, nuclear, wind, biomass and hydroelectricity;

- existing planning programs and conservation activities;
- ordinances, regulations and statutes pertinent to the demand and supply of energy within Riverside;
- transportation modes and patterns
- socio-economic and infrastructural characteristics of census tracts.

We emerged from this data gathering effort with a detailed inventory of the community's resources and estimates of their potential contribution to reducing the city's dependence on oil and natural gas.

The next step of the study involved the formulation of three population growth scenarios and the projection of energy demand based on a "business-as-usual" scenario, that is, no changes in the per capita or sectoral (residential, commercial, industrial) distribution of energy consumed in the city. We examined state and local population projections and modified them in accordance with the growth management measures recently adopted by the city.

With a "business-as-usual" scenario as a starting point, a large number of conservation opportunities in the areas of building structures, industrial processes, community design and transportation were evaluated. Included in this assessment were options such as:

- revision of zoning and building codes to encourage passive solar design;
- revision of the General Plan to emphasize planned unit developments (PUD's);
- expanded conservation education programs aimed at small industry and business;
- appointment of a City Energy Coordinator;
- rapid implementation and increased enforcement capabilities to implement the revised state building codes;
- reduction in the number and changes in the type of public street lighting;
- enactment of a building retrofit code.

Each measure was assigned to a minimum, moderate and/or maximum strategy according to our preliminary estimates of the feasibility of implementation. In some cases, such as the revision of zoning and building codes to encourage passive solar design, varying levels of implementation differentiated the three types of scenarios. In the case of zoning and code revisions for example, it is assumed that 20, 40 and 60 percent of detached residential units (corresponding to minimum, moderate and maximum strategies) would be passively heated by the year 2000.

Upon completion of the estimates of conservation impacts for each measure and each population growth scenario, we proceeded to revise downward the demand profiles projected for the year 2000. On the basis of these projections, we then considered a range of fuel options identified in Figure 2. Our fundamental criterion in selecting various options was, once again, whether the community exercised control over their implementation. For example, development of a large-scale synthetic fuel or breeder reactor program at the national level were not considered. Larger global issues (i.e., an oil embargo, nationwide gasoline rationing, a national or regional four-day work week) also were excluded because they are outside the control of the City of Riverside. In identifying supply options, it was assumed that the city would continue to be in the electric utility business, and that it is capable of participating in the financing, management and operation of both centralized or decentralized energy production systems. We did not consider generation alternatives for Southern California Edison, the exclusive supplier of electricity to the city's municipal utility. These guidelines led us to examine supply options such as:

- investment in remote coal-fired and geothermal electric generation facilities;
- a coal and refuse-fired integrated cogeneration system for the core area;
- methane production from waste;
- active solar space and water heating;
- local geothermal district heating;
- hydrogen production for the city's municipal vehicular fleet;
- remote wind-powered electrical generation.

As in the conservation case, each option was assigned to one or more energy strategies on its feasibility and extent of implementation.

With a set of minimum, moderate and maximum packages of conservation and supply options, we proceeded to estimate the environmental impacts of implementing each strategy. The effect on emissions of hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2) and particulates were estimated. Because of existing severe air pollution in Riverside, it was clear from the outset that for both legal and poltical reasons any recommended energy strategy must produce *at minimum* no additional primary pollutants. This guideline was strictly adhered to in the final recommendations to the city.

The next step in the strategy formulation process was a more in-depth feasibility assessment and the estimation of secondary outcomes associated with each conservation and supply measure. At this point in the study, we more explicitly addressed public acceptance constraints, legal/institutional barriers, technological constraints and private/public sector costs. Secondary outcomes evaluated included additional health effects, local economic impacts, effects on supply stability and lifestyle adjustments required for implementation. In many cases, we were led to rethink our original feasibility assessment and reclassify the various measures into different strategies than those defined earlier. During this phase, the input from the Advisory Committee was critical to the formulation of a package of proposals that had a reasonable probability of implementation within the 20-plus year planning horizon used in the study. To maximize the usefulness of this effort, a simple quantitative technique was developed to order the various options according to their feasibility and secondary outcomes. Values ranging from 0-10 were assigned to each option for each measure of feasibility and each secondary outcome, (Figure 2), yielding total scores ranging from 40-58. These scores were used as a basis for reevaluating our initial assignment of options to strategies.

The final step in the study process involved the formulation of an action plan and implementation time schedule for each strategy between 1978-2000. The plan was intended to provide Riverside decision-makers with guidance and benchmarks against which they could measure their actions and progress. The timing ranged, for example, from immediate appointment of an energy coordinator to the initiation in 1984 of a cost/feasibility study for the proposed integrated utility system. Most measures disaggregated into two or more steps and the relevant actors involved in the implementation effort were identified.

Detailed Findings: An Example

To illustrate the variations in oil and natural gas savings associated with various conservation and supply options, we present in Table 7 the estimates for a moderate population growth scenario. Consider the figures for a moderate impact strategy which, it will be recalled, is defined as a set of options reasonably feasible within the limitations imposed by Riverside's legal, financial and political environment. Remote coal-fired electric generation represents the single greatest opportunity for displacing oil and natural gas consumption. Estimated savings total 14.3×10^{12} Btu's/year. This is followed by the proposed IUS which would provide heating, cooling and some electricity for a portion of the city's downtown and business areas. District heating with nearby geothermal resources would also significantly reduce oil and natural gas consumption at a rate of 2.8×10^{12} Btu's/year.

Among the energy conservation options, three produce particularly large savings: an education program to encourage vanpooling and carpooling and the purchase of fuel efficient vehicles (1.202×10^{12} Btu's/year), an educational program to improve the efficiency of industrial processes and operations (0.927×10^{12} Btu's/year), and a building retrofit code to improve the energy efficiency of the existing stock (0.923×10^{12} Btu's/year).

Environmental impacts are most dramatic for those measures which reduce vehicular travel and car sizes, and those which substitute alterna-

TABLE 7. COMPARISON OF ENERGY SAVINGS, ENVIRONMENTAL IMPACTS WITH SECONDARY OUTCOMES AND FEASIBILITY ISSUES IN TERMS OF MODERATE POPULATION GROWTH RATE IN THE YEAR 2000

	Energy Savings		Environmental Impact (Decrease in Emissions, lb x 10^3/yr)					Secondary Ou and Feasib Values
Options	Impact	Savings	HC	CO	NO_x	SO_2	Particulates	
		BTU's x 10^{12})						
Building Retrofit Code	Low	.660 (a)	4.3	8.3	152.3	86.6	10.3	40
	Moderate	.923 (a)	6.1	11.5	212.6	120.9	14.4	40
	High	1.186 (a)	7.8	14.9	272.0	154.4	18.4	40
State Energy Code	Low	.283 (a)	1.8	4.1	63.7	35.2	4.3	58
	Moderate	.476 (a)	2.9	7.1	101.5	55.3	6.9	58
	High	.715 (a)	4.4	10.5	153.3	83.8	10.4	58
Continued Upgrading of Energy Codes for New and Existing Buildings	Savings too Variable		-	-	-	-	-	51
								51
								51
Modified Housing Mix	Low	.025 (b)	.26	.5	9.2	5.2	.63	41
	Moderate	.079 (b)	.83	1.6	29.1	16.5	2.0	41
	High	.142 (b)	1.5	2.8	52.3	29.7	3.6	41
Energy Efficient Neighborhood Development	High Only	.573 (b)	343.8	4526.7	744.9	28.7	74.5	57
Planning Policy to Encourage Use of Passive Solar Building	No Direct Savings Attributable		-	-	-	-	-	49
Passive Solar Thermal Standard	Low	.252 (b)	.882	7.560	24.444	.151	1.512	47
	Moderate	.412 (b)	1.442	12.360	39.964	.247	2.472	47
	High	.475 (b)	1.663	14.250	46.075	.285	2.850	47
Passive Solar Cooling Standard	Low	.187 (b)	3.4	.075	119.7	78.2	8.2	50
	Moderate	.293 (b)	5.3	.103	187.5	122.5	12.9	50
	High	.393 (b)	7.1	.138	251.5	164.3	17.3	50
Convert Incandescent Lights to High Pressure Sodium	Low	.028 (b)	.50	.01	17.9	11.7	1.2	49
	Moderate	.028 (b)	.50	.01	17.9	11.7	1.2	49
	High	.028 (b)	.50	.01	17.9	11.7	1.2	49
Reduce Total Energy Demand in Street Lighting	Low	.038 (b)	.68	.013	24.3	15.9	1.7	48
	Moderate	.076 (b)	1.37	.03	48.6	31.8	3.3	48
	High	.114 (b)	2.05	.04	72.9	47.7	5.0	48
Education Program to Improve Efficiency of Industrial Processes and Operations	Low	.627 (c)	.63	2.5	110.9	117.3	5.6	57
	Moderate	.927 (c)	.93	3.7	164.1	173.4	8.3	57
	High	1.223 (c)	1.22	4.9	216.5	228.7	11.0	57
Education Program on Vanpooling, Carpooling, Purchasing Fuel Efficient Vehicles, Driving Efficiencies	Low	.801 (d)	480.6	6327.9	1041.3	40.1	104.1	47
	Moderate	1.202 (d)	721.2	9495.8	1562.6	60.1	156.3	47
	High	1.603 (d)	961.8	12663.7	2083.9	80.2	208.4	47
Integrated Utility System Based on Gasification of Cost and Refuse	Low	7.2 (e)	120.	-80.	2000.	800.	80.	45
	Moderate	8.7 (e)	150.	-100.	2500.	1000.	100.	45
	High	10.5 (e)	180.	-120.	3000.	1200.	120.	45
Solar Water and Space Heating	Low	1.0 (f)	3.5	35.	98.	0.6	6.0	50
	Moderate	1.2 (f)	4.2	42.	118.	0.7	7.2	50
	High	2.0 (f)	6.7	67.	188.	1.1	11.5	50
Geothermal District Heating	Low	2.3 (g)	62.	48.	224.	1.4	14.	40
	Moderate	2.8 (g)	76.	58.	273.	1.7	17.	40
	High	3.4 (g)	93.	71.	333.	2.1	21.	40
Methane from Wastes	All	0.2 (h)	Essentially No Change					45
Remote Generation	All	14.3 (i)	257.	5.	9152.	6000.	630.	50
Hydrogen Vehicles	All	0.24 (j)	144.	1896.	312.	12.	31.2	44

tive fuels for oil-fired generating facilities. The proposed transportation education program achieves the first of these, whereas the IUS achieves the second. It is particularly noteworthy that local coal burning in the IUS will not, on balance, contribute to further environmental deterioration.

While attractive oil and natural gas savings are achievable through many options, the secondary outcomes and feasibility scores of some of these options reduce their viability as workable policy alternatives. For this reason, building retrofit codes were judged to be appropriate only for a maximum strategy. Similarly, because the full-scale implementation of an IUS would be extremely costly, only a scaled-down version is recommended for a moderate impact strategy.

Conclusions and Epilogue

The Riverside study offered a rare opportunity to expore the full range of methodological and practical issues associated with comprehensive community energy planning. The results of our effort suggest that:

- the major impediments to comprehensive energy planning at the local level are primarily institutional and political in nature;
- a systematic analysis of a community's conservation and supply options can yield a wide range of opportunities to reduce dependence on oil and natural gas, and many of the most effective options involve a minimal commitment of local resources;
- local government, working in cooperation with business, industry and citizen groups, can utilize a comprehensive energy planning program as a vehicle for promoting economic growth and energy security.

Since the results of the Riverside study were presented to the city in January, 1979, the Committee has recommended to the city council that Riverside:

- employ a full-time Energy Cooordinator
- implement those conservation measures most adaptable to the city including:
    - amending the city's building code to insure that all feasible energy conservation techniques are incorporated;
    - conducting an energy audit of all city buildings;
    - developing a new off-peak electric rate structure;
    - authorizing a public relations/education program;

  - further investigating those alternative energy systems presently available to the city, including a survey of local industry for potential cogeneration of electricity from waste heat; investigating the potential for recovering methane gas from landfill; investigating the possibility of a partnership with Southern California Edison in the development of a fuel cell to supply electricity; considering a joint partnership with the Los Angeles Department of Water and Power in a demonstration geothermal plant;
- seek state funding for the development of alternative vehicle fuels;
- cosponsor a solar/hydrogen seminar in the City of Riverside in January, 1980.

The Advisory Committee remains an active forum for the discussion of energy issues affecting the community and for the communication of recommendations and policy alternatives to the city council and the public at large.

Acknowledgements

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Employment Prospects from Solar Energy: A Bright But Partly Cloudy Future

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Abstract

The current state of knowledge about employment impacts of solar versus conventional technologies is used to make quantitative and qualitative comparisions of these impacts across technologies. For purposes of quantitative comparison, employment requirements are standardized to employee effort per unit of energy per year of operation. These current quantitative employment estimates show solar technology induced employment to be generally greater than employment in conventional technologies. The qualitative discussion focuses on the relative size and spatial distribution of the various technologies, concluding that the effects of solar are more positive than for conventional facilities because of smaller size, dispersed locations, and gradual implementation.

Introduction

Increased employment has been postulated as one of the significant secondary benefits of a shift from conventional to solar energy use. Recent estimates of the potential scale of this benefit support such a claim, though they must be considered tentative and almost speculative at this time.

For solar heating and cooling of buildings (SHACOB) systems, which include hot water heating, active heating, active heating and cooling, and passive heating and cooling systems, labor estimates are based on limited experience with modest numbers of systems. For solar systems which generate electricity, only wind systems have any real employment history; central thermal, photovoltaic, and ocean thermal systems' labor requirements are based almost wholly on engineering estimates and extrapolations from related industries. By contrast, conventional energy systems (coal electric, nuclear, oil electric, gas electric, and coal mining) have a considerable body of actual employment experience on which to base estimates of labor requirements. While a comparison of employment from systems with such widely varying degrees of reliable data is somewhat uncomfortable, it is the only alternative available if we wish to examine relative labor intensities today. The analyses to date yield overwhelming support for the contention that solar, especially SHACOB systems, will require more labor resources than conventional energy sources.

In addition to the relative magnitude of labor required by different energy systems, the issues of location, duration, and occupation of the labor required are also important and heretofore have been largely ignored. While also somewhat speculative, analyses of these issues point toward significant and positive benefits of solar energy relative to planned conventional electric energy sources.

While the employment effects of energy alternatives are complex, they can be classified as either *quantitative* or *qualitative* effects. The importance of each of these effects varies with the type of system being compared, the proposed location of the system, the scale of the geographic area of concern, and the particular issue of interest to the analyst. This paper compares both the quantitative and qualitative employment effects of solar and conventional systems and presents an analytical framework for determining such effects. Findings have been based on three principal sources of information:

1. Technology characterizations of the Technology Assessment of Solar Energy (TASE) program about work currently in progress at Argonne and the other Department of Energy national laboratories [1];
2. Published estimates of the labor requirements of solar energy from the Mitre Corporation, the U.S. Department of Energy, and several other sources [2 to 5]; and
3. Previous work at Argonne on the employment impacts of conventional energy systems [6 and 7].

Methods[1]

Quantitative Employment Effects

In order to estimate the total employment effect of a shift from conventional to solar energy sources, the following types of employment effects must be considered:

1. *Direct Employment* required for:
   A. Construction and/or installation
   B. Operation and maintenance (O&M)
   C. Fuel supply
   D. Direct system manufacturing and/or assembly
   E. Energy transmission and/or distribution (T&D)
2. *Indirect or Secondary Employment* required to support direct employment in sectors such as:
   A. Raw materials mining and processing
   B. Indirect or component parts manufacturing
   C. Business services such as communications, transportation, financing, research, legal, etc.
   D. Retail services for wage earners and stockholders

   It should be emphasized that these effects repeat themselves as expenditures and money recycled through the economy. They are generally estimated using either employment multipliers (ratios of total employment to direct employment) or by using input-output transaction tables.
3. *Displacement Employment,* especially for solar, where it may displace direct and indirect employment from conventional energy sources. Displaced energy employment is important but very difficult to estimate. It depends on the:
   — type of energy displaced
   — impact on: -capacity constructed
   -fuel use
   -O&M, T&D
   — back-up system requirements for solar, and the
   — indirect effects of any direct employment decreases

   Analysis of these effects is a complex and situation-specific endeavor.
4. Employment effects from money available to be spent on other consumer or investment items if solar energy costs less (*Respending Effects*) or money no longer available if solar costs more (*Substitution Effects*). This increase or decrease in available or

disposable income will have employment impacts. Determination of these employment impacts requires macroeconomic modeling with detailed information about:

— the real economic cost of alternatives
— the economic sectors impacted
— the labor intensities of sectors
— the timing of expenditure shifts
— the state of the economy

Estimates of labor requirements for construction/installation, operation and maintenance, and fuel supply are first presented based on references 1, 2 and 7. Next, total direct, indirect, and combined direct and indirect effects are analyzed based on data from references 2, 3 and 4. Net national energy employment including displacement effects are presented from reference 3. Respending or substitution effects are not presented, though Rodberg [5] has found them to be even greater in magnitude than combined direct and indirect effects.

Qualitative Employment Effects

The *qualitative* employment effects of energy alternatives vary with:

— Relative facility size
— Peak number of employees required
— Type and duration of jobs
— Expected locations of facilities
— Population shifts induced
— Community social structure

Where data is available [6, 7] to compare SHACOB, Solar Electric, and Conventional Electric facilities with these characteristics, it is presented. Otherwise, the issue is simply discussed based on current observations and expectations.

Findings

Quantitative Employment Effects

Table 8 presents the basic quantitative data on construction/installation, operation, maintenance and fuel supply for the systems studied, including conversion to normalized employment per 10^{12} Btu delivered per year. Figures 3 and 4 demonstrate the range of employment requirements estimated for the different system types and also the impact

TABLE 8. DATA ON CONSTRUCTION, INSTALLATION, OPERATION, MAINTENANCE, AND FUEL SUPPLY

System Type	Construction/Installation of Standard Systems: Btu/Yr/Syst.	Emp. Yrs/ System[a]	Systems/ 10^{12} Btu-Yr	Emp. Yrs/ 10^{12} Btu-Yr	Yrs. of System Life	Emp. Yrs/ 10^{12} Btu-Yr/ System Life	Peak Employ. Estimates Per System[b]	Annual Operation & Mainten. Emp. Yrs/ 10^{12} Btu-Yr.	Annual Fuel Supply Emp. Yrs/ 10^{12} Btu-Yr.	Total Cons-Install O & M, Fuel Supply Emp. Yrs/ 10^{12} Btu-Yr/ System Life
SHACOB [1]										
Active Hot Water	18×10^6	.016	55,555	889	20	44	-	153	-	197
Active Heating	65×10^6	.0585	15,385	900	20	45	-	51	-	96
Active Heating and Cooling	85×10^6	.142	11,765	1671	20	84	-	52	-	136
Passive Heating and Cooling	66×10^6	.0385	15,152	583	20	29	-	2	-	31
Solar Electric Systems- Approximately 100 MW [2 100 MW [2]										
Central Wind w/storage	2.6×10^{12}	567	.3846	218	30	7	≤ 567	21	-	28
Thermal w/storage	1.5×10^{12}	1133	.6667	755	30	25	≤ 850	40	-	65
Photovoltaic										
- Silicon Crystal	$.837 \times 10^{12}$	1133	1.195	1354	30	45	≤ 1075	10	-	28
- Thin Film	$.777 \times 10^{12}$	1800	1.287	2317	30	77	≤ 1930	10	-	55
- Concentrator	$.897 \times 10^{12}$	2333	1.115	2601	30	87	≤ 1784	10	-	97
Ocean Thermal [8]	2.9×10^{12}	4118	.345	1421	30	47	≥ 1176	12+	-	59+
Conventional Electric Systems [7]										
Coal* - 800 MW - Strip	14.35×10^{12}	4022	.0697	280	30	9	1490	10	5-18	24-37
Deep	14.35×10^{12}	4022	.0697	280	30	9	1490	10	50	69
Nuclear* - 1100 MW	19.73×10^{12}	7000	.0507	355	30	12	2000	4	?	16+
Oil** - 500 MN	7.5×10^{12}	1900	.133	253	30	8	728	12	?	20+
Gas** - 500 MW	7.5×10^{12}	1725	.133	229	30	8	792	9	?	17+

* Capacity factor of .6 assumed
**Capacity factor of .5 assumed.

[a]Estimates of construction employment for solar technologies are not available and have therefore been assumed to be 2/3 of total direct employment, the modal value for SHACOB technologies.

[b]Solar electric estimates adapted from [8] with speculation on adjustment of future estimates.

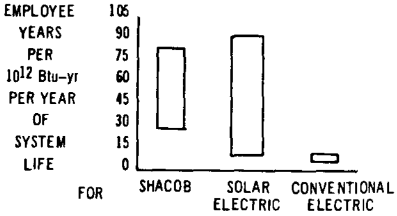

Figure 3. CONSTRUCTION AND INSTALLATION EMPLOYMENT REQUIREMENTS OF SOLAR VERSUS CONVENTIONAL TECHNOLOGIES [1, 2, 7]

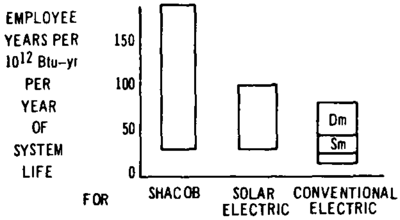

Figure 4. CONSTRUCTION AND INSTALLATION, OPERATION AND MAINTENANCE, AND FUEL SUPPLY EMPLOYMENT REQUIREMENTS OF SOLAR VERSUS CONVENTIONAL TECHNOLOGIES [1, 2, 7]

which continuous operation, maintenance, and fuel supply requirements can have on employment. The range is greatest for SHACOB technologies, with passive systems requiring moderate amounts of additional construction labor and almost no operating and maintenance labor. The relatively high range of construction/installation labor intensities of SHACOB and solar electric systems can be seen in Figure 3. Figure 4 shows the effect of adding operation, maintenance, and fuel supply requirements. The yearly cleaning and maintenance of active hot water systems (153 employee yrs./10^{12} Btu-yr.) may be excessive. Other references do not show such a disparity between active hot water and heating systems. Coal mining, both strip (SM) and deep (DM) mining causes the peak of the conventional range to move up substantially with respect to solar electric.

Table 9 presents the total direct and indirect employment estimates for the same technologies as before, however, only solar electric estimates are based on the same reference [2] as in Table 8. Note also that the units (Employee-Hours/10^{12} Btu-yr) are different but comparable. Tables 8 and 9 have been checked and are reasonably consistent. Figure 5 shows the ranges for total direct employment, including direct manufacturing/assembly and transmission/distribution. SHACOB and solar electric systems are comparable and somewhat higher than conventional electric systems. When indirect employment is considered in Figure 6, the higher multipliers assumed for SHACOB systems (apparently based on higher material cost components of these systems) result in significantly higher indirect employment. Figure 7 shows the combined effects of direct and indirect employment.

Figure 8 shows the Domestic Policy Review of Solar Energy [4] figures for net employment under three different national scenarios, each providing the same amount of end-use energy but with increasing shares of solar technologies. The numbers are cumulative totals for 1978-2000,

TABLE 9. DIRECT, INDIRECT, AND COMBINED EMPLOYMENT ESTIMATES

System Type	Employee Hours Per 10^6 Btu Output Per Year			
	Direct	x Multiplier	= Indirect	Direct & Indirect
SHACOB (3) , (4)				
Active Hot Water	2.81	2.0	5.62	8.43
Active Heating	4.23	2.0	8.46	12.69
Active Heating and Cooling	4.94	2.0	9.88	14.82
Passive Heating and Cooling	1.70	1.5	2.55	4.25
Solar Electric Systems (2)				
Central Wind	0.6-1.0	1.5	.9-1.5	1.5-2.5
Thermal	2.12	0.94	2.0	4.12
Photovoltaic	2.4-6.3	0.55	1.3-3.5	3.7-9.8
Ocean Thermal	1.5-2.6	0.6	0.9-1.6	2.4-4.2
Conventional Electric System (3)				
Oil	1.65	0.6	1.0	2.65
Coal - Low Btu Coal	1.95	0.7	1.37	3.32
High Btu Coal	1.68	0.7	1.17	2.85
Nuclear - HTGR	2.55	0.56	1.43	3.98
LWR	1.38	1.2	1.66	3.04

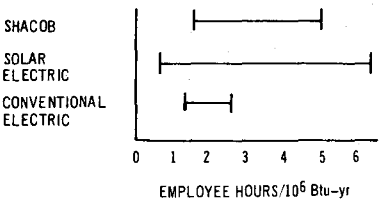

Figure 5. TOTAL DIRECT EMPLOYMENT REQUIREMENTS INCLUDING MANUFACTURING, ASSEMBLY AND TRANSMISSION DISTRIBUTION [2, 3, 4]

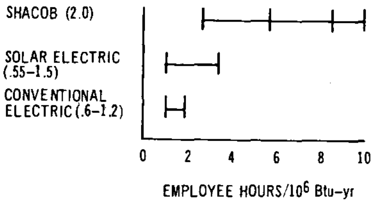

Figure 6. TOTAL INDIRECT EMPLOYMENT REQUIREMENTS [2, 3, 4]

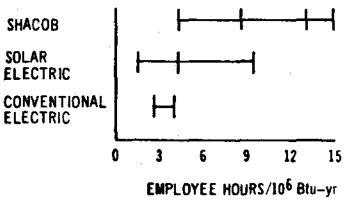

Figure 7. TOTAL EMPLOYMENT REQUIREMENTS INCLUDING DIRECT AND INDIRECT EMPLOYMENT [2, 3, 4]

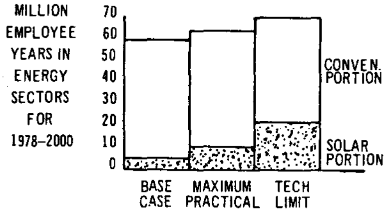

Figure 8. TOTAL AND SOLAR ENERGY EMPLOYMENT ESTIMATES UNDER ALTERNATIVE SOLAR PENETRATION SCENARIOS [3]

and include displacement effects, both direct and indirect, as solar contributes more energy and conventional sources contribute less. As can be seen in the future, total employment increases with increasing contributions from solar. This demonstrates that the increased employment from solar more than counterbalances the decreased employment from conventional sources.

Qualitative Employment Effects

Table 10 presents information on the average size of planned energy facilities, the peak number of employees required to build or operate the facility, and the number of counties in the nation in which that type of facility is planned to be constructed. These estimates are based on actual electric utility plans [6] and historical employment requirements [7]. Except for photovoltaic solar electric systems, conventional electric energy facilities cause several orders of magnitude higher peak employment requirements at the sites of the facilities due to their larger size. In addition, their larger size means that fewer areas will experience employment from

TABLE 10. SOLAR ENERGY SYSTEMS COMPARED TO PLANNED ELECTRIC FACILITIES AND COAL MINING (1, 2, 6, 7)

	Average Size Planned in MWe	Peak Employment Required for Average Size Plant	No. of Counties
SHACOB	<1	5	3,069
Solar Electric	100	567-1,930	100-1,000
Oil Electric	750	1,024	10
Coal Electric	917	1,653	116
Coal Mining	1,209*	98-1,390**	82
Nuclear Electric	2,083	3,367	78

*320 MWe per million tons per year assumed for 3,777 million tons per year average. (7)

**Based on the extremes of 26-368 employees per million tons per year for strip mines in Wyoming to deep mines in Utah. (7)

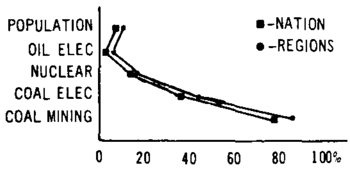

Figure 9. PERCENT OF TOTAL PLANNED CAPACITY IN LOW AND X-LOW ASSIMILATIVE CAPACITY AREAS [6]

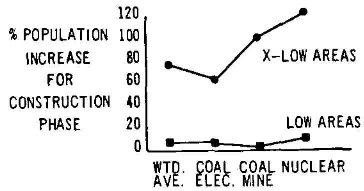

Figure 10. PREDICTED PEAK POPULATION GROWTH DUE TO AVERAGE FACILITIES [6]

these sources. SHACOB and solar electric technologies, on the other hand, are much more widely dispersed and of smaller size.

Many of the coal facilities and a number of the nuclear facilities are planned for relatively isolated rural counties with low assimilative capacities (low populations, low population densities, low numbers of available workers, and located at a distance from metropolitan areas). Large new facilities (see peak employment column in Table 8) in this type of county can cause significant boom-town effects as construction workers and their families migrate to the work site for a period of several years. As can be seen in Figure 9, low and extra-low assimilative capacity counties receive a disproportionate share of new facilities (when compared to share of population). Figure 10 shows that, when receiving an average size conventional facility, these counties can experience significant population shifts into the region, sometimes more than doubling the population.

The location, duration, and type of jobs required by SHACOB technologies are much more benign in their impact on localities. In fact, there appear to be no significant drawbacks of these jobs. They will generally be:

- — increasing steadily over time
- — similar to construction and servicing jobs
- — associated with smaller businesses
- — where people (job seekers) already are because they are:
  - correlated with consumption, and
  - not in isolated areas

To the extent that SHACOB (and solar electric to a lesser degree) displaces conventional facilities, adverse impacts of conventional energy developments will be diminished. Solar energy may:

- — decrease population and employment shifts
- — lower government costs for servicing such shifts
- — lower the need for impact assistance aid
- — increase community stability
- — offer long-term local jobs

Conclusions

Current quantitative employment estimates show employment from solar technologies to be substantially higher than conventional electric facilities on a Btu-delivered basis. Depending on the solar technologies considered, Construction/Installation employment has been estimated to be 1 to 11 times that of conventional electric sources. Total Direct employment is ½ to 4 times, Indirect employment is 1 to 10 times, and Total Combined Employment is 1 to 5 times that of conventional energy sources. *Net* total employment in the energy sectors for the nation under solar scenarios has been estimated to be higher as well.

Qualitative employment effects of solar are generally much more positive than conventional energy facilities due to their small size, dispersed locations, and gradual implementation.

Note

1. A Detailed description of the methodology, data manipulations, data sources and shortcomings, and additional information are to be described in a forthcoming Argonne National Laboratory Technical Memorandum.

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A Wood-fired Cogeneration System for UC Santa Cruz

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Overview

Like so many organizations all over the country, the University of California at Santa Cruz found itself paying more and more for less energy—its conservation efforts could not keep pace with price rises.

The alternative developed includes a wood-fired fluidized bed boiler, fed by forest product waste from the local redwood industry. In the winter it will provide domestic hot water and building heat, and air-conditioning in the summer through an absorption chiller. A significant portion of the campus electricity will also be generated by use of a gas turbine. The retrofit is expected to pay back in approximately six years.

Abstract

This paper describes the design of an innovative solid-fuel-fired total energy system to supply most of the electrical and heat needs for the University of California Santa Cruz campus from a local renewable resource. The system would utilize waste wood from local sawmills in an indirectly-fired gas turbine with fluidized bed combustor. This cogeneration system would operate at 83% net efficiency and pay for itself in less than six years.

Introduction

The University of California Santa Cruz campus is a microcosm of the present energy situation in the United States. Except for a few solar water heating installations, the campus is entirely dependent for all of its energy needs (23 million kilowatt hours electric, 1.7 million therms natural gas per year) on the local utility, Pacific Gas and Electric. All of this energy is imported from outside the county, with natural gas coming from Canada and Texas, and electricity from thermal power plants and remote hydroelectric facilities. These energy sources have been subject to rapid cost increases in recent years, and the University has had little choice but to pay the increases.

Present Energy Use and Costs

The energy use for the campus has remained relatively constant for the last six years, with campus expansion being offset by conservation efforts. While demand has not increased significantly over these years, the price for the energy has increased at an average rate of 25% per year, quadrupling the energy expenditures over six years. In 1973, the campus paid $325,000 for its energy, while in 1978 it paid $1.2 million for less energy.

While electricity represents only one-third of the energy used, it represents two-thirds of the cost. When compared on an equivalent energy basis, electricity costs $10 per million Btu while natural gas costs only $2 per million Btu. This is of course partly due to the higher capital costs associated with electricity production and distribution, but much of the difference can be attributed to the way fuel is converted to electricity in thermal power plants. Due to fundamental thermodynamic limitations, only 35-40% of the energy in the fuel is converted to electricity, with the remaining 60-65% of the energy being exhausted as waste heat. This waste heat is usually deposited in a local body of water or exhausted into the atmosphere with large cooling towers. This waste heat serves no useful purpose, yet it must be paid for by the electricity customer in order to get the electricity. In addition, electricity is transmitted considerable distance before use, which adds to the cost because of line and transformer losses, and because the cost of transmission towers and rights-of-way must be paid for. The net result is that only about 25% of the energy in the fuel reaches the customer as electricity, yet the other 75% of the fuel must still be paid for.

The most logical step would be to make some use of that waste heat coming out of the power plant. Distributing the heat as steam or hot water through pipelines to homes and businesses in a district heating system is feasible for short distances. The problem is that most power plants are so large that to find use for all the heat would require distributing it over hundreds of square miles, and the pipeline costs would be prohibitive. In addition, the heat exiting most power plants is at such a low temperature that it would not have many uses.

Cogeneration

The solution is to disperse several smaller power plants, each located where the heat is needed, and each designed to produce both electricity and useful heat. This idea of cogeneration of both heat and electricity immediately increases the overall efficiency of the system. Figure 11 shows the disposition of the original fuel energy for both a typical central power plant and for a typical cogeneration system. The net energy used increases from 26% (electricity alone) to 84% (electricity plus maximum heat).[1] To summarize cogeneration advantages:

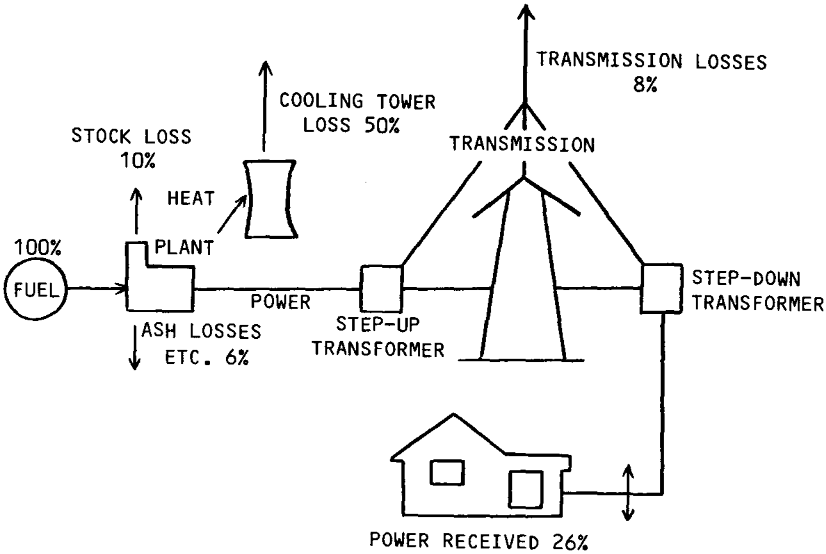
1. It can utilize 60-85% of the energy content of the fuel.
2. It reduces transmission costs.
3. Electricity costs are about the same as heat since there is no waste heat to pay for.
4. It is independent of grid failures.
5. The heat can be utilized in the summer for cooling using absorption air conditioning.

In order for cogeneration to be effective, the amounts of electricity and heat produced must match the demands of the user as closely as possible. The UCSC campus loads are suitable for cogeneration if the system is fairly efficient in electricity production, with a heat to electricity ratio of less than three to one.

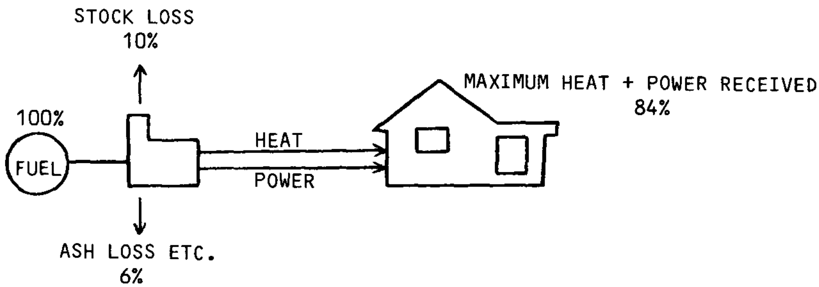
Wood Fuel

A cogeneration system loses many of its advantages if the fuel for it becomes unavailable or prohibitively expensive. The premium fossil fuels used in most cogeneration schemes are undergoing rapid price increases and becoming more uncertain in supply. A locally available renewable fuel would provide a more stable economic base for the payback of the capital cost of cogeneration equipment. Such a fuel is available in many parts of the country in the form of wood. Wood is a form of solar energy, with the trees acting as both collectors and storage devices. Wood has several advantages as a fuel:

1. It is renewable if harvested on a sustained yield basis.
2. The supply and price are potentially more stable since they are local.
3. It has negligible sulfur content and low overall pollution.
4. It has low ash content; the ash is useful as a soil amendment.
5. It is often available as a waste product from forest industries.



(A) CONVENTIONAL POWER GENERATION



(B) TOTAL ENERGY POWER GENERATION

Figure 11. ORIGINAL FUEL ENERGY DISPOSITION FOR TWO POWER GENERATION SYSTEMS

Locally available wood sources include logging slash, lumber mill waste, timber management thinnings, municipal trimmings, construction and demolition wastes, and land clearings. Two local sawmills would provide the 100 tons per day of fuel for the proposed UCSC system. Sawmills are a particularly good source because the wood waste is clean, already concentrated, and in steady supply. Approximately half the log ends up as waste wood. The two local mills produce 68,000 tons of wood waste per year from a milling volume of 23 million board feet. A long term contract would be negotiated to establish a steady supply at a reasonable price. Transportation over the 15 miles to the campus would be by truck, with approximately five loads delivered per day.

Not to be ignored are the problems associated with wood fuel. It is bulky (half the energy content per pound of coal), so it requires large storage areas and significant transportation costs. It is difficult to handle, and its moisture content affects the energy content per pound (freshly cut wood is 50% water). Despite these problems, waste wood has been used as a fuel for decades by the forest products industry. The city of Eugene, Oregon, supplies electricity and steam heat to the downtown area using wood waste. Weyerhauser Corporation has eleven wood-fired cogeneration facilities in the Pacific Northwest, all of these utilizing steam turbines.

Because steam systems have been developed to a high degree of efficiency and reliability by utilities, they seemed an obvious choice at first. However, on closer examination, steam systems in sizes smaller than 50 megawatts cost three times as much per kilowatt as large utility systems, and have unacceptably low efficiencies, in the 15-20% range without heat recovery. Adding heat recovery lowers the electrical efficiency further, giving a heat to electricity ratio of five or six to one.[2] In addition, steam is not easily compatible with the present campus district heating system that utilizes pressurized hot water.

System Description

The design described here combines readily available components into a high efficiency, cost effective, non-polluting cogeneration system that should have wide applicability for solid waste fuels. The system uses an indirectly-fired gas turbine with a fluidized bed combustor. The system would produce 2.6 megawatts of electrical power and 5.3 megawatts of useful thermal energy.

The system operates by taking in air from the outside and compressing it with a compressor driven by the power turbine (see Figure 12). The compressed air is then heated to 1600°F by passing it through tubes that

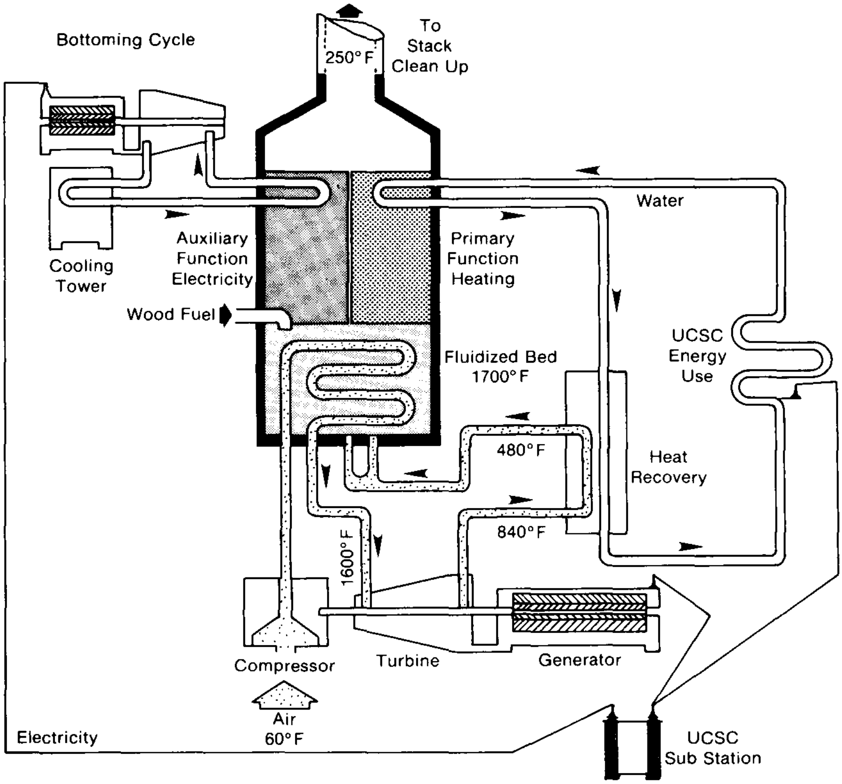


Figure 12. Wood Energy Co-generation Plan for UCSC

are immersed in the fluidized bed combustor. The heated air is then allowed to expand through the power turbine to drive the generator. By heating the air inside tubes, only clean air passes through the turbine, uncontaminated with combustion products. This will greatly prolong the life of the turbine. The air exiting from the turbine is still hot, so it is used as pre-heated combustion air to burn the wood. Because the heat for the power cycle is extracted from within the burning mass of wood, the combustion gases coming off the top of the fire will be very hot. The heat recovery part of the cogeneration process takes place in this exhaust stream with a gas-to-water heat exchanger, which cools the exhaust gases to 250°F. These relatively cool gases exhausting up the stack are the only heat loss in the system, and are much less than the cooling tower and stack losses of conventional power plants.

By making use of every Btu of heat possible, the efficiency of this system is very high. About 28% of the fuel energy is converted to electricity and about 55% ends up as recovered heat to be used for space and water heating on campus. This combined 83% net efficiency is more than twice the efficiency of conventional power plants. The system incorporates a 400 kilowatt steam bottoming cycle to make use of the waste heat during the summer months when space heat demand is low. This relatively expensive bottoming cycle could be omitted in regions of the country with high summer cooling demands. The waste heat would be used in absorption air conditioners which would have a higher efficiency and shorter payback period than the bottoming cycle.

The system will incorporate a fluidized bed combustor to burn the wood. Because of their burning characteristics, fluidized beds are particularly effective for wet biofuels and solid wastes. In a fluidized bed system, the wood particles are mixed with sand in the combustor bed. The bottom of the bed is a perforated plate through which air is blown. The rising air acts to buoy up the wood and sand mixture so that it is partially suspended and no longer lies still; it flows and is thus in a fluidized state. A fluidized bed in operation looks very much like a red-hot boiling liquid. The moving air serves to mix and stir the material so that each particle of burning wood can get full combustion air for complete burning. The sand serves to scrub the burning particles to constantly expose fresh surface for burning and to provide a heat reservoir to evaporate water from the wood. This heat reservoir allows substantial fluctuations in moisture content, particle size, and heating value of the fuel without affecting the combustion process or furnace stability.[3] Within the limits of the fuel handling system, a fluidized bed can operate on all types of waste fuels. If the waste supply is interrupted, the bed can also operate on natural gas. For the system under consideration here, fluidized beds provide excellent heat transfer to the tubes immersed in the bed, which means that this expensive high-alloy heat exchanger can be made smaller and more economical.[4]

The mixing in the bed also keeps the temperature very even throughout the bed, preventing hot spots that are responsible for nitrogen oxide pollutants. The thorough combustion in a fluidized bed eliminates most of the unburned hydrocarbons and carbon monoxide pollutants. The low sulfur content of the wood fuel makes the sulfur dioxide pollution insignificant. The final air pollution component, particulates, can be controlled with conventional fabric filters in a baghouse.

The principle problems with the system will be truck traffic, noise, and ash disposal. With five trips per working day, the truck traffic will not add significantly to the present bus traffic of 80 or more trips per day.

The trucks will be routed to avoid residential areas when climbing hills to reduce noise problems. While the power plant itself will be heavily sound-proofed, the outdoor fuel handling noise could be a problem. Proper placement of the fuel storage area and sound absorbing fencing could reduce this problem. The plant will produce 1000 pounds of wood ash per day which will require disposal. The ash is a good soil amendment, with significant potassium and phosphorus, so dispersal to local farmlands could be arranged.

Economics

The capital cost for the proposed system would be $3.9 million, broken down as follows:

fluidized bed	$ 600,000
gas turbine and generator	600,000
heat exchangers	300,000
steam bottoming cycle	300,000
cooling tower	100,000
baghouse	50,000
fuel handling	500,000
ash handling	40,000
building	200,000
road	40,000
district heating lines	280,000
building retrofits	200,000
12% engineering fees	490,000
5% contingency	200,000
Total	$3,900,000

The annual operating costs would be:

fuel (including transportation)	$340,000
additional wages	100,000
maintenance and ash handling	100,000
standby utility charges	23,000
Total	$563,000

Annual operating credits will be given for electricity sold to the utility (3.3 million kilowatt hours at 1.5 cents per kilowatt hour), and for reduction of demand charges, which are charges for the peak amount of electricity drawn from the utility.

electricity sold	$ 50,000
demand charge reduction	100,000
Total	$150,000

By comparing system capacity to the actual hourly heat and electrical demand, the actual energy delivered to the campus can be determined. In a normal year, the system would produce 19 million kilowatt hour of electricity and 1.2 million therms of heat. Assuming a 7% general inflation rate, a 7% interest rate (the rate used for state funded projects), and a 12% inflation rate for conventional energy costs, the system would pay for itself in under six years.

Conclusion

The system described is a community-sized total energy system capable of supplying conventional energy needs from renewable biomass sources. It uses conventional technology, is highly efficient, and would be applicable in most regions of the country. The high net efficiency and cost effectiveness depend on utilizing the waste heat. District heating systems can supply space and water heating for residential or commercial areas. The system could be applied to industry wherever process heat is needed. Because of the high cost of heat distribution ($50 per foot of pipeline), the systems will have to remain relatively small and localized. This will give communities greater control of their energy delivery systems. By utilizing local biomass resources, a community can attain a degree of energy self-reliance.

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The Western Solar Utilization Network

Lina Robinson
Western SUN
Portland, Oregon

Lina Robinson, Public Review Coordinator for the Western Solar Utilization Network, one of the four Regional Solar Energy Centers, held a session to obtain citizen input into Western SUN's annual operating plan.

Robinson opened by noting that the Department of Energy has required that Western SUN develop programs in the following solar technologies:

1. Active Solar Heating and Cooling
2. Passive Solar
3. Solar Hot Water
4. Agriculture and Industrial Process Heat
5. Photovoltaics
6. Wood Combustion
7. Small Wind Energy Systems

In addition, they are expected to address the following categories for each of the above technologies:

1. Market Analysis
2. Systems Development
3. Market Test and Applications
4. Market Development and Training

A large emphasis will be placed on training, information, and education projects, *not* research, development, or studies.

The purpose of the meeting was to solicit suggestions from residents of the 13 western states on high-priority project areas in which the organization should consider issuing "requests for proposals."

Some suggestions included the following:

1. Full-scale feasibility study of wood-fired district heating system.
2. Travel funds for city and county planners.
3. Plans for solar municipal utilities.
4. Neighborhood-scale municipal waste recovery systems that would produce feedstock and methane.
5. Films on passive solar systems.
6. Educational forums for building tradespeople.
7. Information and training on gasohol for transportation.
8. Funding for locally initiated local energy planning.

An Explanation of the Programs of the National Center for Appropriate Technology

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Butte, Montana

Aims

The National Center for Appropriate Technology (NCAT) addresses the need for small-scale technologies as solutions to the problems of rapidly rising costs of energy, the increasing shortages of non-renewable energy resources, and the continuing problem of devising ways in which individuals and communities can become self-reliant and self-sufficient. Although these problems affect the entire country, it is the low-income communities which have been most affected by the current energy crisis and which are most in need of effective assistance to achieve self-reliance. The primary mission of NCAT is the development and application of technologies appropriate to the needs of these low-income communities.

NCAT is funded by the U.S. Community Services Administration as part of its Emergency Energy Conservation Services Program. Actual program operations began in January, 1977, with the majority of its current staff of 50 coming on board in June. During its initial period of operation, NCAT has brought together a widely diverse staff to develop resources in technical research, information, outreach and grants.

While the center in Butte, Montana, is national in scope, it is the basic premise of NCAT that the Butte center will serve as the vehicle for disseminating information and resources and providing technical and program support. The actual program operation of NCAT will be localized and regionalized as much as possible. The dissemination and decentralization functions work in a variety of ways: multi-media communications, publications, grants opportunities, field extension workers, decentralized information systems, regional advisory panels, regional newsletters, workshops, conferences, and technical research—all work together toward the overall purpose of providing tools for the development of community-based self-reliance.

Goals

The goals of the National Center for Appropriate Technology are to:

- develop viable short- and long-range appropriate technology solutions to energy and energy-related problems experienced by low-income communities.
- expand, in a comprehensive and systematic way, appropriate technology solutions available to low-income communities which address all aspects of the ecosystem and the political economy.
- promote social, economic, and technical self-reliance and self-determination on the part of low-income communities.
- encourage the dissemination and transfer of appropriate technologies to low-income communities and to the broader community.
- encourage decentralized, community-based generation of small-scale technologies.
- generate an awareness and appreciation in the nation of the value and use of alternatives through appropriate technology.

Technical Resources

Technical issues which NCAT currently addresses include energy conservation, renewable energy development, food production, waste management, local resource utilization, and economic development.

Under an initial NCAT contract with the Montana Energy and MHD Research and Development Institute (MERDI), the technical research staff has focused attention in the area of heat source efficiency, low energy cooling and ventilation, low cost insulation manufacturing, and mobile home weatherization. In meeting NCAT's ever-expanding objectives, its technical research staff has undertaken a number of additional activities in such areas as urban gardening, solar space heating, grey water use, methane generation, wind energy, transportation, waste treatment and utility rate reforms. When necessary, NCAT occasionally sends technical personnel to provide on-site assistance. More often, in the spirit of decentralization, NCAT will identify resource people in the regions who can provide technical assistance, or assist in the presentation of workshops.

The monitoring and evaluation team of NCAT's technical staff conducts the technical reviews of grant applications and also constructs and evaluates appropriate technology devices. For example, NCAT is developing a systems approach to residential energy audits in evaluating the various weatherization options. This approach utilizes a number of simple measurements which can be made when a house is inspected before weatherization work begins and this eliminates the oversimplification inherent in other audit techniques.

The monitoring and evaluation team is also working on the development of a project which will provide both technical support, testing, and evaluation of community-produced solar equipment. NCAT will work closely with local groups who are developing manufacturing capability in this area to help them improve equipment design.

Information and Communications

The focus of NCAT's information and communication efforts is directed towards collecting and disseminating information and research on appropriate technologies as well as encouraging networking on a decentralized basis. This is central to NCAT's mission of providing educational and informational resources and serving as a technical research monitoring and evaluation resource to Community Action Agencies, Community Development Corporations and other community-based organizations.

NCAT is establishing a national information sharing network based on a low-cost "deep indexing" information retrieval system, a library and clearinghouse, publications and visuals on appropriate technology, and a network of regional newsletters.

The deep indexing system involves three processes: information input, storage, and retrieval. It is designed to incorporate the effectiveness and sophistication of extremely expensive computerized systems without the high capital cost of such systems. The system can be easily created, operated, and reproduced in any location by low-income people and Community Action Agencies. A description will be made available on request.

The clearinghouse serves as a resource base to enable the NCAT staff to answer requests and to provide update and information on materials available in the field.

The publications of NCAT include technical reports, position papers, sourcebooks, updates and a newsletter. A list of current publications is available.

Grants for Community Experiments and Demonstrations

In order to facilitate locally developed solutions to technical problems and encourage broad dissemination of small-scale technologies, NCAT has a small grants program available. In its support of community experiments and demonstrations, several thousand general purpose Requests for Proposals (RFPs) have been mailed to Community Action Agencies, Community Development Corporations, appropriate technologists, grass-roots groups, and others. RFPs are periodically revised to reflect changed criteria and grant procedures.

The range of projects reviewed by NCAT has reflected a diversity of concerns experienced by communities across the nation. These include proposals on the uses of solar energy for hot water, home heating and greenhouses and the harnessing of renewable sources of energy such as wind and wood. Community groups have also prposed more ecological approaches to food production. Related to this are projects on aquaculture, fisheries, and urban gardening. Other proposals include insulation, weatherization, transportation, economic development, and waste recycling. Proposals also meriting mention are innovative approaches to communication such as traveling road shows and low-cost information retrieval for community groups.

Outreach

The Outreach Component of NCAT consists of regionally-based field representatives facilitating direct communications between NCAT and local communities and the development of supportive relationships between community action agencies and appropriate technologists around the country. It is through this component that decentralization is accomplished.

An integral part of the NCAT staff, the field representatives have the following duties:

- utilizing and disseminating information and research, including grant program opportunities, and obtaining technical assistance from the technical research staff when needed;
- identifying needs expressed by Community Action Agencies and grass roots groups and supporting these groups in their efforts at seeking political, economic and social solutions.

- organizing and working with Regional Advisory Panels to identify regionally appropriate agendas for technological concentration, to devise ways to review and assist proposals from groups in the region, to NCAT, and to obtain recommendations for working in the region.

A second component of the Outreach area is the Internship Program. Interns will be nominated by Community Action Agencies, Community Development Corporations, other community-based organizations, and appropriate technologists. One of the functions of the extension workers in identifying community needs will be to encourage participation in the internship program to help develop local skills and expertise. Interns will work on specific projects in Butte with technical research and other NCAT staff, or at other well-recognized centers around the country offering particular appropriate technology training.

Through the mobilization of its various resources, NCAT's objectives include:

- rapid, appropriately designed dissemination of information and resources through both central and decentralized information systems.
- making accessible, immediate impact financial opportunities for education, demonstration, experimentation, and training programs.
- provision of reliable and useful technical research and development for application in low-income communities.
- promotion of economic and job opportunities through use of small-scale technologies.
- development of appropriate technology networks on a national, regional and local basis.
- conducting social, economic and governmental policy research to identify barriers to appropriate technology and to advocate and support the development of appropriate technology.

Section G
Plenary Session III: Communities Plan Their Energy Futures

August 21, 1979

Plenary Session III: Communities Plan Their Energy Futures

Moderator

Ben Bronfman
Oak Ridge National Laboratory

Speakers

Mark Cherniack
Jake Plante
Franklin County (Massachusetts) Energy Project

Marion Hemphill
City of Portland, Oregon

W. Kim Boas
City of Dayton, Ohio

Roger Hedgecock
San Diego County Board of Supervisors

Clara G. Miller
Robert M. Kleinman
Southern Tier Regional Planning & Development Board

Edward A. Holt
ENERGY, Ltd.

Anne E. Cline
City of Richmond, Indiana Energy Program

Summary

In the community planning process, energy is playing a greater and greater role. Local, state, and regional governments now realize that energy impacts their operations significantly and, in turn, can be impacted by their actions. Typical courses of action pursued at the community level include car and van pooling, purchase of efficient vehicles, land use and planning regulations, building codes, etc.

The speakers in this session had much to offer as practical advice for local officials and "grass-roots" organizations.[1]

Note

1. Papers by Mr. Kleinman, Mr. Hemphill, Mr. Holt, Messrs. Iden and Boas and Ms. Cline follow. No paper was available for Messrs. Cherniack and Plante; the reader is referred to "The Franklin County Energy Project: A Renewable Energy Future," prepared for the DOE office of Solar Systems, April, 1979. Ms. Miller's paper is printed in Section E, Workshop on Community Energy Planning Methods. Mr. Hedgecock's paper is also in Section E under the Workshop on Legal Strategies.

Citizen Based Renewable Energy Technology Assessment: Problems and Insights

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Abstract

The success of the year-long Southern Tier Central Regional Planning and Development Board's (STC) Citizen Based Renewable Energy Technology Assessment program was due to the careful planning, enthusiasm, and hard work of the citizen volunteers and the STC staff. This triad enabled the STC planners to deal with alterations to the original program plan.

The focus of this paper is to share with other communities some of the problems encountered and insights gained by the STC staff while working on the Citizen Based Technology Assessment program. The STC staff found that all difficulties could be resolved by ongoing evaluation of the program by the staff and close cooperation with the citizen volunteers and public officials.

STC Involvement in Energy Planning

The Southern Tier Central Regional Planning and Development Board originally became active in energy planning early in 1976 because of severe natural gas cutbacks in the region in 1975. Following the cutbacks, the Economic Development Policy Committee (EDPC) of the Board saw the need to establish firm regional energy supplies and to reduce local energy vulnerability in order to attract industries or allow existing industries to stay in the region and grow.

Because the Economic Development Policy Committee of the STC Board is oriented toward development, the staff channelled its efforts toward investigating the economic possibilities of increased development of local energy resources. The result was a resolution by the Board which directed the staff to create a plan for the development and use of local energy resources in the region. These energy resources include renewable energy resources: solar, wind, biomass (plant materials), and water.

With funding from the United States Department of Energy through Oak Ridge National Laboratories, STC planners developed and used a three point planning process: (1) The planners have assembled data which establish a local-scale view of energy problems; have made an inventory of local energy *resources* as well as energy imports; and have described energy technology in an easily understandable way with local examples. (2) The planners have set the stage for citizens working independently and with local officials, to create, analyze and present an energy conservation and development action plan to the public and to public officials with planners serving as advisory staff. (3) Technology assessment—the enumeration and evaluation of the second and higher order consequences of technological change (in this case, the increased use of decentralized renewable resource technology)—is the focus of the planning process.

Problems and Insights

Instead of reviewing the STC program again[1] I thought it would be more appropriate to share some of the problems we have encountered and insights we have gained during our work on Citizen Based Technology Assessment.

Maintaining the interest of our volunteer groups was the first major problem that we faced. We had no problems in attracting volunteers to participate in our program. In fact, the response was overwhelming and as a result we increased the number of planned participants from 36 to 48. At the beginning, however, we spent a good deal of time helping our volunteers to become more familiar with renewable energy issues and the process of technology assessment. At times the going got pretty tough and maintaining the morale and interest of the citizen groups became our primary concern. This problem was due in part to our own careful planning. From the outset it had been our intention not to influence the groups. In other words, to let them do their own thinking and planning, however, this conscious decision to avoid influencing the groups resulted in our failure to give the citizens adequate direction.

The difficulties the groups were having was complicated by the very nature of the task which lay ahead—developing a comprehensive energy plan for their community. Most citizen participation projects revolve around a single well-defined issue. When dealing with energy, however, and the plethora of issues in energy planning, production and conservation it was sometimes very difficult to make it through a meeting without numerous unrelated and tangential issues being raised by the citizen volunteers and the STC staff. Superficially, it appeared that our meetings were getting bogged down because of inconsequential or ill-timed questions and conversation. This contributed to the frustrations felt by everyone participating in the program. Once we recognized these problems and modified our involvement—we added more direction—there was a resurgence in the interest shown by the groups. Once over this initial hurdle, the groups worked at a rapid pace and requested to meet more often (once a week instead of once every two weeks). The groups worked at a steady rhythm until it was time for them to begin meeting with public officials from the three counties which comprise our region. Our original plan was to have had representatives from each county work with a group from their county to develop an action plan which reflected the needs of our communities. Though we achieved our final goal—county action plan—the methods used to get there varied from county to county.

Only one of the three counties has a county executive. In the other two, the Boards of Supervisors elect chairpersons. We did not consider these political arrangements to be a formidable obstacle. However, our failure to fully understand the political mechanisms of the three counties cost us both time and credibility. Our request of the public officials was the same for all three counties: We submitted a list of names, to the one county executive and to the chairmen of the Boards of Supervisors in the other counties, of officials who we thought would be interested in participating. The results of this approach differed markedly. In one county, the chairman of the Board of Supervisors quickly responded to our request and appointed a committee to meet with our citizens group from his county. In the second county there were delays, but a group was eventually appointed. In the third county, however, we were almost strangled in the red tape. After assurances from the chairman of the Board of Supervisors that a committee would be appointed, the county attorney intervened. He had a number of legal questions about the nature of the committee and the work it would be doing. For example, he wished to investigate whether the appointment of a committee would need the approval of the entire county legislature. After a protracted period of time, the county attorney advised the chairman that appointing a committee to meet with the citizen group was not at the chairman's discretion. Instead we were informed that our citizens should meet instead with a standing committee of the county legislature. The end result was that one county group progressed exactly as we had planned, the second group met periodically with public officials and the third group met only once after a one-month delay.

These modifications in our original plan had a major impact on the action plans which the citizen groups developed. The level of interaction between the citizen volunteers and the public officials can be measured in their plans. The group which met weekly with their officials designed a plan which addresses the energy problems facing the county in a broad context and focuses on the needs of the county residents. The second county group, which met intermittently with their officials has also placed a greater emphasis on county sponsored demonstration projects. The third county group which met only once with their officials, has made only passing reference to an overall county energy plan and has focused its energies instead on a specific project.

Though we are very satisfied with the results from each county group, we would alter our approach in dealing with the county officials. We would allow more time—instead of just one month—for contacting the appropriate officials. We feel this would help to promote a clear understanding between ourselves and the public officials and their role in the planning process. A longer and more thorough planning period would have helped us to alleviate many of the problems outlined above.

Finally, our experience with the program has shown that the intensity of the work required to perform a citizen-based technology assessment requires that the staff directing the work be committed whole-heartedly to the project. The excitment and involvement of the staff (or lack of it) is communicable because of the closeness with which the planners must work with the citizens and local officials. We have found through trial and error this enthusiasm, if used properly, can infect the rest of the community.

Note

1. See Clara Miller's paper in Section E for a detailed description of the planning process used by the Southern Tier Regional Planning and Development Board staff.

The Portland Energy Conservation Policy

Marion Hemphill
Energy Advisor
City of Portland, Oregon

Project Rationale

While the entire nation was suffering the effects of the 1973-74 Arab Oil Embargo, the Pacific Northwest was also suffering from an electric energy shortfall. Heavily reliant upon hydroelectric power, the Northwest found itself faced with a 15 percent emergency cut-back in supply due to a "low water year." Portland's Mayor Neil Goldschmidt and Oregon's Governor Tom McCall worked together to devise an emergency plan to cope with the two fuel shortages. Oregon's odd-even gasoline rationing plan has now become the standard throughout the country for coping with gasoline shortages. The electric crisis was met through voluntary efforts of Oregon's residents and the cut-back of unessential government services, like street and highway lighting.

Mayor Goldschmidt then became concerned that the federal government had provided a number of planning tools to municipal governments, which assisted them in coping with urban growth and development, but had failed to provide even the basic rudiments of planning for and coping with energy shortfall for curtailment situations.

While participating in a National League of Cities conference later that year, Mr. Goldschmidt happened to be on the same discussion panel as then F.E.A. Administrator, Frank Zarb. Informal discussion, followed later by a formal proposal to F.E.A., indicated that the Energy Administration was deeply involved in "Project Independence" in order to attempt to satisfy the supply side of the equation. Since most cities are not in a position to be energy suppliers, Project Independence offered little for most city governments.

The mayor then approached Secretary Lynn, of the U.S. Department of Housing and Urban Development. Under the philosophy that HUD is charged with assisting our urban areas to cope with their major developmental problems, energy conservation seemed a likely topic for their investigation. Eight and one-half months after the initial contact, HUD awarded a contract to the City of Portland to develop the first local energy conservation planning methodology in the nation.

The results of that contract were turned in to HUD in 1977. HUD's Policy Development and Research staff were pleased with the results and have subsequently disseminated the information to several hundred cities. The documents are also available through the National Technical Information Service. Records show that over 4,000 copies of the documents have been sold or distributed. According to HUD, over 100 cities have adopted the methodology for their particular needs.

Although the project was a success, the city council wanted to guarantee that the programs called for in the plan were what the citizens desired. Consequently, the Portland Energy Conservation Policy was developed to reflect that citizen concern.

Portland Energy Conservation Policy

Project Sponsors and Budget

The initial HUD study was conducted under a contract of $224,305. Line 6 of the report states that we believe that the study could be replicated for considerably less money and considerably less staff effort due to the fact that other communities can benefit from the mistakes made by Portland.

The Energy Policy effort was supported by staff and services costs of only $62,000.

Project Description

Portland City Council appointed a 15-person Energy Policy Steering Committee to head up the effort. The committee, in turn, appointed six task forces made up of an additional sixty citizens in order to review the economic and technical feasibility of the initial study.

Task force and steering committee members met at least weekly for the past eighteen months. During that time they reviewed the initial study as well as other information supplied by Portland city staff.

The result is a Comprehensive Energy Conservation Policy which addresses a multitude of energy consumption points. In addition to the conventional building orientation of conservation plans, Portland's policy addresses transportation, land use alternative energy, and city government operations.

Project Results

The enormous efforts of the citizens committee were rewarded by the adoption of the Energy Conservation Policy by the city council on August 15, 1979. After several months of city-wide citizen involvement and review, the ordinance reflected the true concerns and conservation belief of the majority of Portland's citizens.

The mandatory aspects of the policy have, of course, received the most recognition. These aspects, although important, are not the total sum of the Portland Plan. I have attached a copy of the enabling legislation to this report, in the hope that it may be published in the proceedings for your information.

The city is now gearing up for the major implementation efforts that will be required in order to carry out the Conservation Policy. These efforts include the appointment of an on-going Energy Commission charged with overseeing the implementation of the policy and to act as an on-going Policy Advisory Board to the city council. Members of the commission will also serve as the Board of Directors of a non-profit corporation (Portland Energy Conservation, Incorporated) which will be the implementing agency of the policy.

Portland Energy Conservation, Incorporated will act as the private sector liaison between the city and businesses and industries engaged in conservation practices, and will be responsible for the final rules and regulations of the implementation programs. These include such things as standardization of the energy audit inspection techniques, the cost effectiveness calculations necessary to ensure that conservation measures result in economic benefits to our citizens, and consumer protection initiatives.

Although it is infeasible to discuss the entire policy and its effects in such a short paper, I hope you have received a flavor for what the policy is about. My presentation to this conference will include more detailed information about the contents of the policy, and I also refer you to the Energy Conservation Policy ordinance that follows.

An Ordinance adopting an Energy Conservation Policy for Portland: Ordinance 148251

The City of Portland ordains:

Section 1. The Council finds:

1. That Resolution No. 31911 directed the formation of the Energy Policy Steering Committee (Committee) and that Resolution No. 32032 appointed the membership of that Committee.
2. That the Committee was charged with examining the findings of the Portland Energy Conservation Project and based upon the technical feasibility of certain conservation measures, their social and economic impact and their potential to save conventional energy resources, with developing for Council consideration a comprehensive energy conservation policy for Portland.
3. That the Committee and its technical task forces were remarkably diligent, volunteering over 3,500 hours of work to develop the Proposed Policy, the result of which is a model plan for conserving energy within this or any other municipality.
4. That in certain cases, the Proposed Policy recommends actions that, in fact, are already being carried out by the City government in order to conserve energy. These include life cycle costing purchasing arrangements, the set-aside of City funds to implement conservation measures and other actions previously authorized by Council in Ordinance No. 145413 which accepted the policy and procedure recommendations of the City Energy Management Task Force, a standing internal committee of City government.
5. That the City, state, nation, and world face drastic energy price increases in the short run and energy scarcity in the long run; that these problems have a direct local impact on the health, safety, and welfare of the citizens of Portland; and that it is possible through local action to contribute the resolution of these problems. Increased energy costs reduce the amount of money available to citizens to pay for the other basic life necessities and for the amenities that enhance the quality of life; lead to decreased business activity and increased unemployment; and increase the cost of local government with resulting reductions in service or increases in taxation. Eventual curtailments in energy supply can lead to inadequate supplies for residences with resulting health problems and to cutbacks in commercial and industrial businesses with resulting unemployment. It therefore is appropriate for local government presently to assume leadership in conservation activities, in order to protect the health, safety and welfare of present and future citizens.
6. That national, regional and state governments have provided insufficient direction and support for local energy conservation programs such as ours. The City intends, through this policy and consequent programs, to take all actions feasible for our commu-

nity, and at the same time, encourage and lobby for more aggressive legislation and administrative initiative at other levels of government in support of our actions.

7. That the Committee developed the following stringent set of principles to guide the Policy:

   (a) The Policy must be aggressive and achieve significant results;
   (b) The social and economic differences between people and firms must be recognized and accommodated;
   (c) All sectors of the City's economy must be dealt with equitably;
   (d) All actions must maintain Portland's attractiveness as a place to live and do business;
   (e) Conservation measures must be cost-effective; and
   (f) The City government's role must be to support private activity, not to replace it.

8. That the mandatory requirements called for in the Policy are balanced by the standard of cost-effectiveness and the availability of low-cost financing to our citizens; that they insure an equitable community sharing of the benefits and responsibilities of conservation; and that they follow a five-year non-mandatory "incentive" phase where weatherization and other conservation actions will be optional.
9. That the "Discussion Draft" of the Policy contained a number of specific justifications for each of the proposed policies and their objectives as well as a series of "example programs" which *might* be carried out to implement the Policy. A copy of the Draft is attached as "Exhibit A" in order to establish those justifications and to indicate to those charged with implementation of the Policy the direction which the Committee and the Council believe should be taken. However, this ordinance does not authorize any program listed in Exhibit A unless specifically enabled in the directive action section, below.

NOW, THEREFORE, the Council directs:

a. The Energy Conservation Goal of the City of Portland is to:
   Increase the energy efficiency of existing structures and the transportation system of the City through policies and programs which encourage conservation of nonrenewable

energy resources while maintaining the attractiveness of the City as a place to live and do business.
In order to accomplish this goal the following six policies and their objectives are adopted as the Energy Conservation Policy (Policy) of the City of Portland.

b. Policy #1 shall be:

THE ROLE OF THE CITY IN ENERGY CONSERVATION: The role of the City is to ensure the accomplishment of the Goal. All of the energy policies are to be policies of the City and depend on City action. The City shall implement conservation actions by the private sector. This shall be accomplished through education, incentives, and mandatory actions. The City's efforts shall include promoting conservation; informing all sectors of available programs and conservation techniques; developing financial incentives; advocating the support of the City efforts at the state, regional, and federal levels; and regulating conservation actions where appropriate. The City shall evaluate indicators of energy consumption to assure the effectiveness, comprehensiveness and fairness of private sector actions.

The objectives of Policy #1 are:

(1) To assure proper review and evaluation of the Policy by a nine-member Energy Commission (Commission) comprised of citizen representatives appointed by the Mayor and confirmed by the Council, which will advocate conservation actions, monitor the progress of implementation, and propose to the Council changes in the Policy as appropriate. The Committee will make periodic reports to the Council on its activities and will issue an in-depth analysis of Policy implementation activities and Policy effects not later than three years from the enactment of this Ordinance, again not later than five years from the enactment of this Ordinance, and at least every three years thereafter.
(2) To assure proper City support for the Policy and the Commission by establishing a City Energy Office within the Office of Planning and Development which will provide staff support for the Committee, shall evaluate the Policy implementation, administer and monitor City government conservation activities, review City policies and programs for consistency with the Policy and make recommendations

to the Council on the policies and programs, and accomplish other functions as required or directed by the Administrator of the Office of Planning and Development, the Commissioner-in-Charge or the City Council.

(3) To assure proper implementation of the Policy by assisting the establishment of Portland Energy Conservation, Inc. (PECI), a non-profit corporation whose responsibilities will include the development and implementation of Programs which it determines are necessary to carry out the Policy. All activities and directives of the Policy relating to private sector implementation will be the responsibility of PECI. The Board of Directors will be selected from the members of the Commission.

(4) To encourage people to choose the City of Portland as a place to live and do business by developing a marketing program which features the advantages of the City's energy conservation program in addition to other quality of life features.

c. Policy #2 shall be:

RETROFIT OF EXISTING BUILDINGS AND EQUIPMENT: All buildings in the City shall be made as energy efficient as is economically possible as determined by costs of conservation actions and price of energy. The retrofit of existing buildings for the purpose of energy conservation shall be accomplished through voluntary actions initially, with mandatory requirements imposed five years after the adoption of the Policy. Retrofit programs and the requirements must be cost-effective, comprehensive, and have the most equitable impact possible on all sectors of the community.

The objectives of Policy #2 shall consist of two general subsets: Residential (c.i.) and Non-Residential (c.ii.).

c.i. The Residential objectives are:

(1) To ensure maximum voluntary compliance with the Policy by PECI establishing a "one stop" energy conservation center for energy audits, financing, energy conservation action, referral to private contractors and program documentation for tax and regulatory purposes.

(2) To further ensure maximum voluntary compliance with the Policy by establishing as a key element of PECI's work program the development and implementation of a strategy to aggressively market energy conservation. Such strategy should be designed for specific target groups; use printed and media material as well as personal contact through individual meetings, seminars and workshops; be coordinated closely with the private sector and governmental conservation efforts; make positive use of accomplishments already achieved by the private sector; and rely on voluntary cooperation.

(3) To assist residential property owners to reach a zero net outflow of capital expended for energy conservation actions through a range of financial and tax incentives.

The goal of this directive is to enable conservation actions to be taken which result in owners paying no more for their combined monthly fuel bill plus the weatherization costs than they paid previously for fuel alone. Such monthly costs would be averaged over any year, would assume no increase in average monthly consumption for the monthly average of the first year after the actions are taken and would be calculated in constant dollars.

The needs of renters will be satisfied by stimulating owner investment through these and other incentives which reflect the unique character of investor-owned residential properties.

(4) To provide financing for measures not covered by existing programs through establishment of a loan pool in cooperation with private lenders which could be used for conservation loans where no other financing mechanisms are applicable.

(5) To facilitate the choice of financing options so that property owners can maximize their financial benefits.

(6) To achieve the retrofit of 15% of the City's housing units annually through voluntary actions which are cost-effective and satisfy the recommendations of the energy audit.

(7) To achieve the eventual compliance of 100% of the

City's housing units by requiring the cost-effective retrofit of all residences in the city beginning five years from the enactment of this ordinance. The requirement will be enforced at the point of sale of the building and will include both owner-occupied and investor-owned properties.

Further, in the case of structures containing rental housing the retrofit requirement may also be enforced at the point of unit turnover.

The Commission shall recommend to Council new or amended City code provisions and administrative rules, including any authorized exceptions, to carry out this Policy.

(8) To ensure that energy audits are comprehensive and that actions recommended are comparable for energy customers by developing a standard method of analyzing conservation measures and investment decisions.

(9) To improve the energy efficiency of new construction by amending the City Building Code to include specific standards for equipment which will reduce energy consumption.

(10) To expand the financial resources available for conservation by requiring that cost-effective weatherization measures be included in home rehabilitation loans funded by the Housing and Community Development Block grant and any other housing program administered by the Portland Development Commission.

(11) To assist the oil heat suppliers located in the City to identify and pursue alternative business opportunities to offset sales lost to conservation.

(12) To avoid additional bureaucratic and administrative procedures by relying on a self-certification procedure for recording weatherization actions for tax rebates, resale, or rental requirements of this section.

(13) For purposes of this section (c.i.), a "cost-effective retrofit" means those retrofit conservation improvements which meet a ten-year simple payback criterion. A "retrofit conservation improvement" means any non-renewable energy conservation improvement applied to an existing building that was not installed at the time the building was constructed and any replace-

ment or rehabilitation of a non-renewable energy conservation improvement that was installed but is in need of replacement or rehabilitation. An improvement or the replacement or rehabilitation of an improvement meets a "ten year simple payback criterion" if the cost of making, replacing, or rehabilitating the improvement (including any interest on the cost of doing so) less the amount of any tax credits, rebates, or other tax savings and financial incentives, less the calculated dollar value of the energy to be saved by the improvement, replacement, or rehabilitation over the immediately following 10 years, is equal to or less than 0.

For the purpose of the section below (c.ii.), "cost-effective retrofit" has the same meaning as in section c.i., except that the payback period is five years instead of ten years.

c.ii. The Non-Residential objectives are:

(1) To encourage reduced energy consumption in non-residential buildings and in industrial processes through a program of energy audits and energy plans which identify retrofit actions and industrial process modifications and mechanical system efficiencies. Undertaking of audits and development of plans will be mandatory beginning five years from the enactment of this ordinance.

(2) To facilitate the accomplishment of such energy audits and conservation plans by directing that PECI develop standard procedure and methodology for performing and certifying the energy audit. In addition, PECI shall provide, or assist in providing or arranging for the technical personnel and financial resources necessary to acomplish such audits and plans as requested by Portland residents and businesses. The preferred method of accomplishing this activity is through private sector firms working in cooperation and coordination with PECI.

(3) To reduce the energy consumption in non-residential buildings by requiring that cost-effective retrofits be

undertaken by the building owner when the building is sold or when remodeling equal to 50% of the replacement value of the building is undertaken, beginning five years from the date of the adoption of this ordinance. Industrial *processes* are exempt.

(4) To encourage the voluntary achievement of the energy conservation goal in non-residential structures and industrial processes by establishing programs to market energy conservation through educational and information forums, media presentations and other techniques.

(5) To obtain tax incentives for process industries by encouraging the adoption of state and federal legislation providing for accelerated depreciation of energy inefficient equipment and investment tax credits to offset the costs of energy conservation actions; including audits and engineering reports, retrofit, and process modification.

(6) To assist industry to obtain the capital required for investment in improved process and mechanical systems efficiencies, alternative energy systems, and other major conservation actions through loans made available from the sale of municipal bonds, such as industrial revenue bonds. This applies especially to small businesses with problems of capital accumulation.

(7) To reduce the ratio of energy consumed per employee in the industrial sector by including an evaluation of energy consumption in decision criteria when allocating City economic assistance resources and recruiting new industry.

(8) To assure the availability of conservation material and alternative energy systems by encouraging the location and development of businesses in the city which are engaged in manufacturing or installation of conservation material and alternative energy systems.

(9) To encourage reduction of energy consumption by private and public schools through a joint effort with School District #1 which identifies areas of mutual interest and furnishes examples to other educational institutions based upon the school district's success in energy conservation.

(10) To reduce energy consumption of nursing homes and

hospitals by encouraging the health industry accreditation and licensing agencies to include energy conservation programs in their evaluation requirements.

(11) To assist non-taxpaying institutions by arranging for energy audits and recommending finance mechanisms to facilitate installation of appropriate conservation measures.

(12) To reduce energy consumption in normal business operations by encouraging business to adopt life cycle costing purchasing procedures.

(13) To reduce energy consumption in general illumination and display lighting which is not necessary for the operation or safety of the structure or its occupants by establishing an aggressive marketing and educational program designed to reduce such energy use.

d. Policy #3 shall be:

LAND USE: The City shall develop land use policies which take advantage of density and location to reduce the need to travel, increase access to transit, and permit building configurations which increase the efficiency of space heating in residences.

The objectives of Policy #3 are:

(1) To promote patterns of land use which decrease consumption of fuel for transportation and space heating by making energy conservation a critical element in land use decisions made by the City.

(2) To reduce the need to travel by promoting a density, location and mix of land uses which would tend to decrease the length of required daily trips and encourage the consolidation of related trips.

(3) To increase access to transit by promoting medium to high density residential, employment intensive commercial, and retail commercial development near proposed transit stations, and medium density residential development along major transit streets.

(4) To reduce energy consumed for space heating residential buildings by promoting the construction and renovation of

attached single and multi-family dwelling units.

(5) To increase the economic feasibility of close-in urban housing.

(6) To carry out the above objectives, the Council finds that the following land use actions will provide sound and effective means to fulfill the energy conservation objectives and instructs the Portland Planning Commission to consider these, as well as other energy conserving measures, in development of the Comprehensive Plan and in considering other land use decisions brought before the Commission. The Council further directs that when the Commission finds that it is not appropriate to apply these recommended actions to specific properties or situations of the Plan or to other land use decisions, the Commission shall note in its report to Council the proposed exception to this Policy and shall summarize the issues in an understandable and meaningful manner. The actions include:

(a) Development of downtown, regional and neighborhood service commercial centers with a balance of complementary retail and employment activities.
(b) Consolidation of neighborhood retail, office and community service establishments in neighborhood service centers located on major transit and arterial streets.
(c) Development of medium- and high-density residential zones in and adjacent to the downtown core and other general commercial centers and development of medium-density residential zones adjacent to neighborhood service centers.
(d) Development of housing adjacent to employment areas.
(e) Construction of energy efficient planned unit developments including residential, commercial, industrial and mixed use projects.
(f) Zero lot line/common wall construction in designated low and medium density zones.
(g) Development of buildable "substandard" lots.
(h) Construction of a secondary rental unit in single-family, owner-occupied homes.
(i) Elimination of the R20 zone (20,000 square feet minimum lot size).

(j) Include the application of cost-effective solar technology as one of the criteria in the "density bonus package" in the zoning process.

e. Policy #4 shall be:

RENEWABLE RESOURCES AND ALTERNATIVE ENERGY SYSTEMS: The consumption of non-renewable resources for residential and business use shall be reduced by encouraging the application of renewable and alternative energy sources.

The objectives of Policy #4 are:

(1) To facilitate the use of renewable and alternative resources, such as solar and waste heat systems, by removing administrative obstacles to their installation.
(2) To reduce residential space heating needs by encouraging residential developments which increase opportunities for solar use.
(3) To facilitate acquisition of solar rights by arranging for a deed covenant running with the land to record private negotiations between property owners.
(4) To reduce water and space heating needs through waste heat recovery systems and solar applications by allowing local improvement districts (LIDs) to be formed to finance such systems.
(5) To increase awareness of the potential for alternative technologies in commercial construction by requiring consideration of their application in all public and private projects where City or State code requires the use of a registered architect or engineer. This Policy shall be enforced by requiring that the architect/engineer and the building owner certify that such application was evaluated during the preliminary (schematic) design phase of the project.
(6) To promote the proper use of the technology by including technical information on solar and alternative energy sources in the City's energy conservation marketing program.
(7) To expand the financial resources available for solar and alternative energy applications by including such measures in the financial and tax incentive programs called for in this Policy.

(8) To recapture energy which would otherwise be lost in the traditional methods of solid waste disposal by requiring all refuse collectors doing business in the City to provide a recycling option to their customers as a condition of obtaining a City business license issued after July 1, 1980. This requirement will apply only to those materials which are cost-effective to recycle. Such a recycling option would have to be provided at no additional cost to the consumer.
(9) To encourage voluntary recycling of other solid waste and motor oil through a program of education and promotion and the siting of private recycling depots throughout the City and at landfill sites.
(10) To encourage, if necessary, recycling activities by initiating City economic development efforts to foster an adequate number of secondary material handlers to market the recycled "waste."

f. Policy #5 shall be:

TRANSPORTATION: The consumption of non-renewable fuels for transportation shall be reduced through actions which increase the efficiency of the transportation system operating within the City. These actions will encourage individuals to choose the method of travel which is the most fuel-efficient for the purpose of the trip; promote the energy-efficient movement of goods; and provide incentives for the use of fuel-efficient vehicles.

The objectives of Policy #5 are:

(1) To improve the operations and service delivery capability of the transit system by: (a) carrying out projects which speed and smooth the flow of traffic; (b) reducing peak hour transit and transportation demand by encouraging employers to institute staggered work hours; (c) evaluating the system and its routes for energy efficiency and including this information in the decision criteria for system changes; (d) lobbying for changes in federal rules and regulations which cause inefficiency in the maintenance of system equipment; and (e) continued advocacy by City Government of the need for the fuel-efficient movement of City residents.
(2) To speed and smooth the flow of traffic by carrying out ap-

propriate projects, to be funded by imposing a one cent tax per gallon of gasoline and diesel fuel sold in the Metropolitan Service District area, assessed and collected at the wholesale level. *To facilitate the adoption of the tax, the City will work with the District to have appropriate legislation placed on the ballot for voter ratification at the next general election.*

(3) To increase the effectiveness of existing ride-share (carpool/vanpool) programs by encouraging a private market approach to system delivery and by reducing the administrative obstacles to such an approach.

(4) To increase transit and car/vanpool use by allowing businesses, industrial plants, and multi-family units to reduce their parking space requirements provided that long-term transit or ride-sharing commitments are obtained.

(5) To increase the energy efficiency aspects of the parking system by providing more small parking spaces, and incentives for car/vanpools.

(6) To decrease the use of private automobiles by students and staff of schools by supporting efforts to make more efficient use of school buses and transit, restrict parking opportunities around schools, and assign faculty to schools which are closer to their residence.

(7) To reduce recreation-related transportation needs by expanding the joint use of school facilities and City parks, developing and promoting close-in recreation opportunities, and improving the scheduling of events.

(8) To increase bicycle and pedestrian travel in everyday commuting by development of a network of safe, direct routes, and provision of secure bicycle storage facilities, and education and promotion efforts.

(9) To reduce the energy consumed in the local movement of goods by developing economic assistance programs which will assist small trucking firms specializing in local cartage and delivery to maintain their terminal facilities within the City.

(10) To reduce petroleum use by solid waste disposal services by encouraging more efficient routing.

(11) To reduce fuel use in vehicle engines by including in the Oregon Department of Environmental Quality's testing procedure an independent diagnosis of engine efficiency, by

assisting vehicle owners in having indicated adjustments or repairs made, and by providing owners with a report describing potential energy savings attainable from simple maintenance actions.

g. Policy #6 shall be:

CITY GOVERNMENT: City bureaus shall reduce energy consumption by investing in energy conservation opportunities and changing operational procedures to the most energy- and cost-effective extent possible.

The objectives of Policy #6 are:

(1) To reduce overall City government energy use by abiding by the policies and objectives contained in the Energy Policy which are applicable to City government.
(2) To procure the most energy-efficient goods, equipment and building through full implementation of the life cycle costing procedure.
(3) To reduce work-related local travel by City employees by 10% in comparison to the base year travel pattern through monitoring and reporting systems.
(4) To increase the energy efficiency of all City-owned buildings by establishing and carrying out a set of standard operating procedures to reduce energy use in mechanical and operational functions.
(5) To reduce energy use in the solid waste disposal system by (a) changing the collection process to eliminate overlapping service area allocation; (b) efficient route management; (c) construction of transfer stations to reduce trip length for small operators; and (d) the Metropolitan Service District establishing working arrangements with private firms capable of capturing the energy generation potential of solid waste.
(6) To reduce the energy used by City employees in their journey to work by requiring all new city employees, and existing employees who change their domicile, to reside within the City. *This directive will be carried out by proposing a City Charter amendment at the next general election.*
(7) To reduce energy use for street lighting by continuing the

systematic shift from mercury vapor and incandescent street lights to more efficient high pressure sodium vapor fixtures.

(8) To manage City government energy use more effectively by establishing and maintaining an accounting system to track City energy consumption and costs in order to identify conservation opportunities.

(9) To conserve energy and reduce the operating cost of City government by continuing the Energy Conservation Setaside Fund in order to carry out building and equipment improvements until all cost-efficient projects have been carried out.

(10) To reduce energy use in both the public and private sectors by evaluating existing and new City code provisions for unnecessary energy use requirements and by modifying said provisions to allow for the lowest energy use possible while still providing for the health, safety, and welfare of the public.

Passed by the Council, August 15, 1979, Neil Goldschmidt, Mayor of the City of Portland. Attest: George Jeckovich, Auditor of the City of Portland.

Seattle's Experience With Energy Planning

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Abstract

Seattle's success in energy planning is made possible through meaningful public participation in energy policy-making and by locally elected officials taking responsibility for energy choices. Acting on a public consensus, the city has made a commitment to and investment in energy conservation. Adequate attention has not yet been given to forging a consensus on renewable energy supplies, but this will be addressed in current planning efforts. Lacking a consensus on renewables, a personal view of a sustainable energy future is offered. Several specific examples of Seattle's research into renewable energy are given. The lessons to be learned from Seattle's experience are (1) local government can play a role in energy planning, and (2) public participation is the key to establishing a consensus. The role of local government is (1) to provide a forum for the public debate on energy, and (2) to advocate energy supplies that are indigenous and locally manageable.

Local Energy Planning: The Intermediate Term

The City of Seattle has a tradition of energy planning dating back to the early 1900's. This tradition stems from the fact that, at that time, a municipally owned electric utility was formed which required locally elected officials—the city council—to make energy decisions affecting our future. Local accountability thus became the foundation for our tradition of local energy planning.

In the early 1970's, this tradition was given renewed impetus by another Seattle tradition, that of broadly based citizen participation. In

Seattle, significant public policies are not made without meaningful public involvement. Three major efforts are noteworthy. The first of these efforts, in 1972-1973, was the citizen-based Seattle 2000 Commission which was a truly grassroots, comprehensive attempt to articulate the future goals of Seattle. The energy-related goals adopted by the mayor and city council are as follows:

- To reach a steady level of per capita energy consumption by the year 2000.
- To select energy sources which use the least of non-renewable resources.
- To use energy efficiently in providing for Seattle's demands.
- To formulate an energy policy for the city.

The second relevant major effort was Energy 1990, a plan for the electrical energy future of the city. In 1975-1976, the city council was faced with a decision on investment in the construction and operation of two nuclear power plants. The council requested a study of alternatives and a new forecast of the demand for electricity. After months of public debate, and supported by an active Citizen's Overview Committee, the council decided against participation in the nuclear plants, and opted instead for a major investment in conservation, with a goal of saving 230 megawatts by 1990. To achieve this goal, an Office of Conservation was established within the utility, and a separate City Energy Office was established as a staff function within the Executive Department, reporting directly to the mayor.

Energy 1990 is not a thing of the past. It is alive and well, and the subject of constant re-examination. A great deal of money is being spent to ensure that the goal is reached. However, it is not without its weaknesses as an energy plan. First, to date, there are no proven data on the real effectiveness of our efforts. Effectiveness evaluation has to be stressed as part of our continuing implementation efforts. Second, Energy 1990 programs focus on the use of electric energy, without adequate attention being given to the conservation of fossil fuels. Third, while local research and demonstration dollars are going into renewable energy systems, the Seattle 2000 goal of selecting energy sources which use the least nonrenewable resources, has not yet led to a more specific statement of objectives, and thus there is no clear direction as to how we ought to get there.

The third major energy planning effort, ENERGY, Ltd., is now six months into a two-year program. While the two previous efforts were locally funded, ENERGY, Ltd. receives 80 percent of its financial support from Argonne National Laboratory. (Seattle is one of 17 communities across the country selected as a demonstration community for local energy management planning.)

The general goals of ENERGY, Ltd. are:

- To provide a fossil fuel complement to the electric energy conservation focus of Energy 1990.
- To examine the trade-offs between using one form of energy and another.
- To establish a consensus regarding the development and use of renewable energy.
- To explore the potential of local government to manage energy use, especially where the sources of supply are not publicly owned.
- To inject energy thinking into comprehensive planning, particularly land use and transportation policies.

ENERGY, Ltd. has a Citizen Committee responsible for formulating more specific goals and objectives over the next several months. The need for a consensus on goals has been stressed by a recent Resources For The Future study on Energy In America's Future. It points out that, "A consensus on goals is essential, not only to provide a starting point for launching timely initiatives to meet long-term needs, but also to aid in coping with short-run problems. Realistic long-run objectives, which identify the nation's energy capabilities and the means for achieving chosen ends, can also dispel the pervasive feeling that this country can do no more than react passively to developments elsewhere in the world. . . . actions and situations over which it has no control."(1)

While Resources For The Future speaks from a national perspective about the perceived lack of control over our energy future, and the need for a national consensus to take control back into our own hands, the same statement can be made from a local perspective. I'll come back to this point in a few moments.

To summarize Seattle's energy planning activity, we can say with assurance that Seattle has a consensus on energy conservation, and is acting on it. This consensus was made possible by the fact of local accountability for electricity supply and by a democratic tradition of meaningful community involvement in major public choices.

We also have a general consensus in favor of renewables, but we haven't yet determined our renewable capabilities, nor have we determined how to get there. I hope that through ENERGY, Ltd. a common vision can be established.

Local Energy Planning: The Long Term

Looking back to the beginning of Seattle's energy planning, it required vision and courage to plan ahead 70 years into the future. But that vision is responsible for the fact that we are now over 70 percent reliant on renewable energy: hydropower. That's what we're using now, and will continue to use far into the future. Put into that perspective, planning for the year 2050—70 years into the future—doesn't seem so impractical. I should also remind you that this investment in renewable energy, through which energy costs are virtually zero, has given us a handsome return in the form of the lowest electricity rates in the nation.

A Sustainable Energy Future

Lacking, as yet, a local consensus on what renewables can do for us in the next 70 years, I would like to offer a personal vision. This vision is of a sustainable energy future, and has both energy use management components—such as conservation, cogeneration, district heating, and waste heat utilization—and renewable resource components—such as solar, wind and biomass. There are certain elements that qualify this vision:

First, the future should make use of "income" energy rather than "capital" energy. This means investing in an energy stream that is essentially non-depletable rather than in an energy stream that is finite.

Second, the energy future should emphasize independence and responsibility. The community should meet its own needs to the maximum extent possible. This does not rule out interdependent or joint ventures, but indicates that individuals and local institutions should take responsibility to control their own future.

Third, energy choices should emphasize systems that are democratic, that is, that are available equally to all. Decentralized energy supplies serve the democratic notion better than centralized ones because decentralized supplies are more accessible to the people they serve.

Fourth, the energy sources should be effectively controlled at the local level and fit within the "span of control" capabilities of the community or neighborhood.

Fifth, they should reflect local resources and conditions. This means that energy supplies should come from indigenous resources.

Sixth, energy systems should be comprehensible to the municipal authorities charged with overseeing them and should be readily explainable to the public.

Seventh, the technology should be readily available to build, install, and maintain all portions of the system.

Eighth, it should be policy that the quality of energy be matched to the requirement at the point of end use. For example, electricity is high-quality energy needed to drive motors or power lights, but solar energy is better than electricity as a means of heating water.

Ninth, energy systems should be environmentally gentle.

Tenth, future energy systems should fail gracefully, not catastrophically. The energy system should be able to withstand component unit failures without significant total system impact; any failure should hold minimal threat to life or property.

Eleventh, future energy systems should be resistant to accident or sabotage.

Getting There: Some Examples

Having looked at some of the possibilities, let's look at what Seattle is actually doing. Again, the fact that Seattle owns its own municipal utility has made it easier to fund research and development leading toward a sustainable energy future. That should not, however, discourage communities lacking a similar arrangement. Federal interest in decreasing dependence on oil and gas and increasing the availability of renewable energy resources, has provided opportunities for imaginative local governments to work with utilities and the private sector.

It would be impossible in this brief time to recount all of the relevant research into renewables being carried out in Seattle. A few examples should be sufficient to convey the range of activities. Most of them are common, but specific to our geography and climate.

The first project is a standard house retrofit with 22 roof-mounted flat plate solar collectors, an insulated water storage tank, a hot water duct heating coil, a water-to-air heat pump, a pre-heating coil for domestic hot water, and a six kilowatt wind generator. The purpose of the project is to provide accurate information on the application of active solar systems to residential space and water heating, and on the potential of wind energy conversion systems for residential electricity requirements. Since the spring of 1976, solar energy has contributed 47 percent to space heating and 30 percent to water heating needs. The windmill has provided less than 10 percent of the electricity to the house.

The second example is an effort to identify potential sites for geothermal plants for the production of electricity. The research could be extended to examine the feasibility of piping hot water to the city for district heating. Although no large geothermal wells have been identified in the North Cascades, the abundance of young volcanic rock suggests the potential for geothermal energy in this area. (At the Geysers development in Northern California, operating geothermal plants at present provide 800 megawatts of capacity.) Through a consultant, potential geothermal sites will be ranked by net generation potential, land availability costs, accessibility, economics, transmission requirements, and environmental impacts. Once sites have been selected, we will solicit funds from the Department of Energy and other agencies to support exploratory drilling.

The third example, the fuels from woody biomass program, is intended to demonstrate the feasibility of growing trees as an energy source. This project is in the second year of research and is being conducted by Seattle City Light, in conjunction with the University of Washington College of Forestry Resources.

Electricity generation from woody biomass has the advantages of:

- Using wood as a renewable energy resource.
- Competitive cost with other new generation sources.
- Utilization of the existing industrial, organizational and technical infrastructure of the wood products industry.
- Opportunities for cooperation with the wood products industry and other major industries requiring process heat.

City Light has established two experimental sites of ten acres each on a transmission line right-of-way. Red alder and black cottonwood are being grown on the test plots to determine the effects of variations in soil, spacing, harvest cycles, irrigation, fertilization, and cultivation upon the growth rate.

The final example is not a renewable energy resource, but rather demonstrates an integrated community energy system designed for greater efficiency. Seattle City Light is investigating the recovery of waste heat from major electrical transformer substations for residential and commercial space heating applications.

Phase I demonstrated the technical and economic feasibility of recovering waste heat from the Broad Street substation and supplying it to the Pacific Science Center, on the site of the 1962 World's Fair. Phase II, now in progress, is a site-specific design for the integrated system. The utility is now seeking funds to install a heat recovery unit at the substation and a hot water transmission system from the transformers to the Pacific Science Center. It is estimated that the transformer waste heat can provide 70 percent of the space heating, and up to 50 percent of the water heating requirements.

These example show that Seattle is beginning to think more in terms of renewables, but it isn't easy to establish a radical new direction overnight. You can't just turn the corner—there's a lot of momentum to overcome. Besides, we don't yet have a consensus on where we want to end up. My hope is that ENERGY, Ltd. will provide that consensus.

Lessons for Local Government

What lessons can we learn from all this? First, local governments can plan an effective role in creating our energy future. Second, public participation is the key to establishing a consensus on energy policy goals, and the means for achieving those goals.

The problem—or rather the opportunity—involves a question of investment choice, because the debate on energy is in fact a debate on investment. It's a cliche to say we're in a transition, and choices are seldom simple in a transitional period. In this transitional period, however, society will be compelled to choose between "continued depletion of finite resources and investments calculated to provide a permanently available 'interest' energy income."(2)

Who is making these investment choices? Largely the private energy companies and the federal government. The federal research budget commits large sums of money to "big solar"—expensive, high technology projects that mimic the space and nuclear programs. Prominent examples are the power tower and the space orbiting satellite. These approaches are capital-intensive and highly speculative, and have little relevance to local governments.

What, then, is the role of local government? Because these investments have significant societal implications, there should be a public debate, both to set policy for public investments and to send signals to private investment. The first role for local government, then, is to provide a forum to conduct the debate. Seattle's experience—still ongoing—provides a good example.

Seattle has already made a clear investment choice for conservation. Investment in conservation or decentralized renewable energy, however, is not always easy to make, as the Harvard Business School Energy Project points out. Because they are diffuse energy sources, they have no clear constituencies in the way that oil, gas, coal, and nuclear do. "Public policy must be its champion, and many different strategies will be needed."(3) The second role for local government, then, is to advocate those forms of energy supply—including conservation—represented by available technology and which are locally manageable, remembering that this carries with it local responsibility and accountability.

The underlying message that I want to leave with you should be clear by now: local government can and must become a force in energy policy-making, not only by sending investment choice signals to the federal government and the private sector, but also by making policy—perhaps literally—in our own backyards.

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The City of Dayton's Approach to Comprehensive Community Energy Management Planning

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and
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Abstract

This paper outlines the approach taken by the City of Dayton, Ohio in undertaking the Comprehensive Community Energy Management Program (CCEMP), a Department of Energy program for involving units of local government in energy planning for the future. The paper also discusses some renewable energy alternatives already initiated by Dayton.

Areas of concern to the CCEMP are the types of energy used and their end uses according to physical-use categories. A community energy audit is being accomplished to delineate energy useage for 1978. Projections of energy use based on the energy audit will be developed for the years 1985 and 2000.

Far from being the end result, the energy audit will assist the community in formulating energy objectives and selecting energy alternatives. The final phase of the CCEM Progam will be the development and adoption of a community energy management plan.

Introduction

Dayton is a city of about 200,000 population located in southwestern Ohio. Although its population and industrial base have declined significantly in the past twenty years, the city is working to halt or reverse this trend and to make Dayton a more desirable place to live and work. In order for the city to attain its goals, there must be a reasonable assurance that the future energy needs of the city can be met.

It is obviously difficult, if not impossible, for any local community to have a significant influence over the availability of energy supplies whose production and distribution are determined at national or international levels. However, a community can effect the pattern, character, and amount of energy used at the local level. Many useful actions can be initiated on an ad-hoc, one-at-a-time basis. However, limited community resources might be more effectively applied if a careful energy management plan for the community were developed and used to guide its energy initiatives.

The City of Dayton is fortunate to be one of seventeen communities selected by Argonne National Laboratory to develop a Comprehensive Community Energy Management (CCEM) Plan for a pilot Department of Energy program. This paper presents a description of Dayton's CCEM Program and also provides a brief description of a few renewable energy projects that have been implemented by the city.

The City of Dayton CCEM Program

The City of Dayton initiated its Comprehensive Community Energy Management Program (CCEMP) in October 1978. The program involves a two-year effort to develop a comprehensive energy plan for the city.

Argonne has provided a DOE-produced CCEMP Methodology to guide the programs of the seventeen participating communities (1, 2, 3). The methodology provides a step-by-step, "cookbook approach" to the development of a plan. But, Argonne and DOE have emphasized that planning efforts should be tailored to meet local situations, and that participants need not be bound by the detailed step-by-step procedures. Dayton, however, has elected to follow the general approach outlined in the methodology because it provides a firm planning foundation based on sound energy management principals, and because it appears to provide an optimum approach for a city that has not been involved in prior comprehensive energy planning activities.

Three basic principals of the DOE CCEMP Methodology were outlined in the Argonne National Laboratory Request for Proposals for the CCEM Program:

- A community should know its current and future energy use patterns. For each energy form used in the community, the questions, "Who uses it?", "For what purpose?", and "How much?" should be answered.

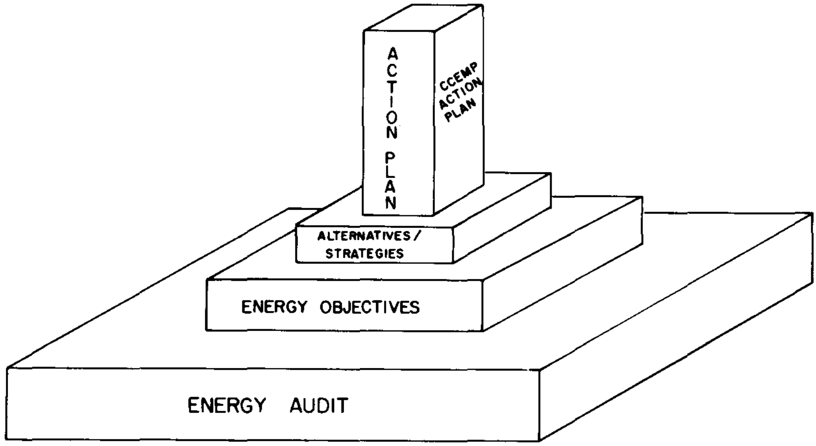

Figure 1. THE DAYTON CCEMP

- Energy use analysis should be based on the physical characteristics of the community and community activities.
- Energy objectives that are formulated must support the overall values and goals of the community.

The foundation of Dayton's CCEMP is a comprehensive energy audit that covers all aspects of energy use in the city for the recent year, 1978. Upon this base will be built a program that will culminate in the development and adoption of an "Action Plan" targeted for 1985 and 2000. The Action Plan is to be comprised of energy alternatives and strategies selected to satisfy energy objectives formulated in the second technical task of the program.

The objectives will, in large part, be based on analyses of the energy audit results and on projections of energy use and availability in two future years, 1985 and 2000. The Dayton CCEMP approach can be pictured as a pyramid in which the lower levels are required to support the principal program output, the Action Plan (see Figure 1). The steps in the pyramid represent the principal tasks of the technical progam which are to be conducted in serial fashion.

City of Dayton CCEMP Organization

The Dayton CCEM Program is managed by a senior member of the city staff, who also serves as the energy coordinator for the city. A CCEMP Steering Committee comprised of twenty-two members representing a cross-section of the city, provides direction and guidance to the program. The Steering Committee is chaired by one of Dayton's five city commissioners, Pat Roach. The technical program of the Dayton CCEMP is being conducted by an Action Plan Team comprised of members of the city administration, regional government planning agencies, the local utility, and the University of Dayton. The University of Dayton is serving as principal technical consultant to the city for the CCEM Program.

The Energy Audit

The comprehensive audit of all aspects of energy use for the base year 1978, will provide information essential to the development of the best possible forecasts of the energy needs of the city for future years. The principal steps in the Energy Audit Task are outlined in Figure 2. Energy use determinations for the base year, and projections of energy needs for the future years, are based on the type, number, and energy use characteristics of the physical components that make up the city. Analyses of energy use for the base year will enable the city to establish, for each fuel type/energy source, its distribution of use by physical component category (residential, commerical, industrial, etc.); and energy-use activity

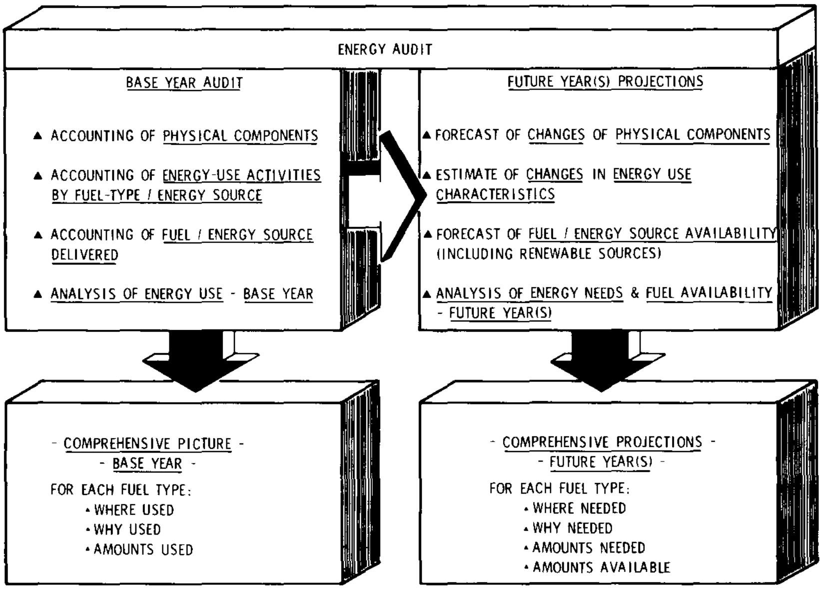

Figure 2. ENERGY AUDIT TASK

(space heat, transportation, etc.); and the amounts used for each subclass, (Kwh, CCF, Barrels, etc. and Btu equivalent).

Base-line projections for the future years may involve up to three scenarios: optimistic, median, and pessimistic. Changes in the future energy use patterns will be determined by forecasting the changes in the number of units per physical component category and from projected changes in the energy use characteristics of the components. The analyses of energy needs and of energy availability forecasts for the future years will provide a sound basis for the identification of future problems and the formulation of energy objectives.

The breakdown of energy use information that will be employed in the audit of the Residential Physical Component Category, is illustrated in Figure 3. The five physical component subcategories are arranged along the vertical axis. Within each physical subcategory, energy is used in a number of activities which are depicted on the horizontal axis on the bottom of the figure. Each energy use activity is supplied by one or more fuel types as listed on the oblique axis on top of the figure. The cells in the figure represent combinations of the three classifications into which energy use in Dayton was likely to fall in 1978. Solar space heating for single family detached homes, for example, would be associated with the cell in the upper corner of the figure.

Assuming that reasonably accurate determinations of energy use can be obtained, the methodology audit classification system approach will enable energy planners to aggregate energy use by fuel type/energy source, with sub-breakouts for physical subcategories and energy use activities. This audit classification system will provide a good picture of energy use in the city and will provide a very useful means for evaluating the needs for energy sources expected to be in limited supply in future years.

The detailed breakdown provided by the energy audit will also provide a basis for the rapid estimation of the likely impact of energy alternatives in the later stages of the program. For example, it would be easy to calculate the potential savings in natural gas used for hot water heating if all single family dwellings were converted to a specified type of solar hot water system. Then, for a more accurate estimate, an estimated rate of adoption of solar hot water heating could be used to predict the probably contributions of this renewable energy resource in any given future year.

Energy Objectives, Alternatives/Strategies, and the Action Plan

Following completion of the energy audit, a set of energy objectives will be formulated. These objectives will establish explicit goals for

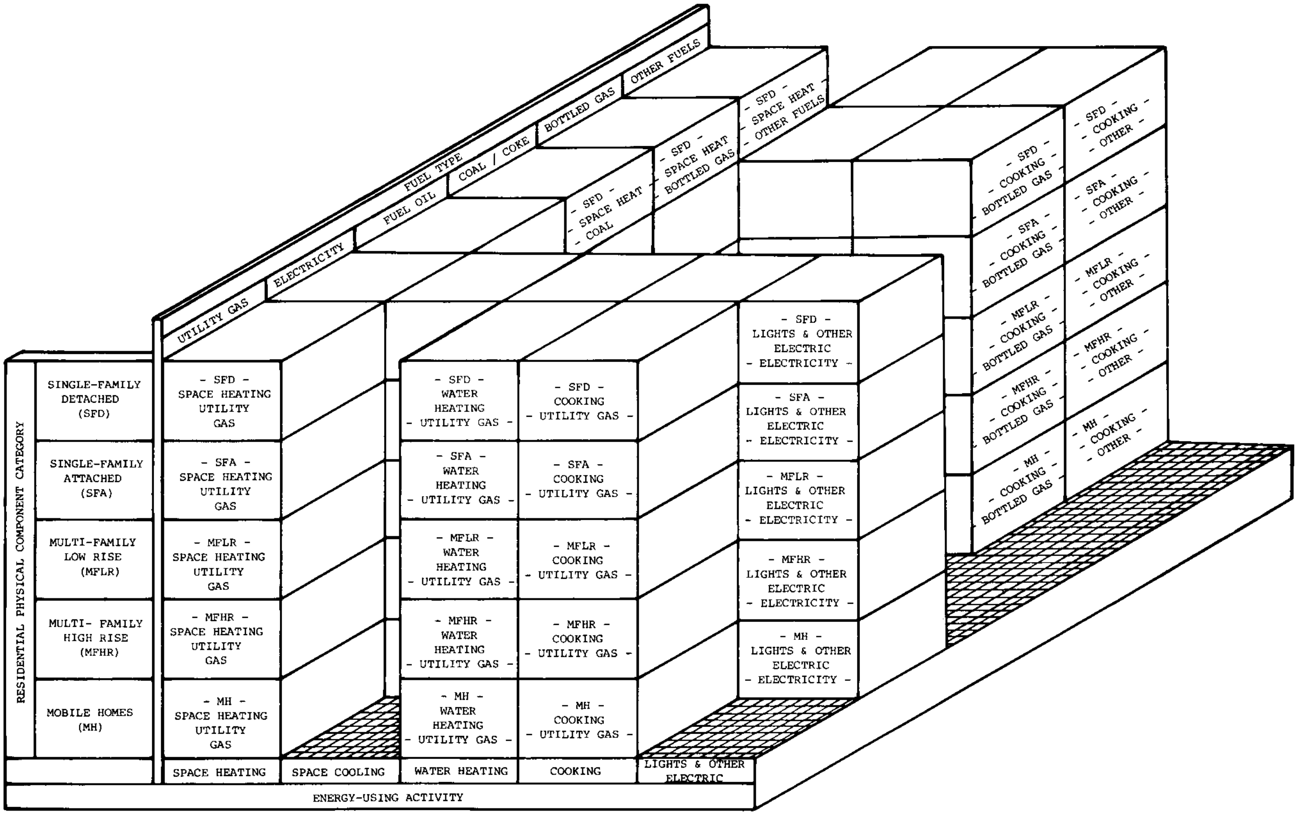

Figure 3. ENERGY AUDIT CLASSIFICATIONS: RESIDENTIAL PHYSICAL COMPONENT CATEGORY

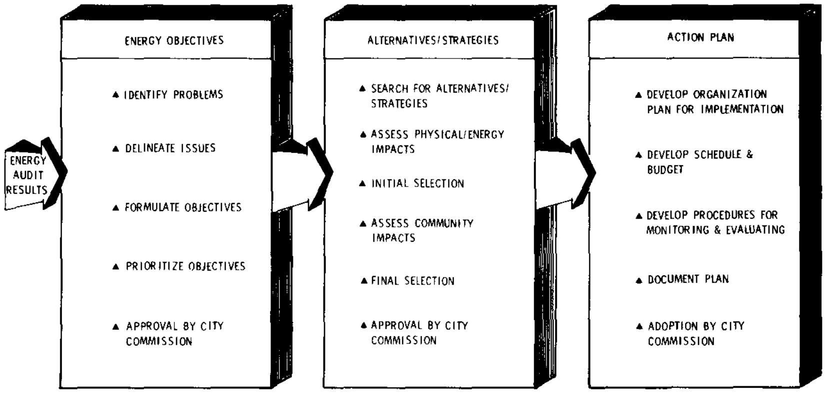

Figure 4. FINAL TASKS OF THE DAYTON CCEMP

reduction in energy use for fuel types, whose availability in the future years is expected to be inadequate or greatly uncertain. The objectives for fuels such as gasoline, whose future availability is likely to be extremely uncertain and beyond the control of the city, could be set to match or improve on proportionate shares of national goals. It should be noted that, although the projections of future years' energy needs and forecasts of energy availability will play a major role in identification of energy problems, these quantitative estimates will be tempered by the qualitative perceptions of citizens and community leaders.

The outline of the procedure to be followed in formulating energy objectives is illustrated in Figure 4, which also shows the remaining primary tasks of the CCEM Technical Program, Energy Alternatives/Strategies and development and adoption of the Action Plan.

Energy alternatives and strategies for their implementation will be sought to provide a quantitative reduction in the use of each fuel type equal or greater than the amount specified in the energy objectives. It is likely that several alternatives will be required to satisfy any given objective. The alternatives will undergo a two-stage review before a final selection is conducted. First, candidate objectives will be addressed for potential impact on the physical makeup of the city and on energy use. The energy audit analysis approach will provide a ready means for conducting such assessments.

Consider for example, a conservation alternative that would reduce energy use in existing gas-heated single family detached homes by 33% and in newly constructed homes by 67% (see Figure 5). The total gas energy use for heating such homes in the base year, 1978, is shown sche-

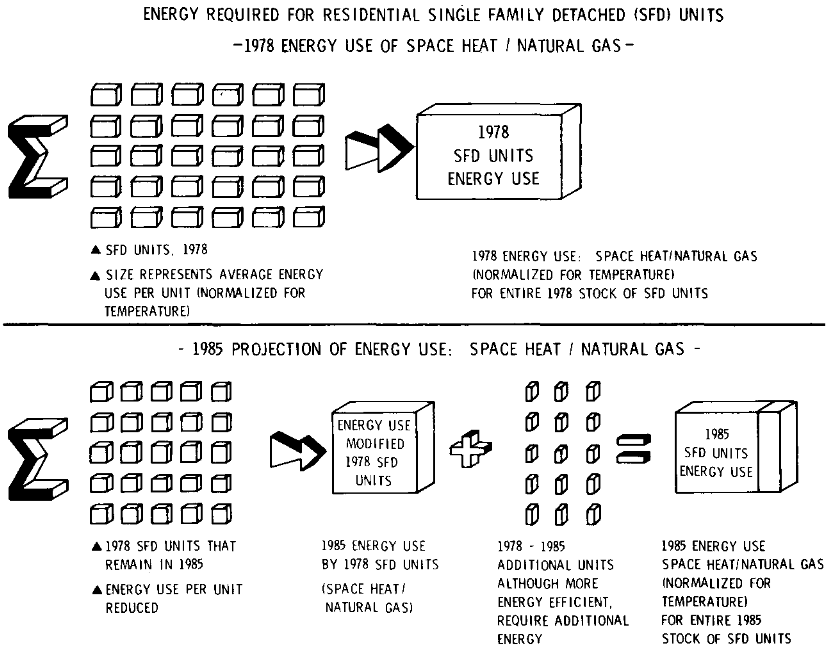

Figure 5. ENERGY USE ANALYSIS FOR RESIDENTIAL SPACE HEATING

matically by the aggregation of a number of small blocks in the upper part of this figure. Each block represents a single residence and the size of the block is proportional to the average energy use per unit. For the example, it has been assumed that five-sixths of the units using gas heat in 1978 would remain as gas-heated homes in 1985.

The 33% reduction in energy use per unit in 1985 is illustrated by the smaller size of the blocks. The energy use by these homes, summed together, is represented by the block labeled "Energy Use—Modified 1978 SFD Units." For purposes of the example, it is assumed that a number of new gas-heated SFD units will be built between 1978 and 1985. With the suggested alternative in place, the average energy use in these homes is depicted as about 50% less than the average value for the modified 1978 units that remain in 1985.

The total gas use for heating the city's entire stock of single family detached homes in 1985 is represented by the block labeled "1985 SFD Units—Energy Use." With the suggested alternative enacted, the 1985 energy use value is much less than the 1978 value, although there has been a 33% increase in the total number of units.

The framework of the energy audit analysis system thus provides a means of making a rapid quantitative estimate of the energy impact of given alternatives and also provides a means for a comparison of the energy impact provided by different alternatives.

It is planned to conduct an initial selection of the most promising alternatives prior to subjecting them to a more thorough assessment that includes analyses of secondary impacts on the community. This second assessment will include consideration of impacts on employment, the economy, the environment, on the demographic structure of the community, and so on. The final steps in the Alternatives Task will be a final selection by the Steering Committee, and review and approval by the city commission.

The final tasks of the CCEM Technical Program will involved the development and adoption of the Action Plan. The Action Plan will include the identification of an organization responsible for implementation and monitoring of alternatives, schedule and budgeting arrangements, and procedures for monitoring and evaluating the plan as it is implemented.

The CCEM Program will be culminated with review and adoption of the Action Plan by the city commission. The target date for completion is September 1980.

Renewable Energy Alternatives

Even before the start of the Dayton CCEM Program, the city had initiated a number of alternative energy actions. These alternatives have included energy management, energy conservation and renewable energy actions. Renewable energy activities in Dayton include the use of methane gas generated from the city's wastewater treatment plant and the provisions of solar hot-water and space heat for three new fire stations.

Methane Gas Production

The Department of Water of the City of Dayton has produced and utilized sludge gas for more than 45 years. The City of Dayton's wastewater treatment plant produces approximately 600,000 cubic feet of methane gas per day. This gas has a low-Btu, (700 Btu/CCF) content and is comprised of approximately 65% methane, 34% carbon dioxide and 1% hydrogen sulfide. The methane produced is used to heat the anaerobic digesters to the optimum temperature for sludge digestion and to heat nineteen buildings at the wastewater treatment plant.

The system is comprised of four 85 foot diameter digesters with floating roofs which maintain an airless environment for the anaerobic digestion process. The four digesters each hold 1.2 million gallons of digesting sludge. The continuous process of input and withdrawal handles an average of approximately 200,000 gallons per day of raw municipal wastewater sludge which is 70% organic and 30% inorganic material. The sludge must be kept at a constant temperature of 98°F to provide the optimum environment for the natural biological processes to function. During the high rate digestion period of approximately 20 days, much of the organic solids are converted to gas. The effluent sludge then stabilizes into a form satisfactory for disposal on land without odors or other problems associated with raw sludge.

Most of the methane gas produced in the process is utilized in the heating of the sludge to sustain the optimum temperature of 98°F. For example, the basic Btu requirement to heat 200,000 gallons of raw sludge to 98°F is 400,000 cubic feet per day in extremely cold weather.

In addition to the sludge digestion process requirements, the winter time heating of all treatment plant buildings and other miscellaneous requirements of about 100,000 cubic feet/day are met with sludge gas.

Solar Fire Stations

Three of the newest municipal structures in the city of Dayton are fire stations. The city has elected to use the opportunity presented by their construction to demonstrate the feasibility of the use of solar space and hot water heating. One of the new stations is being equipped with both solar hot water and solar space heating systems. The other two will have solar hot water systems, only.

The solar equipment being used in all stations is of the same general design. Each of the water heating systems employs an array of nine collectors with 189 square feet of surface area. The combined water/space heating system has 70 collectors with an area of 1400 square feet. The collectors are single glazed and employ a steel absorber plate with a black chrome coating. Water is used as the working fluid in each system. Drain-down will be used to prevent freezing damage.

For the space heating system, utility gas burners will be used as a second stage heat source for solar pre-heated water. Heat distribution is through a forced air system. Heat energy is stored in hot water contained in a 5000 gallon insulated tank. A shell and tube heat exchanger is used to preheat domestic water during winter months and to provide nearly total heating of domestic water during summer months. The solar heating system will provide about 42% of the heat energy needs for the solar heated fire station.

Conclusion

The Dayton CCEM Program is still in its initial stages. The renewable energy sources discussed in this paper, although not part of the CCEM Program, may represent useful first steps in the development of renewable energy alternatives for the City of Dayton. In the course of the Dayton CCEM Program, careful consideration will be given to a wide range of renewable alternatives. These will include waste materials, waste heat, and solar energy alternatives which have good potential for reducing the city's use of conventional fuels that are in short supply.

At the present time, the Dayton CCEM Program has not yet addressed the energy problems likely to be faced by the city in future years. Hopefully, the CCEM Program will provide a sound basis for identifying and resolving such problems. In any event, the CCEM Program has enabled the city to break the inertial barriers of conventional planning philosophy and to enter into a strong energy planning activity. In as much as the need for such activity is unlikely to diminish, we hope that the city's comprehensive energy planning effort will be continued long after the limited term CCEM Program ends. We also hope that the program will provide useful assistance to other cities embarking on their own comprehensive energy plans.

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Alleyland Development

Ann Cline
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Abstract

Underutilized central city land, particularly land located adjacent to alleyways, may be a potential community resource if residential development were permitted. Original platting of central districts with alleys typically follows strict north/south orientation, making possible solar alley development directed by special "subdivision" ordinances. Richmond, Indiana has completed a study of alleyland use and is building a prototype solar alleyland house to determine if further alley development ought to be encouraged.

Project Context

Richmond, Indiana is a classic, small American city—that is, it is the commercial, cultural and administrative center for a large surrounding agricultural area. At the same time, it is a manufacturing site for both local and national industry. Richmond is in most senses a typical American city.

Energy planning in a small, classic American city may, in both its specifics and its generalities, be of interest to other communities, large and small. The scale of a small city sometimes allows us to see structure and method which could be obscured as scale increases. The singularities of organization and of physical layout of small cities are simpler to deal with than overlapping multiplicities which characterize large American cities. Richmond is a single hook upon which are hung roughly congruent districts for government, for electrical generation and distribution, for transportation, for garbage collection, and so forth. We are a nucleus of human activity which has defined and limited edges—both organizational and physical. By a series of coincidences of time and place, Richmond is remarkably self-contained. This has suggested the possibility that to an as yet unaccessed degree, we might be significantly more energy self-sufficient than we are at present.

Whether large city or small, all energy management on the municipal level has two basic and seemingly disparate missions—one is to conserve energy and the other is to produce energy. Among the municipal energy activities well known in this country all either encourage energy efficiency and conservation or else they tap new, local energy sources to augment traditional fuels. We have already seen an exciting collection of such local, community scale projects at this conference, yesterday and today.

The Richmond City Energy Program began its task of assessing potential local energy resources in October of 1978, when a DOE contract was awarded to the city as one of 17 pilot cities in the CCEM (Comprehensive Community Energy Management) Program. A search for local energy resources can be one of the most fascinating projects and city can undertake. In general, it is a new look at the city which produces maps the likes of which no one has heretofore seen. Visually representing the geography of the city's energy uses and potentialities has opened our imaginations. The location of prime wind sites, prime solar sites, and aquifers for water-to-air heat pumps brings out into the open potentials for local energy production which were not previously known. Further searches for municipal waste or for waste heat from electric utilities if they are located nearby add to the city's energy production potential. Even the city's river gorge, the site of the earliest power for the city, may once again be tapped as a local energy source. Finally, the location of closely grouped end-users of energy, as in a shopping district such as Richmond's promenade may be considered a "resource" because the economics of distribution will favor dense developments. These examples illustrate locally available energy resources being considered for Richmond's Energy Plan.

Alleyland as a Resource

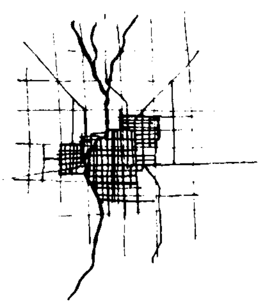
I wish to discuss today an additional resource category which I will refer to as underutilized land in our central city. Richmond, like most cities, has grown at the edges and shrunk in the middle. Only recently have we come to recognize the high cost of urban sprawl. What is less often recognized is the enormous investment sprawling cities make in "embodied energy" (that is, the energy required to produce and lay sewer pipe, build roads and lay new utility lines). At the same time, the central city offers potentially buildable land for which the embodied energy investment in sewers and roads was made long ago. In many central cities, much of this potential building land is located along the cities' alleyways. In a few communities, alleyland for commercial districts has already been developed for new or expanding business. [1]

In Richmond, the city's energy program is presently considering possible *residential* development of alley-bordering land. We are doing this for several reasons: 1) because there is a great savings available to any community which utilizes existing facilities before adding new ones; 2) because of the potential for inexpensive building sites that this presents . . . sites which can be developed for solar houses, if planning goes in that direction; and 3) because underutilized central city land presents the community with an eyesore which frequently is translated into a request for city government to "clean up the neighborhoods." Trash and litter along alleyways may suggest hopeless homeowners; it may also suggest that there is more land in a given lot than people are willing to take care of. To understand why this may be so, and to see alleyland in its widest perspective, it is useful to look at the origins and the evolution of alleyland.

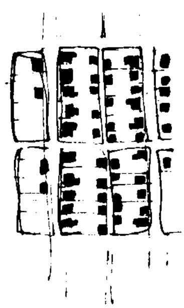
The Origin and Evolution of Alleyland

Richmond's central city was platted in the first half of the 19th century. As in most midwestern cities, land division and street location in Richmond has been an in-fill process within a standard pattern of section and quarter-section land division by which our forefathers divided, claimed and sold the vast New World wilderness. Streets have been created parallel to roads which followed section lines; alleys in turn were created parallel to streets. This type of land division was typical in

GRID DEVELOPMENT



ORIGINAL ALLEY LAYOUT



midwestern cities up to the Second World War. After the war, curvilinear, alley-less land subdivision became the dominant pattern.

Looking at Richmond today one sees an interesting and curious evolution. Many central city lots, while as narrow as 35′ are in some cases as deep as 270′. A typical lot might be about 45′ by 175′. In a few cases the rear, alley-bordering property bears clues to explain the land division's original rationale. Two story horse barns remind us that when the land was first platted, common practice put the odor and nuisance of horse and carriage as far from domestic life as possible. When motor cars replaced horses, it still took a generation for the motorized contraptions to be trusted not to explode or to spread deadly fumes; motor cars were kept at bay along the alley—sometimes housed in the barn of the horse they replaced. For the intervening years to the present, the transition from alley barn to alley garage and finally to front driveway was gradual.

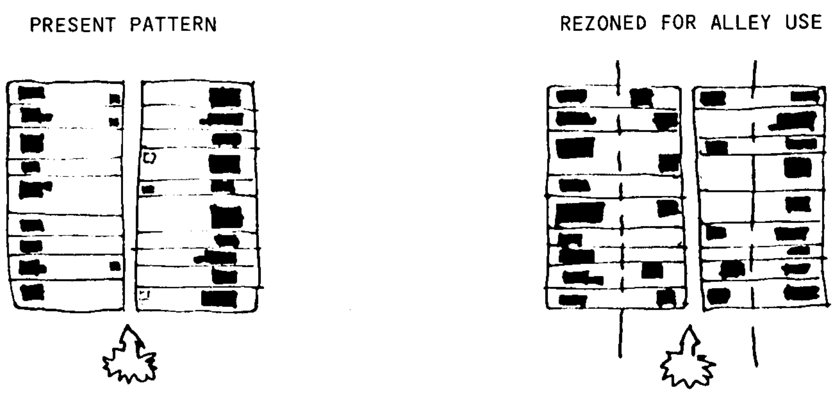
In a city like Richmond, which has grown slowly but steadily during the entire period, about half our city's land contains alleys. Of that half, perhaps half have garages which were built for motor cars sometime between 1920 and 1940 and are still in use. Of the remaining half (that is perhaps a quarter of the city), one finds a mixture of horse barns and garages and something which is especially curious. In some blocks, there are many lots without any alley structure whatsoever. Whatever shelter there once was for garaging vehicles has long since disappeared. What is more curious, of those alley structures which still exist—either barn or garage—few are actually used to house automobiles. Present residents tend to park along the streets in front of their houses; the garage (perhaps because it is too small for modern cars) is abandoned. Left to disuse, the typical pattern is for barns and garages to decay and for trash to accumulate. When the attacks of vandals and arsonists are not enough to remove aging alley buildings, the city will condemn and remove these structures.

Alleyland as a "Subdivision"

Whatever the process, we now find a number of areas where deep lots border alleys with open land; weeds and wild-flowers abound. In some cases the land looks not unlike a small subdivision site. A key difference, however, is that this particular "subdivision" already has its amenities in place; there is a roadbed or a lane, usually about 14-16 feet wide, there are sewers, water, electricity and gas lines—frequently along the alley itself. City buses run within a block or two; schools are within easy walking distance. In short, this alley-bordering land is like a subdivision with the development costs already paid for. What's more, because of the strict cardinal development of alleys, building sites all have true north/south orientation. Depending on the exact location of nearby obstructions, solar access might be secured. The opportunity presented by open land along alleys could be considerable.

The step between opportunity and reality is, in this case, a long one. Basically, in any community not everyone will see opportunity here. And, even when opportunity is perceived, the problems may be overwhelming. Since alleyland on any given block will be owned by as many as twenty-five individuals, it is difficult to plan how orderly development of this land might take place. Ideally, a single developer would buy up the rear half of each lot and redivide it into new parcels, given the zoning to permit this. However, it is likely that some among the property owners would not wish to sell. Another plan would write a strict "subdivision" ordinance which would limit size and insure minimum quality of any structure permitted along the alley "subdivision." This would allow each property owner either to sell *or* develop his own property and acquire solar rights, if needed, from his neighbor. In any case, since alley residences are strictly prohibited by most cities' comprehensive plans, the most serious impediment to alleyland development might be that the plan re-opens the subject of alley residences, which most planners have felt very happy about closing. Key to overcoming this impediment would be the enforcement of quality building code measures which would effectively prohibit garage remodeling for residential use and would insure quality new construction along the alley.

If quality building were enforced, however, another problem comes into play. A well constructed residence might be built along an alley for under $40,000. However, since the value of surrounding property would often be much lower, this would depress the value of the alleyland house,



at least until several alley residences had been built and successfully marketed. It should be noted, however, that new construction along the alley would tend to appreciate the value of older houses nearby.

While the impediments to alley development are considerable, one is still faced with the opportunity which may here be present: inexpensive building lots with *automatic* sun orientation which turn underutilized urban land into a new neighborhood of taxpayers, school children, city bus riders, concerned citizens. Perhaps the most happy occurrence of all will find the new alley residents on-site landlords for the existing older homes in the area. In this case, one might view these blocks as PUDs or planned unit developments combining single family units along the alley with apartment units along the street.

Who in the City of Richmond Is Involved in this Project and How Is It Being Pursued?

The major impetus for alleyland development in Richmond comes from the City Energy Program with support from Community Development Planning and the Bureau of Buildings. Also involved is the City Energy Program's advisory board which consists of the mayor, a councilman, a plan commissioner, the city engineer and the city planning director. Some months ago, this group authorized the Energy Program to study the alleyland problem. This spring Energy Program staff worked with senior design students in the School of Architecture of Miami University on a study of the implications of alley development. The students then designed a number of possible prototypes which illustrated the type of residence which might be built on alley-bordering land. The results of the students' work have been published and distributed to community leaders and government officials. [2]

Next the advisory board authorized the Energy Program to seek funds to build a single, prototypical alleyland solar house which would illustrate the scale and character of desirable alley development, and which might bring to the fore the possible problems and considerations this development would entail. The Energy Program located a local builder with experience in solar construction and teamed him with the group's solar consultant, Fuller Moore, who is the architect of half a dozen solar residences and institutional buildings. The two applied for and received a HUD Cycle 5 Solar Design award. Plans for the alleyland prototype house have just been submitted to HUD for the construction award Phase. If construction money is awarded, construction will begin on the alleyland site in November. In March or April of next year the City of Richmond may have its first alleyland residence. In the succeeding months, the community will be asked if and how it wishes to encourage further development of this concept. We anticipate a planning study to identify the characteristics of potential areas for alleyland development. Once this study is completed, blocks can be targeted and ordinances written to direct future development of vacant alley-bordering land.

Acknowledgments

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Section H
Energy, Liberty, and the Pursuit of Happiness

Luncheon Address by Martin R. Adams
Deputy Program Director for Solar,
Geothermal, Electric and Storage Systems,
U.S. Department of Energy
August 21, 1979

Energy, Liberty, and the Pursuit of Happiness

Martin R. Adams
Deputy Program Director
for Solar, Geothermal, Electric
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Many of us here today have heard of the ancient Chinese curse, "May you live in interesting times." For those of us in the energy business, 1979 has not been boring. Public interest and concern over the national energy picture is at its highest level since the 1973 embargo. Over the past five or six years we've had some sort of shortfall or "crunch" in one fuel or another each year—coal one year, natural gas another, home heating oil yet another—but the gasoline shortage this summer really got to people where they live: in their independence. For the first time, individuals have had to stop and plan real changes in their lives. It might be something small, like planning the family schedule around whose car is odd or even, or taking a bus to work. On the other hand, a family which was considering buying a house fifty miles out in the boondocks may have had second thoughts. At the moment we have gasoline, but we know we're never going to have forty cents a gallon and free dishes again.

When this country was founded we were promised life, liberty and the pursuit of happiness. Somehow, we've come to equate these values with the right to cheap, abundant energy from depletable fuels. We tend to forget that many of our forebears ran their lives on whatever the individual family or small community was able to gather and that most of their fuel sources were renewable. Until the coming of a nationwide rail network made it possible to distribute coal to every home, the colonial family and the Western homesteader lived pretty much the same. Homes were heated with wood fires. Land transportation and agriculture ran on horses, mules, oxen, and people. Wind moved boats on river and ocean.

Lighting came from bear fat or whale oil or beeswax or sheep tallow. Water power ground wheat into flour and spun wool and cotton into yarn for clothes. This "First Age of Renewables" lasted a remarkably long time and never died out altogether in the more remote parts of the United States. Henry Ford was a long-time advocate of alcohol from farm crops as a motor fuel, reasoning that this would take up the slack in wheat production as horses were phased out. West Virginia coal was shipped to Washington on mule barges via the C&D Canal until 1924. Windmills supplied electric power and irrigation pumping on farms until the 1930's, when they were replaced by rural electrification programs. Boise, Idaho began heating homes with geothermal energy in the 1890's; this system is still functioning, although many homes went "modern" with natural gas later on. Solar hot water heaters were popular in Florida before cheap depletable fuels came along.

Perhaps by coincidence, the discovery of large quantities of oil and gas in this country occurred during the heyday of the giant trusts. A consumption economy made a lot of sense at the time—the consumer enjoyed a warmer home and the ability to get around fast, and the industries profited. During this period the United States was transformed into a world power, partly on the basis of its domestic energy resources. We rationed gasoline during the Second World War, but we didn't have to fight out the consequences of an embargo to win the war. Even as we started importing cheap Middle Eastern crude to take care of more and more of our needs, we became smug about our energy future. The Sherman Anti-Trust Act and the progressive income tax diminished the power of individual energy resource companies, but the age of conspicuous consumption went on and on.

Meanwhile, individual Americans became accustomed to energy that was not just cheap but convenient. No need to go out to feed and water and curry Old Paint every morning—just drive him around the corner and fill him up every couple of days. Chopping wood is something you do to add a little atmosphere to the parlor. A flick of the switch turns night into day and winter into summer and summer into winter. Don't waste valuable personal energy on striking matches, brushing teeth, or opening cans: there's an electric appliance for every task. Even now, the most popular wedding present in D.C. is a machine that performs a dozen tasks that used to be done with a paring knife or a hand-operated egg beater. Need to get away from it all? If you don't have a camper, you can still load up the family car or hop on a plane and head for the beach or the hills.

The price we've paid for all this convenience is the loss of our independence, of control over our lives. We've all heard jokes about people who went hungry during a blackout because the electric can opener wouldn't work. The near hysteria this summer over the gasoline shortage—reports of fist fights and near riots at gasoline stations—demonstrates how strongly people will react when freedom is equated with energy availability, and that availability is threatened. At the same time, the search for a scapegoat persists: blame the oil companies, blame the government, blame OPEC.

At this point, community-based renewable systems begin to look very attractive at a grassroots level. Just to give you an idea: my wing of the Energy Department gets maybe 200 Congressional referrals—citizen mail sent over for expert replies—every week. At least 50 of these are inquiries about biomass fuels, from people who want to make their own liquid fuel with a little still in the back yard. The folks over in Transportation Systems are getting just as many. Since my office deals in advanced R&D, we're not supposed to see the mail from people who want to put solar in their homes, but the size of the trickle that gets through anyway makes me believe that the average citizen is ready for small renewable systems.

This isn't to say that we don't have a selling job to do. There are a lot of people out there, both in and out of the energy business who've picked up the notion that economy of scale means "big is beautiful" and small is for backpackers, *New York Review of Books* radicals, and little old ladies in tennis shoes; that small-system advocates are at best impractical and at worst out to undermine the free enterprise system that made this country great. Some of us in the small-systems community haven't made things any better by characterizing our critics as tough, cigar-smoking rednecks or smooth three-piece suit utility executives out to put a nuclear plant on every corner and an LNG dock in every salt marsh. The convenience mentality has also created a great reluctance to give up reliance on central systems, blackouts and shortages not withstanding: "You mean I should run my life by the wind and the sunshine? Are you crazy? I've never gone out of my way for energy before and I'm not going to start now?"

The best answer to these folks is to show them that small systems work, that they are relevant to individual and community needs, that they shift power both literally and figuratively back to individuals and communities. One thing we have to do is not get too attached to any one source as the whole solution, even on an individual scale. Our country has been blessed with many energy resources—not the same ones in every location, but a variety wherever you go. It is now up to our ingenuity to see how we can combine them into total energy systems.

A single large chicken-farming operation might, for example, make methane from the chicken manure for heating, distill alcohol fuel from grain before feeding the protein-rich residue to the chickens, and heat water for processing the chickens for market with solar or geothermal energy, all the while drawing electric power from the regional utility grid.

A small town might supplement its electric power with wind, a solid-waste-fired generator, or a low-head dam in a nearby river. At the same time, solar energy could provide hot water and some of the heat, backed up by waste heat from the garbage-fired generator.

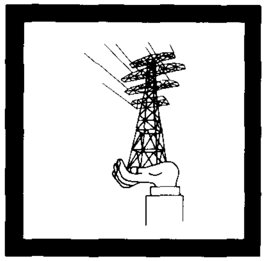
An agricultural cooperative might operate a central still using grain surpluses and farm wastes and an anaerobic digestor to convert animal wastes into methane. It could also assist individual farmers in obtaining wind machines and solar crop-drying systems.

An inner-city cooperative apartment building might supplement its power with a windmill on the roof and fire up the boiler with trash. Its inhabitants would, of course, get around on the subway, which runs on old-fashioned PEPCO or Con Ed juice.

Another thing we need to do is to restore the meaning of the term "appropriate" to "appropriate technology." Over the last couple of years, there has been a tendency to think of "appropriate" as what fits in a Third World village or a remote Appalachian hamlet, since the concept first addressed the needs of those sites. However, we have to recognize that what works for a little community in the middle of nowhere doesn't necessarily "fly" if you're talking about a high-density population of half a million people. "Appropriate" means just that, and at this point we need to call a truce with the large-scale system people and see what we can borrow from them to develop or enhance small-scale systems. At DOE we've inherited a lot of talent from the space program and the AEC and we are trying to apply some of the things we've learned over the last twenty or thirty years. We've learned a lot about aerodynamics from the aerospace industry and put a large 2000-kilowatt wind machine in a little North Carolina town. We hope in the long run this is going to help us build wind machines that are more efficient than the ones you remember from the Kansas scenes in the "Wizard of Oz." We are calling upon the expertise of the oil and gas industry to locate geothermal resources and drill for them. The entire concept of photovoltaics is a spin-off of the space programs, and if we can get the cost down we can wipe out unemployment in Silicon Valley.

The modern rapid-rail system is a splendid example of how both large-system and small-system people can learn from each other. BART and Washington Metrorail were both built by people who had sent rockets to the moon. They are run by the very finest computer equipment. When they work, they are very clean and safe. However, if you've used either system, you may have wondered if the planners forgot why you have a subway—it is to get you to work on time. I don't suppose anyone would want to recreate the New York City subway system exactly as it is—dirt, muggers, graffiti, blaring tape decks—but that system will take you all over town twenty-four hours a day, and you get in by dropping a token in the slot. That's what a subway is all about. But in spite of its defects, consumer acceptance of the Washington system has gone way beyond anyone's expectations. During the peak of the gas crunch this summer, it carried over 300,000 passengers a day, even while less than half complete, and the figures show a permanent gain of 20,000 trips per day now that the worst is over.

To sum up, we are a nation of individuals. Rugged individualism tamed a wilderness on the basis of the resources we have in this rich land. If we go back to our roots, if we give up our fears of losing control over our lives, this same spirit of individualism and self-help can get us through our present tight squeeze. We can learn to live with the resources we have and bring in a "Second Age of Renewables" for ourselves and our children.



Section I
Concurrent Workshops

August 21, 1979

Workshop on Urban Design

August 21, 1979

Workshop on Urban Design

Chairman

T. Owen Carroll
State University of New York, Stony Brook

Panelists

Robert Blaunstein
U.S. Department of Energy

Ralph Knowles
University of Southern California

Robert Twiss
University of California, Berkeley

Duncan Bremer, AIA
AIA Research Corporation

Murray Milne
University of California, Los Angeles

Summary

Owen Carroll opened the session with remarks on the foci of the workshop and the discussions which were to follow.

Robert Blaunstein of the DOE Office of Environment explained that that office provides an understanding of the effects and impacts of various DOE policies. It reviews policies and provides the feedback which may lead to changing or abandoning particular policies or confirming that a policy is environmentally sound.

Murray Milne summarized work his group has recently completed about planning for solar cities. The study examined three national energy scenarios: high petroleum use, high hydroelectric use, and high solar use. The study asked the question, "What would happen in 2025 A.D. if . . . ?" Through various scenarios, population estimates, building designs, and weather conditions, the study postulates what a solar city would look like, its size and population, energy efficiency, etc.

Peter Pollock of SERI and Mark Braly of the City of Los Angeles filled in for Ralph Knowles. They indicated that solar access is the key issue in urban areas, that easements are now required to protect one's solar ac-

Robert Twiss posed a number of questions: "Will 'soft path' strategies encourage urban sprawl? Can a certain level of solar reliance be achieved? At what levels of density and solar reliance do problems occur? At what level of government should these problems be addressed (i.e., block, city, state, etc.)?" Twiss et al. have recently completed a study for DOE on the effects of the Domestic Policy Review. Their conclusions are that it should be easy to meet the active solar goal by retrofit and that multi-family dwellings pose potential problems, which may be solved by their obtaining energy from nearby solar development lots.

Duncan Bremer stated that "design is a renewable resource in itself." The AIA Research Corporation has found that, using currently available design methods, 30-50% reductions are possible over buildings actually built as late as 1976. To point out the possibilities, 40-80% energy use reductions are possible in newly-urbanizing areas, while 10-30% reductions are possible in existing built-up areas. Regarding the issue of solar-based cities all looking alike, Mr. Bremer indicated that use of local materials of construction could alleviate this problem and make cities blend aesthetically with their locales and climates.

Three Solar Urban Futures: Characterization of a Future Community Under Three Energy Supply Scenarios

Murray Milne
Marvin Adelson
Ruthann Corwin
School of Architecture and Urban Planning
University of California, Los Angeles

A hypothetical city of 100,000 people in the year 2025 was analyzed for D.O.E. based on three initially given energy supply scenarios: Future 1 specifying approximately 6 percent of the city's demand being met by solar technologies; Future 2 specifying about 25 percent; and Future 3 seeking maximum use of solar technologies. These three versions of the hypothetical city are to be identical in terms of population, goods and services produced, and energy demand. Their differences are compared in terms of physical layout, environmental quality, socio-economics and quality of life.

In the residential sector of this city four different building types are considered: a large and a small residence, a row house, and an apartment. The commercial-institutional sector is represented by a midrise office building, a small strip commercial building, and a one-story shopping center. Three versions of each residential and commercial building prototype are considered: an Uninsulated version of the kind common in the past; a Standard version satisfying the new ASHRAE 90-75 Energy Standards; and a Passive Solar version designed for better solar energy performance (Table 1). End use energy demand is computed for heating and cooling, lighting, equipment, and domestic hot water in each building prototype. The prototypes are then aggregated for each of the three versions of the hypothetical city in proportions calculated to

TABLE 1. PROPORTION OF BUILDINGS NEEDED TO MEET THE GIVEN ENERGY SUPPLY SCENARIOS

PROTOTYPE SOLAR	FUTURE 1	FUTURE 2	FUTURE 3	FUTURE 3A
RESIDENTIAL				
"Uninsulated"	29.0%	39.9%	0%	0%
"Standard"	68.8%	47.7%	0%	0%
"Passive"	2.2%	12.4%	100%	100%
COMMERCIAL				
"Uninsulated"	6.9%	12.2%	0%	0%
"Standard"	89.4%	70.3%	0%	0%
"Passive"	3.7%	8.3%	100%	100%

match the given energy supply scenarios and assumed demographic constraints (see Table 2).

Industrial sector energy demand is dominated not by building design characteristics, but by requirements for production and process energy of various qualities. The proportion of this demand that can be met by the given solar technologies is calculated to meet the given supply scenarios for each of the three versions of the hypothetical city.

Under the initially given terms of this study, transition impediments were assumed to have been overcome and, in addition, the city's transportation sector was to be excluded. The given national-level scenarios specify the quantities of energy that would be supplied by each different energy technology (i.e., solar, hydroelectric, coal, etc.). For this study non-urban components of the national scenarios are eliminated (i.e., mining, agriculture, etc.), and the figures are scaled down to a city of 100,000 people.

The results of the study include the following:

In Future 1 and Future 2, the city's residential, commercial, and industrial sectors can easily meet the on-site energy collection requirements of the given supply scenarios (see Figure 1). In Future 3, the Solar City, the residential sector can be totally energy self-sufficient (collecting all needed energy on-site), and the commercial sector can collect 59.7 percent of its energy requirement. Passive design of buildings plays a large

TABLE 2. SUMMARY OF ON-SITE COLLECTED SOLAR ENERGY AND IMPORTED ENERGY NEEDS FOR THE HYPOTHETICAL CITY IN 2025

	Future 1	Future 2	Future 3	Future 3A[1]
City Land Area (acres)	10,000	10,000	10,000	13,450
On-Site Collected Solar Energy (percent of total "metered demand")				
Residential	4.5%	31.6%	100.0%	100.0%
Commercial	4.4%	16.7%	59.7%	100.0%
Industrial	3.4%	14.3%	18.2%	100.0%

	Future 1		Future 2		Future 3		Future 3A[1]	
	BTU	%	BTU	%	BTU	%	BTU	%
Imported Energy Needs (BTU's x 10^{12} and percent of total energy supply)								
Residential = 4.948	4.725	95.5%	3.383	68.4%	0.000	0.0%	0.000	0.0%
Commercial = 3.540	3.384	95.6%	2.949	83.3%	0.970	27.4%	0.000[2]	0.0%
Industrial = 19.900	18.870	94.9%	17.050	85.7%	16.280	81.8%	0.000[3]	0.0%
Total Imported Energy[4]	26.979	96.3%	23.387	83.4%	17.250	61.6%	0.000	0.0%

1) Future 3A shows the values that result if all three sectors are energy self-sufficient, which requires a 34.5 percent increase in city land area
2) If additional 650 acres of on-site solar collectors are added to the 1000 acres in Commercial sector it can become energy self-sufficient.
3) If an additional 2800 acres of on-site solar collectors are added to the 650 acres in the Industrial sector, it can become energy self-sufficient, except that high temperature (above 600°F) industrial processes cannot be accommodated.
4) Some of this imported energy is also solar (i.e., hydroelectric, synfuels etc.)

part in these results. The industrial sector can collect on-site only 18.2 percent of its energy needs.

In what is called Future 3A, all three sectors of the hypothetical city can be 100 percent energy self-sufficient if the land area available for various types of solar collectors is increased 34.5 percent; the commercial sector needs 650 additional acres, while the industrial sector needs 2800 acres, provided that moderate temperature energy (250°F to 600°F) is adequate to meet industrial process needs. The resulting energy self-

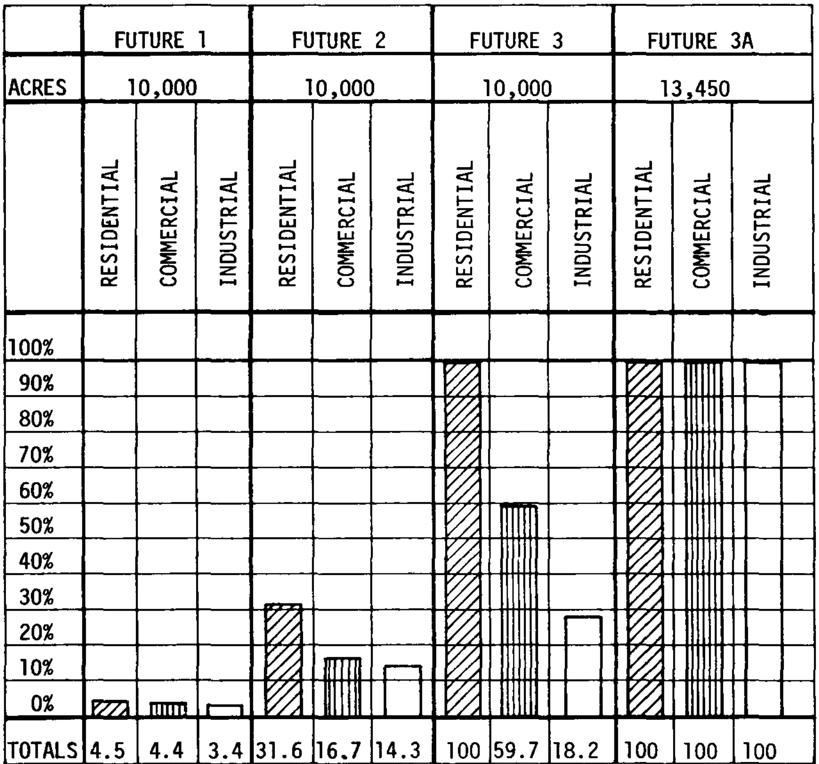
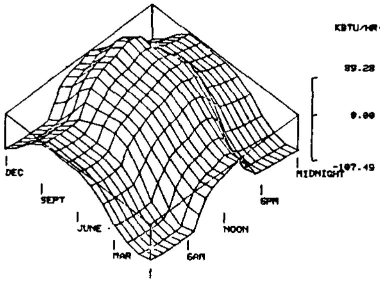


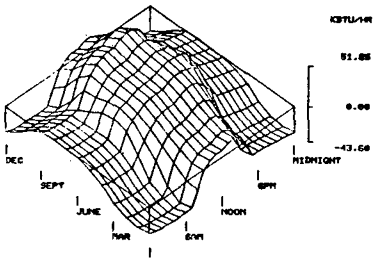
Figure 1. PERCENTAGE OF TOTAL ENERGY SUPPLIED BY ON-SITE COLLECTED SOLAR

sufficient city of 13,450 acres is still less than the median area (14,784 acres) of 23 existing United States cities of about the same population. It is important to recognize that much of the energy imported into the city is also solar (i.e., hydroelectric, wind, biomass, etc.), but only solar energy collected within the city limits is considered in the definition of an energy self-sufficient city. Only Futures 1, 2, and 3 can be compared with each other; Future 3A is presented parenthetically to give some perspective to the dimensions of a total solar city.

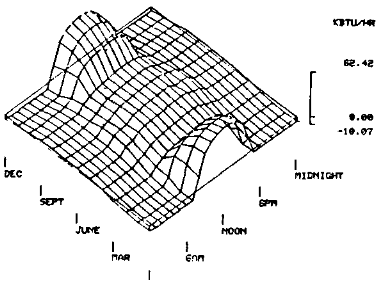
In conclusion, all versions of the hypothetical city can be achieved without major shifts in urban form, density, or municipal operations. For example, passive solar residences need not look different from con-



The Uninsulated version's graph exhibits the worst possible energy performance: maximum heat gain in the summer months when it is least needed and maximum heat loss in the winter. This characteristic "heat mountain" shape is due to lack of insulation plus glazing which is distributed equally on all four exterior surfaces of the building. It utilizes very little passive solar energy to temper the extremes of heat loss and gain. In the winter it loses heat all day long, and in the summer it is always gaining heat except in the early morning.



The ASHRAE 90-75 Standard version has the same shaped graph but the extremes are greatly reduced, primarily because there is less glazing and better insulation. The maximum hourly heat gain is reduced approximately 40% and the heat loss 60% (the magnitude of the improvements is noted on the scale to the right of the graph). Notice that this building gains a bit of heat at mid-day in winter.



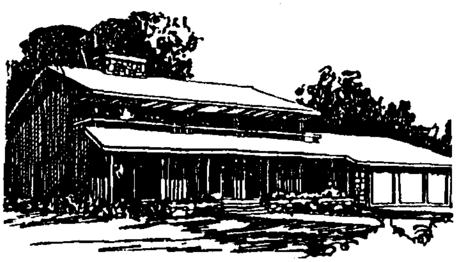
The Passive version's graph configuration has actually reversed due to the use of south glazing as a passive heat collector in the winter months, along with better insulation. Note that in this graph the maximum hourly heat gain is nearly 50% greater than the Uninsulated version and its peak has moved from summer to winter where it is obviously most needed. Shading the major glazing areas during the summer months flattens out the heat gain from March to September, the period when it was highest in the other two versions. Notice that in December this building has the potential to gain much more heat than it loses.

SOLAR-5 graphs of heat loss and heat gain of the Uninsulated (top), ASHRAE 90-75 Standard (middle), and Passive version (bottom) of the Large Single Family Residence.

Figure 2.

Uninsulated

ASHRAE 90-75 Standard



Passive

The three different versions of the large single family house initially look almost identical, but careful comparison reveals important differences between the Uninsulated version, the ASHRAE 90-75 Standard version, and the Passive version respectively. These were intentionally designed to look like contemporary tract houses, because no matter what homes look like in the twenty-first century, they will seem as conventional to our children then as these do to us now. However, no matter what they look like, the passive versions will all have to incorporate the same essential elements including lots of south glazing, shaded in summer, internal mass, thermal drapes, etc.

Figure 3. THREE TYPES OF LARGE SINGLE FAMILY RESIDENCES

ventional houses, and passive solar commercial/institutional buildings may be virtually indistinguishable from existing versions that consume up to twenty-five times more energy (see Figures 2 and 3). No significant environmental socioeconomic or life-style consequences are required or implied by the physical changes introduced, or from the solar equipment used.

References

The material in this paper is drawn from the executive summary of a D.O.E. research project conducted by Professors Murray Milne, Marvin Adelson, and Ruthann Corwin, with a team of eight UCLA graduate students at the Urban Innovations Group, completed in April 1979. The full project report is entitled "Three Solar Urban Futures: Characterization of a Future Community Under Three Energy Supply Scenarios." It constitutes Task 7 of the Technology Assessment of Solar Energy (TASE) Project conducted for Dr. Robert Blaunstein, Chief of the Conservation, Solar, and Geothermal Branch, Office of Environment, U.S. Department of Energy (D.O.E.). This study is one of three Community Level Studies coordinated by Dr. Ronald Ritchard of the Energy and Environment Division, Lawrence Berkeley Laboratory.

The SOLAR-5 computer program is described in "SOLAR-5, An Interactive Computer-Aided Passive Solar Building Design System," by Murray Milne and Shin Yoshikawa, Third National Passive Solar Conference, International Solar Energy Society, San Jose, California, January 1979.

Urban Design and Land Use Implications of Decentralized Solar Energy Use

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Abstract

The pattern of energy demand that results from variations in urbanized land uses significantly affects the potential of decentralized solar technologies to replace non-renewable energy sources. The critical measure for comparing energy use among land use types is not how much solar energy can be generated on-site or how much energy can be saved by conservation, but how much energy demand remains after these techniques have been implemented.

Case studies indicate that an increase in residential densities to those characteristic of townhouses and low rise apartments, for the purpose of reducing transportation and bound energy consumption, would not preclude the viability of on-site solar technologies to displace a substantial portion of the remaining demand in both the short term and the long term. Combined energy savings are expected to exceed those which can be attained by on-site solar technologies in current land use patterns dominated by detached single family housing and to be accompanied by fewer impacts and lower costs. Managing a transition to community renewable energy systems, then, should include the development of energy efficient land use patterns which will optimize energy savings in all energy use sectors.

Recent research within the Institute of Urban and Regional Development at U.C. Berkeley has been focused on the community level impacts of decentralized solar technologies (1). Projections for increased reliance on renewable energy sources have elicited concern about the physical changes that communities are likely to undergo in the coming decades in order to facilitate a transition to on-site energy production.

The purpose of our research was to examine the physical, spatial and land-use related impacts of decentralized solar technologies applied at the community level to achieve the President's current solar goal of 20 percent by the year 2000. To carry the analysis further we have used the results as a basis for evaluating the way in which a shift toward reliance on decentralized energy technologies may eventually alter the form of a community. Because we are concerned with the transition of existing cities to solar reliance, we looked first at the solar potential of cities as they exist today and then assessed the extent to which land use patterns might have to be reshaped by urban designers and planners to meet the solar goal of 20 percent.

In addition, we have been concerned with the question of how to maximize energy production within a community using either solar collection systems for individual structures or district systems in which energy is stored at a centralized location within a neighborhood. The potential of a community to use on-site energy production depends on its climatic conditions, latitude, and its mix of land uses. Within each land-use sector variations in on-site energy potential result from variations in the patterns of building types, the pattern of functional activities and density. Our analysis has attempted to identify where within a community physical characteristics limit on-site energy potential.

Research Approach

To do this, land uses were categorized based on building type, activities and density, i.e. characteristics which influence on-site energy demand and supply. These land-use types may be thought of as "energy-sensitive" land-use patterns. Patterns examined were single-family detached dwellings and multiple-family townhouses, row houses, low rise apartments and high rise apartments in the residential sector; strip commercial development, warehousing and the central business district in the commercial sector; and central-city facilities in the industrial sector.

We selected a series of case study sites with land use and energy use characteristics typical of each category. The solar potential of six different solar energy supply systems was evaluated for each case study, ranging from thermal collectors which are economically feasible today and which use short-term thermal storage, i.e. two to three days, to technologies which have not achieved widespread use at the present time but which are likely to be economically feasible in the next twenty-five years.

If the required amount of collector area is available, each of these technologies has a theoretical potential to meet a given mix of end uses, e.g., space heating, hot water and lighting. This theoretical potential results from the ability of a particular technology to provide the required mix of end uses, based on a matching of thermal and electrical energy produced with thermal and electrical energy demands. For example, given unlimited collector area, flat plate thermal technologies with short-term storage could provide up to 80 percent of the hot water and 70 percent of the space heating demand in a residential land use. Depending on residential density and type of construction, this represents about 40 percent of the total on-site energy requirements in an average U.S. climate. The only way to increase the solar supply is to use a more advanced technology which can provide long-term storage to meet 100 percent of the heating demand or which can provide electrical energy. If there is not enough collector area available, then energy use and/or land use patterns have to be modified in order to achieve a better match of solar supply with end use demand.

Table 3 is a summary of the results of our analysis of the on-site energy potential of five land use types in which six alternative active solar systems are employed. In this analysis we assumed that conservation measures were implemented first. Our assumptions regarding conservation are summarized in Table 3. The performance of each technology is evaluated for the five non-industrial land use patterns and is presented vertically in the table. For each technology in each study area, on-site solar supply is compared with the potential of the technology to meet that study area's total energy demand if collector area were unlimited. Performance is recorded as a percentage of the total energy demand that can be supplied. If the on-site solar supply is less than a technology's potential, then the solar supply is limited by physical characteristics of the land use type.

This analysis is built on case studies selected to represent typical U.S. climatic conditions and energy demands. Therefore, it is not sensitive to regional differences or variations in energy demand and solar energy supply. Assuming typical climatic conditions, however, it appears that communities can meet the administration's 20 percent solar scenario goal. However, not every land-use type can meet the goal identified for its land use sector. This goal consists of meeting 37 percent of the residential sector's total demand, 18 percent of the commercial sector's demand and 23 percent of the industrial sector's demand with decentralized

TABLE 3. ON-SITE SOLAR ENERGY SUPPLY AS A PERCENTAGE OF TOTAL ENERGY DEMAND BY LAND USE TYPE AND TECHNOLOGY

Direct Solar Technology and its end use energy supply potential		Percentage of Total Energy Demand: A. Solar Scenario Goal	B. Technology Potential	Collector Location: C. Roofs	D. On-Site Open Space	E. Total On-Site	F. Surplus or Deficit Relative to Scenario
1. Thermal Collectors w/existing output and short-term storage (80% DHW; 70% space heat 70% cooling[3])	SFD	37	40	40[1]	NN[2]	40[4]	+ 3
	MFD	37	44	26	7	33	- 4
	Strip	18	43	32	11	43	+25
	CBD	18	39	3.6	0.1	3.7	-15
	WH	18	56	56	NN	56	+38
2. Thermal Collectors w/improved output & short-term storage (80% DHW; 70% space heat 70% cooling[3])	SFD	37	40	20[5]	20[5]	40[5]	+ 3
	MFD	37	44	38	6	44	+ 7
	Strip	18	43	43	NN	43	+25
	CBD	18	39	7.2	0.2	7.4	-11
	WH	18	56	56	NN	56	+38
3. Cogenerating photovoltaics w/short-term storage (80% DHW; 70% space heat; 100% lights & power 100% cooling[3])	SFD	37	85	40[5]	20	60[5]	+23
	MFD	37	86	44	18	62	+25
	Strip	18	86	35	51	86	+68
	CBD	18	86	6.2	0.4	6.6	-11
	WH	18	87	78	9	87	+69
4. Thermal Collectors w/existing output and long-term storage (100% DHW; 100% space heat)	SFD	37	55	55[5]	NN	55[5]	+18
	MFD	37	66	31	15	46	+ 9
	Strip	18	61	27	34	61	+43
	CBD	18	56	3.3	0.3	3.6	-14
	WH	18	79	65	14	79	+61
5. Thermal Collectors w/improved output and long-term storage (100% DHW; 100% space heat 100% cooling[3])	SFD	37	55	55[5]	NN	55[5]	+18
	MFD	37	66	61	5	66	+29
	Strip	18	61	48	13	61	+43
	CBD	18	56	6.7	0.4	7.1	-11
	WH	18	79	79	NN	79	+61
6. Cogenerating photovoltaics w/long-term storage (95-100% of total demand)	SFD	37	100	54[5]	26[5]	80[5]	+43
	MFD	37	100	66	26	92	+55
	Strip	18	100	57	43	100	+82
	CBD	18	100	9.7	0.4	10.1	- 7.9
	WH	18	100	93	7	100	+82

1. Assumes removal of up to 35% of the tree canopy.
2. Not needed as collector area to meet technology's potential in the study area.
3. Active solar cooling is assumed to be feasible for commercial uses only.
4. Assumes removal of 15-20% of the tree canopy.
5. Assumes no removal of tree canopy.
6. 20% national goal includes provision of the following portion of land use sectors' total demand by decentralized solar technologies, i.e. direct solar, wind and biomass: residential 37%, commercial 18%, and industrial 23%.

TABLE 3 (CONT.)

NOTE: Analysis assumes that retrofit conservation measures have reduced demand to the following levels:

	HEAT LOAD (Btu/ft^2/degree day)	Total end use energy demand in a 5200 heating degree day climate with 78° wet bulb and 94° dry bulb summer design conditions (°F)
Single Family Development (SFD) 8 Units/Net Acre	6.0	97,100
Multiple Family Development (MFD) 30 Units/Net Acre	5.5	65,400
Strip Commercial Development (Strip)[2] Floor Area Ratio[1] of 2.3	10.5	110,000
Central Business District (CBD)[3] Floor Area Ratio[1] of 6.7	10.5	102,100
Warehousing District (WH) Floor Area Ratio[1] of 4.6	5.0	43,300

1. Floor Area Ratio is the ratio of floor area to parcel area
2. Consists of 75% offices, 15% hotels, 10% retail stores
3. This value reflects a low estimate because it excludes elevators and assumes the same demand as in low-rate structures

renewable energy sources, i.e., solar, wind and biomass. The variation in the solar potential of different land-use patterns permits us to make some observations about the energy efficiency of existing urban land uses and the consequences of future building activity which will shape cities in the decades ahead.

Findings

Low Rise Development Patterns

Flat-plate collectors with short-term storage can achieve their full potential using only roof tops in an existing single-family neighborhood with a typical density of 8 dwelling units per net acre. Single family development accounts for 66 percent of the existing residential stock (1970 inventory). An estimated 35 percent of the existing suburban tree canopy may have to be removed to meet this goal, but this impact could be reduced to 15 to 20 percent if collectors were mounted in suburban front and back yards or on garden or patio structures. The impact can be reduced still further if photovoltaics or long-term storage are used (technologies three, four, five, or six in Table 3) or if neighborhood districts are established so that thermal energy can be shared within a residential block.

The Table indicates that multiple-family dwelling units (at a density of 30 dwelling units per net acre) fall slightly short of meeting the technology potential of currently available flat-plate collectors (technology one). Additional analysis shows that residential densities between the two case study examples, typical of townhouses and low rise apartments, can achieve the same technology potential without preempting adjacent land uses. The on-site energy demand of townhouses and low rise apartments ranges from 50 percent to 67 percent of the demand of typical single family detached housing (2). Consequently, a shift in density and building form from the predominately suburban pattern we see today to more compact residential patterns would achieve substantial savings of transportation energy and energy bound in structures and infrastructure without sacrificing the opportunities to maximize on-site solar energy production. Reliance on decentralized solar technologies, contrary to some speculation, does not mean sprawl.

Commercial strip patterns with typically low land coverage ratios or warehousing districts with relatively low energy demands, are capable of producing more energy than they can utilize on site. These land-use patterns can produce surplus energy which could be transferred to areas that cannot meet their energy demand on-site.

High Rise Development Patterns

The most prominent finding in the commercial sector is the inability of high rise development to take even marginal advantage of decentralized solar energy sources. This kind of development has a significant impact on potential on-site energy development for two reasons: first, its high energy consumption per net acre of development requires that nearly all of its energy be imported; and second, the shadows cast by high rise structures reduce the solar potential of a substantial portion of adjacent tracts of the urban landscape.

If conservation efforts were increased beyond those easily achieved techniques assumed in this analysis, the results of our analysis would be modified. A recently completed high rise apartment structure in Toronto has reduced energy consumption to less than 2 Btu/square foot/degree day and is able to meet all of its thermal energy requirements using seasonal water storage. However, the high rise will still condemn large areas of land to the north to a reliance on imported energy.

Optimizing Energy Savings

The critical measure for comparing energy use among land-use types is not how much solar energy can be generated or how much energy can be saved by conservation, but how much energy demand remains after these techniques have been implemented. This measure can take into account savings of on-site, transportation and bound energy from increased density and altered building form. The remaining energy demand of various land use patterns must be compared over time so that efforts to reduce energy consumption today do not foreclose a future in which greater reliance on decentralized energy sources can be achieved with more advanced technologies.

Implications of Short-Term Actions for Maximizing Community Self-Reliance

To effectively manage a transition to a substantial level of reliance on community energy production, urban designers must recognize what is economically feasible in the short run and, at the same time, anticipate the effects of various land use patterns on solar reliance and the potential of new technology systems to further increase solar reliance. Managing the transition requires that actions taken now do not limit the opportunity for greater solar reliance in the future.

Implications of short-term energy saving measures on long-term solar reliance include:

Conservation. In all land uses conservation is the essential first step to energy savings. Obviously, if the energy demand is minimized it will be cheaper and easier to meet that demand on-site.

Passive Design. As much energy can be saved using passive design techniques as can be saved using active collectors with short-term storage in both residential and low rise commercial development (3, 4, 5). Reliance on passive design leaves roof tops free for the installation of photovoltaic arrays in the future.

Increased Density. Altering the pattern of new development can save on-site energy as well as transportation and bound energy. However, increased density in the form of high rise structures can obstruct the solar access of nearby buildings.

Building height controls or solar envelope zoning become important tools for protecting the solar access of new and redeveloping urban areas where density is increasing.

If high density, high rise development continues to be built, a community of the future attempting to achieve a high level of reliance on decentralized solar energy will have to transfer energy from parts of the community which have surplus collector area.

Active Solar Technologies in Existing Communities.

After conservation measures have been maximized in existing development, active collectors can be installed to provide heat and hot water. Shared storage systems can be employed now or individual systems can be integrated into neighborhood systems at a later time.

Renovation at the neighborhood scale, provides an ideal opportunity for installing shared solar systems. Neighborhood systems can increase the on-site solar supply to 100 percent of the total heating and hot water demand. This additional supply is especially important because it eliminates the need for a back-up heating source during peak demand periods and reduces adverse physical impacts.

Conclusions

In trying to manage a community as an energy system, the primary goal is to maximize energy self-reliance. This requires attention to the trade-offs among on-site, transportation and bound energy savings, as well as to both short-term and long-term strategies. Increased density and on-site solar energy use must be balanced to optimize total energy savings. This will require different tactics in new and existing development and will consequently require different regulatory mechanisms and urban design techniques.

In existing areas the most important strategy is to first reduce consumption using conservation measures. Secondly, on-site active and passive retrofits can provide substantial amounts of the total on-site energy demand in the short run. If this reliance is to be increased in the long run, design solutions should anticipate the availability of new technologies and the economic feasibility of shared systems.

In new construction, conservation and passive design techniques applied to the residential sector at densities of 16 to 20 dwelling units per net acre appear to optimize on-site energy self-reliance, physical impacts and costs (6) in average climatic conditions, in the short-term as well as in the long term. Consequently, an increase in density to reduce transportation energy consumption can also permit substantial energy savings from on-site solar technologies.

New construction can also take advantage of passive design techniques and should do so in order to leave roof top collector area for the eventual installation of photovoltaics. The variety of passive design techniques available suggests that there is no single development pattern which will optimize passive energy collection in a given urbanized setting. This suggests that flexibility in development patterns should be promoted by adopting performance standards which are accompanied by a range of alternative solutions.

In the commercial sector, on-site energy self-reliance can be maximized in medium density low rise development. The trade-off between optimum on-site energy savings and energy use in the transportation sector has not been fully explored.

Community renewable energy systems provide an opportunity for saving more energy than is currently possible with individual on-site techniques. However, because land use patterns affect the solar energy supply as well as the energy demand, community energy systems need to be planned and designed in the context of evolving land use patterns in order to maximize total energy self-reliance.

Acknowledgments

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Design for Energy Independence

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Abstract

The role of design is to provide quality environments. In the recent past this has been achieved substantially through the use of nonrenewable resources. Quality environments can be achieved through better design by present practitioners in the field with present technology and require 40% to 80% less energy in newly urbanizing areas and 20% to 60% less energy in existing built-up areas. Future cities will be more varied and have more vitality than the present cities they will grow out of.

Introduction

The design professions' job is to design high quality environments. Our currently built environments are poorly suited for an energy-scarce, energy-interruptible future. We can design better ones saving energy in the process.

This paper is in two parts. The first part discusses the ability of design to displace energy demand in buildings and communities, that is, design as a renewable energy resource. The second part comments briefly on the appearance of the city of the future.

Energy Displacement by Design

Design can displace energy demand. If the design disciplines are effectively applied using apparently cost-effective existing proven technology, what energy demand reductions can we expect?

First, let's look at *newly urbanizing areas.*

- New buildings can be designed by typical designers in the field using available proven technology, to save 30% to 50% on the average of overall energy requirements as compared with current practice. This is well documented.
- Through better community planning, we can realize shifts in transportation modes—say from car to bicycle or pedestrian, or group transport and better utilization of vehicles, reduced travel distances, and reduced need for travel and transportation.
- We can design-in opportunities for shared energy systems such as district heating, and cogeneration.
- And we can design-in shared environmental control systems such as trees, earth berms, and even large space enclosures such as domes.
- We can translate spatial needs from one building type to another which uses less energy, say from single family attached to low rise multi-family or from single family detached to single family attached.
- And we can shape the environment so that it psychologically reinforces people's energy saving behavior.

The community scale is not well documented but might conservatively be estimated to reduce energy demand by an additional 10% to 30%, below current practice.

I conclude that for newly urbanizing areas we should be able to reduce energy demand by 40% to 80%. Now let's look at *existing built-up areas.*

- I estimate we could save 10% to 30% through building modification and management, on the average, in existing buildings.
- Looking at the community design scale there are opportunities for transport improvements through design, shared energy systems and shared environmental systems.
- There is an opportunity to shift spatial needs from new areas to existing areas and to accelerate adaptive reuse of existing buildings, saving not only operating energy but also net energy used in construction and demolition.
- And there are opportunities to psychologically reinforce people's energy saving behavior.
- These opportunities at the community scale are poorly quantified, but might be fairly estimated at being in the neighborhood of 10% to 30% of current energy use.

I conclude that for existing built-up areas we should be able to reduce energy demand by 20% to 60%.

All this can be accomplished through wise architecture, planning and design, using existing, proven technology.

Appearances

Next, let's look at the appearances of the future city. It will be a modulation of the current and past cities we know today but with substantial differences.

First, I expect more vitality in urban areas, for instance more pedestrian, people-oriented activities. Cities will tend to be somewhat denser with richer blends of activities. This will happen because of demographic trends but the energy situation will reinforce it.

Second, there will be better design at the urban scale. More often individual buildings will be seen in their context and integrally tied to their surroundings, improving the landscape. We will learn to see the urban landscape as a whole with interlocking parts. The energy situation will help us learn to solve common problems through design.

Third, cities will become more differentiated one from another because of variety or climate and approach to providing environmental needs. Just as the mansions of old New Orleans differed from the brownstone of Philadelphia, the Philadelphia of the future will differ from the New Orleans of the future. Those differences may be special chimneys for wood furnaces and stoves, glass and plastics for solar heating, vegetation, and evaporation/radiation pumps for cooling and so on. We cannot say exactly what the differences may be, but we can assert that they will exist.

Fourth, buildings will be seen as operable structures, changing with the time of day, the weather and the season. They will open and close like Morning Glories or Night Blooming Jasmines; they may track the sun like Sunflowers. They will reflect the sun like mirrors or absorb it like pools of deep water. We should look for vegetation to play perhaps a greater part in defining and providing our environments. For instance, biological research should provide us with plants to shade, evaporatively cool, grow good and fuel, and provide shelter from wind, rain, snow, and hail.

Conclusion

In summary, the city of the future begins with the city of today. It appears to be a fascinating place or rather a collection of places.

Workshop On Utility Roles in Implementing Community Renewable Energy Systems

August 21, 1979

Workshop on Utility Roles in Implementing Community Renewable Energy Systems

Chairperson

Abbie C. Page
The MITRE Corporation

Panelists

John Bartels
Eugene, Oregon Water and Electric Board

Mark Braly
City of Los Angeles

Joanne Devlin
Donaldson, Lufkin & Jenrette Securities Corporation

Michael J. Maguire
Tennessee Valley Authority

Henry A. Bell
Columbus, Ohio Division of Electricity

Bill D. Carnahan
Lamar, Colorado Utilities Board

W. Ross McCluney
Florida Solar Energy Center

Dennis L. Meadows
Dartmouth College Resource Policy Center

Summary

The public utilities in the United States are often suggested as having the resources and funds capable of accelerating the introduction of renewable energy systems. The "pros" and "cons" of this are being debated at several levels.

Ross McCluney spoke first of his experience, suggesting that, though the utilities are often viewed suspiciously, they are necessary evils and are likely to take some role in the commercialization or renewable technologies. The utilities, he added, view renewable energy as foreign systems which may increase direct and indirect costs without a corresponding increase in revenues.

Michael McGuire of the Tennessee Valley Authority asserted that energy conservation and solar energy utilization will take place with or without utility involvement, but that the utilities must plan for such. Otherwise, a positive feedback loop could be set up, whereby the utilities continue to add capacity, increasing their costs, driving more people to solar energy, in turn creating more excess capacity, etc.

John Bartels related a project the Eugene Water and Electric Board is undertaking with the U.S. Forest Service to fire boilers with hogged wood from forest slash. He also told of the Oregon utilities' involvement in wind, hydro, and geothermal applications.

Bill Carnahan told of a planned gas-producing facility in Lamar, Colorado, for which the feedstock will be cattle feedlot wastes. After anaerobic digestion, the residue of the plant will be returned to the feedlots as protein-rich feed, and the methane gas will supply the local gas utility. The plant is a net energy producer and is anticipated to supply gas at $1.75 per million Btu's with the digesting algae recycled.

Henry Bell described Columbus, Ohio's answer to several local problems, a plant to burn municipal waste. This alleviated the City's landfill problem as well as pollution control problems in its existing power plant, both of which had come under serious EPA scrutiny. The refuse burned is low in sulphur and provides clean, economic power.

Joanne Devlin delineated the realities of funding community-scale projects. Investors are conservative in nature and must see the opportunity for a return on their money. Thus a complete feasibility study by a respected firm or consultant is a must to assure potential investors of the technical and economic feasibility of a project. Also the sponsor must show confidence in the undertaking by showing equity in the project—100 percent debt financing just "does not fly."

Mark Braly discussed efforts in Los Angeles to form a "solar utility," which may be a public corporation, financed through public equity and private firms. Conventional and municipal utilities are wary of renewable energy systems, he pointed out, making such a new entity more likely to accept the new responsibilities. Even if such an organization does not become self-sustaining, his hope is that it will at least discover an efficient method of subsidizing solar development as an alternative to the present tax credit.

Dennis Meadows summed up many of the issues discussed, including what one might reasonably expect utilities to do to promote renewable energy systems (and what one cannot reasonably expect). He also listed ten reasons why most of the utilities are not now actively promoting renewable energy, most of them institutional in nature. Meadows cautioned the renewable energy community from declaring war on the utilities, pointing out that, if the utilities were to fail, the economic and political consequences would be disastrous.

The majority of the subsequent questions were directed at Ms. Devlin, regarding ways to overcome financing barriers. She mentioned that venture capitalists now seem to be entering the renewable energy market, but that it will take time before large, more conservative investors begin to view renewable energy systems as reliable as or on a par with conventional power plants.

Utility Roles in Implementing Community Renewable Energy Systems

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Abstract

This paper presents a summary of issues and options that have been identified regarding utilities' roles in (1) implementing community-scale renewable energy systems and (2) the near term commercialization of renewable energy technologies.

Three broad classes of issues are discussed: (1) utility buy-back of power from small-system power producers; (2) the sale of backup power to the independent system; and (3) utility direct participation in promoting distributed energy systems. Included are a list of the technologies under consideration and present (1977) policies of state Public Utilities Commissions (PUC's).

Utility Buy-Back of Small-System Power

Table 4 lists examples of renewable electric energy systems potentially suitable for small scale or community applications. Many of these renewable energy systems, most notably cogeneration facilities, wind energy conversion systems, low-head hydro plants, and biomass-fired electric plants, could produce more power than would be usable on-site. In such cases, the potential owner/operator of these distributed systems would like to sell the excess power to the local utility, which in turn

TABLE 4. ELECTRIC GENERATION TECHNOLOGIES USING RENEWABLE ENERGY RESOURCES

Large Scale

Examples:

- Hydroelectric power
- Solar power satellites
- Ocean thermal energy conversion (OTEC)

Advantages:

- Economies of scale, especially in operations and maintenance
- Centralized management and control over power production, distribution licensing, pollution control, financing
- Matching non-simultaneous demands through a national electric grid

Small Scale

Examples:

- Cogeneration facilities, up to approximately 150 MW_e, using
  - solar thermal
  - biomass fuel
  - photovoltaics
- Solar total energy systems
- Wind energy conversion systems (WECS)
- Biomass electric plants
- Small scale and low head hydro
- Geothermal power plants
- Solar thermal and photovoltaic plants, up to approximately 100 MW_e, with
  - storage systems, and/or
  - repowering of fossil fuel plants

Advantages:

- Reduced transmission costs
- Easier to repair (less complex)
- Less spinning reserve needed for reliability
- Local accountability and control
- Less complex pollution control systems
- Can be better matched in thermodynamic quality and scale to end use needs
- Shorter approval and construction times, therefore better demand forecasting economics
- Technologies more easily understood on the community level

would feed it to the "grid." However, the decision to actually install small scale systems will depend on satisfactory resolution of a number of issues, economic, physical and institutional in nature.

Paramount in the economic issues category is the price which the local electric utility offers to pay for excess power. The original wording of the National Energy Act (NEA) specified that the utility was to buy power from the small producer at a rate not to exceed the cost to the utility of generating that power itself, from other sources *at the time of generation.* Presumably, the intention was to have the utilities pay higher buy-back rates at times of high demand, or when it would normally expect to pay high prices for conventional fuels. Proposed DOE regulations do not include such a "time of generation" provision, and would likely lead to a year-round or "flat" rate for buy-back. In either case, the criterion is the buyer's (the utility's) avoided cost, not the seller's (the small producer's) actual generation cost. This proposed regulation would apply to small-power producers of 80 MW_e or less who utilize renewable resources.

There are also issues concerning physical interconnection of the small producer with the electric grid. From the point of view of the utility, system integrity is a prime concern. Relying too heavily on a number of small producers could jeopardize this integrity. On the other hand, designed correctly and managed well, small power-producing facilities could benefit the utility through their diversity and the alleviation of the need to add new capacity. Clearly, the perceptions held by the utilities on the status and reliability of renewable energy technologies will play a very important role in determining the speed with which they move in accepting small systems as part of the grid.

Rules and regulations, on the federal and state levels, will also play a major role in the development of small-power systems. Rules proposed by the Federal Energy Regulatory Commission (FERC) would make 10 kW the minimum size for a small-power producer who anticipates providing energy to the local utility. This may exclude some potential uses of wind and low-head hydro.

The Federal Power Act, as currently in effect, says that a small producer selling to the utility must itself be considered a public utility, subject to the usual regulation by the state PUC. The Public Utility Regulatory Policies Act of 1978 (PURPA), Section 210, specifies the qualifications which cogeneration and small-power systems must meet in order to gain exemption from such regulation. Such exemption should prove an incentive to the potential small-system installation. At the state level, some PUC's have already taken steps to encourage cogeneration and small power facilities. A list of "current" policies is attached as Table 5.

TABLE 5. STATE UTILITY REGULATORY AGENCIES' POLICIES ON RATES FOR CUSTOMERS WITH SOLAR, WIND AND SMALL GENERATION SYSTEMS

State	Policy	Effect on Renewable Electric Energy Systems
Colorado	A demand energy rate for solar users is optional, not mandatory.	encouraging
Connecticut	—	encouraging
Florida	Customers with less-than-25 KW loads were exempted from standby charges in a rate case.	—
Illinois	Solar-assisted heating rates are permitted.	—
Idaho	Policy is to encourage supplemental generation of power.	nondiscrimination
Kansas	Customers with solar systems can keep their "total electric" or "space heating" rates.	encouraging
Maryland	—	nondiscrimination
Massachusetts	Utilities required to file a proposal concerning such rates.	—
Michigan	Special rates for auxiliary services to residential customers generating their own power, with sale of excess power by customer to the utility at reasonable cost.	—
Montana	Opposes standby charges. Encourages buy back.	encouraging
New Jersey	Supplemental power owners eligible for all-electric rate.	nondiscrimination

TABLE 5 (CONT.)

State	Policy	Effect on Renewable Electric Energy Systems
New York	Solar, wind rates.	
North Carolina	Persons using nonfossil fuel eligible for an all-electric or water-heating rate which they would not otherwise be entitled to.	encouraging
Oklahoma	Commission approval required for installation of supplemental or auxiliary power sources.	discouraging
Wisconsin	One company has lower cost off-peak.	—

Note: States not listed apparently did not have a policy on rates for customers with solar, wind and small generation systems. The information presented above is excerpted from the 1977 Annual Report of the National Association of Regulatory Utility Commissioners (NARUC), and, according to Daniel J. Burke of NARUC is the latest available summary of the status of state policies (personal communication to Abbie C. Page).

Sales of Backup Power to the Independent System

Some might visualize eventually complete disconnection from the utility as the outcome of the installation of small renewable energy systems. However, the extra storage capacity this would entail for many systems could make such a move non-economic. Thus, most community-scale systems will still have to purchase power from the utility at times of high demand, cloudy or windless days, low water conditions, etc. The major determinant in the development of independent systems may well be the rate which the utility charges for such backup power. Some present electric utility rates are very unfavorable to renewable energy systems. For example, many rates contain "demand ratchets," which base a monthly demand charge on demand readings over periods of up to one year. These provisions penalize a user for a single demand peak, such as might occur during a series of sunless days, for many months thereafter. However, the PUC's in some states are encouraging inexpensive off-peak and "inclined block" rates, making the small system more attractive. Notes on the various states' policies are also included in Table 5.

The next section includes a discussion of the rate and pricing options which the utilities might employ to encourage renewable energy system development.

Utility Participation in Promoting Distributed Energy Systems

Utility Direct Participation: Background

In terms of direct participation, three modes are most often discussed:

1. Direct utility ownership of equipment (repaid through the rate base)
2. Financing mechanisms, such as loans to the utilities' customers (to be repaid as part of the monthly bill) and
3. Cooperative marketing programs

The utility program of the National Energy Act prohibits public utilities from supplying, installing or financing solar equipment, unless it is for the purpose of load management. Thus, a utility could sell electrically-heated storage devices, to be charged off-peak, as an adjunct to a solar energy system.

The prohibition against utility sale can be waived by the Secretary of DOE, if petitioned by the governor of the state in question. However, this would require close cooperation between the utility, Public Utilities Commission and the governor's office.

Several provisions of NEA affect the economics of small systems. For example, utility rates must reflect the cost of providing electricity to a particular customer class, which may alter the preferred rates large customers have enjoyed in the past. Also, the business energy investment tax credit excludes utility property from the additional tax credit for alternate energy systems, making utility ownership of systems less attractive. The residential energy tax credit does apply, and should accelerate homeowner uses of alternative energy sources. This will affect utility load duration curves and peak demands as a result.

The utilities are also required to disseminate information regarding solar energy, its reliability and cost-effectiveness, as part of NEA. However, given that they are prohibited from entering the market, their incentives for extensive information campaigns are few.

Given the relatively high capital cost of alternate energy systems, it may take some form of utility involvement to accelerate alternate energy use.

Arguments for Direct Utility Participation

There are several arguments in favor of utility participation in accelerating commercialization of alternate energy systems. From an economic standpoint, costs could potentially be reduced.

It has been argued that as primary users, the utilities perceive the "true" costs of backup energy, and could optimize the mix of conventional and alternate energy sources used in their service areas. They are also in a position, due to their information-gathering abilities, to formulate such a mix in an intelligent and cost-efficient manner.

If the utilities were to enter the solar market, it would shorten the "time horizon" for commercialization. The utilities would present a relatively small number of consumers to the market, which would encourage early equipment standardization. By buying in bulk, distribution costs for equipment would be reduced, and continuing purchases would ensure quality control, presently a major deterrent. Also, the risk to lenders (and thus the cost of capital) would be reduced, as the utility would recover the initial costs through monthly bills, or terminate the customer's service.

Utility purchase of renewable energy equipment would also have benefits as a result of the regulatory framework. With alternate system costs added to the rate base (the stock of capital equipment), the entire system would subsidize the increased use of renewables. Many see this as an alternative to the current method of subsidy from tax revenues. Increased costs due to the expanded rate base would raise the cost to all customers, and encourage conservation in all sectors. Utility monopoly profits could also be re-invested in R&D activities. For businesses, utility ownership provides another incentive. There is a bias against high capital cost equipment that requires a major investment. Fuel costs, for conventional energy sources, are a deductable expense, while investment costs are recoverable only through depreciation. Utility ownership is seen as a possible alternative to accelerated depreciation schemes as a method of removing the bias against capital costs.

Arguments Against Direct Utility Participation

Many of the concerns are social in nature. The fact that the utilities may be able to lower costs (through mass buying, etc.) and have better information at their disposal does not ensure that the choices made as a result will be "socially correct." That is, they may not benefit a large segment of the population, but instead may benefit the utilities disproportionately. Overcapitalization may occur as a result of the regulatory structure. Because utility rates are based on capital stock, utilities would most likely decide to invest in the most capital-intensive alternate technologies, just as they have done with the conventional technologies (this is referred to as "gold-plating").

The solar industry and the nation may not benefit from a reduced number of purchasers, and could actually be harmed. Early standardization could lead to the development of a limited number of systems, stifling innovation and subverting the operation of the free-enterprise system. By buying a large number of systems, the utility industry could bring about an excessive concentration of economic power in its hands.

Institutionally, the utilities have not traditionally been the bearers of technological risk, preferring instead to cling to the more "proven" technologies. Forcing them to bear such risks in the alternate energy field could prove unwise, especially if one holds the view that we are not indeed involved in an energy emergency situation. Traditionally, the utilities are "big system" people, and it is not clear that there are any economies of scale to be had in alternate energy systems. (Lovins has argued that such economies do not exist even for conventional utility technologies.)

Alternatives to Direct Utility Participation

Given the uncertainties of utility participation, and what appear to be good arguments on both sides of the issue, there have been proposed several alternatives to utility participation. The first involves municipally-chartered solar utilities, modelled after municipal water and sewer systems, among others. Such arrangements could encourage the elimination of first-cost biases as outlined above, without the anti-competitive aspects of large-utility involvement. On the other hand, it is not clear that a municipally-chartered organization would be any better at managing a program of commercialization than the larger utilities.

Even without any form of direct participation, the utilities could encourage deployment of alternate energy systems through their rate structures. Time-of-day and time-of-season rates would provide great incentive in solar energy systems with efficient storage. Based on long-run incremental costs (i.e., including investment costs), these rates would provide "true" signals to potential buyers, so that "correct" economic choices could be made. Properly devised and managed, these rates would be of benefit to the utilities in their load planning and management activities. Another possibility is interruptable power rates, whereby a customer with an alternate energy system simply could not obtain power from the grid at certain hours of the day. This load-shedding technique is widely advocated by utility system managers. "Inclined block" rates, the opposite of the traditional "declining block" rates, would encourage small users (i.e., alternate energy users with limited backup power needs), and conservation. In all these rate schemes, the trick would seem to be to make the rate reflect the "true" cost of generation.

Natural Gas Utility Participation

The foregoing has dealt with the electric utilities, for upon them has focused much of the current debate about incentives for alternate energy systems development. However, the natural gas utilities may prove the place for experimentation.

Natural gas utilities differ from electric utilities in that they see less difference between peak and off-peak costs. They are thus less interested in avoiding peak load costs. Instead, they view solar and other alternate energy sources as slowing the need for acquisition of ever more costly new supplies, such as Liquified Natural Gas (LNG), imported gas from Mexico or Canada, and more costly Alaskan sources. From the gas utility's standpoint, solar energy could reduce the need for these high-cost sources and allow high solar capital costs to be added to the rate base. The old, low-cost sources would thus subsidize alternate energy development.

The economics of alternate energy sources are changing rapidly for natural gas consumers. This will become even more apparent as deregulation increases prices in the future. As with the electric utilities, the gas utilities are prevented from direct participation by NEA. However, if the gas companies begin to see the advantages of alternate energy to their supply situations, they may begin requesting waivers.

Summary

The following points have been made regarding the utilities' role in community-scale renewable energy systems, and can serve as a "springboard" for future discussions:

- The National Energy Act makes participation by the public utilities in alternate energy development difficult
- Utility participation would most certainly accelerate commercialization and increase market penetration
- In the long run, though, the end might not justify this means. The end result might be to stifle competition and innovation, by reducing the number of buyers in the market.
- Electric rates devised for backup power and for buy-back will

play a major, if not the deciding, role in commercialization.

- Natural gas utilities may participate extensively in alternate energy development in the future.

Reference

An excellent source for more detailed discussion of these issues and options is "Solar-Utility Interface Issues," by F. T. Sparrow of Purdue University. His paper was presented at the International Solar Non-Technical Issues Symposium in Brussels, June, 1979.

Consumer Perspectives on Utility Involvement in Solar Energy

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Abstract

A love-hate relationship exists between utilities and the public—people have become very dependent upon utility electricity but would like not to be. Solar electricity is an option for both the utility and the individual consumer. There are several ways in which utilities can become involved in solar energy, and in each case there is potential for this involvement to be either a help or a hindrance to solar development or to be beneficial or detrimental to the overall public good. The future is very uncertain; rising electricity rates are reasonably certain and may lead to strong energy conservation measures. Utilities' lack of preparedness for such measures can get them and their customers into serious economic difficulty. In order to avoid these problems, utilities need to refine their prediction capabilities and draw the public more directly into their planning processes.

Introduction

As love-hate relationship exists between large electric utility companies and the public, which thinks of them as necessary evils. They are necessary because the electricity they provide is seen by nearly everyone as being essential for an active productive life and because the limited-monopoly electric utility is the only game in town—there is no viable alternative for most people. They are "evil" because they are expensive, because they seem to be getting less reliable and because they are viewed as "speaking with forked tongues."

When I say less reliable I mean that from previous experience the public has come to expect and take for granted a very high level of reliability, one which is essentially unachievable today. They are therefore disappointed with the present-day lack of perfection.

Probably everyone here is aware of the forked-tongue syndrome. From the early days of the environmental movement, through the energy shortages of a few years ago, and now into the nuclear era, utilities have been less than candid about their plans and motives, have denied responsibility for failures, and have attempted to cover up mistakes and actions which have been counter to the public interest. As with the Watergate scandal, the situation probably wouldn't have been so bad if they had just admitted their weaknesses and asked for public understanding.

In some respects I think utilities (or at least their advertising departments) are their own worst enemies. It is only after considerable public debate, pressure, and usually a strengthening of the regulatory laws that they change their tunes and get over on the side of the people. Many past utility excesses could have been corrected by better oversight and vigorous action by state regulatory bodies.

In a March 1971 article in Nuclear News, David Jopling and Stephen Gage pointed out several cases in which utilities attempted to sneak their plans for major nuclear plant construction by the public without adequate public discussion in advance. They described seven stages through which public antagonism was stirred by utility actions.

It took several years following the oil embargo and the ensuing delineation of the oil shortage for utilities to stop advocating increased use of energy and to encourage energy conservation. It also took intense public, state and federal pressure, and strong legislation to accomplish this transition. Numerous recent nuclear incidents and utility cover-ups have added to the public distrust of electric utilities.

Also recently, in an apparent knee-jerk reaction, some utilities have advocated charging their solar customers higher rates than their non-solar ones (for valid economic reasons) without first looking at the alternatives and seeing whether this action is warranted or wise.

My own local utility, Florida Power and Light, has a clever way of putting down solar energy while at the same time appearing to embrace it. They damn it with faint praise, saying that solar energy is great but that it can only provide a small amount of power some time in the distant future. They also refuse to recognize passive solar homes using cross ventilation and no air conditioning as "Watt-Wise Living" homes—because these homes don't have efficient air conditioners.

Florida Power Corporation recently denied an Energy Saver New Home Award to a very energy-saving new home near Tallahassee because Florida Power has no way of rating a home without any air conditioning.

In Dade County, Florida, a yearly energy briefing is given to public school science students by Florida Power and Light Company, which presents its own energy philosophy, stressing nuclear now and solar much later.

A few years ago most electric utilities encouraged people to build all-electric homes (for reasons which seemed sound at the time) and then, a few years later, turned around and charged them high prices to live in these homes while asking them to spend more money to make them energy-efficient.

It should not therefore be surprising that these problems have resulted in ambivalent feelings on the part of the public regarding utility involvement in solar energy.

In general, people would like utilities to provide solar energy to them with the same taken-for-granted reliability they used to enjoy from non-solar sources. On the other hand, the general distrust of large, monolithic organizations makes them leery of allowing utilities to continue their exclusive hold on the main energy lifeline coming into their homes and offices.

I will admit at this point that my discussion so far has been pretty hard on the utilities, impugning their motives and accusing them of a lack of candor. After listening to a recent radio talk show, however, I believe this to be a pretty fair representation of public sentiment. My own views are not quite so strong, but this is a serious problem which must be dealt with if the utilities are to play a significant role in the development and use of solar energy.

In at least a partial defense of the utilities, I must say that people working for utilities do not wish to become unemployed, and people investing in utilities wish to continue receiving a secure return on their investments. If the demand for utility electricity slackens, increased costs, declining revenue, and reduced employment may result. Except in cases when generating capacity is short it is not usually in the short-range interest of the utilities to encourage conservation.

The accepted relationship between increased sales and reduced cost is a strong motivation for all business, utilities included. It is therefore my view that most of the responsibility for limiting utility excesses should rest with the government—both state legislatures and public utility commissions.

Utility Involvement in Solar Energy

Let's look at some of the ways in which utilities can become involved in solar commercialization and discuss some of the advantages and disadvantages of each. We'll take each item in order of increasing utility involvement.

Advertising Campaigns

By moving into an active, advocacy position regarding renewable energy systems, utilities could use their size and the large financial resources available to them to encourage early use of solar energy by the public. In so doing, they could encourage the installation of certain "preferred systems" shown to be most beneficial to the utility and to their customers. This "encouragement" could take the forms of advertising and public presentations, or it could be more strongly manifest as lobbying efforts on behalf of certain rate structures which could promote renewable energy systems most beneficial to utility operation.

If such campaigns were carefully devised and were "believable," they could exert a net positive and beneficial effect on solar development. However, certain types of renewable energy systems might be discouraged by such a program, even though they could be beneficial to all but the non-solar utility customers or the utility shareholders.

The encouragement of "time-of-day" or special "interruptible" electric rates could be very favorable, both to solar customers (with their large energy storage capacities) and to the utilities (with their need to level energy demand patterns). However, utilities have been dragging their feet in this, probably due to perceived problems with the special equipment which would be required for metering and a perceived lack of public interest, based on very limited surveys and past pilot projects which may not have reflected the present and future needs of the public.

Low-Interest Loans

With their access to lower interest money markets, utilities could take a more active role in the development of renewable energy systems by helping small customers finance the relatively high initial cost of those systems.

This could be helpful in getting both single users and larger, community-scale renewable energy systems started. However, regulatory agencies would have to guard against utilities pressuring borrowers to select systems thought to be beneficial to overall utility operation, at the expense of renewable systems.

Beneficial Interfacing Provisions

Since most renewable energy systems will require backup power from a utility, utilities are in a position to encourage their use through special provisions to ease the interfacing problems discussed by other speakers. On the other hand, utilities could potentially impose some very difficult and costly interfacing requirements which would strongly discourage renewable systems. The provisions involved could include both technical, hardware facilities and economic arrangements, such as favorable or unfavorable energy "buy back" rates.

Sales, Installation, Service, and Leasing

Utilities in many states are presently free to pursue competitive business ventures without formal regulation. Many utilities several years ago sold appliances on the side as a commercial activity which also stimulated sales of their primary product. Many still do. In these cases, the company does not operate as a monopoly, is not restricted to or guaranteed a fixed profit, and is not regulated by the Public Utilities Commission. Thus, the decision for a utility to enter the competitive market for renewable energy systems will be based almost entirely upon the economic viability of that market.

Utilities could also ask for a monopoly on the distribution of renewable systems. While central station generation of electricity for widespread distribution is a natural monopoly that requires regulation to substitute for price competition, it is difficult to justify monopoly control of renewable systems. Although utilities could argue that solar systems will strongly affect their load curves, this issue can be addressed through the rate-making process.

Potential advantages of direct utility participation in solar markets to the consumer include:

a. Early rapid acceptance of renewable energy systems could result from the utility's familiarity with high initial cost ventures and its access to capital markets.
b. Market fragmentation could be overcome through large-scale deployment. This could enhance overall system reliability and durability.
c. Large utility organizations are in a good position to overcome institutional and cultural biases against solar in the housing industry.
d. High initial costs presently deter consumers. Utilities could overcome this problem with financing or leasing arrangements involving little more than a token initial deposit followed by moderate periodic payments.
e. A large utility is in a good position to offer complete system design and sizing. When large systems are involved, concern over maintenance and reliability of relatively unproven systems can be an especially significant deterrent to sales. A large company clearly has an advantage in overcoming this problem because of its ability to offer warranties backed by a stable corporate struc-

ture, service contracts supported by trained personnel, and/or leasing arrangements which provide the user with a very reliable service and a favorable, fixed monthly cost.

Potential disadvantages of direct utility participation include:

a. Possibly reduced innovation, resulting from the selection of only one or two types of systems.
b. "Gold-plating"—a tendency to invest in excessively durable, reliable, and costly systems requiring little maintenance, at the expense of early commercialization and low cost to the consumer.
c. Installation of equipment with reduced performance or efficiency in return for greater sales of backup energy by the utility.

Central Station Ownership

For completeness, we here include utility ownership of large, central-station, renewable energy systems and the sale and distribution of this energy through existing networks, which is unlikely to take place on a large scale until the utilities perceive a distinct economic advantage with this approach. The hoped-for benefit to the consumer is greater stability in energy prices.

Utility Influence

Under the present system of utility regulation, utilities are obliged to try to optimize service (maximize reliability and minimize cost) to their customers. Energy from a renewable system produced outside the utility (or even within it) is basically in competition with the present way of doing things. There is therefore a built-in tendency for utilities to favor non-solar customers over the solar ones. It is for this reason that Public Utility Commissions around the country have a very important responsibility to see to it that renewable energy systems are not unfairly disadvantaged in the competition.

Even if utilities do not enter the market for dispersed renewable energy systems directly, they will have a strong influence on the commercial development of these systems. Their present and future rates form the yardstick by which proposed renewable energy systems are measured. Through the provision of backup and supplemental energy, they will have some say over what kind of renewable system is selected. They are effective lobbyists and testifiers at rate hearings and will have a strong influence on the creation of rate structures which can potentially be either favorable or unfavorable to renewable energy systems.

Future Trends

So far what I have said represents fairly conventional thinking—a discussion of the present state of affairs. But what of the future? Do we simply wait for fuel oil and electricity rates to slowly climb upward until one after another renewable energy systems slowly come to economic viability? I think not. Let me describe a little scenario that has already begun happening in some parts of the country.

As electricity rates rise rapidly due to oil shortages, higher prices of oil, and increased costs of nuclear electricity, utility customers will try harder and harder to use less electricity, and will be encouraged to do so by nearly everyone, even the electric utilities themselves. I predict that in two or three years these efforts will be very successful. So successful, in fact, that reduction in demand will begin to outstrip the ability of utilities to cut back on their general expansion plans.

With less revenue being produced, and costs rising, the utilities will have to have their rates increased in order to continue receiving their guaranteed return on investment. These rate increases will be over and above those required by increased fuel and nuclear operating costs.

As a result of the increased rates, customers will cut back even further on demand, and the utilities will have to continue raising rates in an ever-increasing spiral of rate inflation and demand reduction. To be connected to the utility at all could become a severe financial liability, for it would be the people still connected who would have to pay for the idle generating capacity.

This has already happened with isolated water and electric utilties around the country. These utilities have even resorted to asking people not to conserve so much, to go ahead and use their products, so that they can keep revenues up and avoid excessive rate increases.

This may sound strange to many people today. Most utilities are facing just the opposite problem—trying to keep up with demand. A March 1979 article in *Industrial Research and Development* magazine quotes utility industry officials as claiming that the U.S. faces "impending disaster" in the future availability of key electricity. They claim that by the mid-to-late 1980's electric utilities will be unable to generate sufficient electricity to meet energy needs during peak load times. (Peak load pricing could alleviate some of this, but utilities are presently slow to adopt this system.)

The key to understanding the difference in these two viewpoints lies in one's assumption of the rate of inflation of electricity prices and the degree of price elasticity of demand. I believe that the low elasticity of demand seen in recent years will change when prices around the country in general reach around 10 to 15 cents per kWh. I further believe that these prices will come a lot sooner than most utilities presently are predicting. As with most predictions, only time will tell what actually happens and even the best predictions can go awry due to unforeseen circumstances.

Cutting Loose

Even if this situation does not develop as strongly as I have projected, there will be increasing numbers of people wanting to disconnect completely from the utility. The process has already started in isolated cases around the country.

Utility electricity is so pervasive today that it is impossible to cut loose entirely (including indirect uses of electricity), unless you move to the hills of West Virginia and try to become totally self-sufficient. Direct use of utility electricity, however, can be drastically reduced, and *will* be, when the price is right.

The idea of cutting off entirely from an electric utility is an intriguing one. Accepting this rather unrealistic constraint forces you into some very interesting alternatives:

1. Looking at the typical American single-family dwelling, the occupants' drinking water and air spaces can be heated with solar energy, their food can be cooked with solar alcohol. Their spring, summer, and fall cooling loads can be greatly reduced by a variety of architectural and other techniques that are available.
2. Remaining cooling loads can be handled by a small amount of electricity from the utility, and possibly from photovoltaic cells on the roof. Natural sunlight can be used for all daytime illumination, and low-voltage, direct-current electricity in batteries (charged in the daytime by solar cells) can be used for nighttime illumination and for refrigeration.
3. Clothes can be washed and dried using solar energy, and low-energy-consuming electronic gadgetry can easily be powered by photovoltaic cells or other sources of solar electricity.

Similar actions can be used to greatly reduce electricity consumption in other sectors of society. In offices, artificial lighting can consume 30 to 40 percent or more of total energy use, including removal of the heat generated by the light fixtures. Daytime natural lighting can replace almost all of this electricity use. Adding passive solar heating to this can save a substantial amount of additional electricity in both offices and commercial establishments of other types.

Solar Provides Just Enough

In most cases, the less energy you use, the more of it you can afford to obtain from the sun. One of the great benefits of solar energy is that it provides just enough, but not so much that we can continue to be wantonly wasteful of it. Thus, strong energy conservation measures will be an inevitable part of any program aimed at substantial use of renewable energy systems.

Electric utilities are now paying little more than lip service to energy conservation, but I do not believe they have adequately examined the full consequences of our energy problems. (Or perhaps they have, but are keeping their long-range plans secret.)

Utility Planning

I believe that most American thinking, and that of utility boards of directors, is still oriented toward the philosophy that growth is good, more growth is better, even in per capita energy use; and that present energy conservation measures are temporary, needed only to hold us for a while, until science somehow finds a miracle cure and provides us with all the energy we need at a price we can afford.

When you are dealing with resource depletion, this kind of thinking is not only fallacious, it is dangerous—because it can deceive us into thinking things are not so bad and keep us from making the changes that can take place gradually now but which must take place very rapidly later. Rapid change is very disruptive of social institutions and can lead to economic, social, and physical chaos.

Public utilities should be pace-setters in this process of change. They should lead the way. Not only to help the country but also to save their own skins. Unfortunately, however, utilities are very conservative and reluctant to change. They have developed this characteristic naturally over many years of growth, development, and relative economic stability. (When they bought one form of change, nuclear energy, it turned around and bit them. So now they are understandably reluctant to get bitten again.) Circumstances are forcing them to make some changes, however, but the changes are not rapid enough.

I therefore see the real likelihood of new and different alternatives developing. From the individual who cuts off completely from the utility to the user-owned, solar electric cooperative. From the creation of new, almost totally independent community utilities to government takeover of investor-owned public utilities. Most of these changes will probably be stimulated by major pricing policy revisions forced on the utilities by the regulatory bodies in response to public pressure.

As the price of electricity continues to rise, people will be even more disenchanted with the utilities and will be even more willing to "bite the hand that feeds them," both before PUC's in rate hearings and in their own consumption patterns. This is fine; it encourages conservation and reduces waste. Through the use of "lifeline rates" which are kept low for low usages of electricity, low-income families can be protected from bearing the brunt of rising costs and will be rewarded for their energy conservation practices.

The utilities can halt the growing distrust of their motives, can take a more active and positive role in the process of learning to live better with less electricity. To do this they will have to get their advertising departments talking to their research departments, with their boards of directors listening in on the conversations.

They will have to find ways of listening better to the people, their customers, and of better predicting both the future needs and the behavior patterns of those customers. Furthermore, they are going to have to take this information and transform it into effective programs to serve their customers better. They will have to learn to be more versatile, something that is rather foreign to their nature. They will have to learn to look far enough down the road to see the economic benefits of deferred capital requirements produced by conservation measures.

As Jopling and Gage pointed out in 1971, utilities must find ways of involving the people in their planning process. They should abandon their traditional public relations policy that emphasizes corporate anonymity, and, in Jopling's words: "establish a wide range of unobstructed and flexible communication channels with the general public."

When they do this, I believe we will begin to see more active participation by utilities in solar energy development. As discussed above, this participation could be either beneficial or detrimental to the consumer and to solar development. We must therefore examine each development carefully before we lend it our support.

Solar energy is an inherently dispersed, or people-scaled form of energy. Its use therefore does not require monopoly control over the market in all cases. As utilities begin to enter the solar market, I look forward to seeing the healthy and productive results of active competition. This should force the utilities to be more innovative, cost-conscious, and user-oriented.

Acknowledgments

Some of the material contained in this paper came from a study which the Florida Solar Energy Center (FSEC) performed for Florida Gas Company in 1977, titled "Solar Energy and Florida Utilities, a Preliminary Assessment," and from a DOE-sponsored project called the "Southeast Regional Assessment Study," performed by Stone and Webster Engineering Company, and in which FSEC participated. The contributions of Duke Woodson to this study were particularly helpful.

The Lamar Utilities Board's Bioconversion Facility

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Abstract

The Lamar Utilities Board, a small municipal electric utility, is planning to construct a $14 million bioconversion facility in southeastern Colorado that will convert cattle feedlot manure into methane gas and a protein-rich residue to be sold to the feedlots as a cattle feed supplement. Much effort in the development of plant design, financing and the infrastructure to successfully complete this project has been undertaken by the utility. It is anticipated that this project could become a model not only for future projects of this type, but also to demonstrate that utilities can and should take an active role in the development of projects for renewable energy sources.

Introduction

The major emphasis of this presentation is to be an analysis of a utility's role in implementing community renewable energy systems. I will attempt to do that by giving some insight to the Lamar Utilities Board's role in the Lamar Bioconversion Project as a specific example and share with you some thoughts and ideas that I have had, during my four-year association with the project, that could relate to other projects.

It is my observation that generally electric utilities tend to look rather skeptically at renewable energy systems and treat them as either an insignificant contributor to the whole energy picture, or as a real threat to the continued growth of the industry. After spending considerable time on the Lamar project, in reviewing other projects and viewing the advancements made in the area of renewable energy sources, it has become evident to me that neither industry viewpoint is correct. First, an individual form of renewable energy source will not in and of itself solve the energy dilemma; for that matter, neither will coal-fired or nuclear generation alone solve the problem. We must use a blend of the conventional and innovative forms of energy production to achieve the desired results of producing the most reliable and most economic energy supplies, reducing our dependence on foreign oil and protecting the environment. I must say that the results just mentioned are not in any necessary order of priority and our society as a whole must tell the industry what priority it desires.

Secondly, the utilities must not take the other extreme position that renewable energy sources pose a "threat" to their continued growth. By working together, the utilities could be in a position to take the lead in alternative energy development and thus provide much needed capital and technical expertise to commercialize these new technologies. This is particularly true for municipal electric systems whose "stockholders" or owners are the very customers they serve. What is good for the customers is of direct benefit to the utility even if it means a temporary or even permanent reduction in sales. Lamar is a small utility involved in a small project but we think our customer/owners will benefit from this project and we plan to continue to develop it to a point of commercial operational success.

Project History

Lamar's interest in the process came about as a result of the concern over the future availability of natural gas for its 25 MW power plant. In 1976, Bio Gas of Colorado, Inc., a research and development company, was doing a research project for the Four Corners Regional Commission on the feasibility of using cattle feedlot manure to produce methane gas.

A part of this research was to inventory the cattle on feed to determine the prime areas for development in the four-state region. Utah was found to have very few cattle on feed in confinement facilities. However, New Mexico, Arizona and Colorado were found to have a great deal of potential. Next, a single site was chosen to do site specific studies on the costs to construct and operate the facility and to develop the infrastructure needed to commercialize the process. Lamar was more than pleased to be chosen as that site since it provided an additional alternative to the Utilities Board to help solve its future gas supplies problem.

Next, a mobile digestor was constructed equivalent to about 50 cow units to do field research. Bio Gas designed and built the unit.

Since water was critical in the areas of the predominance of cattle feeding, it was felt that recycling of the water would be desirable and that an algae system would be considered. The digestor was then taken to Belen, New Mexico, where KLA Labs did six month's worth of research on what types of algae would best clean the digestor effluent. The algae test results provided two different types of algae that would not only clean the water, but could be harvested and fed to the cattle as a high protein feed supplement.

The digestor was then brought to Lamar where E. S. Erwin and Associates conducted feeding trials to determine if the protein recovered from the manure as a result of the digestion process was palatable to the cattle, would allow the cattle to gain weight, and determine a value for this residue. Two feeding trials have been completed and a third will soon be underway. The reason the feeding trials are so important is that the revenue derived from the sale of residue will reduce the cost of gas from the facility.

The final engineering and process design is now proceeding with the engineering firm of CH2M Hill and Bio Gas of Colorado contracted to do this work by the Utilities Board.

Project Operation

Figure 4 shows the process flow diagram of the plant, as presently envisioned. Trucks will haul the 350 tons of manure used per day from the three feedlots, located within a 15 mile radius of the plant, to the Bioconversion site. The manure will then feed into a hopper for transfer to tanks for grit removal and mixing with water to form the slurry. The slurry is then pumped into one of the three digestor tanks where digestion of the slurry will take place. The tanks are circular and 135 feet in diameter and 30 feet tall. The slurry will have an average retention time of 21 days in the digestor. The reason for the term "average" is that the digestors will be fed continuously. The temperature in the digestors is controlled at 95°F to maximize the volatile solids' destruction and gas production. This heat will be supplied in part from waste heat sources in the power plant. The biogas will be compressed and carbon dioxide will be removed by an amine absorption process to raise the gas quality from approximately 650 Btu per cubic foot to 1000 Btu per cubic foot.

Two centrifuges will dewater the sludge coming out of the digestors to a 25% solids concentration. Conveyors will then transport the solids to an on-site area for drying and storage. This residue is actually a form of protein recovery system and will be taken back to the feedlots for use as a supplement in the cattle feedlot ration. The cattle feeders are willing to buy the residue and contracts are presently being negotiated. It is interesting to note that the residue has already been accepted and registered

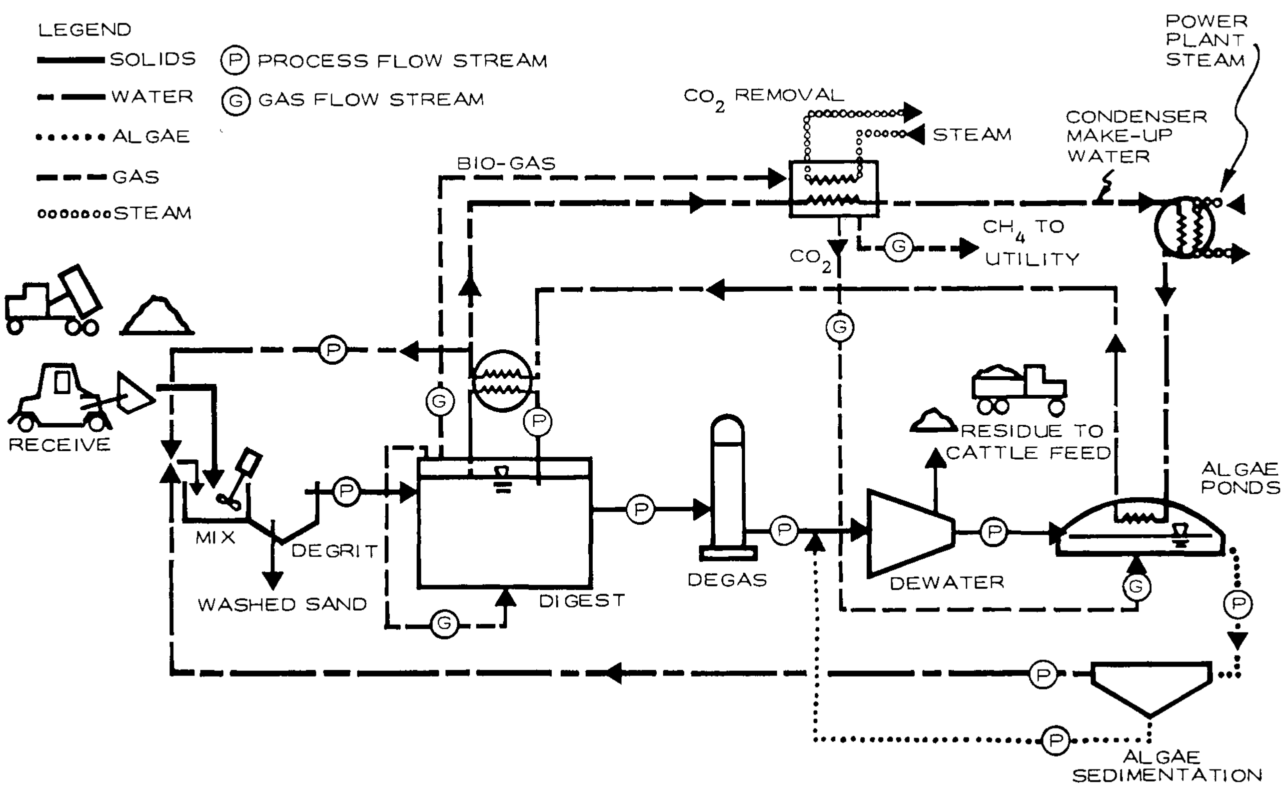

Figure 4. PROCESS FLOW DIAGRAM OF LAMAR BIO-CONVERSION FACILITY

by the Colorado Department of Agriculture as a feed component. The real advantage of being able to sell the residue is that these revenues, approximately $2 million per year, will reduce the net cost of gas produced from the facility. The concentrate or liquid from the centrifuges will be pumped from the centrifuge building to the covered algae ponds for processing and recycling. This process of algae cleaning is presently being re-evaluated to determine its cost effectiveness.

Project Financing

The facility is estimated to cost $14.2 million, including interest during construction and six month's start-up costs, and will be owned and operated by the City of Lamar's Utilities Board. The project has been funded through the research and development stages by the Department of Agriculture, the Four Corners Regional Commission, the Lamar Utilities Board and Bio Gas of Colorado. The permanent financing will be through a direct loan from USDA's Department of Agriculture. (Please note that the bulk of the funding is in the form of a loan and not a grant. Lamar is receiving a favorable loan rate but when the project is completed and gas is produced, the Federal Government will be repaid its investment in the commercialization of this technology plus interest.)

Project Benefits

In our opinion, the exciting prospect of this facility is the fact that it will help solve many problems for the parties involved:

1. First and foremost, it will produce competitively priced, renewable gas supplies for Lamar's power plant, up to about 30% of our requirements.
2. It will help the feedlots to not only dispose of an environmentally undesirable waste product, but will in fact recycle it for resale as a feed supplement at a cheaper cost than the raw protein that is presently being purchased. Since there are 134,000 feedlots in the U.S., this could enhance the environment considerably.
3. The water for the process is being recycled so that consumptive use of water at the plant is minimal. This is important in semi-arid regions such as southeastern Colorado.
4. The project is an example of cogeneration since a part of the heat required for the digestors will come from waste heat sources at the power plant.
5. This project would provide a new industry to rural areas that will stimulate the area's economy.

6. The project will provide the first commercial demonstration of the use of this technology and can be duplicated in other plants in other areas.
7. Will help solve a small part of the national energy problem.
8. Will provide a facility for satellite research studies as spin-offs to the original process.

Conclusion

In conclusion, let me say that while not all feedlots are candidates for plants of this type and this process will not solve all of our energy problems, it does provide one piece to the solution of the nation's energy supply picture, and the lead role has been taken by a small municipal electric utility.

It has been estimated by the Four Corners Commission that bioconversion facilities of this type for the State of Colorado alone could produce some 18 million cubic feet of gas per day, or about 5% of all the gas used for residences last year.

While estimates vary on the national impact of fuels from biomass, the Battelle Memorial Institute estimates that present biomass research could provide plants capable of producing one quad of energy per year with another quad added fairly easily with additional research. This compares with present production from conventional hydro-electric sources of 3-5 quads per year. It is estimated that there could be 350 tons of harvestible manure available in the U.S. every year which could yield between ¾ and 1 quad of energy per year.

The technology being developed indicates that 28½ head of cattle could supply the heating needs of the average household using anaerobic digestion to produce methane gas.

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Refuse/Coal-Fired Generating Facility of the City of Columbus, Ohio

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Abstract

The City of Columbus, Ohio, as many cities in our nation, is presently confronted with increasing restrictions imposed by the EPA. At the beginning of this decade, the Municipal Electric Plant, along with the City's Sanitation Landfill, operated out of compliance with EPA regulations. Because of deadlines imposed, and because of projected costs to comply with such regulations, studies were made. A first result of these studies was to implement operation of three trash shredding stations in August of 1975. While the Sanitation Division operated an experimental landfill, the Municipal Power Plant contributed one of its boilers for researching the use of Columbus' shredded trash to generate electric power. The research project was successful and enhanced the determination that construction of a 90-megawatt trash-fired power plant was technically and economically feasible to build. The Mayor recommended to Columbus City Council to proceed with the construction of a trash-fired power plant and obtain voter approval of General Obligation Bond financing. The project was begun with preliminary approval of the State and Federal EPA's. Site work is now underway with the project. Construction is scheduled to begin in October, 1979, with initial operation slated for the Spring, 1982.

Description of the 90-Megawatt Refuse-Fired Power Plant

The energy source of the power generating station is provided by six (6) water wall boilers fueled primarily with Columbus' shredded refuse. High pressure steam from the boilers drives three 30-megawatt electric

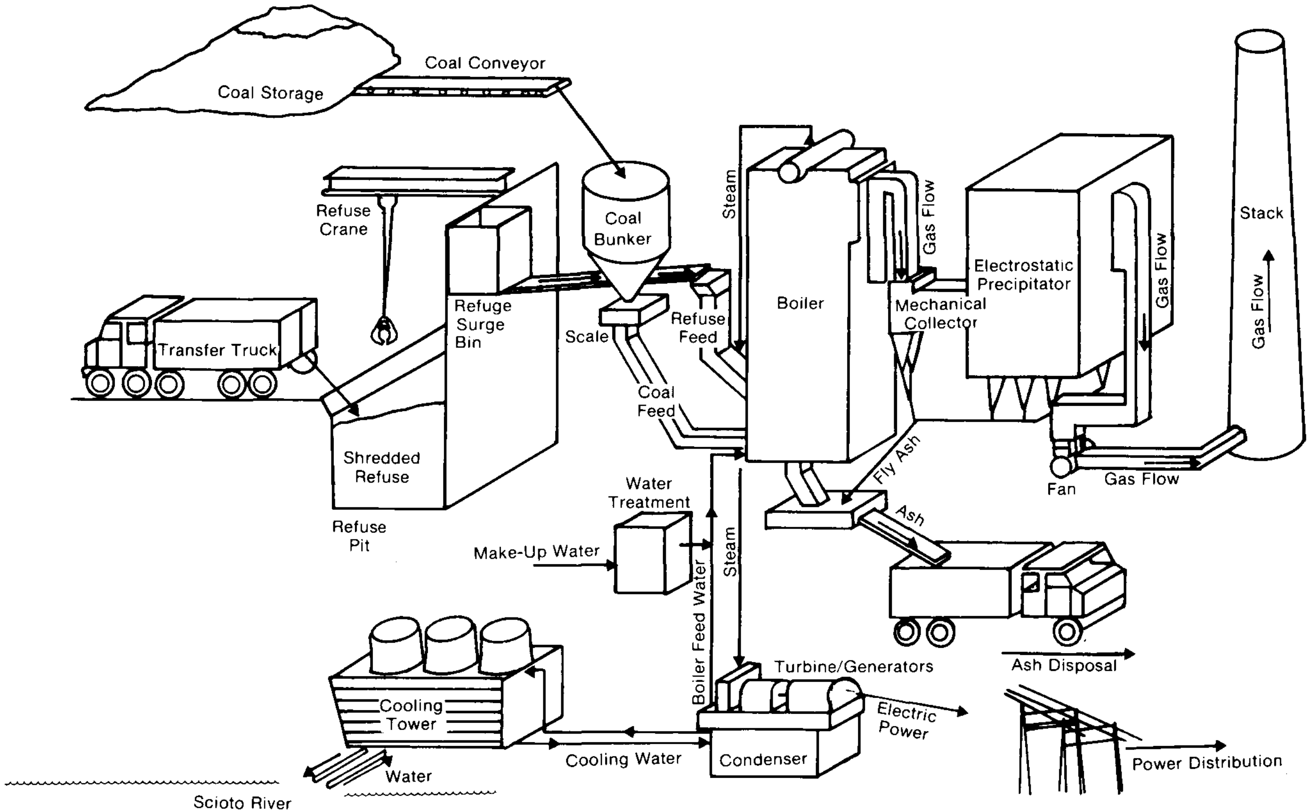

Figure 5. Refuse/Coal Fired Power Plant of Columbus, Ohio

turbine generators. (See Figure 5.) Costing an estimated $118,000,000, the plant is expected to be on line by early 1982. In operation, the plant would eliminate Columbus' refuse disposal problem and all of the environmental problems related to present landfilling operations. Tax dollars required to operate a landfill would no longer be needed. Electricity generated from the facility would be sold to the existing 7600 customers of the Divison of Electricity.

Benefits From the Plant Operation

The plant is feasible for Columbus because revenues from the sale of electricity would:

1. pay for all of the operating cost
2. pay for all debt service and retire the bonds sold to build the plant
3. pay for the maintenance of Columbus street lights
4. pay for the electricity used to power street lights throughout the city. In 1978, 27 million kWh were required to light the streets. By the year 2000, the power requirement is estimated to be 69 million kWh.
5. have a profit exceeding all of the above cost amounting to approximately $2.5 million each year during the first six years of operation, with more than $3 million per year in the years beyond.

The plant would benefit the citizens of Columbus by:

1. eliminating landfill cost and saving tax dollars
2. providing the electricity and maintenance for Columbus street lights
3. using the annual reserves to construct more than 75 miles of new street lights each year.

This total benefit, over a 20-year period beyond 1982 for avoiding landfill cost, for the construction of new street lights, and for the operation and maintenance of existing and new street lights, added together, amounts to approximately $150,000,000. In addition, the plant pays for itself.

Facts Regarding Feasibility of the Refuse-Fired Power Plant

To make electricity, 80% of the energy in heat obtained to make steam in the plant boilers would be furnished by Columbus refuse. This would consist of a fuel mixture of approximately ten tons of refuse mixed with one ton of coal. The plant generates a valuable product—electricity—with fuel which has a very low cost—refuse. In future years, as the demand for electricity increases, so does the quantity of refuse.

To determine feasibility, growth in electric sales was projected at 5% per year from 1975-1980, at 3% per year from 1980-1985, and 1% per year beyond 1985. This is conservative since the Division of Electricity's sales have increased 8% per year over the last ten years.

Refuse quantities are projected to increase with population. Between 1976 and 2000, the population of Columbus and Franklin County is projected to increase from 884,000 to 1,200,000, based on information from the Mid-Ohio Regional Planning Commission. In 1979, the population was slightly greater than one million.

The per capita refuse generation rate is expected, by the EPA, to grow at an increasing rate. The refuse generation rate per person is expected to increase 2½% per year from 1975-1980, 2% from 1980 to 1990, and 1½% from 1990 to 2000.

The plant would dispose of 100% of Columbus refuse and, conservatively, 50% of Franklin County's collection. In 1975, this refuse collection rate was nearly 801 tons per day. In 1980, this is projected to be 1,096 tons per day, increasing to 1,872 tons per day by the year 2000.

The heat value of refuse is assumed to be 4500 Btu per pound. In comparison, coal has a heat value of approximately 12,500 Btu per pound (approximately 2.7 times that of refuse).

The cost of electricity sold is projected to increase at a rate tied closely with increases in operating costs. Between 1975 and 1980, electric rates are projected to increase 12% per year while operating costs increase 10.5% per year. (Purchased power is projected to increase approximately 10% per year.)

As a result of the plant operating on refuse, electric rates would not increase at the same rate but are projected to increase 5% per year from 1980-1985, then 1% per year beyond 1985.

To simplify the above, as a result of the Refuse-Fired Electric Plant, the average annual increase in the sales price per kilowatt-hour between 1980 and 2000 is projected to be 3.7%. Factors affecting operating costs are:

Escalation—at 0.75% per month or 9.4% per year (during construction)
Labor cost—increasing at 8% per year
Materials cost—increasing at 6% per year
Purchased Power—increasing at 6% per year

Circumstances which favor construction of a refuse-fired power plant in Columbus are that Columbus has:

1. a shredded refuse fuel source
2. a plant site
3. personnel trained to operate a power plant
4. an electrical distribution system
5. customers for the electricity generated

Why use coal?

1. Coal is an emergency fuel.
2. It protects equipment from corrosion experienced in refuse-burning plants.
3. It is a fuel supplement to provide additional energy when not enough refuse is available.
4. It will improve combustion.

68 people would operate the plant on a continuous 24-hour/day basis. The present coal-burning plant is operated by 47 people.

The refuse plant design meets operating emission standards of the EPA. Its operation is environmentally sound.

The plant would use a closed private 180-acre lake for cooling water, a plan which exceeds the EPA guidelines.

The plant will meet the EPA sulfur regulations by using low sulfur coal. Use of trash reduces SO_2 emissions even more, which is an obvious environmental plus.

Should no trash be available for fueling the plant during conditions of extreme cold weather, the plant would be capable of using 100% coal for fuel.

The ash residue would be disposed adjacent to the power plant site on the existing landfill, which is presently closed and sealed. The landfill soil samples indicate that the ground will sink at approximately one foot per year. The 60-acre tract of land would offer area for disposal of the refuse/coal ash for a period beyond the year 2000.

Ten Facts Hindering Utility Support for Solar Energy

Dennis L. Meadows
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Dartmouth College, Hanover, New Hampshire

When I listened to Amory Lovins's speech on Sunday evening, I was inspired to think about the constructive changes that are possible in the domestic energy system. He portrayed graphically a variety of initiatives that are technically feasible and economically attractive today. The purpose of this panel is to discuss the relationship between the electric utilities and the process of change described by Amory. Several of my colleagues on this panel have described radical and constructive new initiatives by their firms to promote solar energy. But, you and I both know that the sorts of proposals being discussed in this conference will be ignored or actively resisted by the vast majority of our local utilities once we return home and begin trying to promote soft-path energy strategies.

In theory there are many things that the utility managers could do to promote the transition towards a sustainable energy system. They could deliberately opt for low-growth futures, build smaller and more environmentally benign generating plants, search for ways to use alternative fuels, promote conservation by their consumers through education programs and direct investment, accelerate their use of load control technologies, encourage appropriate use of electrical energy, work to revise the rate structure so it rewards those who save on electricity use, offer backup electrical power to those who have implemented on-site generating capacity, pay reasonable prices for the excess power generated by those same facilities, and work to find economically attractive uses for waste heat generated by their plants. In practice most utilities are pursuing none of those options. This has led many participants in this conference to the conclusion that we would be better off without the utility companies. Indeed I even heard some applause at a recent panel when it was suggested that electric companies may generally go bankrupt over the next decade. But I insist that the financial resources, the administrative expertise, and the political support of the utility companies are crucial assets in any attempt to reduce our current dependence on oil and gas. We simply have no alternative but to understand the sources of the utilities' current resistance to innovation, and to work at overcoming the reasons which currently make most of them reluctant to help in the shift towards solar energy.

Through my recent participation in an Aspen Institute conference on utilities and solar energy, through my involvement with a diverse array of energy policy makers in New England, and from our detailed case study of utility responses to small-scale hydropower and wood-fired power plant initiatives in New England, I have identified 10 factors that characterize most utilities and lead them today into active opposition to the programs which Amory so enthusiastically espouses. We must understand these reasons and think through ways of eliminating them or minimizing their impact if the utility companies are to be brought into the solar transition as active partners. In the remainder of my formal remarks I will list the reasons without much elaboration. I could muster substantial empirical evidence to suggest that each of these factors does indeed characterize most utility companies, but I would prefer to leave that to the informal part of this panel discussion.

The first fact is that many utility companies are dominated by a group of managers incompetent to conduct and act upon rational, long-term policy analyses. The industry for the past 30 years has been characterized by the absence of competition; a steady, predictable, exponential growth in demand and a guaranteed rate of return to investments. Competence in strategic planning has not accorded much survival value in the utility industry. The result is a C-minus in long-range planning for the industry. I believe the pressures currently at work on the industry, together with the stimulus of several impending bankruptcies will slowly open up the board of directors to outside influence and bring investors more actively into the search for quality among the utility executives managing their assets. But for the next 10 to 20 years the industry as a whole will be one in which high level management skills are relatively undeveloped. The industry is exquisitely adept at short-term administration and maintenance of the grid, but maintenance skills are quite irrelevant to the problems inherent in long-term shifts off oil.

The second fact, itself a direct consequence of the first, is that the industry currently labors under an enormous burden of excess capacity. About 37 percent of the capacity is in excess of current needs. The cost of this capital must be born by current users. And that excess capacity combined with the plants that are currently under construction impose a threat for the future which makes any utility executive extremely unhappy about the prospects for increased efficiency in electricity use. Once again this problem will disappear over the next two decades, but it will linger on through the 80's and will inevitably dampen enthusiasm for the solar and conservation initiatives which we find very attractive.

The third fact is that most companies are extremely hard pressed financially. There's hardly a utility company in the country today whose stock is worth more than its book value. And of course, book value is a small fraction of the replacement cost of the utility companies' assets. This leads to high debt ratios and difficulty in raising the capital necessary for new initiatives. The problem is exacerbated by an extremely conservative financial community.

The fourth fact which makes most utility companies very unhappy with prospects for increased use of distributed sources, is the threat which these potentially pose for the electrical and mechanical stability of the grid. Managerial policy, the computer programs, and the habits of the utilities maintenance staff are all predicated on the use of a small number of large generating facilities. While I am certain that many small-scale sources can be successfully integrated into the grid, this remains to be proven to utility executives. And until it is demonstrated, they must be quite skeptical about prospects for increased solar energy use.

The fifth fact is the historical emphasis which has been placed on growth as an index of managerial success. Stockholders, boards of directors, bankers, and even the corporate executives themselves, all use the annual increase in consumption, sales and profits as the measure of their success. When we propose a stabilization in energy consumption and eventually a reduction, we are threatening the very basis for the ego satisfaction and self-esteem derived by many in the industry.

The sixth factor influencing the industry's response to our proposals is its dependence for technical advice on the traditional manufacturers of production equipment. Westinghouse, G.E., and their associates have traditionally moved to larger installations. With their business goals defined in these terms it becomes very difficult for utility vendors to provide objective data about the costs of small-scale sources when called upon by their customers.

The seventh fact hindering rational action by utility companies is the irrational rate structure facing most companies. Prices are based on average rather than marginal costs, and political and equity considerations may often predominate over hard-headed long-term economic analysis. With a rate structure that systematically discriminates in favor of the short-term, increased energy use, and production over conservation it is no wonder utility companies systematically oppose our proposals. The problem is exacerbated because the costs with which the utilities are confronted are a relatively small set of those actually imposed on society by different energy production alternatives.

The eighth fact is one which has begun already to plague other utilities, such as the telephone system and the post office. No rational manager wishes to lose the best, most profitable, most stable part of his demand and be left servicing the worst. We now see in the postal system a spiral in which increased costs make some small select market extremely attractive to the private sector, such as United Parcel System. Corporations come in, take over this profitable sector of the market and leave the U.S. postal system with a set of demands that are progressively more and more expensive on average to serve. The ability of the utility companies to participate in the solar transition depends intimately on their continued profitability, and they have to oppose anything which seems to threaten increased costs.

The ninth fact is the instability and uncertainty which any utility executive must have when confronting a government that cannot make up its mind about a national energy policy. Utilities can have little confidence that programs of change which are expensive and which threaten their traditional markets will continue to be rewarded in the future by a government which changes its stance on energy every six months or so.

A tenth factor which hinders innovation in this area is the tradition of absolute reliability which has characterized the industry. Nothing is more sacred to a utility executive than the notion that the customer must always be able to have power when he turns on the switch. We are clearly moving into an era when some of the most inexpensive modes of coping with energy scarcity will be to impose new usage patterns and expectations on the consumer. So long as the utility companies define this kind of change as lying outside their sphere of influence, they will inevitably oppose initiatives that seem to diminish their ability to provide reliable power.

Some of these problems have solutions, others will diminish only over decades. Some of them are based on a misperception of reality, others are subject to reform through rather simple changes in the legal and regulatory system. But together they currently constitute a body of influences which will make it very difficult for most utility companies to participate enthusiastically in the kind of energy transition which Amory Lovins portrays. If we fail to understand that fact, we are headed for frustration. We will be drastically reduced in our ability to work out with utilities the kind of compromises needed to uncouple production of electricity from growth in the use of oil.

Workshop on Government and Foundation Support

August 21, 1979

Workshop on Government and Foundation Support

Chairman

Henry Lee
John F. Kennedy School of Government
Harvard University

Panelists

William Butler
ECO Funding

Donald W. Clifford
Argonne National Laboratory

Richard Holt
U.S. Department of Energy

Webb Otis
U.S. Department of Energy

Summary

This workshop covered sources of government and foundation funds for community renewable energy projects. The general consensus of the panelists was that funding is available, but there is serious competition for it; that applicants for funds must clearly show an understanding of the particular interests and the agenda of each funding source they approach; that project promoters should begin to seek funds from "new," untapped sources in both the public and private sectors.

During the question-and-answer period which followed the panelists' presentations, two themes emerged. First, much of the discussion revolved around new approaches to fund-raising and new sources of funds. Dick Neill from Hawaii mentioned that some venture capitalists were beginning to look at renewable energy projects. Bill Butler described a new funding mechanism some foundations were exploring called "program-related investment funds." Under this scheme, the foundation would use investment funds to take an equity position in the project.

Other potential funding sources discussed were churches and insurance companies.

The second theme emerging from the question-and-answer period was methods by which communities could keep abreast of funding developments. The discussion revealed several information sources: The *Commerce Business Daily* [published by the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (202) 783-3238]; National Center for Appropriate Technology, P.O. Box 3838, Butte, Montana; and The Center for Renewable Resources, which publishes a guidebook called "Sources of Funds for Solar Activists."

Financing Community Energy Planning

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Abstract

Energy planning is a new element in community planning that has evolved as abundant sources of cheap energy (or fuel) become less available. Successful energy planning depends on the ability to organize and to plan for energy management at the local level. This paper demonstrates some of the opportunities and methods that the Comprehensive Community Energy Management communities have used to supplement their energy planning budgets. CCEMP is a two-year, DOE-funded pilot effort involving 17 communities to determine capabilities and programs to organize and to plan energy conservation and management at the local level.

CCEMP communities have leveraged available DOE funds with cash, in-kind non-cash contributions, and CBDG funds. Economic Development Administration, '701,' '208,' and other federal programs have provided information essential to the process. Private funds also are used. The Farmers Home Administration with DOE cooperation provides a small-scale energy planning pilot for smaller communities. "Energy boom town" legislation has been proposed, as well as new legislation that would provide additional funding for local energy planning.

Local Energy Planning

Energy planning and the financing thereof at the local level is a relatively new realm of community planning and development. Little was accomplished in this area before the 1973–74 fuel crisis. Planning has been accomplished in the community planning process with several elements (i.e., housing, population, land-use, etc.) essential to energy planning. Now, with the complexity of energy supply and demand, and as abundant sources of cheap energy (or fuel) become less available, a whole new area of community planning has evolved.

The current energy problem is so crucial that the emphasis at the local level should stress quick, accurate energy planning, rather than the immediate availability of federal and state funds to finance that planning. A key element in helping to solve energy problems is the ability and willingness to organize and to plan for energy use at the local level. The situation is such that eventually financial assistance will become available. This paper demonstrates some of the opportunities and methods that the communities in the Comprehensive Community Energy Management Program (CCEMP) have used to supplement the funds available through their CCEMP contracts. The CCEMP represents the most intent and varied local energy planning effort to date. Efforts in this program vary from the planning of building retrofits in Janesville, Wisconsin to the broad scope comprehensive planning for the City of Los Angeles.

Energy planning is viewed by some as a separate element in the planning process. However, communities in the CCEMP consider energy planning as an integral part of the overall community planning process. It is agreed that energy planning should be performed in an efficient manner with inputs from all levels in the community, including public and private officials, suppliers, consumers, and the general public to help ensure an adequate and continuous energy supply and to maintain energy dollar efficiency.

The Comprehensive Community Energy Management Program

The CCEMP effort is a two-year pilot application phase of a Department of Energy program to formulate strategies and methodologies to assist local authorities in the preparation of comprehensive community energy management plans. In a prior 26-month task, a contractor built upon exploratory projects and devised a ready-to-use methodology for developing, implementing, and managing a comprehensive community energy plan. The methodology was designed to be applicable to communities of any size and degree of previous experience.

In general, the methodology is straightforward and similar to approaches often used by communities in developing plans for other purposes. First, it suggests that the user community perform an assessment or audit of its current and future energy use. Next, the user community is required to define its energy problem and set energy objectives. After energy objectives are selected, procedures are provided to facilitate the further selection of alternatives that will best meet the objectives considering energy savings, implementation costs, and behavioral impact on the community. Last, broad guidance is provided as a basis for the development of a community energy program and plan.

In addition to testing the applicability of this and other available methodologies, the pilot communities will provide experience in formulating innovative municipal organizational structures for initiating and executing comprehensive energy planning programs. Organizational innovation will be necessary to bring together all groups that have a part in local planning and the provision of energy services—functions that conventionally have had little formal coordination. The organization for comprehensive energy planning must be appropriate for a community's specific institutions. Diversity among the pilot communities will demonstrate a variety of appropriate organizational structures.

The 17 pilot CCEMP communities were selected in July, 1978 by an RFP issued by Argonne National Laboratory. Argonne is the contract manager of the program for the Department of Energy (DOE).

The CCEMP effort is funded by a $5,000,000 DOE appropriation. Costs of the community efforts vary from less than $10,000 in Janesville, Wisconsin, to $664,000 in Los Angeles, California. Contract amounts vary according to the size of the community and the depth of analysis and planning to be accomplished.

Participating CCEMP communities represent a broad range of population, land area, location, form of government, energy issues, and managerial approaches toward energy problems. Continuous monitoring and evaluation of the pilot communities by the Academy for Contemporary Problems will: develop generalized conclusions on potentials and problems in applying comprehensive community energy management planning methodologies; and communicate findings on general technical, management, organization, and procedural experience to local governments. The pilot studies will form the basis for improved methodologies and recommendations for their national application.

CCEMP Funds

In the CCEMP communities, DOE funds are used entirely for energy-planning activities. The funds are provided through a performance contract, rather than through a grant program. The funds are used several ways, varying from total support of the local in-house staff to complete use of the funds for consultant support. Consultants may provide both technical and administrative support or any combination of staff/consultant work load that the community recommends. The important issue is that a complete CCEMP scope of work is approved, both locally and by

Argonne National Laboratory, and that the CCEMP is accomplished, as required by contract. One illustration of consultant effort is the training of technical staff and operation; management and planning is provided by the community staff.

CCEMP funds may be used in combination or "piggy-backed" with other public or private funds. The funds most often used are a local cash match, in-kind non-cash contribution, and Department of Housing and Urban Development (DHUD) Community Development Block Grant (CDBG) funds. Several examples exist of cash and in-kind non-cash contributions from public utilities and private companies. There are no use restrictions on the use of non-DOE funds. Non-DOE funds are employed in several instances to provide services beyond the Argonne contract Scope of Work or to supplement an activity the community determines is underfunded. (The CCEMP is a one-time, pilot effort with limited availability of funds.)

In all CCEMP communities, there is an in-kind contribution mostly by coincidence. In some cases, the amount may be budgeted or, in other instances, may not be estimated or accounted. One-third of the communities are providing a direct-local cash contribution that may vary from $1,000 to $40,000 or 16% of the total budget as in the South Florida Regional Planning Council program. This contribution is to finance an additional study of energy intensity factors that was not included in the initial contract and for which no funds remained in the DOE budget.

Use of Other Federal Funds

CDBG funds are used by Wayne County, Michigan, as the local cash contribution amounting to $98,000 or 49% of the CCEMP budget over a two-year period. Moreover, the county has set aside $2,500 per community from CDBG funds to be used with a local 100% match for local master plan revision to reflect energy-efficient programs and development methods. Other DHUD funds, '701,' or CDBG monies are being used indirectly in most communities. The indirect input is for the energy audit from information used to develop the Housing Assistance Plan and other back-up from DHUD housing programs. Information also is being provided from housing rehabilitation and the Community Action Programs.

CETA employees are used in several communities to assist in the development of data for the energy audit.

Data inputs to the program also are being received from the EPA '208' water quality planning program, EPA Air Quality Program, Department of Transportation Planning and Development Programs, and the Coastal

Zone Management Program of NOAA. The National Science Foundation Residency Program is to be used to support a student intern program in Tulsa, Oklahoma.

The private sector also is making cash and indirect contributions in support of CCEMP. In several communities, the public utility has provided or financed the aerial thermogram of the city. These have not been an eligible cost in this program because of the limited funding. Several utility companies are making contributions for computer services. For example, the Philadelphia Electric Company is making a substantial cash contribution to the development of the City Energy and Econometric Models. In each community, the public utilities are directly involved in the process by serving on the energy policy and advisory committees and the various task forces essential to the success of the CCEMP. In some instances, the indirect costs of these efforts have been calculated. However, the total in-kind contributions by the utilities and others may be immeasurable.

In Philadelphia, funds from the Economic Development Administration (EDA) are being used in the CCEMP process. Here the CCEMP is being developed in the Office of the Director of Commerce, where the efforts are combined with EDA eligible development projects and include an industrial energy audit program and industrial solid-waste energy plant feasibility study. The City of Philadelphia claims that the CCEMP management framework has leveraged the development of seven new energy-related industrial or commercial programs and has enhanced and coordinated six other energy-related study and demonstration programs. There are similar examples in other communities.

DOE funds from other demonstration programs are being used in several communities for projects that will be considered in the implementation phase of the CCEMP. Two examples are:

1. incorporation of a waste disposal program and a community energy system by the Tulsa Energy Resources Recovery Authority; and
2. a solar energy demonstration in Philadelphia.

There are no DOE funds other than CCEMP presently available for energy planning efforts.

Farmer's Home Administration/DOE Pilot Program

As a parallel effort in its support for energy management planning in larger communities, DOE is working with the Farmer's Home Administration (FmHA) of the Department of Agriculture to help smaller communities resolve their energy problems.

The dual goal of the DOE/FmHA interagency agreement is to "improve the capacity of small towns (under 10,000) to assess their energy problems and to act for conservation and local resource development." Similar to CCEMP, but on a smaller scale, the Small Town Energy Planning (STEP) program is intended to discover that can and should be done to help solve rural energy problems and to demonstrate and evaluate energy planning methods such as those developed for DOE by Hittman Associates and Sizemore Associates.

Nine jurisdictions have received funding under the STEP program, and DOE funds have gone to regional planning agencies. The fund transfer is through FmHA's existing network of Area Development Assistance Planning grants. Of the nine projects, five are DOE-funded, and four are funded by FmHA.

Despite differences in local conditions and project purposes, each of the projects will: (1) involve technical assistance from regional agencies to local units of government; (2) include some energy auditing; (3) involve creation of a local advisory group; and (4) culminate in a local implementation plan.

Following slightly behind the CCEMP schedule, the STEP communities are now beginning to organize their committees and to initiate their auditing work. It is not known if this program will be expanded in FY 80.

Legislative Proposals

On May 18, the Administration sent the Energy Management Partnership Act (EMPA, S.1280) to Congress. The proposal would consolidate programs now operating under authority of the Energy Policy and Conservation Act (EPCA), the Energy Extension Service (EES), and Energy Conservation and Production Act (ECPA).

S.1280 would grant state and local governments $110 million a year for five years to:

1. assess their present and future energy needs,
2. develop and improve their information base, and
3. identify ways to receive the greatest energy conservation benefits.

The funds could be used for new or existing activities, such as energy supply and demand planning, assessment of new energy facility needs, energy emergency preparedness, and development of new energy supply opportunities. However, the funds could *not* be used for construction purposes.

Up to 10% of the funds received by a state could be passed through to local governments; of the $110 million per year, $5 million are discretionary funds to be awarded by the Secretary of Energy for direct assistance to local units of government or Indian tribes for innovative projects.

Under the bill's provisions, at least 60% of the funds would be earmarked for energy conservation, renewable resources, and energy emergency measures. The remaining 40% could be used by states within the guidelines of the Act.

After an initial period, states would be eligible for grants if they enacted mandatory energy conservation standards for new buildings, offered advice and assistance as the EES is now doing, and adopted a statewide energy management plan (or modified an existing one). The state plan, required to be updated annually, must include:

1. an energy emergency plan,
2. a description of the state's overall energy situation,
3. goals and objectives,
4. a description of programs to meet those objectives—especially how DOE funds would be used, and
5. a description of the role of local governments in the planning process.

On April 8, Sen. Charles Percy (R., Ill.) introduced the Local Energy Management Act (LEMA) to the Congress. The proposal would create three interlocking programs:

1. a Demonstration Grant Program for energy conservation implementation, and the development of renewable energy resources;
2. a Local Energy Reference Center Project as a data bank and clearinghouse for locally based energy management efforts; and
3. a Technical Assistance Panel Program with a branch in each DOE regional office to provide energy information.

The bill would provide $8 million for the first year, $10 million for the second year, and $12 million for the third year. The Demonstration Grant Program would receive a minimum of 50% of the authorized funds, the Local Energy Reference Center would receive up to 10% of the funds, and a minimum of 25% of the funds would be allocated to the Technical Assistance Panel Program.

The Demonstration Grant Program would be used to develop programs providing:

1. an estimation of fossil fuels to be displaced by these programs in one year, five years, and ten years;
2. information dissemination programs regarding energy conservation and renewable energy resource options;
3. mechanisms to involve the public in energy policy decisions; and
4. programs to foster private industry in energy conservation and renewable energy resources development.

Recipients would be required to outline their plans for future progress, particularly involving major capital expenditures.

The Reference Center would draw on the experiences of demonstration grant localities and collect information on other successful localities outside the grant communities. The Center would be established outside of DOE through a contractual arrangement.

The Technical Assistance Panels Program would provide available technical assistance information from appropriate resources. In more demanding cases, the Technical Panel would provide direct, peer-based exchange of information among local officers. I have no report on the status of either the EMPA or LEMA bills.

The FmHA administers Section 601 of the Powerplant and Industrial Fuel Use Act of 1978 that would assist development in small communities undergoing rapid growth because of coal and uranium mining. The enabling law authorizes grants of $60 million in FY 1979 and $120 million in FY 1980 to provide for planning, site development, and property acquisition in "energy boom towns."

The FmHA has issued the final regulations for the program, effective June 19. Interested persons should contact the FmHA representatives in their home state.

Section 601 is similar, but smaller in scope, to the EDA Inland Energy Impact Assistance Bill introduced in the last session of Congress. The current EDA bill would provide $150 million per year for five years to assist inland communities that are experiencing rapid population and employment growth because of coal and uranium extraction. It has been reported that if Congress passes the EDA bill then the FmHA bill could be combined with the EDA's. There is no further report on either the EDA or FmHA legislation.

Conclusion

Although few federal dollars are available for local energy planning, it can be accomplished as an extension and an integral part of the comprehensive community development planning process. Energy planning requires the same techniques as other elements in the development plan. The major difference is that energy, more than any element in the process, crosses all barriers and affects the whole population. Experience gained and the financing technique being developed with the present limitations on funds will help to determine more efficient methods of energy planning at the local level.

Government and Foundation Support Panel

Richard Holt
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Abstract

New federal funds to facilitate renewable resource development at the community level are not likely to be available in amounts that come within a factor of 1000 of the amounts that are needed. Further, federal funding for these efforts is not fully in harmony with the basic concepts of community resource development. This paper suggests three alternatives to new federal funding: (1) more imaginative use of existing federal programs, (2) state and local actions, and (3) increased efforts to encourage private sector investments.

Government and Foundation Support Panel

I have been asked to discuss the types of Federal financial and technical assistance that may be available to further the development of conservation and renewable energy resources at the community level. I am sure that most of you are aware of programs, or proposed programs, such as EMPA, the Comprehensive Community Energy Management Planning Program (CCEMP), and the Appropriate Technology Small Grants Program. In addition, there are a large handful of ad-hoc studies or programs such as:

- The California Distributed Energy Study
- The New England Sustainable Energy Project
- The Community-Based Technology Assessment Project
- The New York Southern Tier Work of Clara Miller

- The Community Studies in Colorado of Susan Carpenter (until recently funded by a foundation grant)
- and a modest number of others.

You should also be aware of things such as Anita Gunn's pamphlet: "Sources of Funds for Solar Activities," and the "Grassroots Fundraising Book," available through the Center for Renewable Resources.

Although I would be prepared to discuss these programs during the question and answer period, I would like to postpone discussion of them now, deferring to my colleagues on the panel who are equally familiar with these programs.

By any standard, however, the current level of funding is inadequate for the task ahead of this nation. I would suggest that we consider these small amounts of existing funds as transition measures—needed to assess end-use demand, to do community self-directed energy planning, to inventory renewable resource availability, and to design new energy systems at the appropriate scale.

But, in the future, how can funding for the design of large-scale community energy systems come from the federal treasury? This notion implies that billions of dollars would have to be allocated in Washington for those local communities that supplied the funds in the first place. Pushed to its extreme, the notion would be roughly equivalent to everyone paying their neighbor's utility bill. I say billions of dollars because that is literally the amount involved if we are speaking about repairing, upgrading or replacing the entire capital stock of this nation so that it is based upon decentralized renewable energy resources, rather than upon highly centralized fossil fuel systems.

If I contend that new or special federal funding for these efforts is in the long run not really available or appropriate, what do I suggest as alternative? There are three main areas:

1. There are countless existing federal programs in HUD, Agriculture, FmHA and the Rural Electrification Administration, Commerce, Labor, the Cooperative Development Bank and other agencies (even Defense) whose missions can be carried out more effectively if the agencies were willing to consider the renewable versus fossil fuel implications of their programs. These agencies have field offices and regional offices throughout the country, and can be educated and informed and otherwise pressured to support community based renewable systems as part of their mission. The President's Domestic Policy Review of Solar Energy identified many of these opportunities, but I suspect that

many others remain with Bill Becker's presentation of the way in which the people in Soldier's Grove, Wisconsin used federal flood control programs to develop a primarily solar community.

2. There are many programs and policies at the local level that the Federal government cannot really touch. It remains the responsibility of local and state groups to see to it that building codes, zoning ordinances, tax and tax exemption policies, utility regulation, banking practices, educational curricula and a whole host of other practices and policies are overhauled to put conservation and renewable resources on an equal footing with conventional fossil or nuclear systems. This in itself does not assure project funding, but it helps to build the infrastructure and common basis of understanding that will make community-based renewable systems more easily funded.
3. The private sector must be informed of long term advantages of conservation and renewable energy resources. I know that it is not easy, for example, to persuade 200,000 building contractors that passive design and construction of homes provides both a selling advantage (no utility bills) and a social benefit. However, most of the investment in this country is in the private sector, and influencing those private sector investment decisions is of prime importance. Some fraction of industrial investment is now tending in the direction of conservation and renewable energy resource use, and the proposed investment tax credit for industrial process heat may help, but substantially increased local and state efforts are needed to accelerate this process. State and local governments can do things to influence private sector investment that the federal government cannot. State and local groups are most appropriate to issue site permits, give property tax preferences, enforce and administer the provisions of the Clean Air Act Amendments of 1977, as well as other federal environmental regulations.

So, at least for the sake of discussion I would like to sum up by saying that new federal dollars are likely not to be available or of much use. Instead I suggest a do-it-yourself program to:

1. Steer existing Federal programs in the right direction—there are lots of programs with lots of funding;
2. Overhaul the myriad of state and local practices that now work against renewable resource development at the community level;

3. Help to move private sector investment decisions in the right direction by education, regulation, and incentives.

I believe that these, and similar actions, are likely to be both faster and more effective than a search for massive new federal funds. I further believe that ultimately these strategies will be consistent with the basic concepts of decentralized and renewable energy systems for the neighborhoods and communities of this nation.

Section J
Informal Presentations and Discussions

August 21, 1979

Changing Local Land Use Laws to Protect Solar Access and Encourage Solar Use

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Overview

Local land use agencies and agents have in numerous instances established regulations for the use of land or buildings or adopted administrative procedures for the review and evaluation of land use proposals which effectively serve as legal and institutional barriers to the use of solar energy systems. Local land use regulations in the Central Naugatuck Valley Region of Connecticut were found to create legal barriers to the installation of both passive and active solar energy systems and posed significant barriers to solar access when a hypothetical residential development was built under the worst case conditions allowed by zoning regulations under various street orientations and land slope conditions. Despite barriers to the installation of solar energy systems and barriers to solar access, the study found that local planning and zoning commissions could play a significant role in the long-term promotion of solar energy by adopting solar incentive zoning in areas of the community where solar access is optimum.

Overcoming Land Use Barriers to Solar Access

Although no one has yet been able to regulate the sun, many communities in the United States regulate their land in such a way that solar energy is not a viable energy alternative. This problem appears to be greatest in those areas of the United States such as Connecticut where land use regulations exercize the most restrictive control over the development of land. In Connecticut, solar energy systems are potentially subject to the regulatory powers of numerous land use agencies and agents including planning and zoning commissions, inland wetlands agencies, historic district commissions, building inspectors, and town sanitarians. These agencies and agents have in numerous instances established regulations for the use of land or buildings or adopted administrative procedures for the review and evaluation of land use proposals which effectively serve as legal and institutional barriers to the use of solar energy systems.

In brief, these are the findings of a recently completed study by the Central Naugatuck Valley Regional Planning Agency titled "Overcoming Land Use Barriers to Solar Access: Solar Planning Recommendations for Local Communities." While the findings of the study are based on a review of the land use regulations and interviews with the land use agents operating in a 13 town region in Western Connecticut, they are generally applicable to other municipalities in Connecticut and other states which have adopted substantially similar methods of regulating land development.

Solar energy systems must contend with local land use regulations for two very distinct reasons. First, because local zoning regulations or historic district regulations may directly or indirectly prohibit the installation or use of solar energy systems. Secondly, because local zoning or subdivision regulations may permit adjoining property owners to build structures or plant vegetation which blocks access to the sun.

Barriers to the Installation of Solar Energy Systems

Of course, the initial problem faced by individuals wishing to use solar energy is simply whether or not solar energy systems are permitted by local regulations. This problem appears to be greatest for individuals wishing to install a solar energy system (such as a domestic hot water system) on an existing building when the house and lot were not originally planned to accommodate a solar collector. Under these circumstances, local zoning commissions could prohibit the installation of a solar energy system if the system violated the height, yard or area standards established for buildings or accessory buildings. Our study found that the most significant barriers to the installation of solar energy systems are encountered when a solar collector must be mounted on the ground. In this case the front, side and rear yard setback requirements found in most municipalities of our region categorically prohibit the installation of accessory uses—such as a solar energy system—when the principal building has been built to the minimum setback requirements. Indeed, we found that some municipalities—typically urban or urbanizing municipalities—categorically prohibit accessory uses in the front or side yards even if there is sufficient yard area not to violate the minimum setback requirements established for the principal building.

In certain instances, solar collectors mounted on the roof may also be prohibited if the collector should extend beyond the maximum height limitation set for buildings or if it should project or overhang into the required yard area. This problem may not be too serious for newer houses which are typically built to lower heights than the current standards found in zoning regulations. However, for older homes which already meet or exceed the height limitations of zoning a solar collector would not be allowed to extend over the peak of the roof.

Solar energy systems and their components may also be directly regulated when they are installed on the ground by those regulations which control fences, glare and the height and ground coverage of accessory structures. Our study found that solar collectors may in certain instances be prohibited if the solar collector is too tall (12 feet high or more) by zoning standards limiting the maximum height of accessory structures. Similarly, solar collectors could be prohibited if they cover too much of a rear yard area (400 square feet or more) by zoning standards limiting the maximum coverage of rear yards by accessory buildings.

If a solar collector is used as a fence it could be prohibited if the solar collector is placed along the property line and is too tall (6 feet high or more) by the standards for the maximum height of fences set by local zoning regulations. Finally, solar collectors could be prohibited if they produce an excessive amount of glare thereby creating a highway safety problem or impairing the value of surrounding property, by zoning performance standards for light and glare.

Barriers to Energy Efficiency of Solar Energy Systems

Local zoning regulations may also serve as barriers to the use of passive or active solar energy systems used for space heating by unnecessarily increasing the heating requirements of a structure. We found that the efficiency of passive solar design concepts may be seriously retarded by (1) zoning standards which establish excessively large minimum allowable floor areas for single family or multi-family dwellings, (2) zoning standards limiting or prohibiting the use of underground or earth sheltered housing design concepts, (3) zoning standards prohibiting passive solar design concepts such as attached greenhouses or seasonally habitable rooms from meeting minimum habitable floor area requirements if they are not heated by a central heating system using oil or gas, and (4) subdivision standards which prohibit development on steep slopes of 15 percent or more whether the orientation of the slope is facing to the south or to the north.

Barriers Created by Past Land Use Development Patterns

Another significant barrier to the use of solar energy systems has been caused by past development patterns which did not consider building orientation in the design of subdivisions. Based on 1970 aerial photographs we found that roof orientation in the Central Naugatuck Valley Region was almost a random process. Only 11 percent of the roofs in Southbury, Connecticut were oriented to the south or within 15 degrees of south. Similarly, only 13 percent of the roofs in Waterbury and 18 percent of the roofs in Woodbury faced to the south.

The limited number of buildings with suitable roof orientations largely reflects the past and present policies and regulations of local planning commissions charged with the responsibility of regulating the subdivision of land. Until 1978, planning commissions in Connecticut had no enabling legislation supporting the use of energy considerations in the land use planning process. With the passage of Public Act 78-314 planning commissions in Connecticut may consider "energy efficient patterns of development, the use of solar and other renewable forms of energy and energy conservation." However, despite the passage of this act we found that none of the commissions in our region of Connecticut has yet considered modifying its regulations to consider energy issues and more significantly few if any of the commission members are even aware that Public Act 78-314 was passed.

Barriers to Proper Siting of Buildings

Since proper building and roof orientations are critical to the use of passive and active solar energy systems installed on buildings or integrated into the design of buildings, and since most homeowners prefer to install solar energy systems on their roofs or as part of the design of their houses, it is clear that one of the most significant means of promoting solar energy is to require the proper siting of buildings in all new subdivisions. Unfortunately, the planning commissions in the Central Naugatuck Valley Region have essentially created numerous institutional barriers to the use of solar energy through the manner in which they are currently administering their standards for (1) the subdivision of land, (2) the design and configuration of streets, buildings, lots, and open spaces, and (3) the standards for landscaping and density of development. Typically, subdivisions are laid out without any consideration for the orientation of streets, lots and buildings with respect to the sun. Street orientation is probably the most significant factor since it largely determines the orientation of lots and in turn lot orientation largely determines the orientation of the building and its roof with respect to the sun. This step down relationship between street orientation and building orientation has generally led to an almost random pattern of orienting buildings with respect to the sun. In the future, planning commissions could play one of the most significant roles in the promotion of solar energy simply by encouraging east-west street patterns and by requiring lot and building orientations which are consistent with optimizing solar energy. This would mean that lot lines should, insofar as possible, be based upon orientation to the sun rather than orientation to the street. Of course, when the street orientation is east-west then the lot orientation would be consistent with the design of the street as well as the use of solar energy systems.

Other institutional barriers to the use of solar energy systems are subdivision regulations for the dedication of open space. In theory, large open space areas in new subdivisions could be planned to serve as community solar energy systems if the open space is located centrally to all the buildings so that heat losses from the point of transmission to the point of end use are minimized. Community solar energy systems offer numerous advantages including reducing the per unit cost of solar energy to each household, allowing for more flexible patterns of development and avoiding the potential shading problems that might threaten single family dwellings using solar energy systems. However, despite these advantages community solar energy systems are unlikely to become a reality unless planning commissions establish standards for the location and size of open space dedications so that this land can be integrated into a neighborhood plan for solar energy use. As an example, we would foresee community solar energy systems becoming viable concepts when planning commissions begin encouraging or requiring developers to locate lots as spokes off a central open space serving as the hub to the neighborhood or to cluster development to achieve higher densities. This approach could revitalize the use of open space and make it a meaningful community resource much like the town green was for the early New England communities.

Finally, very significant barriers to the future use of solar energy in our region and many other parts of the United States are restrictive zoning regulations prohibiting or discouraging higher density development such as attached housing and multi-family developments. In the Central Naugatuck Valley Region only two of the region's municipalities permit multi-family housing as a matter of right. Seven other municipalities permit multi-family housing under a special permit process but have all too often constrained the advantages of this housing option by establishing (1) bedroom restrictions, (2) placing limitations on the maximum number of dwellings per structure, and (3) by establishing excessive minimum floor area requirements. These policies have effectively limited the energy efficiencies of higher density development. This in turn has restricted the use of solar energy systems since it is at higher density development that solar energy is most economical and attractive. Contrary to popular opinion, solar energy systems do not require low density residential locations to ensure solar access or locate suitable sites for the systems. The advantage of higher density development is that it encourages the shared use of solar energy systems, it avoids shading problems associated with systems on single family dwellings since in multi-family housing they are normally shared by an entire building, it facilitates the installation of solar energy systems since multi-family housing often has flat roofs, and it is more energy efficient than single family housing since it can make use of common walls, zero lot line techniques and smaller minimum floor area requirements.

Barriers Created by Other Land Use Agencies

While zoning and subdivision regulations exercize the greatest influence over solar energy systems, in certain instances inland-wetlands agencies, historic district commissions, building inspectors or town sanitarians may also play a role in the regulation of solar energy systems. As an example, when a solar energy system utilizes water from rivers or waterbodies for cooling purposes it could be regulated by an inland wetland agency in Connecticut. Similarly, solar energy systems can not be placed on the roof or wall of an historic district building in Connecticut without the approval of the historic district commission. Historic district commissions in Connecticut have already rejected at least two solar energy systems for failure to harmonize with the design of the historic district building and with the aesthetic values of the commission members.

In contrast, the policies of the town building inspector and town sanitarian are unlikely to impede the development of solar energy in Connecticut. This is partly due to the fact that many solar energy systems (8 out of 35 in our region) are being installed without a building permit and partly because building inspectors in Connecticut have so far not been familiar enough with solar energy systems to restrict their development. However, recent solar energy amendments to the State of Connecticut's building code may inadvertently impede installation of solar energy systems in the future by creating administrative delays in the building permit process and by increasing the cost of the system by requiring contractors to hire an engineer to certify the performance capabilities of the solar energy system when a full back up system is not installed.

Barriers to Solar Access

The second reason that solar energy systems must contend with local land use regulations is related to the issue of solar access. Once a solar collector is installed it must be guaranteed continuous availability of sunlight during the major portion of each day. This may not always be possible at every site due to (1) unfavorable topographic conditions, (2) trees, (3) buildings or other man made objects. Each one of these three shadow producing objects is subject to a greater or lesser degree to the controls of local planning and zoning commissions. Our study identified specific zoning and sub-division regulations which could permit adjoining property owners to build structures or buildings that could create solar shading problems. These regulations include setback requirements, building height limitations, exceptions to maximum building height, projections into required yard areas, maximum height of fences and similar structures, accessory building regulations, street tree requirements, and non-conforming use regulations. The most serious problem was found in the Waterbury Central Business District where no limitation has been established on the maximum height of buildings. This is a clear area of concern for anyone installing a solar energy system since there is no right to light under current state enabling legislation in Connecticut.

Topographic conditions can also affect solar access since shadows cast on steep north slopes are much longer than those cast on steep south slopes. In a hypothetical development occuring on an east-west street our study found that south facing slopes of 15 percent protected solar access in all municipalities under the worst case conditions allowed by local zoning regulations whether the solar energy system was mounted on the roof, the south wall or within 4 feet of the house. This held true for lot sizes ranging from 6,000 to 100,000 square feet per lot.

In contrast when our hypothetical development occurred on a north facing slope with an east-west street axis there was generally no guarantee that solar access would be protected (under the worst case conditions allowed by local zoning regulations) whether the solar energy system was mounted on the rooftop, the south wall or within 4 feet of the house.

These findings emphasize the strong role that planning and zoning commissions can play in protecting solar access in areas of hilly topography. By discouraging development on steep north facing slopes and encouraging development on steep south facing slopes planning and zoning commissions can decrease the likelihood of shading problems emerging in future residential developments.

Vegetation as a Barrier to Solar Access

While buildings and topographic conditions threaten solar access the biggest barrier to solar access is the problem of shadows cast by trees. Planning and zoning commissions in Connecticut exercize little control over trees and vegetation on public property and virtually no control over trees and vegetation on private property. Mature maple trees and oaks reach heights from 60 to 120 feet. In contrast, local zoning regulations have generally limited the maximum height of residential structures to 30 or 40 feet. Consesquently, trees can effectively create shadows anywhere from 1.5 to 4 times as great as those cast by residential structures. The magnitude of the tree shading problem is not hypothetical. Through interviews with local installers of solar energy systems and by our own observations of these systems we found that 7 of the 21 solar domestic hot water systems operating in the region are already or will be shaded by trees located on neighbor's property within the next ten years.

Furthermore, an additional six installations will be subject to shading from trees located on the owners property by 1989. In effect, 61 percent of all the solar domestic hot water installations in our region will soon face the spectre of tree shadows and 30 percent will face the spectre of tree shadows which are immune to homeowners' pruning shears and which will continue growing in length to ultimately darken the surface of the solar collector panels. This finding indicates that unless there is some public control over private vegetation, solar energy faces a problematic future.

Renewable Energy Systems in Communities Around the World

Panelists

Robert Tanenhaus
International Energy Agency

T. Owen Carroll
State University of New York at Stony Brook

Edward Sharpe
MITRE Corporation

Summary

Robert Tanenhaus opened the session by posing the questions: To what degree are renewables being used around the world and what is being done to promote their use? He observed that since the Iranian Revolution last winter, OPEC has drastically revised its marketing strategy to one of even more rapidly rising prices and reductions in export target levels. This strategy poses a serious problem on capital-starved Less Developed Countries (LDC's): staying on oil and getting off oil are both expensive options. Use of renewables may be their least expensive option because technologies are less costly and less degrading to the environment. About twenty IEA countries (developed countries, by and large) will have limited renewables use by 1990 (3%). For LDC's, renewables may ease the balance of payments problem, but unless coupled with conventional energy sources, will not be enough to promote industrialization. Tanenhaus also discussed certain relevant points from the Tokyo Summit report. Among these were emphasis on renewables in the context of the developing nation and need for training.

Edward Sharpe viewed that the virtue of renewables in the LDC setting is their flexibility and their prospect for near-term use. They are suited for agriculture and remote communities, but also for vehicle use and desalination. The MITRE Corporation has done work for the U.S.

Agency for International Development that shows that economic growth rates in the LDC's have dropped since 1973, a drop coincident with the enormous OPEC price increases. A correlation does exist between energy use growth in LDC's and quality of life indices. He cited additional work MITRE had done along these lines in India and elsewhere. He also said that it appeared AID was changing its approach from an essentially rural bias to a more integrated approach.

Owen Carroll felt that renewables cannot only play a role in reducing oil imports, but can aid in preventing deforestation which is a serious problem in Africa. Financing can be a dilemma for LDC's which try to develop new energy sources. Capital requirements can be enormous when compared to current debut service and foreign exchange earnings. Many LDC's are behind in energy planning, and only now are some beginning to do national energy plans in which renewables may be featured. LDC's have tended to focus their renewables thinking on rural areas. But he agreed with Sharpe, AID and OECD are now beginning to help change this approach.

A number of questions ensued when the discussion was opened to the audience. These included questions on deforestation, solar greenhouses, etc., as well as assertions that renewables are being discouraged by international lending and development institutions in favor of centralized energy systems as a means of controlling LDC's economies. Members of the panel had serious reservations about the validity of this latter assertion.

Renewable Energy Systems in the World Energy Situation*

Robert Tanenhaus
Principal Administrator
International Energy Agency/Organization for Cooperation and Development
Paris, France

Abstract

Renewables offer several advantages over other alternative energy sources and are becoming increasingly practical in a variety of applications to reduce the United States' dependence on imported oil. Presently, most developed, market economy countries do not plan to satisfy more than 3% of their primary energy requirements in 1990 in this way, the principal constraints being costs and institutional barriers. Although some developing countries have used renewables for a long time, many such countries could significantly increase the amount and use efficiency. There are several steps that both developed and developing countries can take independently and together to accelerate renewables development and use.

Changing OPEC Policy

An overview of trends in OPEC oil policy since the Iranian revolution suggests that OPEC policy is evolving toward more rapidly rising prices and constant or decreasing production, corresponding to domestic revenue and energy requirements. This is a shift away from the trend before the revolution of more slowly rising prices and steadily rising production, corresponding more to industrialized countries' price

*The views expressed in this paper are solely those of the author and do not necessarily represent those of any organization or country mentioned.

preferences and demands. As long as the market favors the producers, the OPEC countries will be able to turn to higher prices rather than higher exports to maintain a tight market and maximize revenue, possibly without full consideration of the jeopardy to other countries' economic growth and to the international financial system. The situation is likely to prevail until the IEA countries greatly reduce their dependence on imported oil through conservation and alternative energy sources. With the U.S. and the other non-OPEC countries' economies heavily dependent on this imported oil, the situation suggests that, unless we act, including accelerating the development and application of renewables, we can look forward to the increasing drain of national economies, the growing likelihood of energy shortages disrupting the economies and the rising influence of oil in political decisions.

Application of Renewables

Renewable technologies are becoming increasingly practical and competitive solutions. Although the overall impact of renewables on the energy supplies of LDC's in the medium term is expected to be small, it could lay the foundation for a larger role later. Moreover, renewables are beginning to demonstrate their potential in several important areas for LDC's, including agriculture, rural communities (e.g., water pumping, heating, cooking and lighting), industry, desalinization, vehicular fuel, forestry, low-temperature urban uses, food and medical preservation and remote communication. Sometimes renewables can also be "kinder" to the natural and social environments than highly polluting conventional energy systems.

Renewables in IEA Countries

Renewable energies in the IEA countries are primarily in the RD & D stage. Only recently, as more and more technologies are maturing, the work increasingly is focusing on how to bring them to commercialization.

Although it is difficult to judge with the limited information available, under present plans the 20 IEA countries are not likely to rely on renewable energy sources for more than 3% of their primary energy requirements in 1990. The share may be slightly higher in some countries.

The principal constraints are costs and institutional barriers. Many countries have some financial incentives, but although some countries are actively trying to remove institutional barriers, many still remain.

Renewables in Developing Countries

As developing countries industrialize, their share of world energy consumption could rise from 16% presently to 25% by 2000. In many of these countries, existing energy sources, both commercial and so-called non-commercial, such as fuel wood, have lately been subject to great supply and price pressures and can no longer be regarded as reliable and cheap as they once were.

Renewables can contribute to energy supplies, support and provide economic development that is appropriate from the broad economic, social and environmental points of view and help ease external balance of payments problems. Some developing countries already have long experience with the applications of certain renewable energy systems, such as wood, water and organic waste, especially in rural areas. Renewables may constitute as much as half of all of the energy consumption of these nations.

It is important to note one caveat to put renewables in perspective. Renewable energy sources are part of the total requirements of developing countries for a variety of energy sources, including conventional energy. Supplies of all of these sources will need to increase if these countries are to industrialize.

First Steps

A recent report[1] by the International Energy Agency/Organization for Economic Cooperation and Development outlines the current and prospective state of renewable technologies and analyzes some of the problems and opportunities in applying such technologies in developing countries. The report focuses on the potential for co-operation between developing countries and the twenty member developed countries, including the United States, and sets out policy options which the member countries might follow in order to bring about a coordinated effort. Formulated below as do-it-yourself measures, these policies might serve state and local governments as well.

1. Emphasize and support renewables in the context of state and local energy and development situations (including government activities).
2. Assess renewable energy potential and resources.
3. Develop project formulation and evaluation techniques.
4. Support and conduct RD & D for renewables.

5. Develop training, infrastructural and institutional support.
6. Exchange information and provide education on renewables.

Note

1. "Report by the Working Party of the Council to Develop a Co-ordinated Effort to Help Developing Countries Bring into Use Technologies Related to Renewable Energy" (Paris), 7 May, 1979.

Integration of Solar Energy Technologies Into Urban Design Opportunities and Impacts

Panelists

Ronald L. Ritschard
Allan Gatzke
Lawrence Berkeley Laboratory

Marilyn Duffey-Armstrong
Armstrong Associates

Robert Twiss
University of California, Berkeley

Murray Milne
University of California, Los Angeles

Summary

This session consisted of three presentations of tasks performed as part of DOE's Technology Assessment of Solar Energy.

The University of California, Berkeley group discussed the percentages of total energy demand that could be met by six solar systems employing either photovoltaics or thermal collectors in five different land-use/building-type configurations. Stanford Research Institute studied institutional impediments to national solar deployment. They also ranked each potential impediment in terms of the probable time required to resolve it (e.g., 3-5 years, 6-8 years; 10 or more years). Some of their "intractable" impediments included:

1. The fragmentation of the building industry.
2. The slowness with which aesthetic standards, and hence public acceptance, change.

3. The legal problems that attend any changes in land use, zoning, rights of way, land sales.

U.C.L.A. looked at some of the ramifications of designing three new "solar cities" of 100,000 people that could meet 6%, 25%, or 100% of their energy needs through solar energy.

A general conclusion reached independently by several of the above investigators was that the potential contribution of passive solar techniques has probably been grossly underestimated.

Note

The paper by Ms. Duffey-Armstrong follows. Papers by Professor Milne and Professor Twiss, Mr. Gatzke, and Ms. Smith were printed as part of the workshop on Urban Design.

Projected Impediments to Widespread Solar Technology Implementation for the Year 2000

Joe E. Armstrong and Marilyn Duffey-Armstrong[1]
Armstrong Associates
Healdsburg, California

Abstract

The paper presents findings of a six month long study to identify likely community and institutional impediments to widespread solar technology implementation by the year 2000. The applicable solar technologies for the year 2000 were specified as binding constraints on the study as were their respective contributions to the national energy supply. From those contraints a national average 100,000 population hypothetical city for the year 2000 was synthesized and used as input into two workshops attended by representatives from seven institutional sectors most directly concerned with solar technology implementation.

The findings are presented as categories of impediments or barriers likely to cause delays of ten years or more, 6 to 8 years, or 3-5 years after national energy policies have been adopted to cause the specified solar technology penetration by the year 2000. Those in the 10 year category, and thus the most intractable of the impediments are: the residential building industry; public and local government acceptance of new aesthetic standards; and legal issues of solar and wind access, and use of public lands for energy supply installations.

Projected Impediments to Widespread Solar Use

The material in this paper resulted from a six month long project to assess community impacts of solar energy. The study, administered by the Lawrence Berkeley Laboratory for the Department of Energy, was one of a 3-part community level assessment providing input to a national level technology assessment of solar energy. The study focused on the year 2000 and took the maximum practical solar scenario from the Domestic Policy Planning and Review Committee (DPPRC) as the level of solar penetration for that year. The DPPRC scenario, and LBL's interpretation and refinement of the detailed data, provided the study with the total amount of projected end use energy to be supplied by each of the seven solar technologies within the residential, commercial, and industrial demand sectors. Transportation was specifically excluded from the study.

The projected solar technologies identified for the year 2000 are as follows:

- Active and passive solar space heating—residential, commercial and industrial buildings.
- Space cooling—residential, commercial, and industrial buildings.
- Domestic hot water—residential, commercial, and industrial.
- Solar thermal electric—electric generation from conventional steam cycle generated by focusing collectors.
- Photovoltaics—direct conversion of sunlight into electricity.
- Wind energy conversion—generation of electricity and mechanical power, e.g. for irrigation of municipal water pumping and pumped hydroelectric storage.
- Agricultural and industrial process heating—use of solar heat for drying and curing certain crops (e.g. tobacco), for preheating water used for generating steam or for a variety of industrial process applications.
- Biomass and urban waste conversion—direct combustion or generation of fuels derived from vegetation and urban wastes.

With hydroelectricity included as a solar technology, the DPPRC scenario accumulated 13.5% of the 95 quads of end use energy supplied by solar for the year 2000.

In order to permit a concentration on the environmental, social, and institutional aspects rather than on purely technical and economic factors, the study assumed that the solar industry would be capable of providing the necessary equipment in quantities specified in the year 2000 scenario. The final basic assumption for the study was that major institutions would continue to function in essentially the same manner as they do now and that government policies would be restricted generally to peace time limits.

Study Approach

The approach used for the study consisted of the following primary tasks:

1. The identification of community level institutions judged most involved with solar technology implementation and the preparation of background descriptions of each. Institutions included were:
   The U.S. Utility Industry
   Financial Institutions
   Government Regulation and Planning
   Environmental Organizations
   The U.S. Construction Industry
   Special Sector Consumer Groups
   Legal and Insurance Institutions
2. Syntheses of hypothetical city of 100,000 population depicting a national average of all the solar technologies for the year 2000 scenario (Table 1).
3. Conduct of two workshops, consisting of representatives from each of the major institutional sectors, for discussions of how their parent institution was likely to react to, and be affected by the scenarios described for the year 2000 and illustrated by the hypothetical city.
4. The final task assembled the initial list of potential community level barriers to widespread solar technology implementation; and conducted follow-up interviews with additional representatives of the seven institutional sectors to verify and augment the results gleaned from the workshops and to obtain a broader sampling for analysis. All impediments were then assigned to categories of projected time-delays for implementation of 3-5 years, 6-8 years, and 10 years or more.

Background Descriptions of the Institutional Sectors

Though the resultant list of impediments was the primary objective of the research effort, the study team believes that a major contribution of the study is the identification and discussion of the institutions most likely to be involved with implementing solar at the community level. It is only within the context of how these institutions operate independently and with others that the impediments have any meaning and that corrective policies should be formulated. Tables 2 through 7 and Figure 1 present a one page summary of the salient characteristics of each of the seven institutional sectors most directly concerned with solar technology implementation.

Study Findings

Figures 8 through 10 depict the anticipated community and institutional impediments to widespread solar technology implementation arranged in time period categories of ten years or more, 6-8 years, and 3-5 years. These time periods represent our best judgement of the delays that can be expected to arise from inherent inertias associated with institutions after national policy initiatives have been taken. It should be noted that these time delays were arrived at under the assumption that peace time conditions would prevail and the major life style changes would not be widespread.

A second format for the study findings consisted of detailing potential difficulties associated with each of the solar technologies. These are presented in the project report and will not be repeated here. Instead, this paper presents in outline form, a third format, consisting of case studies which the authors were unable to include in the report because of time limitations. This third format provides insight into the interactions among institutional sectors for a variety of realistic case studies. Since it is the complexity and subtlety of institutional interactions which makes policy initiatives so difficult to formulate, we believe these case studies would be useful in formulating effective energy policies and in testing candidate policies for loopholes and effectiveness. Two example case studies of this type are presented in Tables 11 and 12. A list of additional candidate case studies are presented below, many of which are considerably more complex than those outlined in Tables 11 and 12.

- Large scale WECS, utility installed and operated.
- Medium scale WECS for commercial application.
- Small scale WECS, cooperative use for cluster housing complex.
- Photovoltaics installation: combined single family-apartment in subdivision.
- Consortium for light industries adopt cogeneration.
- Cogeneration for regional shopping center—combining solar, WECS and biomass components and natural gas and fuel supplement.
- Dispersed small scale urban wastes generating plants.
- Solar thermal complex of six generating stations within city con-

fines—built and operated by local utility.

- Solar space and hot water heating system for 10 unit cluster housing complex.

Note

1. The authors, now with Armstrong Associates, were with SRI International for the conduct of the study whose findings represented the basis for the paper "Community Impediments to Implementation of Solar Energy," Final Report, Contract 5294002, SRI International, Menlo Park, CA., for Energy and Environmental Division, LBL, Berkeley, CA., June, 1979.

TABLE 1. SOLAR TECHNOLOGY SUMMARY FOR A HYPOTHETICAL CITY IN THE YEAR 2000

	Residential	Commercial	Industrial	Total
Area	4,000 acres	490 acres	590 acres	11,150 acres*
Total Solar Panel Coverage	(43% of residences would be solar-equipped for a 70% efficiency.)	274 acres	466 acres	740 acres + residential
Required Solar Technology Units**				
Wind Energy Conversion Systems (WECS)	95 (100 kW)	47 (200 kW)	5 (1 MW)	147
Solar Thermal Electric	10 (100 kW)	16 (100 kW)	4 (1 MW)	30
Photovoltaic	101 (100 kW)	101 (100 kW)	2 (1 MW)	204
Total Number of Installations	206	164	11	381

*This total includes acreage devoted to infrastructure and open space.

**Figures in parentheses indicate generating capacity per unit.

TABLE 2. SUMMARY CHARACTERISTICS OF U.S. ELECTRIC UTILITIES

Types of U.S. Utilities and percent of total capacity.	
Investor owned	77.7%
Municipal	3.8%
Federal Agencies	11.6%
Public Districts State Projects	4.9%
REA Coops	2.0%
	100.0%

CHARACTERISTICS:

Charged with responsibility of meeting total service demand.

5 and 10 year plans for new generating capacity.

Distribution of capacity among base, Intermediate and peak load generators.

Among most conservative of all U.S. Institutions
- --penalized for miscalculation
- --use time tested, dependable technologies
- --little R & D funds

REGULATION:

State Public Service Commissions: rates, securities, accounting.

State and local Commissions: regulates siting and licensing.

Interstate wholesale power: regulated by Federal Energy Regulatory Commission.

Nuclear Regulatory Commission has jurisdiction over construction and operation of nuclear plants.

EPA, State, and Regional Districts establish environmental quality standards.

TABLE 3. SUMMARY CHARACTERISTICS OF U.S. FINANCIAL INSTITUTIONS ASSOCIATED WITH LAND USE SECTORS

	New residential single family	Apartments	Commercial	Industrial
Savings and Loans/mutual savings (70% in residential mortgages)	50%	40%		
Commercial Banks (20% in residential mortgages) (holds 50% of short term construction loans)	25%			Largely self Financed
Mortgage Brokers (insurance co. and trusts)	25%	40%	Dominant	
Federal Agencies		20%		

Regulation:

Federal Home Loan Bank Board (FHLBB), State Banking Boards, Federal Home Loan Insurance Corp.(FSLIC), Federal Reserve, Comptroller of Currency, State Bank Agency, Federal Deposit Insurance Corp. (FDIC) State regulates insurance and mortgage Companies.

Secondary Mortgage Market:

Federal National Mortgage Assoc. (FNMA-"Fannie Mae")
Federal Home Loan Mortgage Corp. (FHLMC-"Freddie Mac")
VA, and FHA-mortgage insurance

TABLE 4. SUMMARY CHARACTERISTICS OF REGULATION AND COMMUNITY PLANNING AGENCIES INVOLVED WITH SOLAR TECHNOLOGY IMPLEMENTATION

LARGE FACILITY SITING:	
Nuclear Electric	State Commissions, NRC, EPA, Federal-e.g. Park Service, Utility, Critical State Concerns, Historical Sites, State Zoning.
WECS Bio-Mass Solar Electric	State Commissions, EPA, Utility, Federal-e.g. Park Service, Local Zoning, Master Plans, State Zoning, Appeals Board.
SMALL FACILITY SITING:	
WECS Bio Mass Solar Electric	Local Zoning, Building Codes, Utility, EPA, Special Districts, Master Plans
SOLAR HEATING AND COOLING:	
Residential	--Local Zoning, Building Codes, Solar Access, Subdivision Regulations, Federal-HUD, FHA.
Commercial	--Local Zoning, Building Codes, Solar Access, Federal-Model Cities.
Industrial	--Local Zoning, Building Codes, Solar Access.

CHARACTERISTICS:

Each separate level has their own planning guide and constituency.

Plans and planning districts often conflict in objectives and geographic boundaries.

Planning directors and regulatory boards are politically influenced.

All must respond to public input.

TABLE 5. SUMMARY CHARACTERISTICS AND CONCERNS OF ENVIRONMENTAL ORGANIZATIONS AND CONCERNS

ENVIRONMENTAL CONCERNS BY SOLAR TECHNOLOGY:

Passive Solar -- most environmentally benign.

Space Heating/Cooling -- Antifreeze liquid disposal, household water contamination.

Thermal Electric -- Cooling water, glare, land area and siting, albedo change.

WECS -- danger from blade failure, EM interference, bird collision, wind rights, siting-land use and aesthetics.

Photovoltaics -- disposal of toxic materials, land area and siting.

Biomass:

Direct burning -- air pollution, loss of soil nutrients, land area for crop production, ash residue useful soil supplement, transport impacts of transportation.

Liquid/Gas Extraction -- preserves soil nutrients of catalytic chemicals permit, odor.

Urban Wastes -- more toxic than biomass products, direct burning after metal and glass separation.

ENVIRONMENTAL ORGANIZATIONS:

Tend to consider each solar technology on individual merits: Siting of large facilities largest overall concern; also concern over Utility involvement without strigent controls. Environmental groups offer major identifiable group for gaining active organized support for solar, though the present task of coordination among separate interest groups could serve as a major barrier to solar as each fights separate issues.

TABLE 6. SUMMARY OF SPECIAL INTEREST AND CONSUMER GROUPS

THE GROUPS AND THEIR MAJOR CONCERNS:

Handicapped -- automatic actuation for residential systems.

Elderly -- higher winter, cooler summer temperatures, filtered air, automatic activation, fixed income need financial assistance, less fluxuation about normal temperatures.

Welfare/Low Income -- capital cost prohibitive to achieve utility savings, non-ownership of homes introduces complexity.

Special Cultural Setting -- achieving solar implementation in keeping with cultural setting and architectural characteristics (ethnic neighbors)

Indian Reservation -- Unique cultural setting, royalties for land used for any installation producing power beyond reservation demand.

Testing and Certification: Consumer reports, testing laboratories - UAL, Better Business Bureau, County-State Consumer Affairs Offices, National Consumer Interest Organizations.

TABLE 7. SUMMARY CHARACTERISTICS OF LEGAL/INSURANCE CONCERNS

Using vacant Urban land for solar technologies:	Litigation essentially removes land from local control A large part of vacant urban land is under litigation.
Solar and Wind Rights:	Entirely new legal area with few court precedents.
Warranties:	Legal aspects similar to conventional heating and cooling equipments. Until firm base established, insurance coverage to be limited and expensive.
Shared Facilities:	Requires legally binding committments. Theft, fire insurance also cooperative.
Professional Insurance:	Solar architects and engineers find it very difficult to obtain professional insurance and when they do, rates are exorbitant.

CHARACTERISTICS:

Litigation process very slow and time consuming.

Decisions can have a major effect on solar technology implementation.

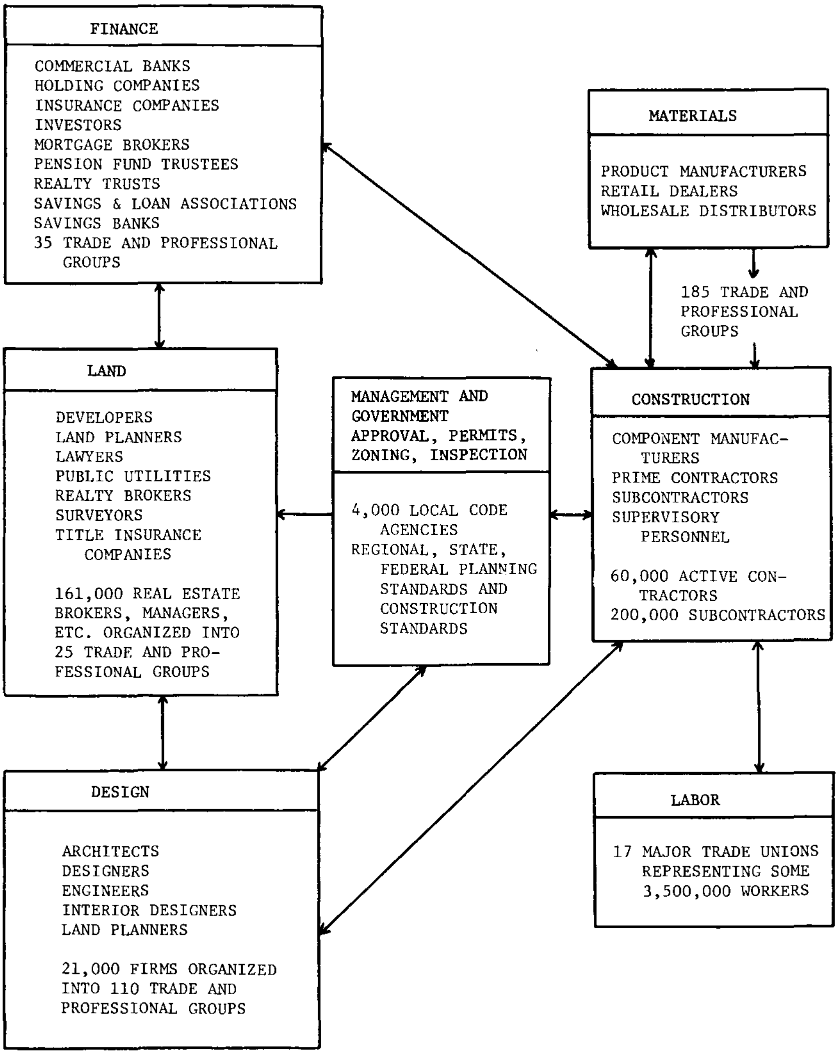

Figure 1. THE U.S. CONSTRUCTION INDUSTRY

TABLE 8. SOLAR TECHNOLOGY IMPEDIMENTS: 10 YEARS OR MORE DELAY AFTER POLICY INITIATIVE

The Residential Building Industry	Numerous independent entities in highly competitive industry....Entrepeneurs, contractors, sub-contractors, local planning representatives, building inspectors, labor unions and training. Time delays for permits for financing critical.
Public and Local Government Acceptance of new aesthetics standards.	Innovative designs using outbuildings, fences, decks, garages. Pervasive southern exposure orientation--sewer, water, electric services arranged to support, tree and building height controls. Siting WECS, solar thermal, photovoltaics, and urban waste plants.
Legal issues of Solar and Wind Access, use of Public Lands for Sites, Urban Infilling.	Energy facility land banks. Numerous legal issues surrounding rapid solar implementation, e.g. (381 solar technology installations for 100,000 population in prototypical city).

TABLE 9. SOLAR TECHNOLOGY IMPEDIMENTS: 6-8 YEARS AFTER POLICY INITIATIVES

Finance:	Responds quickly to reward initiatives: tax credits, rapid depreciation, subsidies, loan guarantees; but without incentives will move cautiously. Secondary mortgage guidelines influence new residential market extensively.
Utility Involvement:	Widespread public distrust prevails. Peak loading valid concern. Utility financing, installation, choice of vendors, maintenance, control of storage for back-up major concerns.
Biomass Collection Compaction, and Transportation:	Wood wastes immediate opportunity. Extensive household use--involves building codes, insurance, air pollution. Large amounts of dedicated land for crop production required. Conversion facilities unpopular and siting difficult. Transport costs high, capital costs high, and conversion from conventional fuels costly.
Acceptance of Cooperative/ Neighborhood Electric-Generation:	Shared facilities have compelling technical and economic advantages but require cooperative agreements and insurance.
Cogeneration:	Utility interface, buy-back rates, back-up power dependability and rates, insistance by industry on 3-5 year pay-back for capital investments.

TABLE 10. SOLAR TECHNOLOGY IMPEDIMENTS: 3-5 YEARS DELAY AFTER POLICY INITIATIVES

Warranties:	Need long-term system warranty (5-year desired by consumers).
Professional Liability:	Insurance: aid data collection for risk assessment, license practitioner, legal limit to liability.
Solar Technology Standard:	Nationwide standard specification to increase consumer confidence; ANSI-solar collectors.
Technical and Legal Interfaces with Utilities:	Stand-by rates, peak usage time of day charge, utility control of storage medium, rates and technical criteria for utility on-site generation interface. Dispersed photovoltaic and WECS pose unique technical interfaces and storage methods. Definitions of what constitutes a utility.
Retrofit Solar Space and Hot Water:	Need to achieve prestigious par with decks, hot-tubs, family rooms, personal lines of credit, non-economic motivation.
Utility Plans for Future Capacity:	How to plan for base, intermediate, and peak load capacity when combined with anticipated conservation measures as related to all the solar technologies.
Averaging Factor for Small Scale Electric Generation:	Reliability directly related to excess capacity--higher probability of simultaneous use.
Assistance to Local Code Officials:	Performance rather than prescriptive codes requires trained staff. Technical advisor help.
Local Planning Initiatives:	In reactive mode now--need active leadership in planned subdivisions, cluster and cooperative housing, cogeneration, WECS.
Life-Style Changes and Solar Technology:	Thwart advertising that frugal energy use implies hardships or rural 19th century.
Maintaining a Viable Solar Industry:	How to sustain a regional versatile, competitive solar industry until policy initiatives take effect. Large corporations have financial wherewithal to survive.

TABLE 11. CASE I OUTLINE

INDIVIDUAL HOME OWNER--RETROFIT SOLAR SPACE AND WATER HEATING

Solar Consultant:	Air collector panels, heat exchangers into 800 gallon storage water tank, liquid anti-freeze panels, heat exchanger into 80 gallon preheat tank for electric water heater. Attic insulation. Low bid $4200.
Financing:	Full loan covered by second mortgage on home. --must not impar normal operation of space and hot water. --3 year, 12%/year-offer open for 30 days. --full 3 year warranty.
Permit:	--cooperative city department. --esthetic installation. --insulation meet fire standards. --adhere to plumbing, electrical and building codes.
Variance:	plastic glazing over non-tempered glass. Hearing with due process takes 5 weeks.
Finance:	Interest to 12.5%. Could not get 3 year warranty passed by loan officer only because of good credit rating.
Utility:	Not involved under assumption that interface with their services protected by city codes.

TABLE 12. CASE II OUTLINE

CONTRACTOR-ENTREPRENEUR:	NEW CONSTRUCTION SOLAR ASSISTED SPACE AND HOT WATER FOR DUPLEX RESIDENCE.
Architecture design:	Shared collectors and water storage. No individual metering of solar contribution. $5100. Added costs contribute 40% of space and water heating.
Financing:	Sought 80% low interest solar incentive loan. Insisted on separate solar installation for each unit to qualify for solar loan (9%); otherwise 12.5%. Separate units drives costs to $9000. Contractor chose combined system.
Permits:	No difficulty.
Construction:	Contractor also worked as carpenter, so could supervise installation. Worked closely with engineering firm who chose vendors. Plumbers International Union offered technical assistance to the local by phone.

Neighborhood Energy Planning

Dennis Holloway
University of Colorado

Professor Holloway presented a superb slide show, covering four community-scale renewable energy systems. These planning studies were carried out by teams of his students at the University of Colorado since 1975. For further information, Professor Holloway may be contacted at the College of Environmental Design at the University.

The Decentralization of Solar Technology Assessment Program: Citizen-Based Energy Futures

Moderator

Ben Bronfman
Oak Ridge National Laboratory

Panelists

Gordon Enk
Institute on Man and Science

Roy Stype, City Manager
John W. Ostrowski, Project Manager
Kent, Ohio

Clara G. Miller
Robert M. Kleinman
Southern Tier Central Regional Planning and Development Board

Eugene Frankel
U.S. Department of Energy

Janet Patton
Alan Singleton
Eastern Kentucky University

Citizen Participation in Technology Assessment: An Application of Group-Process Techniques

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Project Manager
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Abstract

Effective citizen participation in technology assessment is difficult to achieve due to the nature of temporary-group interaction. To enhance citizen participation, group-process techniques such as Nominal Group Technique, Delphi, and Interpretive Structural Modeling are suggested. The general value of each of these techniques, including a brief overview of processes involved in facilitating citizen participation is presented. The techniques are placed in the context of the Kent, Ohio, Solar Technology Assessment project. Applications to both scenario development and evaluation are discussed.

Introduction

Active citizen participation in the public policy process is usually desirable, increasingly required, and almost invariably difficult to achieve. In this paper, we will focus on an application of group-process techniques to facilitate productive citizen participation in the solar energy technology assessment program.

Many of the problems with securing productive citizen participants may be traced to the temporary nature of such participation. Since participants in any organized effort to encourage citizen participation are likely to come from different backgrounds, hold varying expectations, and contribute unequally; most such groups spend their collective lives caught in the early phases of group development [1]. Unless some way is found to move the citizen group beyond the stages of "forming" (identifying personnel and task boundaries, and dependence relationships) and especially "storming" (conflict resolution) [2], the ultimate-performing-stage of group development will never be achieved.

Group-process techniques, or what John Warfield terms "cognitive aids" are designed to facilitate group development by imposing a strict *task* orientation on the group. The techniques are designed as aids in problem-solving. As such, they work only in the task-oriented group. This context of application is vital to ensure the productive use of the process-facilitating techniques. They are *not* an end in themselves capable of solving all the difficulties of group citizen participation.

In general, group-process techniques are designed to improve group decision-making capabilities by focusing the group energy on:

1. Fact-finding to either specifically define the problem area or determining specific solutions.
2. Evaluation and choice among alternative solutions. [3]

While there are a whole range of techniques that may be applied to group decision-making dependent on the nature of the problem and the desired product, our application of citizen participation to technology assessment suggests two specific applications.

1. Development of Solar Future Scenarios.
2. Assessment of scenario impact.

These applications involve the use of three group-process techniques: Nominal Group Technique (NGT), Delphi, and Interpretive Structural Modeling (ISM).

Nominal Group Technique

Nominal Group Technique is a technique used in a structured-group environment to generate responses to a specific issue or problem. [4] NGT, developed by Delbecq and Van de Ven in 1968, is an outgrowth of concern for the need to—

> . . . find viable methods for making decisions when a number of people, differentiated in backgrounds and perspectives, need to be involved in the problem-solving process. [5]

As an approach to group problem solving, NGT has two major strengths particularly relevant to citizen participation in solar energy technology assessment:

1. The process structures group participation to ensure focus on a specific problem and equalized individual participation. [6]
2. The process encourages creative responses to the discussion issue by inhibiting sanctions against unorthodox lines of thought. [7]

In these two areas, NGT has been found to produce a significantly higher quality product than that produced in a traditional interactive group format. [8] This is of particular importance to a citizen participant component in technology assessment. As the problem becomes more technology-dependent, non-experts tend to adopt a "follower" attitude which discourages innovative, or non-traditional, solutions. The structuring of the NGT process serves to minimize this attitude by encouraging participants to pursue their own individual line of thought. This is not to suggest, however, that such creative responses are less useful in securing a viable group product. Studies have demosntrated that even non-experts with very little technological knowledge are capable of producing high-quality, realistic products. [9]

Although NGT and several similar techniques such as brain-writing and idea-writing may be adopted to suit a variety of conditions, there are four basic steps in the process:

1. Silent generation of ideas in writing.
2. Round-robin recording of ideas.
3. Serial discussion of the list of ideas.
4. Voting [10]

For a full discussion of NGT procedures, see Andre Delbecq, Andrew Van de Ven, and David Gustafson *Group Technique for Program Planning* [11] or the pamphlet by James Coke and Carl Moore "Guide for Leaders Using Nominal Group Technique" (1978), distributed by the Academy for Contemporary Problems, Columbus, Ohio.

Delphi

Delphi is a method for soliciting, aggregating, and analyzing expert opinion. The technique was developed by Norman Dalkey and Olaf Helmer at the Rand Corporation during the 1950's. Delphi was named after the oracle at Delphi, which was supposed to be able to predict the future. [12] In its traditional format, Delphi is a series of controlled feedback questionnaires designed to develop consensus on an issue or number of issues. The process utilizes a number of experts in a non-face-to-face anonymous contribution situation which, through a series of iterations, seeks to develop a consensus among participants on the Delphi subject. [13]

The use of Delphi makes it possible to include a larger number of participants than would be reasonable using only Nominal Group. In addition, for technology assessment, Delphi permits a broader range of assessment methodologies. [14]

The written format and multiple iteration nature of the Delphi are built-in mechanisms for what Delbecq, et al., term "proactive search behavior." [15] This allows all ideas to be presented (and committed to paper) before any attempt at evaluation is made. This approach has several advantages for facilitating citizen participation:

1. It prevents short-circuiting of the search behavior by keeping the participants from "fixing" on a particularly controversial item and inhibiting future idea contributions.
2. The anonymous nature of the contribution breaks down the expert-following syndrome seen in interactive meetings.
3. The use of a written medium provides for a higher task commitment and sense of permanence than does verbal expression. [16]

The Delphi is a particularly flexible group-process methodology which may be adapted to fit a variety of circumstances. For a more detailed discussion of the process and application of Delphi, see Linstone and Turoff's *The Delphi Method: Techniques and Applications* (1975), generally regarded as the most comprehensive single source of Delphi material.

Interpretive Structural Modeling

Interpretive Structural Modeling is, by far, the most technically complex group process technique discussed in this paper. While both NGT and Delphi usually focus on problem exploration, ISM is designed to facilitate problem evaluation. ISM is a descriptive modeling process designed to conceptually simplify very complex situations. [17] Organizational theorists March and Simon offer an explanation of the need for such a process:

> An individual can attend to only a limited number of things at a time. The basic reason why the actor's definition of the situation differs greatly from the objective situation, is that the latter is far too complex to be handled in all its detail. Rational behavior involves substituting for the complex reality a model of reality that is sufficiently simple to be handled by problem-solving processes. [18]

We have been stressing the fact that both NGT and Delphi provide a richer response than traditional interactive techniques. This richness, however, creates its own problems. Without some way to structure or create a "cognitive map" of the interrelationships among items generated by NGT or Delphi, the assessment process would rapidly bog down in its own complexity. Add to this the problem of requiring non-experts to make evaluations of sometimes highly technical information and the problem becomes manifest. ISM allows the citizen-evaluators to look at each element of a solar technology program in a one-to-one comparison. This binary comparison makes it possible to build judgments about very complex systems one step at a time. [19]

There is a cost to this utility, however. ISM is a computer-based technology requiring a significant investment in both computer and human resources. For a detailed explanation of the theory and applications of ISM, perhaps the best source is John Warfield's *Societal Systems: Planning, Policy, and Complexity.* Warfield is the developer of ISM.

Application to Solar Technology Assessment

To demonstrate the potential application of group-process techniques to citizen participation in a solar technology assessment program (TAP), we will use the citizen-oriented Kent, Ohio, project. In brief overview, the Kent TAP consists of three phases:

1. Develop a solar future scenario for the City of Kent.
2. Communicate the solar-scenario to the general population of the community.
3. Assess, through the involvement of a representative sample of community members and groups, the social economic, political, institutional, and lifestyle impacts of the solar future scenario.

In Phase I, group-process techniques will be used to determine current and future applications of solar energy within the community. The first method used to accomplish this task will be a Delphi of community perceptions of current and future solar applications. The first iteration of this Delphi will be distributed to citizens through the local newspaper.

This iteration will request citizens to list any actual or potential applications of solar technology within the community.

At this point, the Delphi is being used solely as a "search" instrument. The fact that respondents will not have been exposed to any sort of expert-led "education" program on solar applications should facilitate creative and nontraditional responses. Since the Delphi is being used as an idea generation device, the open-ended nature of the first iteration will allow citizen buy-in at the very outset of the project. This is likely to produce a much greater degree of commitment to the project than would a questionnaire soliciting closed-ended evaluation of expert-developed applications. [20]

Note, also, that the emphasis in the first iteration of the Delphi is citizen, rather than expert, desires. Delbecq, et al., tout this as the real strength of citizen involvement [21], since no technology is likely to be successful without community (citizen) commitment to its adoption. This is one of the keystones to the Kent approach. The assessment program is designed to evaluate the feasibility of a citizen-determined solar future scenario, and not community reaction to a specified technology.

The second iteration of the Delphi will consist of a mailed questionnaire to those who completed the first Round. The instrument will consist of a composite list of the submitted applications and a rating scale to be determined by the project Task Team.

It is important at this stage to include as many verbatim responses as possible. This tends to reinforce participant commitment to the project. This also allows the participants, and not the project staff, to make decisions as to comparability and redundancy of items. This further contributes to a sense of group ownership of the project, which is essential for its success.

Since it is likely that additional applications may occur to the respondents as they are reviewing the list, additional applications will also be solicited in this iteration. To encourage this, applications suggested by solar energy knowledgables on the project Task Team will also be included as part of the list. These will *not*, however, be identified as having been contributed by experts in solar technology. Thus, the Delphi format will allow expert judgment to be introduced into the search process, but without the risk of the "follower" syndrome discussed earlier.

If sufficient additional applications are elicited in the second Delphi iteration, a third iteration covering rating of the added items will be conducted. In this round, however, additional applications will not be requested.

The final product of this Delphi, then, will be a list of potential solar energy applications within the community. This listing will also include a citizen evaluation of the importance or desirability of each application.

The next step is to transform the applications into alternative solar energy scenarios. This process actually encompasses three tasks:

1. Expert evaluation of feasibility (economic and technical) of each suggested application.
2. Aggregation of applications into program elements that may be incorporated in the scenarios.
3. Combining the feasibility evaluations and program determinations into staged "transition scenarios" which will indicate the program-paths to achievement of the future "state" scenarios.

ISM is one technique which will facilitate the second and third tasks. The Delphi participants, Task Team members, and other interested individuals will be invited to participate in several ISM sessions. One series of sessions will be devoted to determining which applications may be grouped into programs. Consider that, if just twenty potential applications are suggested, the group would have to wrestle with 2.43×10^{18} choices! Without the use of a technique such as ISM, this would be impossible. A second series of ISM exercises will be used to stage the transition scenarios by determining which elements should be undertaken in what order. If these tasks were undertaken in a traditional committee or group meeting format, it would take several months for even the most tentative of results to be achieved. Allowing for discussion and voting on approximately 25 items, an ISM session will usually run three to five hours. Considering the difficulty of maintaining citizen cooperation over long periods of time, the ISM approach is clearly advantageous.

The product of these ISM sessions will be twofold. First a series of descriptive models will link solar technology approaches into programs. Second, a series of cognitive "maps" will delineate the staging of the transition scenarios. Neither of these products will be finished scenarios, however. The use of the techniques outlined above will provide extensive citizen involvement in a considerably reduced period of time. They will also provide the project staff and Task Team with a clear, organized perception of community desires and expectations.

It is important that potential users of any of these group-process approaches be aware of the legitimate purposes of the techniques. The Kent project employs group-process techniques as means to an end and not as ends in themselves. This is the way the technique ought to be employed. Too often, the inexperienced user sees the Delphi or ISM result as a finished product, rather than a tool to facilitate informed decision-making [22]. Expectations should be in line with the techniques employed, otherwise, the result is likely to be a failure to achieve the desired end and an unwarranted criticism of the approach employed. (For a review of legitimate applications of group-process techniques, see Delbecq or Linstone books).

Ultimately, the project staff and Task Team will have the responsibility for turning the group-process results into narrative scenarios. Neither this task, nor the communication of the resulting state and transition scenarios, are amenable to the employment of group-process techniques. The tasks are simply not appropriate to the search or evaluation components which require citizen input.

Phase three, community scenario assessment, does provide an opportunity to again employ the group-process techniques. In this phase of the project, the focus of the technique moves from primarily search to evaluation. In the search mode, citizen participation was used to develop desired (or ideal) states and methods for reaching them. In translating these desires to actual scenarios, it is necessary to modify them to account for economic and technical realities. The result of these necessary changes may be to shift the purpose or applications of solar technology in the community. Whether any such shift is necessary or not, it is still vital to the assessment and of the project that members of the community evaluate potential impacts of the scenario.

To provide this input, citizens will be invited to a series of meetings in which NGT or a variation of the process termed "idea-writing" will be used to generate impacts of the scenario. Meeting attendees will be broken down into small groups, according to interests, and asked to provide potential impacts of the solar scenario. Each group will address one impact area:

1. Social
2. Economic
3. Political
4. Institutional
5. Life Style
6. Ecological

The use of a structured, nominal group will allow the production of sets of impacts (rated for importance) in a short period of time.

To ascertain public perception of the inter-relationships among impact elements, each evaluation group will be asked to select a representative for an ISM session. This ISM exercise will combine the most significant impacts from each of the evaluation areas and array them in terms of their value to the community. The product will be a descriptive model of citizen assessment of the solar energy scenario.

This citizen-assessment will serve as a major component in the Task Team's final evaluation and policy analysis. Again, the ISM results should not be considered a final product. It is the responsibility of the Task Team to incorporate citizen preferences and perceptions into its overall assessment. The nominal group and ISM procedures are used to facilitate extensive citizen involvement in the evaluation process in a short time frame.

Conclusions

This discussion of the application of group-process techniques to citizen participation in technology assessment is presented as *one* possible way of applying the techniques. One of the advantages of each of these techniques is that they are *not* subject limited. Each one offers an almost unlimited number of adaptations to suit specific situations. The particular techniques used in the Kent Solar TAP were chosen to facilitate expanded citizen participation. Just as easily, group-process techniques could be used to evaluate expert judgments of a particular technology or set of technologies, to generate priorities for assessment, or to structure a comprehensive energy plan for a community. As long as the potential user remembers that the subject and context should *always* be appropriate to their use, group-process techniques can offer valuable assistance in the technology assessment process.

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Federal Support for Community Energy Development: An Assessment of Current and Forthcoming Federal Legislation

Summary

This session was attended by about twenty people, the majority of whom were from state and local government energy offices. The session covered the status of various bills presently before Congress which deal with increased federal support for state and local energy programs. Three individuals with considerable experience in federal/state and federal/local relations in the energy area, led the discussions: Richard Mounts, Policy Analyst of the National League of Cities; Philip Warberg, who handles energy issues for Senator Charles Percy of Illinois; and Larry Tye, who covers energy and environmental issues for Massachusetts in that state's Washington, D.C. office.

Both the Local Energy Management Act, and the Energy Management Partnership Act (EMPA) were discussed. Both bills would strengthen the role of state and local government in planning and implementing energy projects. Also examined, were the proposed roles of state and local government in the major pieces of energy legislation now before Congress, such as Senator Jackson's Omnibus Supply Bill (S.1308) and the Energy Security Corporation bill of the Administration. The major message of the presentation was that much in the conservation and renewables areas will depend on the size and the terms of the controversial Windfall Profits tax bill.

In the discussion portion of the session, several state representatives inquired about the trend in forthcoming legislation, and DOE administered programs to encourage a state share, or state match in federal energy programs. It was noted that the National Governors Association had agreed in principle to some state match in the EMPA proposals. Some state representatives expressed concern about the trend toward

state match, but others thought that it would result in a high degree of commitment on the part of the state.

Larry Tye described a project which the Massachusetts office has begun to keep state and local officials, as well as community officials in the state, apprised of energy developments in Washington. The office publishes an in depth newsletter called "The Energy Link," which tracks the progress of major legislation and administrative actions affecting state and local programs, particularly in the areas of conservation and renewables. The newsletter also discusses ways in which local officials and community groups can affect the energy decision-making process in Washington, and who the important players are in the field. Tye reported that interest in the newsletter had been very high.

For those interested, copies of Energy Link can be obtained from:

Office of Federal/State Relations
Commonwealth of Massachusetts
444 North Capitol Street
Suite 307
Washington, D.C. 20001

Section K
Lessons Learned from the Conference

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Lessons Learned from the Conference

Robert Odland
Solar Energy Research Institute
Golden, Colorado

After the conference, a small group met for the purpose of a critique. The overall conclusion was that the conference was worthwhile, timely, and that in general, it had achieved its objectives. One negative comment which was repeated by a number of people was that state governments were not involved. We agreed that this was an oversight and that in fact, states should have played a larger role in the conference. Another valid criticism was that although several federal agencies play a significant role in energy policy within the United States, only the Department of Energy participated in the conference.

The remainder of the comments concerned with the lessons that were learned and with issues requiring further study. First, everyone agreed that implementation was a major issue. More information must be produced on steps that a community must follow if it wants to progress from its current energy position to a point where it can begin to plan its energy future—and more importantly, to a point at which it can begin to implement systems that give it more control over its energy future.

The second, and perhaps greatest area of need that was defined was information collection, packaging and dissemination. Conference participants agreed that this differed somewhat from the standard information dissemination process because what is most needed is not necessarily the dissemination of research results produced at some central location, but the dissemination of information produced in numerous communities. A number of ideas were set forth to address this issue. For example, an annual conference was thought to be a good idea. Many people, however, felt that there was a need for some type of regionalization of conferences such as this. Several alternate strategies were addressed. Two options were to have an annual conference followed by regional conferences, or simply to have a series of regional conferences throughout the United States.

Another idea that was brought up was the production of a newsletter which would specifically be addressed to community energy planning. Conference participants felt that a system was needed to enable community leaders and planners to keep up with what is going on in other communities. More than a clearinghouse is needed because research and activities ongoing in one community should be documented or placed in a form suitable for use by other communities. Even a simple thing like producing reports can be a financial drain on a community. Some outside analysis is required because not all activity going on at a community level is necessarily the most efficient use of community resources. The general consensus was that someone should be taking a look at what communities are doing and picking out strategies that seem to work well in various types of communities. A text book on community energy planning was proposed. Handbooks which can be used by community planners and other officials were also proposed. Finally, people felt that more information was needed on specific technologies such as: cost, availability, environmental and social impacts of various energy systems.

The next general subject in which participants felt further research and work should be done was in the area of assistance—especially financial assistance that would enable communities to undertake planning and implementation of community energy systems. There is a great demand for information and technical assistance from government agencies and research institutes such as SERI. Training programs for local planners, for example, might fall into this category.

Another important issue that was brought up was the issue of comprehensive planning. Traditionally, comprehensive planning in the United States has produced little action largely because citizens have not been sufficiently involved in the planning process. However, communities have had extensive experience with comprehensive planning of one type or another. For instance, they have participated in Section 701 planning, they have had to prepare housing plans, transportation plans, open space plans, Section 208 waste water treatment plans, and coastal plans. As noted previously, many of these efforts have accomplished little. However, in several other communities, planning procedures have raised the consciousness of residents and have provided an opportunity for people to become involved in that community's future. This experience should not be cast aside. Energy planning should build upon the experiences, both good and bad, that have been learned from other community planning exercises.

After this discussion, several comments were made about the poor rapport that exists between citizen and government groups. It was pointed out that community activists must become more involved with city government. In addition, federal, state, and local intergovernmental relationships were not very clear to most participants. For example, many felt that the relationships between the Solar Energy Research Institute and the Departments of Energy and Housing and Urban Development need to be spelled out and the role of the regional solar energy centers should be clarified. It was also pointed out that SERI must interact with professional institutions in the solar energy field if solar applications are to spread throughout the United States. Professional institutions must, in turn, take an active role in promoting solar energy. The overall view was that coordination between various federal agencies often left very much to be desired.

Next, it was pointed out that one of the most glaring gaps in the solar energy field is the one that exists between the financial community and the people responsible for the development of the technology. The financial community often does not know what technologies are available, how reliable they are, and what their costs might be. This information should be readily available if financial support for solar energy is to be obtained.

Finally, conference participants pointed out that an important policy issue had not yet been addressed. That issue was, how does a "bottom-up" or community approach to energy policy affect national energy policy? What are the areas in which there are conflicts? What are the areas in which they support each other? In general, what are the relationships between community energy planning and the energy policy of the nation?

In closing, most people reiterated that the conference was a success but that it was only the first step in a more involved chain of events designed to help and encourage communities to take more responsibility for planning their own energy future.

Appendices

Appendix 1
Biographies of Speakers

Joe E. Armstrong holds a Ph.D. degree in Engineering from the University of Texas and a M.A. degree in Ancient History from San Jose State University. He managed electronic design laboratories for Sylvania, Inc. and ESL, Inc. before taking a faculty position in Engineering and Cybernetic Systems at San Jose State University. Since 1974 he has operated as a private consultant with major involvements at SRI International in national energy policy studies and as a Research Associate at Stanford University in Technology Assessment methodology. He is presently a senior partner in Armstrong Associates.

William S. Becker is assistant to the director of the Wisconsin Energy Extension Service (WEES), a federally-funded pilot project specializing in education about energy conservation and renewable fuels. A journalist, Becker served as editor and publisher of the *Kickapoo Scout,* the weekly newspaper in Soldiers Grove, Wisconsin, from 1973 to 1976. During that time he helped lead a drive to relocate the village's business district out of the floodplain of the Kickapoo River. Becker left the community in July, 1976, to become Energy Information Officer with the Wisconsin State Energy Office. He became assistant to the director of the WEES in January, 1979. One of his first responsibilities in the new job was to coordinate a number of state and federal agencies helping Soldiers Grove plan a renewable fuel energy system for its new downtown. He continues to serve as a state and federal facilitator for the innovative Soldiers Grove project.

Henry A. Bell is Superintendent of the Division of Electricity for the City of Columbus, Ohio. As Superintendent, he is responsible for the operation of the small self-sustaining municipal utility, which serves approximately 7600 residential, commercial and industrial customers.

He is currently involved in the fiscal planning stages of the Refuse/Coal-Fired Municipal Electric Plant, one of the largest single projects in the history of the City of Columbus. He is the chief city executive who implemented and promulgated the project, and who is overseeing the design, construction and staffing of the new facility.

Mr. Bell attended Ohio State University, is Chairman of the Public Utilities Review Commission, Vice-President of American Municipal Power of Ohio, and a registered Professional Engineer.

Walter Kim Boas was born in 1953 and graduated from the Wright State University with a B.A. in geography and environmental studies. Before graduation, he served on the City of Dayton's Task Force on Energy and was responsible for seeing that the recommendations of the Task Force were implemented. Mr. Boas served as Housing Coordinator for the City during 1978 and was actively involved in the Comprehensive Energy Management Program. As Dayton's Energy Analyst, he has responsibility for city activities in energy planning, consultant and intergovernmental liaison, community involvement and energy management.

Duncan S. Bremer is an architect and lawyer with several years' experience in community planning and design. In 1966, he completed his first biomass-heated house and this was followed in 1972 by a passive solar house. Since then he has designed and worked as a consultant on several solar projects, he has co-authored a book on energy conservation in existing church buildings, and is now undertaking two major solar access studies for the Department of Housing and Urban Development. He is presently Director of the Department of Energy's Solar Energy programs at the American Institute of Architects Research Corporation, with chief responsibility in the commercialization of solar energy. Mr. Bremer is a Registered Architect, a member of the American Institute of Architects, and the Bar. He holds the J.D. degree from the University of Connecticut Law School, and the Bachelor of Architecture and Master of Architecture degrees from Yale University.

Paul C. Bujak is chairperson of the Albany County (Wyoming) Energy Council, a community-based group that has supported a series of "Town Meetings on Energy" in Laramie and Albany County.

For the last five years, Mr. Bujak has worked with the Laramie Energy Technology Center, on projects for the U.S. Bureau of Mines, ERDA and DOE. He serves as the Technology Center's media specialist, designing exhibits, literature, and brochures for various projects. Mr. Bujak holds a degree in Geology from the University of Wyoming, and received his training in the interdisciplinary Wyoming Human Services Project, a program which provides services to energy-impacted communities.

Charles Burnette received his B.A., M.A., and Ph.D. degrees in Architecture from the University of Pennsylvania where he was also a principal investigator at the Institute for Architectural Research and the Institute for Environmental Studies. While Executive Director of the Philadelphia Chapter of the American Institute of Architects in 1971-1973, he organized and directed an interdisciplinary research, continuing education, and computer service center for the building industry in Philadelphia. He was Dean of the School of Architecture, University of Texas at Austin from 1973-1976. Since 1977, he has been principal in Charles Burnette and Associates, Philadelphia, an independent professional firm engaged in research, industrial design and architecture. Dr. Burnette is a licensed architect, has taught and practiced both industrial design and architecture and has directed both graduate and undergraduate programs in Community Design. Presently, he is Director of the Philadelphia Solar Planning Project, a national pilot for the Department of Energy's Sunact Program and serves as vice-chairman of the Philadelphia Comprehensive Community Energy Management Program.

Bill D. Carnahan has been manager of the Lamar (Colorado) Utilities Board system for the past nine years. He has been actively involved in all aspects of the research, development and implementation of the Lamar Bioconversion project, a 14 million dollar facility to produce methane gas from cattle manure through anaerobic digestion, which is to be constructed by the Utilities Board. Mr. Carnahan obtained his B.S. degree in Electrical Engineering from Colorado State University, is a member of the Institute of Electrical and Electronics Engineers and serves on the Board of Directors of the American Public Power Assocication.

Mary Christianson is an energy activist, artist and Outreach Coordinator for the Energy Task Force (ETF), a non-profit corporation that provides technical assistance on energy matters to low income urban dwellers. She joined ETF in 1976 to apply her experience in building steel sculptures to the construction of support frames for solar collectors. Working on a solar hot water system in the South Bronx, writing ETF literature, drawing designs, and completing a comparative heat loss study of typical New York City building types proved to be an intensive course in energy issues. In her present position as ETF's Outreach Coordinator, Ms. Christianson organizes campaigns to inform community groups about ETF's work, teaches workshops on conservation and appropriate technology and maintains contacts in the housing/energy network.

Donald W. Clifford is manager of the Comprehensive Community Energy Management Program, Energy and Environmental Systems Division, Argonne National Laboratory. He has 25 years experience in community and economic development as a consultant, agency director, manager and staff. At Argonne, Mr. Clifford manages the conservation experimentation and research program with a series of contract communities across the United States. Prior to joining Argonne, he was a consultant in the Maryland, Virginia, and Pennsylvania tri-state area and Director of Planning for the Westinghouse Socio-Economic Programs Group. In this capacity, his activities included comprehensive planning and design in housing, urban renewal, model cities, capital improvements, and new town planning. At Westinghouse, he directed a number of multi-disciplinary studies for improvement of physical environment and housing, social services, manpower, and economic conditions. Mr. Clifford is a member of the American Institute of Certified Planners. He is a charter member and Chairman of the American Planning Association (APA) Economic Development Technical Division and has served on several committees and planning commissions. His education includes a B.S. degree from the University of Massachusetts, a Degree of Master of Regional Planning from Cornell University, and graduation from the U.S. Army Engineer School.

Ruthann Corwin, an Assistant Professor of Environmental Planning at the School of Architecture and Urban Planning at UCLA, is currently on leave as a Fellow at MIT. Dr. Corwin received her education at U.C. Berkeley and has worked with numerous county and government agencies, community planning groups, and citizens organizations on projects dealing with environmental resources planning, environmental impact reporting, and regional planning. She was recently Contract Administrator and principal investigator for the Conservation Foundation in Washington, D.C. preparing a report for use by regional Fish and Wildlife Service administrators. In addition she worked for the State of California, Office of Planning and Research in the Offshore Oil Task Force as a consultant, and had previously been a Senior Planner on assessment of onshore impact of offshore oil development for the same organization.

Denis V. Curtin is Assistant Vice President of the Public Finance Department at Citibank in New York where he specializes in financial advisory services. He has had broad experience in the banking world including two years with the Office of Management and Budget of the City of New York and one year as research director of the Temporary Commission on New York City Finances. Prior to joining the Public Finance Department, Mr. Curtin was a member of the Strategic Planning Department where he participated in the development of Citibank's strategic plan for the 1980's.

He holds a Masters Degree in Business Administration from the Wharton Graduate Division of the University of Pennsylvania and a B.A., also from the University of Pennsylvania.

Stephen M. Dell attended the College of Wooster and received his B.A. in 1969 with a double major in history and urban studies. While an undergraduate, he worked as an aide to a Philadelphia City Councilman and later helped form the first tenants' union in the city. He holds a Masters degree in Urban and Regional Planning from the University of Pittsburgh and is a certified Planner-in-Charge in Pennsylvania. He worked for several consulting firms in the Pittsburgh area before joining the North Central Pennsylvania Regional Planning and Development Commission in 1976. The Regional Energy Plan for this six-county area was prepared under his supervision and with the help of other team members.

Joanne E. Devlin joined Donaldson, Lufkin & Jenrette as Vice President in December 1977. She was previously Assistant Vice President in the Municipal Finance Department of Kuhn Loeb & Co., Incorporated. She received a B.A. degree from Swarthmore College and a Master of Business Administration degree with a concentration in finance and accounting from Columbia University. At Columbia she was elected to Beta Gamma Sigma (the national business honor fraternity).

Ms. Devlin specializes in financing energy projects and has worked with 18 consumer-owned utilties on a variety of projects including low-head hydro electric, co-generation, solid waste, fossil fuel and nuclear power generation. She is co-author of the article *"Geometric Debt Service"* and has lectured on the economics of public power financing in several states.

Fred S. Dubin is internationally recognized as a pioneer in energy conservation and alternative energy systems design. He is currently president of Dubin-Bloome Associates of New York City.

Mr. Dubin has lectured extensively on energy and building systems design at several universities in the United States and abroad. He is a Fellow in the American Consulting Engineers Council, and acts as a consultant to the President's Committee on Energy, the Department of Energy, and the Solar Energy Research Institute, among others. Through Dubin-Bloome Associates, he has been involved in several innovative energy planning and design projects, including: the GSA Energy Conservation Demonstration Building, Manchester, New Hampshire; the Solar Energy Research Institute, Golden, Colorado; School of Engineering, University of Tel Aviv; and the 3M facility in Minneapolis, Minnesota.

Marilyn Duffey-Armstrong holds a B.A. degree in Industrial Design from Michigan State University and a M.S. degree in Cybernetic Systems from San Jose State University. She recently completed seven years of employment with SRI International as a Senior Research Analyst emphasizing research in community impact assessment and evaluation for proposed government projects and industrial installations. She is now a senior partner in Armstrong Associates, a newly formed research consulting organization.

John R. Hagley was Program Manager of the Integrated Energy Plan for Riverside, California as well as task leader for energy conservation and community design. Mr. Hagley has extensive experience in managing both large and small-scale energy research projects. His research interests include energy and resource management, integration of innovative energy technology in communities and buildings, and the evaluation and validation of the impacts of alternative technologies on energy consumption in the construction industry.

Denis Hayes is Director of the Solar Energy Research Institute (SERI) in Golden Colorado. Previously a Senior Researcher with Worldwatch Institute and author of *Rays of Hope: The Transition to a Post-Petroleum World* (W. W. Norton, 1977), his published research encompasses alternative global energy strategies, energy conservation, and environmental issues. He has served as Director of the Illinois State Energy Office and was a guest scholar at the Woodrow Wilson Center of the Smithsonian Institution. In 1978 he received the U.S. Department of Energy's Award for Outstanding Public Service, and in 1979 he was given the Thomas Jefferson Award for Outstanding Public Service by an Individual Younger than 35. Mr. Hayes is a member of the National Petroleum Council and serves on the board of the Federation of American Scientists. He formerly served as a trustee of Stanford University and as a member of DOE's Energy Research Advisory Board.

Roger Hedgecock has been Supervisor of San Diego County, California since January 1977. Since he took office, he has been strongly committed to preserving

San Diego's unique environment by managing and planning growth; cutting the cost of government by consolidating and eliminating costly duplication of services; reorganizing county government structure; and seeking full state and federal funding of county programs.

Mr. Hedgecock served as an elected member of the San Diego County Republican Central Committee during 1975-76 and was an associate member of the State Committee the same year. He is active in conservation and environmental causes and was associated with the law firm of Higgs, Fletcher & Mack from 1972 to 1976. He received a Bachelor of Science degree in political science from the University of California at Santa Barbara in 1968, and a law degree from the University of California, Hasting College of Law. He was admitted to the California Bar on January 5, 1972.

Marion Hemphill is the Energy Advisor for the City of Portland, Oregon. He is charged with developing the implementation strategy necessary to carry out Portland's Energy Conservation Policy, a task that entails working closely with private sector energy conservation-related firms, business and industry, financial institutions, and the residentail sector of the community.

Mr. Hemphill's first Portland assignment was as Assistant Director of the Portland Energy Conservation Demonstration Project. Under a HUD contract, Portland developed the first local government energy conservation planning methodology in the United States.

Before joining the City staff in 1976, he was a member of the faculty of the State University of New York at Brockport, and was a Senior State Planner for Iowa's Governor's Office of Planning & Programming. He holds the B.A. in Economics and the M.A. degree in Urban and Regional Planning, both from the University of Iowa.

Edward A. Holt is the Project Manager of Energy, Ltd., the firm that is currently providing a comprehensive approach to local energy management for the City of Seattle. The two year project in which he is involved will examine the way energy is used in the residential, commercial, industrial and governmental sectors in land use and transportation policies, and prospects for integrated community energy systems in the Seattle area.

From 1974 through 1978, Mr. Holt was an energy policy consultant to electric utilities and to local, state and federal government. In this capacity, he specialized in a variety of energy planning efforts, including the development of energy conservation programs, energy demand forecasts and impact models, energy data management systems, an energy code for new building construction, a handbook for estimating the energy costs of land development in building construction, and energy facility siting policies.

Richard Holt is with the Office of Conservation and Advanced Energy Systems, Division of Policy and Evaluation, Department of Energy. He is a principal staff member on the President's Domestic Policy Review of Solar Energy. Before coming to DOE, he was Project Manager for the California Distributed Energy Systems Study, Director of National Academy of Sciences study program on energy consumption measurement, and Associate Director of an economic development program in rural Alaska, sponsored by the Office of Economic Opportunity. Mr. Holt's academic background includes graduate work in mathematics at the California Institute of Technology, and a Master's degree in physics from the Johns Hopkins University.

Charles F. Horn is the Mayor of Kettering, Ohio, a city of approximately 70,000, in Montgomery County. He is active locally and nationally in community planning efforts, serving, for instance, by Presidential appointment on the Intergovernmental Science, Engineering and Technology Advisory Panel and the White House Advisory Subcommittee on Energy (ISETAP). He has also served as Co-Chairman of the Advisory Committee on Science and Technology of the U.S. Conference of Mayors, and is a member of the Board of Directors of the National League of Cities.

Mr. Horn holds the Bachelor of Science degree in Electrical Engineering from Purdue University, and the LLB degree as a Juris Doctor from Cleveland State University. He is a practicing attorney in Kettering and a member of the Ohio Bar Association.

John J. Huetter, Jr., specializes in system engineering and retrofitting of low-cost, small-scale hydropower plants. He has undertaken a variety of hydropower projects and energy feasibility studies with particular interest in legal, institutional and regulatory paths leading to low-cost rapid development of the small hydropower resource. Previous work includes his appointment with the Transportation Advisory Committee of the Federal Energy Administration, and his report on hydropower development for the President's Council on Environmental Quality.

As Manager of Technical Programs for Energy Research & Applications Inc., he oversees projects dealing with commercial and industrial cogeneration, energy conservation and management, solar market penetration strategies for government agencies and he works with utility groups and private developers—bringing overseas as well as domestic experience to these energy users. He has conducted conservation technology and renewable resource seminars for the Caribbean Conference on Energy Development, Tennessee Valley Authority and the Mother Earth News.

Mr. Huetter was educated at the U.S. Air Force Academy and the University of California, Los Angeles.

Edward E. Johanson received his Bachelor's degree in physics from Syracuse University and did graduate work in mathematics and physics at Northeastern University. He is a vice president and principal at JBF Scientific Corporation and is director of the corporation's Research and Engineering Division.

Mr. Johanson has had a highly diversified background, with most of his activity in the past 17 years being spent on directing government and industry-sponsored research on alternative energy sources and environmental studies.

Robert M. Kleinman is currently Energy Planner at the Southern Tier Central Regional Planning and Development Board in Corning, New York. At this post, he has worked full time on the agency's citizen-based renewable energy technology assessment program. Mr. Kleinman was a major contributor to the concept, design and production of several major agency publications: *The Renewable Energy Resource Inventory, The Renewable Energy Technology Handbook, The Energy Technology Assessment Workbook,* and the forthcoming final report of the citizen-based energy planning effort. Before becoming energy planner, Mr. Kleinman interned with the Seattle City Council and the National League of Cities. He received a Masters of Regional Planning from Cornell University in 1978.

Jan Konisberg is currently Energy Planning Coordinator for the Energy Division of the Montana Department of Natural Resources and Conservation. He is Project Coordinator for the Montana Renewable Energy Viability Project, a plan for studying the feasibility of developing sustainable energy in Montana. He is the author of the forthcoming publication entitled the *Montana Renewable Energy Handbook.* Prior to Mr. Konigsberg's employment with the Department, he was Solar Coordinator at the Montana Energy Office, where he was a principal investigator for the Montana Solar Plan.

Mr. Konigsberg received a B.A. in American Studies/Political Science from Reed College, Portland, Oregon in May, 1969, and a M.A. in Philosophy (Political Philosophy, Philosophy of History, Political Economy) from the University of Montana, Missoula, Montana, in December, 1975.

Richard Krauss, an architect and planner, is a principal of the Cambridge firm, Arrowstreet, Inc., and assists in the direction of the Urban Design Program at the Harvard Graduate School of Design. He is concerned with both good design and having the design process help users and designers clarify and achieve human goals. His role on the Philadelphia Project is to help develop the planning process involving public participation and to formulate from it a model for use in other cities and towns.

He is presently designing residential prototypes for the mentally retarded in Colorado, which includes passive solar design. This project involved statewide citizen participation in making services for the retarded more community based. Other recent projects include developing design guidelines for Army youth activity centers and for the development of new communities on the French and California coasts, all of which will help the users of these environments to be appropriately involved in their design and development.

Stephen G. Lewis is head of the MITRE Corporation's Resource Recovery and Energy Systems Department, which focuses on providing technical consulting services for regional, state and local governments. For over 12 years, Mr. Lewis has served as a consultant to various government agencies in the fields of resource recovery facility planning and procurement, management and cleanup of hazardous chemical waste dump sites, and alternative energy systems planning. He was the senior consultant to the State of Massachusetts in the reorganization of the Executive Branch, he has served 6 years as a local elected official (Selectman) in the town of Acton, Massachusetts, and three years as an appointed member of the Finance Commission. Before joining MITRE, Mr. Lewis was a Senior Research Engineer with Rockwell International. He holds B.S. and M.S. degrees in Engineering.

Amory B. Lovins is an experimental physicist who has been involved with energy and resource issues for over a decade. After spending four years at Harvard and Magdalen Colleges, Oxford, England, he became a Junior Research Fellow of Merton College in 1969. He resigned two years later to become full-time British Representative of the Friends of the Earth, Inc., the American non-profit conservation lobbying group. Since 1970, Dr. Lovins has worked as a consultant for several national and international government agencies and citizens' groups. He is active in energy affairs at a technical and political level in about 15 countries, and has published seven books, several monographs, and numerous technical papers and reviews. Dr. Lovins received an Oxford M.A. degree by Special Resolution in 1971 and a D.Sc. *honoris causa* from Bates College in 1979. He was twice appointed Regents' Lecturer at the University of California (Berkeley, energy policy, 1978, and Riverside, economics, 1979), and was the 1979 Grauer Lecturer at the University of British Columbia.

Valerie Pope Ludlam is a resident and prominent community leader of West San Bernardino, California. She moved to the community in 1962 from Detroit, and soon after her arrival organized a local Welfare Rights Organization aimed at enhancing employment opportunities for the poor, promoting educational achievement, and increasing social agency delivery performance. This led to the development of a non-profit, minority owned/operated community-based organization, incorporated in 1972 as the West Side Community Development Corporation. In her current capacity as Executive Director, she manages more than fifteen funded programs involving: home ownership, social services, and educational counseling, housing rehabilitation, youth employment and skill-building, job development and placement, and commercialization of energy conservation devices.

Mrs. Ludlam has been honored by the Federal Board of Los Angeles for her contributions to the Federal Service. She is the 1978 recipient of the State of California Solar Merit Award, and has been appointed by Governor Brown to SolarCal, the policy-making solar energy arm of the Governor's Office.

Dr. William Ross McCluney is program director of the Florida Solar Energy Center in Cape Canaveral, Florida, where his duties include solar research, contract management, and the analysis of solar system performance. He is presently working on the following major projects: solar illumination and passive heating of building interiors, measurement of long-term performance and durability of solar collectors, and monitoring of the performance of installed solar water heating systems in Florida residences. He has recently completed work on a study of solar electricity options for the Southeast U.S. (the Southeast Regional Assessment Study) for the Department of Energy and on a study of the geographical distribution of the ocean thermal energy resource around Florida. In addition, Dr. McCluney is adjunct research professor of oceanography at Florida Institute of Technology, where he has taught courses in optical oceanography. He holds B.A. and M.S. degrees in physics from Southwestern University at Memphis and the University of Tennessee, respectively.

Dennis L. Meadows is Director of the Resource Policy Center, Chairman of the Graduate Program on System Simulation and Policy Design, and Professor of Engineering, Thayer School of Engineering, Dartmouth College. He has authored five books on the application of systems techniques to problems of population growth, resource availability and institutional change. Among his publications is *The Limits to Growth,* which has been translated into 35 languages and was awarded the 1974 German Peace Prize. He is founder and Executive Secretary of the New England Wood Energy Advisory Council and consults on computer modeling methodologies for the U.S. Congress, the General Accounting Office, and other public and private organizations in the United States and abroad. He is also co-director of the New England Sustainable Energy Project.

Donald E. Megathlin, Jr., has served as Planning Director for the City of Portland, Maine, for the past ten years. He is responsible for all phases of City Planning and Development, including community development, zoning administration, environmental resources, federal programs, capital budgeting, purchase, sale and lease of all city-owned land, and coordination of city public building committees. Mr. Megathlin graduated from Colby College in Maine with a B.A. in Economics; attended Boston Architectural Center and received a M.A. in Urban Affairs from the Graduate School of Public Administration, Northeastern University. Between 1969 and 1972, he was Assistant Regional Director for the New England office of the planning firm, Candeub, Fleissig & Associates, Boston, Massachusetts. He has served on numerous government and citizen committees in Portland and belongs to several professional planning societies, including the American Institute of Planners, the American Society of Planning Officials, the Urban Land Institute, and the National Association of Housing and Redevelopment Officials.

Clara G. Miller is currently Energy Program Manager at the Southern Tier Central Regional Planning and Development Board in Corning, New York. In this capacity, she directs a national pilot project in citizen-based energy planning and development under contract from the U.S. Department of Energy through Oak Ridge National Laboratory. More general activities undertaken by her staff include research, technical assistance, citizen participation, grantsmanship, and capital project planning. Ms. Miller was responsible for the concept, design and production of three major Department of Energy publications: the *Renewable Energy Resource Inventory*, the *Renewable Energy Technology Handbook,* and the *Energy Technology Assessment Workbook.* Before becoming Energy Program Manager, she was a Planner on the Economic Development Staff at Southern Tier Central, where she aided local entrepreneurs in finding venture capital and provided technical assistance to persons and groups trying to commercialize energy related inventions. She received a Master's degree in Regional Planning from Cornell University in 1977.

Murray Milne is a Professor in the School of Architecture and Urban Planning at UCLA where he teaches courses on Architectural Design, Building Climatology, Environmental Control Systems, Lighting, and Computer Aided Design. Professor Milne received graduate degrees in Engineering from the University of Michigan, and in Architecture from the University of California, Berkeley. His current research activities focus on energy conserving architectural design, especially passive solar heating and cooling. He has developed a series of interactive computer aided design programs to assist architects in designing passive buildings. To apply and test these ideas he has designed buildings in various climates throughout the country, including an award-winning passive solar condominium complex near Malibu. His book, *Residential Water Conservation,* published by the California Water Resources center, is in its second printing and its sequel, *Residential Water Reuse,* is due out soon.

A. Raymond Moore is currently Senior Vice President of Shenandoah Development, Inc., the development firm which is managing the design of a planned, energy-efficient community for Shenandoah, Georgia. He is also a Senior Research Associate at Georgia Institute of Technology.

Mr. Moore is active in energy affairs in the Southeast, and serves as a consultant to the Joint House-Senate Committee on Energy Resources of the Georgia Legislature. He was formerly the news director and commentator for WSB-TV in Atlanta. Before that, he was the Southeastern correspondent to NBC News, during the Huntley-Brinkley era.

John R. Mullin is Assistant Professor of Regional Planning at the University of Massachusetts, Amherst. He has worked as a researcher and planner for various university and government groups, particularly in the field of energy planning through which he has focused upon the problems of energy conservation among low income, inner city residents. He has been actively involved in developing conservation plans for the cities of Kalamazoo and Grand Rapids, Michigan, and Springfield, Massachusetts, and is now developing a wind and solar energy feasibility study for the Massachusetts Military Division at Camp Edwards on Cape Cod. Dr. Mullin's academic background includes a B.A. in Political Science (University of Massachusetts), an MCP in City Planning (University of Rhode Island), an MSBA in Business Administration (Boston University) and a Ph.D. in City Planning (University of Waterloo).

Richard Munson is coordinator of Solar Lobby and the Center for Renewable Resources. Formerly co-director of the Sun Day staff, Mr. Munson is the author of numerous articles on solar energy and materials conservation. Before joining the Sun Day organization, he was Executive Director of the Environmental Action Foundation.

D. Richard Neill is coordinator of the Wind Energy Conversion Program, the Solar Energy RD&D Program, and the Effort for Electric-Energy Self-Sufficiency for Hawaii. He is affiliated with the Hawaii Natural Energy Institute of the University of Hawaii.

Previous to joining the Natural Energy Institute, Mr. Neill was a member of the staff of State Senator T. C. Yim, and clerk of the Senate Energy Committee. He prepared the Senate Report on Energy and *A Comprehensive Energy Program for Hawaii*, which resulted in a major appropriation for alternative energy RD&D in the state.

Mr. Neill has a background in housing development and planning, urban renewal, and housing for the elderly, and has been a columnist for the Honolulu *Star Bulletin*. He holds the B.S. degree in Business Administration from the University of Rochester and the Bachelor of Divinity degree from Colgate Rochester Divinity College.

Robert Odland is Chief of the Community and Consumer Branch of the Solar Energy Research Institute (SERI) in Golden, Colorado. He is an attorney and an urban, regional and environmental planner who has had considerable experience working with state and local governments. His areas of specialization include urban planning, land use controls, taxation policy, and environmental regulatory systems. At SERI, he is manager of research on institutional barriers to the application of solar energy technologies and also on the social and environmental impacts of solar energy systems.

Before joining SERI, Mr. Odland worked for Sedway/Cooke, Planning Consultants in San Francisco where he was involved in twelve projects dealing with growth management, land use controls, compensatory regulations, comprehensive environmental management systems, and intergovernmental relations. He has also been part of the legislative staff of the California State Legislature and has conducted research and drafted legislation affecting taxation policies, intergovernmental planning coordination, agricultural lands preservation, and the state role in land use planning. Odland holds a M.C.P. degree in City and Regional Planning and a J.D. in Law from the University of California-Berkeley, and is a graduate of the U.S. Military Academy at Westpoint.

William C. Osborn is an attorney and consultant with substantial experience in the energy field. He is presently doing independent energy consulting work for a number of organizations, including SERI, the Tennessee Valley Authority, and The MITRE Corporation.

Most recently, Mr. Osborn helped form and was the Director of the Massachusetts Solar Action Office, a state office created to commercialize solar energy and remove economic, legal and institutional barriers to its use. Before this, he was chief counsel for the Massachusetts Energy Facilities Siting Council, the agency which reviews the demand forecasts and supply plans of

Massachusetts gas and electric utility companies. Mr. Osborn is the author of *The Paper Plantation* and he holds a Bachelor of Arts degree from Princeton University and a J.D. degree from George Washington University Law School.

John W. Ostrowski is currently the Project Manager for the City of Kent, Ohio, Solar Technology Assessment Program. He is also acting as a Consultant in data analysis and is developing a Management by Objectives System for the city.

Mr. Ostrowski is completing work in his Ph.D. in Public Policy at Kent State University where he also received a Master's degree in Political Science. His primary research interests have been the application of Group-Process Techniques to public policy formulation and adaptation of data processing technologies to descriptive public policy analysis.

Abbie C. Page is Group Leader of the MITRE Corporation's Local, State, and Regional Energy Systems group. Under contract to the Department of Energy, she designed a methodology for regional and local distributed energy system planning (The New England Sustainable Energy Project). She has recently completed a study of the role of state and local governments in accelerating the commercialization of solar energy. Currently she is the principal consultant assisting the Tennessee Valley Authority to develop and implement a multimillion dollar biomass program. Prior to joining MITRE, Ms. Page was Director of the Office of Energy Resources of the State of Maine, a cabinet-level position reporting to the Governor. Under her direction the Maine Energy Office completed a state Comprehensive Energy Plan and Policy; an Energy Emergency Contingency Plan; a state agency Energy Conservation Plan; and a program for conserving energy in the residential, commercial, industrial, and transportation sectors of the state. Ms. Page also provided energy policy analysis to the Governor and Cabinet; was responsible for managing the state fuel allocation program; and instituted a program of state grants for research and development of renewable energy resources and energy conservation techniques. She holds degrees in Chemistry and Biology from Brown and Purdue Universities.

Yale M. Schiffman is an environmental system scientist with the MITRE Corporation, Metrek Division. He has over sixteen years of professional planning and design experience in such areas as solar and biomass energy systems, nuclear and fossil fuel plants, refineries and petrochemical plants. Mr. Schiffman is currently serving as Co-Chairman on the Board of Directors of the Council of Environmental Design Organizations (CEDO), a non-profit corporation consisting of design professionals concerned with solar applications and energy conservation in urban and building design.

Prior to joining MITRE he served as a Principal Investigator on the Southwest Project, the Southeast Regional Assessment Study and U.S. Tidal Energy Study. He taught courses in Energy/Environmental Design at Boston University and served on solar design review panels at the Harvard Graduate School of Design. He holds the Bachelor of Science degree in Interdisciplinary Studies (Urban Planning and Management), and the Master of Science degree in Urban Affairs, both from Boston University.

Kenneth K. Smeltzer is an Assistant Environmental Scientist within the Energy and Environmental Systems Division of Argonne National Laboratory. His principal responsibilities involved social and economic impact assessment of solar energy technologies, focusing on labor requirements. Much of this work is part of the Technology Assessment of Solar Energy program of the Department of Energy, a comprehensive assessment of the environmental economic and social impacts of various solar scenarios through the year 2000.

Mr. Smeltzer holds a Master of Regional Planning degree from Cornell University.

Robert Tanenhaus holds a diplomatic post at the International Energy Agency in Paris, France, where he has been studying the international and national energy situations and developing energy policies, including renewable energy programs, for most of the industrialized, market economy countries. Previously, he was director of energy offices for the New York City government, where he specialized in developing and managing energy policies and programs. He also was President of Planning and Management Associates, a consulting firm, and manager and planner for several New York local and regional government and citizen organizations concerned with various public issues related to energy and community development.

Thomas J. Tomasi is presently the Mayor of Davis, California. This is his second term on the City Council of Davis since he was first elected in 1974. Prior to being on the council, he served on the Davis Planning Commission for two years and was a chemistry teacher at Davis Senior High School for eleven years. He has recently taken a position at the California Office of Appropriate Technology, as the manager of the Community Assistance Group.

Arnold R. Wallenstein is on staff at the Northeast Solar Energy Center (NESEC) where he is responsible for addressing legal issues that arise from the commercialization of solar energy. These include sun rights, building codes, utility interface with solar energy, barriers to obtaining loans and insurance by solar energy consumers, and small solar business financing. He also provides legislative assistance to state and federal legislators on solar energy bills and general legal assistance.

Since joining NESEC, Mr. Wallenstein has written *Legal and Institutional Barriers and Incentives to Commercializing Solar Energy* and has been appointed a member of the New England Congressional Caucus Energy Congress.

Mr. Wallenstein received a J.D. from Harvard Law School, an M.S. in Environmental Sciences from the Harvard School of Public Heath, and a B.A. from the University of Massachusetts. He is a member of Phi Beta Kappa.

James Welch is President of Total Energy Consultants and co-developer of the Wyoming Community Grants Program, a state-wide effort to fund community-scale alternative energy and energy conservation projects. His background in the energy field includes research on the thermal performance of various passive solar energy systems, consulting for the Department of Energy's National Survey of Solar Installations, and receipt of the Department of Housing and Urban Development Passive Solar Design Award in 1978. He is also author of the *Wyoming Energy Handbook*. Mr. Welch holds a Bachelor of Arts degree in Environmental Biology from the University of Colorado, and is presently a candidate for the Master's degree in Solar Design and Technology at Arizona State University.

Peggy Wrenn is the Director of Solar and Renewable Energy Programs and has been solar energy coordinator for the Colorado Office of Energy Conservation since its creation in August, 1977. She is responsible for the state's solar, wind, and bio-fuel planning and programs. She advises the Governor and the legislature on solar and renewable energy policies, and coordinates federal, regional, state and local solar programs within Colorado.

Ms. Wrenn has a B.A. from the University of Colorado and has completed two years of study in solar technology with a fellowship from the Colorado Energy Research Institute. She has built her own passive solar home west of Boulder and has design and construction experience with several solar technologies. She is an active member of the Colorado solar community and a founding member of the Colorado Solar Energy Association.

Charles Vidich is currently working as a Regional Planner with the Central Naugatuck Valley Regional Planning Agency in Waterbury, Connecticut. He has worked with the Agency since 1974 and has been principally responsible for comprehensive planning activities in the areas of land use, housing, transportation, economic development and energy. During the last year he has been the project director of the Agency's Solar Energy Study Team, which has been making an assessment of the legal and institutional barriers to solar access found in the local land use regulations of the region. The study is being funded by the Northeast Solar Energy Center in Cambridge, Massachusetts.

Appendix 2
Resource Materials

General Information

Amory Lovins. *Soft Energy Paths: Toward a Durable Peace,* Ballinger Press, Cambridge, Mass., 1977.

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Energy Planning

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Benson, James. *County Energy Plan Guidebook: Creating a Renewable Energy Future.* Institute for Ecological Policies. 9208 Christopher St., Fairfax, Virginia 22031, 1979.

Planner's Energy Workbook, Brookhaven National Laboratory and the State University of New York. Washington: Federal Energy Administration, 1976.

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Miller, Clara G., Robert M. Kleinman, and J. Bartlett Warren. *Renewable Energy Technology Handbook.* Citizen-Based Energy Technology Assessment Program, Southern Tier Central Regional Planning and Development Board, 53½ Bridge Street, Corning, New York 14830, Dec. 1978.

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The Potential of Direct Solar Energy in Planning. Madolia Massey Mills. Council of Planning Librarians (P.O. Box 229, Monticello, Illinois 61856), 1973 (Exchange Bibliography no. 476).

Planning Aspects of Direct Solar Energy Generation. In *Journal of the American Institute of Planners,* (1776 Massachusetts Avenue, NW, Washington, D.C. 20036), October 1977, pp. 339–351.

Presents basic technical and cost aspects of solar energy and surveys its planning and public policy domain.

Office of Community Planning and Development. *Rapid Growth from Energy Projects—Ideas for State and Local Action: A Program Guide.* Housing and Urban Development, Washington, D.C., 1976.

Developing and Analyzing a Coordinated Approach to Energy Related Community Development. Resource Planning Associates, Inc., Washington D.C.: Energy Research and Development Administration, Draft Final Report, May 1977.

Land Use and Energy

Site Planning for Solar Energy Utilization. In *Solar Dwelling Design Concepts.* American Inst. of Architects Research Corporation. Available from U.S. Gov't. Printing Office, Washington, D.C. 20402, 1976, pp. 64–80.

Discusses the factors to be considered in site selection, requirements for different climates, and the integration of the building and its site.

Bacon, Edmund N. Energy and Land Use. In *Urban Land,* July/August 1973, p. 13–16.

Energy shortages will have an important effect on the distribution of human activities over the land. Land use planning for new lifestyles will have to come under three jurisdictions: local, regional, and federal.

Land Use and Energy Utilization, Brookhaven National Laboratory and State University of New York Land Use-Energy Utilization Project. Washington: Federal Energy Administration, Interim Report, October 1975. (Available from National Technical Information Service, BNL 20577).

This study focuses on the preparation of models and information systems which will permit the examination of the tradeoffs between land use activity levels, mixes and arrangements and the demands on the energy supply and distribution network. The project is developing a Land Use-Energy Accounting System to be used as a straightforward, practical planning tool. The Nassau-Suffolk County region on Long Island is used as a testing ground.

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Harwood, Corbin Crews. Using Land to Save Energy. Cambridge: Ballinger Publishing Co., 1977. (Environmental Law Institute State and Local Government Energy Conservation Project).

Keyes, Dale L. Energy and Land Use. An Instrument of U.S. Conservation Policy. In *Energy Policy,* September 1976, p. 225–236.

Describes studies of energy usage in metropolitan areas of the United States, simulation studies of alternative building types and urban structures, and the potential for energy conservation. More compact high-rise patterns could lead to significant savings in domestic and transportation energy consumption. But caution is in order in case detrimental side effects of single purpose planning outweigh the benefits.

Keyes, Dale L. and George R. Peterson. Metropolitan Development and Energy Consumption. Washington, D.C.: Urban Institute, March 1977, 82 p. (Land Use Center Working Paper 5049-15).

Two uses of energy are thought to be especially sensitive to metropolitan development characteristics—gasoline consumption in travel and space heating and cooling, for which building size and density are believed to be important.

Knowles, Ralph L. *Energy and Form: An Ecological Approach to Urban Growth.* Cambridge: The MIT Press, 1974.

Charles McClemon, editor. *Landscape Planning for Energy Conservation,* ASLA Foundation, 1977.

Real Estate Research Corporation. The Costs of Sprawl: Environmental and Economic Costs of Alternative Residential Development Patterns at the Urban Fringe, Washington D.C.: U.S. Government Printing Office, 1974. 3 vols: (1) Executive Summary, 15 p. (2) Detailed Cost Analyses, 278 p. (3) Literature Review and Bibliography.

Prototype development patterns analyzed in terms of various economic, environmental, and social costs.

Roberts, James S. Energy and Land Use: Analysis of Alternative Development Patterns. In *Environmental Comment,* September 1975, p. 3-11.

An Overview and Critical Evaluation of the Relationship Between Land Use and Energy Conservation, Technology & Economics, Inc. Washington: Federal Energy Administration, March 1976. 3 vols: (1) Executive Summary, 20 p. (2) Main Report, 297 p. (3) Technical Supplement.

Research intended to create a conceptual framework for looking at land use/energy interactions; to review land use control techniques used by governments for energy conservation; and to recommend further research and actions. For land use and energy demand in the residential and commercial sectors, asks how land use affects (1) energy demands for space heating and cooling; (2) energy use for water heating; and (3) miscellaneous building energy use. Also asks how land use affects transportation energy demand and industrial energy demand. The study concludes that land use management can be a significant energy conservation tool, but that there are limiting factors including the time needed to change land use patterns.

Twiss, Robert, Pat Smith, and Peter Pollock. Land Use Implications of a Dispersed Energy System. Chapter XI in *Disturbed Energy Systems in California's Future,* Vol. II, March 1978. Prepared for U.S. Department of Energy, Contract No. W-7405-ENG-48.

This working paper explores the land use implications of an energy policy which factors energy conservation and the use of "soft" energy sources. In addition the constraints and opportunities presented by the California land use planning framework are addressed.

Energy and Land Use. A Statement by ULI—the Urban Land Institute. In *Environmental Comment,* September 1974, p. 1-7.

A comittee statement on energy supply, the federal role in energy policy, the developer's and development community's role, new development and redevelopment, and ULI's role.

Solar Energy and Land Use. In *Environmental Comment.* Urban Land Institute, March 1978.

The Law

Eisenstadt, Melvin M. and Albert E. Utton. "Solar Rights and Their Effect on Solar Heating and Cooling," *Natural Resources Journal*, April 1976, Vol. 16, no. 2, pp. 363–410.

Miller, A. S., G. B. Hayes and G. P. Thompson. Solar Access and Land Use: State of the Law, 1977. Environmental Law Institute, Washington, D.C., Energy Research and Development Administration, 1977. Contract EX-76-C-01-2528.

This chapter on land use is a concise summary of the state of the law in the field but does not present recommended solutions or planning and legislative tools. It is a chapter from a larger study, Legal Barriers to Solar Heating and Cooling of Buildings (available NTIS). It is tentatively concluded that a combination of approaches will probably work best. Fortunately, the authors say, from a legal standpoint, the owners of structures in the existing built communities are interested in solar heating and cooling. Direct Federal role is presently nonexistent, and it should be up to states and localities to choose and enact model laws that meet the special needs of their geographic regions. Some actions and procedures are listed.

Myers, Barry Lee. "Solar Access Rights in Residential Developments," *The Practical Lawyer*, March 1, 1978, vol. 24, no. 2, pp. 13–20.

Solar access rights must be carefully created, taking into account both the technical consideration of the legal devices used and the unique natural considerations affecting solar energy use. Whether a legally protected interest in sunlight is created through easements, covenants, equitable servitudes, or zoning, the lawyer must consider the precision of the language, the term of the right, statutory requirements, and consistency with pre-existing covenants.

Taubenfeld, Rita F., and Howard J. Taubenfeld. "Wind Energy: Legal Issues and Legal Barriers," *Southwestern Law Journal*, Winter 1977, vol. 31, no. 5, pp. 1053–1093.

Wilson, Jones, Morton and Lynch. *Legal Alternatives, Implications and Financing of Solar Heating and Cooling by a Municipal Corporation*, Santa Clara, CA, 1976. (Available NTIS/#SAN/1083-76/1).

Case Studies

California, Energy Resources Conservation and Development Commission. *Solar Energy in California: Residential Thermal Applications.* Draft Report, Sacramento: 1978.

This report contains sections dealing with the state of the solar industry, consumer issues, utility roles, impacts of widespread solar use, solar economics, and legal and building code issues related to solar use. Each section includes recommendations for California actions, which may be appropriate for other states. The appendices contain lists of solar manufacturers, distributors, architects, engineers, builders and developers, contractors, environmental and citizen action groups, lobbyists, unions, and financial institutions that are likely to have roles in statewide solar energy development. Other appendices summarize existing solar codes and statewide solar legislation.

Curl, Huldah, ed. *Winona, Towards an Energy Conserving Community.* Minneapolis, Minnesota: School of Architecture and Landscape Architecture, University of Minnesota, 1975.

Planning for Energy Conservation, prepared by Living Systems (Winters, California) for the City of Davis, California. Draft Report June 1976, 83 p.

Davis already has an energy conservation building code which saves about 50 percent of the energy normally needed for heating and cooling residences. But new building design savings only scratch the surface of the potential for community energy conservation. This program proposes a set of policy changes in land use planning, transportation, landscaping, home environment, and ordinances and resolutions are given.

Davis Energy Conservation Report, Practical Use of the Sun. Living Systems, Winter, Calif. Department of Housing and Urban Development, Washington, D.C., Final Report March 1977. (HUD Grant No. B-75-S1-06-001).

A comprehensive energy conservation program for the City of Davis is described including Building Code, planning, solar houses, and public education.

Distributed Energy Systems in California's Future: Interim Report Volumes I and II. March 1978. Prepared for U.S. Dept. of Energy, Office of Technology Impacts. Contract No. W-7405-ENG-48.

Energy Conservation Guidelines for Evaluating New Development in Contra Costa County, California, Vol. 2: Contra Costa County Energy Resources and Conservation Study. Prepared by Interactive Resources, Inc., Point Richmond, CA for the Contra Costa County Planning Dept., Martinez, CA, May 1976. (HUD 701 Grant, State of California, Office of Planning and Research, Project No. 1002-12).

Energy Use and Conservation in Contra Costa County, California. Contra Costa County Energy Resources and Conservation Study. Prepared by the Contra Costa County Planning Department, Martinez, California.

Fels, Margaret, Fulton and Michael J. Munson. Energy Thrift in Urban Transportation: Options for the Future. In *The Energy Conservation Papers,* edited by Robert H. Williams. Cambridge: Ballinger Publishing Co., 1975. (Papers prepared for the Energy Policy Project of the Ford Foundation).

Studies urban transportation energy consumption in the Trenton, New Jersey, metropolitan area between 1975 and 2000. Land use pattern changes can result in reduced consumption.

Roberts, James S. Energy, Land Use, and Growth Policy: Implications for Metropolitan Washington. Washington D.C.: Metropolitan Washington Council of Governments, 1975.

Analyzes six alternative development scenarios (wedges and corridors, dense center, transit oriented, wedges and corridors with income balance, sprawl, and beltway-oriented) for variations in energy consumption. Concludes with a discussion of policies and implementation strategies that can contribute to energy balance in metropolitan Washington, particularly through control over land use activities by growth management practices.

Energy and Land Use, Skidmore, Owings and Merrill, Portland, Oregon: Portland City Planning Commission, Fall 1976, 36 p. (Comprehensive Plan Working Paper No. 13).

A description for citizens of land use policy and zoning options which can be used to promote energy conservation. Twenty-one zoning and other land use policy concepts for conserving energy are presented and briefly evaluated.

Socolow, Robert. *The Twin Rivers Program on Energy Conservation in Housing: A Summary for Policymakers*, Princeton, New Jersey: Center for Env. Studies, Princeton U., June 1977.

Appendix 3
Solar Energy Information Data Bank Reading List

The following is a list of publications on solar access, land use and energy, community energy planning, and case studies in community energy planning which was prepared by the Community and Consumer Branch and the Solar Energy Information Center of the Solar Energy Research Institute. The list is not comprehensive and does not imply endorsement. The publications cited here should be available from most local libraries or book-stores and should not be ordered from the Solar Energy Research Institute.

Solar Access

Books

Overcoming Legal Uncertainties About Use of Solar Energy Systems. William A. Thomas; Alan S. Miller; Richard L. Robbins; American Bar Association, 1155 East 60th St., Chicago, IL 60637, 80 pp., $5.00 (paperback).

Identifies legal barriers to the use of solar energy for heating and cooling and suggests legislative remedies by proposing model statutes. Includes definitions.

Solar Access Law. Gail Boyer Hayes; Ballinger Publishing Co., 17 Dunster St., Harvard Square, Cambridge, MA 02138, 1979, 303 pp., $18.50.

Evaluates legal strategies designed to protect solar access in developed urban and suburban areas.

Solar Law: Present and Future, With Proposed Forms. Sandy F. Kraemer; Shepard's Inc., P.O. Box 1235, Colorado Springs, CO 80901, 1978, 364 pp., $35.00.

Analysis of public and private issues, legal and technical, related to the use of solar energy with proposed model statutes and model private agreements.

Government Reports and Publications

**Barriers and Incentives to Solar Energy Developments: An Analysis of Legal and*

Institutional Issues in the Northeast. Arnold R. Wallenstein; Cambridge, MA: Northeast Solar Energy Center; December, 1978; Report no. NESEC-1, 103 pp., $6.50.

Analysis of legal and institutional barriers to and incentives for the commercialization of alternate energy sources in the Northeast, with emphasis on solar energy.

**Implementation of State Solar Incentives: Land-Use Planning to Ensure Solar Access.* Peter Pollock; Golden, CO: Solar Energy Research Institute; March 1979; Report no. SERI/TR-51-163. 36 pp, $4.50.

Examines solar legislation and state and private means of assuring solar access. Provides case studies and identifies solar access issues.

Legal Barriers to Solar Heating and Cooling of Buildings. Washington, D.C.; Environmental Law Institute. Prepared for the U.S. Department of Energy; March, 1978; Report no. HCP/M2528-01. 221 pp., $9.50.

Analysis of legal and institutional barriers to solar heating and cooling, such as: solar access; land use; building codes; home financing; utility regulations; patent law; anti-trust labor; labor unions, property taxes; mobile homes; tort liability; insurance; and warranties.

Protecting Solar Access for Residential Development: A Guidebook for Planning Officials. Martin Jaffe and Duncan Erley; Chicago, IL: American Planning Association. Prepared for the U.S. Housing and Urban Development in cooperation with the U.S. Department of Energy; May, 1979; Report no. HUD-PDR445. 154 pp., $4.75. Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Describes and illustrates how planners can use conventional land use controls to protect solar access in new residential developments.

Protecting Solar Access, Report of the Governor's Special Study Committee on Solar Rights. Madison, WI: Office of State Planning and Energy; April, 1978; 31 pp., no charge. Available from: Division of State Energy, Room 201, 1 West Wilson, Madison, WI 53702.

Examines solar easements, land use regulations and current proposed legislation protecting solar access. Makes recommendations.

Site Planning for Solar Access: A Guidebook for Residential Developers and Site Planners. Duncan Erley and Martin Jaffe; Chicago, IL: American Planning Association. Prepared for the U.S. Department of Housing and Urban Development in cooperation with the U.S. Department of Energy; September, 1979; Report no. HUD-PDR 481. 149 pp, $4.75. Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Describes and illustrates criteria to be considered in site planning for solar access.

What Every Community Should Be Doing About Solar Access. Peter Pollock; Golden, CO: Solar Energy Research Institute; to be published.

Suggests ways that local governments can assure solar access. Examines solar easements and zoning policies.

Articles

Legal Obstacles to Decentralized Solar Energy Technologies. Alan S. Miller. Solar Law Reporter. Vol. 1 (no. 3): pp. 595-612; September/October, 1979.

Studies solar access problems and the effect of these problems on planning and zoning policies.

Legal Obstacles to Decentralized Solar Energy Technology. Part II. Alan S. Miller. *Solar Law Reporter.* Vol. 1 (no. 4): pp. 761–783; November/December, 1979.

Discusses potential obstacles to solar energy use posed by aesthetic restrictions on: land use; building codes; warranties; product standards; financial issues; and utility regulations.

Some Comments on Drafting Solar Access Regulations. Martin Jaffe. *Land Use Law and Zoning Digest.* Vol. 30 (no. 8): pp. 4–7; 1978.

Examines strategies for the incorporation of solar energy policies into land use controls and for drafting modifications to existing ordinances.

Wind Energy: Legal Issues and Legal Barriers. Rita F. Taubenfeld and Howard J. Taubenfeld. *Southwestern Law Journal.* Vol. 31 (no. 5): pp. 1053–1093; Winter, 1977.

Wide-ranging study of legal issues and legal barriers related to the use of wind energy. Studies wind machine siting; legal liability; government regulation; utility interaction; and implementation incentives.

Journals

Solar Law Reporter. Published by the Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401. Bimonthly. $12,00 per year. Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Land Use and Energy

Books

Impact of Energy Costs and Supply Prospects on Land Development Practices. Robert M. Bryne; Urban Land Institute, 1200 18th St., N. W., Washington, D.C. 20036, April, 1978, 28 pp, no charge. Also published in: *Urban Land.* Vol. 38 (no. 8): pp. 6–12; September, 1979. Reprint available from Urban Land Institute. $3.00.

Preliminary analysis of response to questionnaire sent by the Urban Land Institute to its members to determine their perceptions of the impact of the energy situation on real estate development.

Landscape Planning for Energy Conservation. Gary O. Robinette, ed.; Environmental Design Press, P.O. Box #2187;, Reston, VA 22090, 1977, 224 pp., $20.00

Study of the effect of vegetation, landforms, and water features on the use of energy in buildings. Extensive case studies.

Using Land to Save Energy. Corbin Crews Harwood; Ballinger Publishing Co., 17 Dunster, Harvard Square, Cambridge, MA 02138, 1977, 336 pp., $19.50.

Studies the alteration of land development patterns as an energy conservation strategy and attempts to identify energy-efficient land development patterns. Suggests modifications in state and local regulations, spending and taxing policies to promote energy-efficient land use.

Government Reports and Publications

Application of Solar Technology to Today's Energy Needs. Washington, D.C.: U.S. Congress. Office of Technology Assessment; September, 1978. Vol. 1, 525 pp., $8.50. Vol. 2, 756 pp., $8.75. Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Stock number: Vol. 1, 052-003-00539-5; Vol. 2, 052-003-00608-1.

Comprehensive technical study of several hundred solar energy systems with methods for evaluating the economic and technical merits of small-scale energy systems.

Assessment of Solar Energy Within a Community: Summary of Three Community-Level Studies. Ronald L. Ritschard; Berkeley, CA: Lawrence Berkeley Laboratory. Prepared for the U.S. Department of Energy; October, 1979; report no. DOE/EV-0054. Available from: U.S. Department of Energy, Technology Assessments, E-201, Office of Environment, Washington, D.C. 20545.

Summarizes three community-level impact assessment studies with the objective of providing policymakers with an analysis of potential community-level health, environmental, and social/economic consequences of large-scale commercialization of solar technologies.

Estimating Energy Impacts of Residential and Commercial Building Development: A Manual. Bellevue, WA: Mathematical Science Northwest, Inc. Prepared for the U.S. Department of Energy, Region X; February 22, 1979; report no. MSNW-79-3054-3. Price not set. Available from: Mathematical Sciences Northwest, Inc., Consulting Division, P.O. Box #1887, Bellevue, WA 98009.

Proposes methods, for use in a non-engineering context, of estimating the amount of energy consumed in the construction and operation of a building and the amount of energy consumed by surrounding land use.

Land Use Barriers and Incentives to the Use of Solar Energy. Paul Spivak; Golden, CO: Solar Energy Research Institute; August, 1979; report no. SERI/TR-62-267. 35 pp., $5.25. Available from: NTIS.*

Analyzes land use techniques and property law as barriers and incentives to the use of solar collectors in existing communities and in new developments.

Land Use Implications of a Dispersed Energy System. Robert Twiss, Pat Smith, Peter Pollock; in *Distributed Energy Systems in California's Future,* vol. 2, pp. 127–162. Berkeley, CA: University of California. Prepared for the U.S. Department of Energy; May, 1978; report no. TID 29007. 683 pp., $32.00. Available from: NTIS* (entire report).

Explores the land use implications of an energy policy advocating conservation and the use of renewable energy resources in the context of California's land use planning framework.

Options For Passive Energy Conservation in Site Design. Reston, VA: Center for Landscape Architectural Education and Research. Prepared for the U.S. Department of Energy; June, 1978; report no. HCP/M5037-01. 232 pp., $9.50. Available from: NTIS*.

Study of the way in which landscaping can be used to take advantage of natural energy systems, such as sunlight and wind for heating and cooling. Numerous drawings illustrate concepts.

An Overview and Critical Evaluation of the Relationship Between Land Use and Energy Conservation: Executive Summary. W. Curtiss Priest and Kenneth M. Happy; Cambridge, MA; Technology and Economics, Inc. Prepared for the U.S. Federal Energy Administration; March, 1976, report no. FEA-D-76/236. 27 pp., $4.50. Available from: NTIS*. Order as report no. PB-258-877.

Outlines the direct effect of land use policies on the energy consumption of residential, commercial, and industrial buildings and on transportation.

Planner's Energy Workbook: A Manual For Exploring Relationships Between Land Use and Energy Utilization. T. Owen Carroll, Robert Nathans, Philip F. Palmedo, et al.; Upton, NY: Brookhaven National Laboratory and Stony Brook, NY: State University of New York. Prepared for the U.S. Energy Research and Development Administration; June, 1977. Report no BNL-50633, 129 pp., $2.75. Available from: NTIS*.

Describes a set of procedures for evaluating the compatibility of present and future community and regional energy requirements with the energy supply-distribution system and for evaluating the implications for energy use of the physical configuration of urban, suburban and rural areas.

Articles

Energy and Land Use. Edmund N. Bacon. *Urban Land.* Vol. 32 (no. 7); pp. 13–16; July/August, 1973.

Discusses how the energy shortage will affect land use and discusses planning practices that federal, metropolitan-wide, and local governments can use to cope with the energy shortage.

Planning Aspects of Direct Solar Energy Generation. Arnold D. Nadler. *Journal of the American Institute of Planners.* Vol. 43 (no. 4): pp. 339–351; October, 1977.

Presents basic technical and cost aspects of solar energy and surveys planning and public policy issues related to the use of solar energy.

Rooftops of San Fernando. George Ellis. *Solar Age.* Vol. 3 (no. 5): pp. 17, June, 1978.

Estimates the potential for photovoltaic-supplied electricity in the San Fernando Valley, California. Original estimate of 120% of demand supplied by photovoltaics revised to 52.7%.

Solar Energy and Land Use. Environmental Comment. Entire Issue. May, 1978.

Issue contains articles on solar problems relating to land use, siting and access to sunlight. Also contains a selective bibliography on solar energy and land use.

Spatial Form and Structure in a Possible Future: Some Implications of Energy Shortfall For Urban Planning. Jon Van Til. *Journal of the American Planning Association.* Vol. 45 (no. 3): pp. 318–329; July, 1979.

Projects five possible energy supply situations that may occur in the future and studies how the supply of energy will affect four possible types of cities. Concludes that, in an energy-short future, only diversified-integrated cities will be viable.

Bibliographies

Energy Efficient Land Use: An Annotated Bibliography. (Planning Advisory Service Report no. 341). Duncan Erley, David Masona, Efraim Gil; American Planning Association, 1313 East 60th St., Chicago, IL 60637, May, 1979; 25 pp., $10.00.

Includes references to materials on energy conservation through site design, land use, transportation, regulations, and zoning.

Community Energy Planning

Books

County Energy Plan Guidebook: Creating a Renewable Energy Future. Alan Okagaki and Jim Benson; Institute for Ecological Policies, 9208 Christopher Street, Fairfax, VA 22031, 1979, various paging, $15.00.

Advocates a "soft path" energy future for the United States and describes how citizens can develop renewable energy resources at the county level.

Energy and Human Welfare. Volume 3: Human Welfare: The End Use For Power. Barry Commoner and Howard Boksenbaum, ed.; MacMillan Publishing Co., 866 Third Avenue, New York, NY 10022, 1975, 185 pp., $14.95.

Presents papers on the social, technological, and environmental problems of electric power consumption.

Energy Conservation Ideas For Community Planning. Pennsylvania Power and Light, Attn: Gerald S. Farber, Supervisor-Community Planning, 2 North 9th

Street, Allentown, PA 18101, 1979, 83 pp., $ No charge for single copy.
Presents information on how local community planning and development can contribute to energy conservation and presents energy-saving techniques. Includes model codes and ordinances.

Energy-Efficient Community Planning: A Guide to Saving Energy and Producing Power at the Local Level. James Ridgeway and Carolyn S. Projansky; JG Press, Inc., Box 351, Emmaus, PA 18049, 1979, 22 pp., $14.95 (hardcover), $9.95 (paperback).
Describes several community energy planning projects and reproduces pertinent documents.

Sources of Funds For Solar Activists. Anita Gunn; Sunvries, 1001 Conn. Ave. NW, 5th Floor, Washington, D.C. 20036, 1978, 32 pp., $4.50 + 15% postage and handling.
Identifies government and private sources for renewable energy projects and explains how to approach those sources. Contains a bibliography on fund raising.

Government Reports and Publications

Colder . . . Darker: The Energy Crisis and Low-Income Americans—An Analysis of Impacts and Options. Eunice S. Grier; Washington, DC: Center for Metropolitan Studies. Prepared for the Community Services Administration; June, 1977; Report no. PB 275-656. 88 p. $8.00.
Assesses the impact of the energy situation on the lives of poor and near-poor Americans and recommends policy alternatives for the nation's lower-income citizens and their use of energy.

Comprehensive Community Energy Planning. Volume 1: Workbook. Volume 2: Appendices. Columbia, MD: Hitmann Associates, Inc. Prepared for the U.S. Department of Energy; November 1978; Vol. 1: Report no. HCP/M0023-01. 154 p. $11.00. Vol. 2: Report no. HCP/M0023-02. 235 p. $14.00. Available from: NTIS*.
Develops a methodology that will help community officials to develop and evaluate an energy conservation program for their community.

Creating Jobs Through Energy Policy: A Guide to Resources For Decision-Makers. Washington, DC: U.S. Department of Energy. Office of Policy and Evaluation; July 1979; Report no. DOE/PE-0013. 269 p. $15.00. Available from: NTIS*.
Provides a method by which public officials can evaluate the potential impact on employment of implementing alternative energy policies.

Design and Evaluation Criteria For Energy Conservation in New Buildings. Jim L. Heldenbrand; Washington, DC: National Bureau of Standards; February 1976; Report no. NBSIR-74-452. 107 p. $9.00. Available from: NTIS*. Order as Report no. PB 272-511.

Sets forth design and evaluation criteria for energy conservation in most types of new buildings.

Energy Conservation Choices For the City of Portland. Volume 4: Model Local Code Revisions For Energy Conservation. Portland, OR: Portland Bureau of Planning. Prepared for the U.S. Department of Housing and Urban Development; June 1977; Report no. HUD/RES-1236. 162 p. $11.00. Available from: NTIS*. Order as Report no. PB 276-787.

Describes the extent of authority that cities have and can use to enact energy conservation measures. Explains how to identify portions of a city code that can affect energy conservation and provides model code provisions. Case study experiences, including potential problems, are also discussed.

Florida Energy Conservation Manual. Tallahassee, FL: State of Florida. Department of General Services; Revised edition March 1977; 89 p. $3.00 Available from: Thomas A. Sechler, State of Florida, Department of General Services, 512 Larson Building, Tallahassee, FL 32301.

Provides a method for evaluating the energy conserving potential of building designs so they will comply with Florida's energy legislation. Also suggests design elements which will conserve energy.

Methodology For Energy Management Plans For Small Communities. Atlanta, GA: Sizemore and Associates. Prepared for the U.S. Department of Energy; July 1978; Report no. HCP/M1834-01. 171 p. $11.00. Available from: NTIS*.

Using LaGrange, Georgia, as an example, the study sets out a step-by-step method for the development of energy management plans by small communities.

Municipal Bond Financing of Solar Energy Facilities. Sharon Stanton White; Golden, CO: Solar Energy Research Institute; July 1979; Report no. SERI-TR-62-191. 111 p. Available from: SERI Document Distribution Service (DDS), 1617 Cole Blvd., Golden, CO 80401.

Explores municipal bond financing of solar energy facilities. Examines laws, principles and hypothetical situations related to bond financing.

Rapid Growth From Energy Projects—Ideas For State and Local Action: A Program Guide. Washington, DC: U.S. Department of Housing and Urban Development; April 1976; Report no. HUD-CPD-140; 66 p. $7.00. Available from: NTIS*. Order as Report no. PB 257-374.

Projects the possible impact of energy projects on communities. Proposes actions, based on experience, that communities can take to offset this impact. Indicates sources for information, planning and financial assistance.

Regional Environment-Energy Data Book: Midwest Region. Argonne, IL: Argonne National Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/6. 870 p. $39.00. Available from: NTIS*.

†See annotation under 'Western Region,' below

Regional Environment-Energy Data Book: Northeast Region. Upton, NY: Brookhaven National Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/3. 715 p. $33.00. Available from: NTIS*.

†See annotation under 'Western Region,' below.

Regional Environment-Energy Data Book: Northwest Region. Richland, WA: Battelle Pacific Northwest Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/5. 849 p. $38.00. Available from: NTIS*.

†See annotation under 'Western Region,' below.

Regional Environment-Energy Data Book: Rocky Mountain Region. Los Alamos, NM: Los Alamos Scientific Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/1. 902 p. $41.00. Available from: NTIS*.

†See annotation under 'Western Region,' below.

Regional Environment-Energy Data Book: Southern Region. Oak Ridge, TN: Oak Ridge National Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/4. 854 p. $39.00. Available from: NTIS*.

†See annotation under 'Western Region,' below.

Regional Environment-Energy Data Book: Western Region. Berkeley, CA: Lawrence Berkeley Laboratory. Prepared for the U.S. Department of Energy; December 1978; Report no. DOE/TIC-10114/2. 442 p. $22.00. Available from: NTIS*.

†Each of the six above reports is comprised of data relating to the energy, environmental, socioeconomic and institutional characteristics of each of six U.S. regions. The data may be used for policy analysis, generic impact assessments, and as a reference source for local groups and institutions. Data for each region is divided into four areas: current and historical energy data; natural and preternatural characteristics of the region; organization, legislative, and regulatory data; energy equivalents, metric conversions, glossary and indexes.

Social Assessment of On-Site Solar Energy Technologies. Topical Report. Washington, DC: George Washington University. Prepared for the U.S. Department of Energy; April 1979; Report no. HCP/R4040-02. 251 p. $15.00. Available from: NTIS*.

Interdisciplinary report on the potential and possible consequences of on-site solar energy technologies. Considers solar space heating and cooling, water heating, photovoltaics, wind energy conversion, and fuel wood burning for space heating.

What Can Municipalities Do About Energy? Charles K. Bons; Pamela Bryant; Anne Golden; Toronto, CN: Bureau of Municipal Research. March 1978; 47 p. $4.00. Available from: Bureau of Municipal Research, 2 Toronto St., Suite 306, Toronto, Ontario, Canada M5C2B6.

Demonstrates how Ontario municipalities can promote the development of renewable energy supplies. Divides possible municipal action into four areas: land use and transportation planning; building and site design requirements; development of local renewable energy resources; and public education and demonstration programs.

Articles

Energy Conservation and Economic Growth—Are They Incompatible? John G. Myers. *Conference Board Record.* vol. 12 (no. 2): pp. 27–32; February 1975.

Examines energy conservation by comparing the rate of economic growth with the amount of energy per unit of product produced.

Energy Demand Forecasting: Prediction or Planning? Herman E. Daly. *Journal of the American Institute of Planners.* vol. 42 (no. 1): pp. 4–15; January 1976.

Provides the reader with an awareness of the limits and biases of energy demand forecasting. Suggests that it is better to shape the future than to predict it.

Bibliographies

Community Energy Plans and Planning Methodologies: A Preliminary Bibliography. M. J. Meshenberg; Argonne, IL; Argonne National Laboratory; June 1979; Report no. ANL/CNSV-TM-10. 12 p. $5.00. Available from: NTIS*.

Annotated bibliography that includes plans and studies by local governments and methodologies for energy planning.

Case Studies in Community Energy Planning

Government Reports and Publications

Citizen-Based Technology Assessment Program. Volume 1: Renewable Energy Resource Inventory; Volume 2: Renewable Energy Technology Handbook; Volume 3: Technology Assessment Workbook; Volume 4; Energy Conservation and Development Plan. Clara G. Miller; Robert M. Kleinman; J. Bartlett Warren; et al. Corning, NY: Southern Tier Control Regional Planning and Development Board. Prepared for the U.S. Department of Energy; 1978; Vol. 1: 48 p. $6.50. Vol. 2: 54 p. $3.50. Vol. 3: 35 p. $3.00. Vol. 4: 55 p. $3.00. Available from: Southern Tier Control Regional Planning and Development Board, 53½ Bridge St., Offices 3, 4, 5, Corning, NY 14830.

Volume one outlines a process by which communities can prepare local resource inventories using maps and overlays. Volume two presents renewable energy technologies capable of being used in the Southern Tier counties of New York. Volume three presents a method by which citizen groups can make technology assessments of the effects of decentralized energy development using renewable resources. Volume four summarizes the work of a volunteer citizen advisory group that worked over a six-month period with regional planners to conserve and develop local energy resources.

Corvallis Energy Planning Framework. Ralph A. Morrill; Corvallis, OR: Ralph A. Morrill and Associates. Prepared for the City of Corvallis Planning Department; July, 1979; 103 p. $5.00. Available from: Tom Coffee, Director, City of Corvallis Planning Department, 501 S.W. Madison Ave., Corvallis, OR 97330.

Establishes a framework plan by which Corvallis, Oregon, can implement energy conservation measures and develop renewable and alternative energy sources.

Davis Energy Conservation Report: Practical Use of the Sun. Woodland, CA: Living Systems, Inc. Prepared for the City of Davis, CA; March 1977; Report no. DAC PL 79-101. 128 p. $10.00. Available from: Living Systems, Rt. 1, Box 170, Winters, CA 95694.

Describes the Davis Energy Conservation Project and how it reduced energy consumption through its municipal code, planning activities, solar homes, and other conservation techniques. Includes photographs and illustrations.

Development of a Comprehensive Community Energy Management Plan for the City of Hobbs, New Mexico. Norman, OK: Oklahoma University. Center for Economic and Management Research. Prepared for the U.S. Energy Research and Development Administration; March 1977; Report no. ORO/5009-1. 208 p. $13.00. Available from: NTIS*.

Develops a methodology for planning an energy program for a local government and, using the methodology, recommends an energy plan for Hobbs, New Mexico.

Distributed Energy Systems in California's Future. Berkeley, CA: University of California. Prepared for the U.S. Department of Energy; May 1978; Report no. TID 29007. 683 p. $32.00. Available from: NTIS*.

Comprehensive study of whether or not California's future energy demand can be satisfied by decentralized or distributed energy technologies.

Energy Self-Sufficiency in Northampton, Massachusetts: Summary. Christine T. Donovan; Lucia M. Ford; Alan S. Krass; et al.; Amherst, MA: Hampshire College. Prepared for the U.S. Department of Energy; February 1979; Report no. DOE/PE-4706. 38 p. $11.00. Available from: NTIS*.

Study of the ability of a small city, Northampton, Massachusetts, to supply its energy needs from renewable sources located within the city.

Energy Use and Conservation in Contra Costa County, California (Volume 1), Energy Conservation: Guidelines For Evaluating New Development in Contra Costa County, California (Volume 2). Point Richmond, CA: Interactive Resources, Inc. Prepared for the Contra Costa Planning Department; July 1976; Vol. 1: 135 p. $3.50. Vol. 2: 140 p. $4.50. Available from: Contra Costa County Planning Department, P.O. Box 951, Martinez, CA 94553.

Method for determining the energy consumption in land development.

A Final Report of the New England Energy Congress: A Blueprint For Energy Action. Executive Summary and Recommendations. Boston, MA: New England Energy Congress; May 1979; 59 p. $ No charge. Available from: New England Energy Congress, 6 Beacon St., Room 1111, Boston, MA 02108.

Contains a summary of the full report and recommendations for an energy plan to the year 2000 for New England. Done by over 100 experts from the region.

Franklin County Energy Study: A Renewable Energy Future. Amherst, MA: University of Massachusetts. Future Studies Program. Prepared for the U.S. Department of Energy; May 1979; Full Study: 600 p. $30.00. Abridged Study: 282 p. $12.00. Available from: Franklin County Energy Project, c/o Northeast Appropriate Technology Network, P.O. Box 548, Greenfield, MA 01302.

Uses a scenario development methodology to match Franklin County's future energy needs to renewable energy sources and estimate the social, political and economic consequences of using renewable energy resources through the year 2000.

Local Government Energy Activities: Volume 1: Summary Analysis of Twelve Cities and Counties. Volume 2: Detailed Analysis of Twelve Cities and Counties. Volume 3: Case Studies of Twelve Cities and Counties. Washington, D.C.: U.S. Department of Energy; July 1979; Report no. DOE/PE-0015/1-3. Vol. 1: 64 p. $7.00. Vol. 2: 192 p. $12.00. Vol. 3: 198 p. $12.00.

Volume one describes the study of twelve urban governments' energy policies and the factors influencing those policies. Also summarizes the study's findings and conclusions. Volume two provides both a detailed analysis of twelve urban governments' energy policies and of the factors influencing those policies. Volume three gives specific information about twelve urban governments and examines their energy goals, policies, plans, problems, programs, and governmental relationships.

Minimizing Consumption of Exhaustible Energy Resources Through Community Planning and Design. Anchorage, AK: Alaska Division of Energy and Power Development. Prepared for the U.S. Energy Research and Development Administration; October 1977; Report no. RLO-2332-1. 149 p. $10.00. Available from: NTIS*

Analyzes the costs, environmental effects, and the social and institutional aspects of energy-saving techniques that can be incorporated in the planning, design and construction of new communities.

Phase I. Integrated Community Energy Plan For Riverside, California. Final Report. Columbus, OH: Battelle Columbus Laboratories. Prepared for the U.S. Department of Energy; January 1979; Report no. DOE/TIC-10201. Vol. 1: 272 p. $16.00. Vol. 2: 357 p. $19.00. Vol. 3: 450 p. $22.00. Available from: NTIS*.

Volume one develops an integrated community energy plan for Riverside, California, and a methodology and policy for working with all levels of government. The second volume presents appendices that include material on methodology, energy consumption, and energy conservation. Finally, volume three presents appendices that include material on alternative energy supply, legal and institutional problems, education, community involvement, and aerial infrared photography.

Relationships of Energy to Land Use. Marsha Mackie and Bill Mackie; McMinnville, OR: Yamhill County Planning Department Energy Office; November 1977; 79 p. $2.00. Available from: Department of Planning, Yamhill County Planning Department, 5th and Evans, McMinnville, OR 97128.

Provides energy and land use information for use by local planning and governmental leaders. Also shows ways in which homes, neighborhoods and communities can be made more energy efficient to comply with Oregon's Land Conservation and Development Commission's regulations.

Solar Heat Guidelines: Shadow Run Residential Development. Mike Harlow; Bellevue, WA: Mathematical Sciences Northwest, Inc.; 1979; Report no. MSNW-79-3059. $ Will charge cost of photocopy. Available from: Mathematical Sciences Northwest, Inc., P.O. Box 1887, Bellevue, WA 98009.

Study of the design of a single-family housing development. Design includes active and passive solar features.

State Solar Legislation. Rockville, MD: National Solar Heating and Cooling Information Center: 1979; 15 p. $ No Charge. Available from: National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD 20850.

State-by-state listing of solar legislation on taxation, grants, loans, land use, standards, and building codes now in effect.

Twin Rivers Program on Energy Conservation in Housing: Highlights and Conclusions. Robert H. Socolow; Princeton, NJ; Princeton University. Prepared for the U.S. Department of Energy; August 1978; Report no. HCP/M4288-01. 85 p. $8.00. Available from: NTIS*.

Presents results of a six-year study of energy-saving modifications performed on thirty-one town houses, with identical floor plans, located at a single site.

Articles

'Community Energy System' Seen as Development Incentive in Downtown Trenton. Ann E. Petty, *Journal of Housing.* vol. 35 (no. 1): pp. 23–24; January 1978.

Describes Trenton, New Jersey's co-generation plant which, at the time of the article, was in the planning stages.

Energy Thrift in Urban Transportation: Option For the Future: Margaret Fulton Fels and Michael J. Munson, in the *Energy Conservation Papers,* pp. 7–104. Robert H. Williams, ed.; Ballinger Publishing Co., 17 Dunster, Harvard Square, Cambridge, MA 02138, 1979, 377 pp., $22.50.

Studies the Trenton, New Jersey metropolitan area's projected transportation energy consumption for the last quarter of the Twentieth Century and shows that land use pattern changes can result in reduced energy consumption.

Note

*These publications are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. All orders must be prepaid or charged to an existing account. Please include the report number to insure that your order is filled properly.

Appendix 4
Selected Federal Activities of Interest to Communities

The following list is not comprehensive; the items selected should give an indication of the types of federal activities taking place.

Decentralized Solar Energy Technology Assessment Program

The Decentralized Solar Energy Technology Assessment Program, sponsored by the Office of Solar Energy, Department of Energy, is a technology assessment and planning activity directed at local communities. The program is managed by Oak Ridge National Laboratory. Specifically, the objectives of the program are:

- to assess the socioeconomic and institutional impacts of the widespread use of renewable energy technologies;
- to involve communities in planning for their energy futures; and,
- to plan for local energy development.

The program consists of three types of effort: background studies, community technology assessments, and support studies. The background studies consist of three energy scenarios and an energy primer, all of which were designed to provide communities with a sample of preliminary planning documents for use in community technology assessment.

Four communities have been selected to undertake an assessment-planning exercise to examine the role of solar renewable energy technologies in their future. The communities are the Southern Tier Central Region of New York State; Richmond, Kentucky; Kent, Ohio; and Franklin County, Massachusetts. The support studies were designed to address specific needs of communities or examine the wider, societal implications of the program.

Solar Cities

The Office of Solar Applications for Buildings of the Department of Energy is sponsoring a Solar Cities Program to assist cities and towns with problems of energy supply, economic development, and urban quality. This is to be achieved through the use of conservation and mixed solar technologies in multiple, large-scale building units. The program includes planning and implementation activities aimed at providing:

- urban and community design and technical assistance;
- pilot/demonstration projects and case studies;
- federal, state, and local incentives;
- communication, education, and information;
- analysis and planning.

An example of a Solar Cities effort is the Philadelphia Solar Planning Project. The objectives of this project are:

- To plan and organize a comprehensive program for assessing and achieving the maximum use of solar energy in Philadelphia;
- To increase energy self-reliance, expand employment opportunities, foster economic development, and improve the quality of the environment;
- To determine the feasibility, organizational structure, implementation opportunities, public policies, communication strategies, assessment practices and probable economic and social impacts for a broad range of solar energy applications to buildings in Philadelphia;
- To produce a solar program plan, planning tools, a feasible demonstration program, and the capability of program management as an integral part of Philadelphia's Comprehensive Community Energy Management Program;
- To gain the commitment of city government, private and quasi-public organizations, financial institutions, universities, energy scientists, design professionals, and contractors towards achieving maximum benefit from the application of solar energy in Philadelphia.

Projects are being planned for other cities.

Community Level Studies, Technology Assessment of Solar Energy Systems

In mid-FY 78, the Office of the Assistant Secretary for Environment of the Department of Energy through its Division of Technology Assessments initiated a comprehensive project related to the extensive use of solar energy technologies. The project, entitled *Technology Assessment of Solar Energy Systems* (TASE), will determine the long-range environmental and socioeconomic impacts of solar energy systems. The primary objective of the TASE project is to determine what potential impact the widespread implementation of major solar energy technologies might have on the environment and on the health and safety of the public.

Three community level studies were included as part of the TASE project.

These community level studies are divided into three areas: 1) community impact analysis, 2) threshold impact analysis and 3) solar city end-state analysis. The overall purpose of the studies is to investigate the impacts of various solar-based energy systems on the community environment and its physical and social structure. The studies identify issues and constraints to local and regional application of decentralized solar technologies.

The organization of the studies has been coordinated by Lawrence Berkeley Laboratory. However each of the studies was designed and conducted, for the most part, by outside investigators. The community impact analysis was carried out by a research team from the University of California, Berkeley; the threshold impact analysis was conducted by a team from SRI, International (formerly Stanford Research Institute); and the end-state analysis was undertaken by the Urban Innovations Group of the University of California, Los Angeles.

Local Government Energy Activities

The Assistant Secretary for Policy and Evaluation of the Department of Energy, with support from the Office of Intergovernmental and Institutional Relations undertook a study to gather information on local government energy activities. The objectives of the study were to help DOE understand what energy activities have been undertaken by local governments; the factors influencing the choice and implementation of these activities; relationships among levels of government, and between government and the community; and barriers experienced by local governments in their energy efforts.

DOE was assisted in this work by the National Association of Counties (NACo), the National League of Cities (NLC), and the U.S. Conference of Mayors (USCM), all of whom participated from the beginning of the project. These groups provided liaison with the study sites, reviewed all draft instruments and reports, participated in the training sessions, and helped monitor the data collection process.

Twelve governments in seven sites were selected for their regional, climatic, economic and social diversity. All are relatively large urban areas. In addition, all were believed to have already undertaken at least a moderate level of energy activity. The activities are described in a three volume report.

Comprehensive Community Energy Management Program

The Division of Buildings and Community Systems, Assistant Secretary for Conservation and Solar Applications, Department of Energy is sponsoring a Comprehensive Community Energy Management Program (CCEMP). The purpose of this program is to test the ability of local communities to conduct energy planning and to provide information useful to policy makers and other communities interested in energy planning. The program makes a structured assessment of specific energy goals as they are impacted by local community decisions and by the suppliers of energy to the community. An action plan for energy conservation strategies and an organizational structure to put the plan into effect will be developed. The methodology for the program will be based on the *Comprehensive Energy Planning Workbook* prepared by Hitman Associates (1978).

The communities participating in the program are: Philadelphia and Allegheny County, Pennsylvania; Boulder, Colorado; Dayton, Ohio; Greenville, North Carolina; Janesville, Wisconsin; King County and Seattle, Washington; Knoxville and Knox County, Tennessee; Los Angeles, California; Portland, Maine; Richmond, Indiana; Wayne County, Michigan; South Florida Regional Planning Council; Toledo Metropolitan Area Council of Governments, Ohio; and Greater Bridgeport Regional Planning Association, Connecticut.

Site and Neighborhood Design Program

The Division of Buildings and Community Systems, Assistant Secretary for Conservation and Solar Applications, Department of Energy is sponsoring a Site and Neighborhood Design Program. This program is focused on case studies of new-town design and development that use state-of-the-art techniques in energy conservation, community design, and land-use planning. The purpose of the program is to incorporate energy planning into the land development process. Energy conservation, community heating systems, passive solar design, waste heat use, solar thermal, and biomass will be considered as applicable in each case study.

The new towns selected for the case studies are: Burke Center, Virginia; Greenbriar, Virginia; Shenandoah, Georgia; Radisson, New York; and Woodlands, Texas.

SERI Community Studies

The Community and Consumer Branch at the Solar Energy Research Institute is conducting community studies in several areas. These include land use assessments, solar envelope analysis, ownership and management alternatives, activities directories, and the Community Renewable Energy Systems Conference. Other parts of SERI also conduct research or provide information on issues of interest to communities.

HUD Publication on Solar Access

The U.S. Department of Housing and Urban Development, in cooperation with the Department of Energy have produced three reports of potential interest to developers, architects, and local officials.

1. Site Planning for Solar Access—available from the U.S. Government Printing Office.
2. Protecting Solar Access for Residential Development—available from the U.S. Government Printing Office.
3. Solar Access Law—available from Ballinger Books.

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