November 2000 • NREL/SR-5500-65343

Subcontractor Report

Next Steps on the Road to Zero Energy Buildings

Report on October 23-24, 2000 Meeting Held at the National Renewable Energy Laboratory, Golden, Colorado

Jerry Comer
Comer & Associates, LLC
Boulder, Colorado

NREL Technical Monitor: Tim Merrigan

National Renewable Energy Laboratory

1617 Cole Boulevard
Golden, Colorado 80401-3393

NREL is a U.S. Department of Energy Laboratory
Operated by Midwest Research Institute • Battelle • Bechtel

Contract No. DE-AC36-99-GO10337

NOTICE

Available electronically at http://www.doe.gov/bridge

Available for a processing fee to U.S. Department of Energy
and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: reports@adonis.osti.gov

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

Printed on paper containing at least 50% wastepaper, including 20% postconsumer waste

Next Steps on the Road to Zero Energy Buildings

- Report on October 23 – 24, 2000 Meeting Held at the National Renewable Energy Laboratory, Golden, Colorado

Prepared For:

National Renewable Energy Laboratory

By:

Comer & Associates, LLC	Boulder, Colorado	888-950-3190

Table of Contents

Introduction

This report summarizes a 2 – day meeting held October 23 – 24, 2000 at the National Renewable Energy Laboratory in Golden Colorado. Approximately 60 individuals attended the meeting from the following segments:

- Building industry,
- Solar thermal manufacturers (solar hot water, SHW),
- Photovoltaic manufacturers (PV),
- Generalists (consultants and interested parties involved in renewable energy),
- National Renewable Energy Laboratory (NREL) and Sandia National Laboratory (SNL), and
- US Department of Energy.

The objectives of the meeting included:

- Acquaint attendees with the Zero Energy Buildings (ZEB) goal,
- Determine the most cost effective methods of incorporating solar technologies in production-built homes,
- Identify “make or break” areas to focus on,
- Outline 6 month, 1 year, 5 year strategies and tactics, and
- Create action plan with designated responsibilities.

The format of the meeting was designed to maximize interaction between all attendees and to create a “working” environment where a roadmap and action plans to support ZEB efforts would be created. Presentations the morning of the first day set the context for the discussions and breakout sessions that followed. The agenda was modified at the end of the first day of meetings to reflect the input of attendees. The revised agenda is included in the Appendix.

Meeting Summary

Goal

The overall goal is to introduce and build Zero Energy Buildings on a broad scale within the next 10 years.

Presentations

Presentations were made as detailed in the agenda. Key topics covered included:

- Viewpoint from Pulte Homes – John Gallagher
- Zero Energy Buildings – Craig Christensen
- Systems Approach to Value Analysis/Value Engineering – Randy Folts with homebuilder perspectives from Ryan Green and Steve Doane
- Solar Thermal Technologies – Les Nelson
- Photovoltaic Technology – Marc Roper
- Whole Building Concept and Process – Danny Parker

Identification of Barriers

The group identified the following *major* barriers to adoption of renewable technologies that impact the marketplace right now and will impact efforts to implement a ZEB strategy:

- How can we **market** renewable technologies and ZEB?
  - What is the "value proposition" for renewable technologies and ZEB?
  - What consumer information is available to influence market?
  - How does the hardware and building industry get renewable technologies and ZEB accepted as "normal"?
  - How can we get homebuyers to invest time and money in renewable technologies and ZEB?

- What is the **cost** of renewable technologies and ZEB?
  - Absolute cost,
  - Payback,
  - Mortgage qualification considerations.
- **Installation** issues:
  - Inconsistent or poorly written building codes; local jurisdictions,
  - Codes, covenants and restrictions (CCR's) in covenant communities,
  - Education of building inspectors,
  - How integrate renewable technology products with existing building industry trades: electricians, plumbers, roofers, framers, etc.
- **Liability** issues:
  - Failure of components can lead to liability questions over the specific hardware or damage to the home.
- **Maintenance** issues:
  - Life expectancy of components and cost of maintaining them is not well known.

In addition, the group identified the following minor[1] barriers to adoption of renewable technologies:

- Overall **value** of the home with renewable technologies?
  - What is the value over time?
- **Competition** of competing energy technologies.
- **Aesthetics** and acceptance of the equipment by the consumer.

[1] Some of the identified issues in this category are not at all "minor" but the team felt this group was less critical than the "major" grouping.

The group further identified the following areas where improvements could be made today. Such improvements would directly contribute to ZEB efforts.

• Marketing and education	• Overall load reduction
• Low energy cooling	• Greater use of SHW and PV now
• Training inspectors	• Greater use of passive solar
• Home design for efficiency	• Home siting/orientation
• Peak load reduction	

In addition, ZEB efforts could be enhanced by:

- ❖ More proactive federal, state and local policies supporting renewable technologies and ZEB concepts.
- ❖ Greater focus on the issue of total "embodied energy" in building materials.

Breakout Sessions

Based on the issues identified in the previous section, five "breakout" teams were established to address different issues. Each team was requested to select a chairperson, discuss/brainstorm their issue and to make a 15 minute presentation on their findings to the plenary session.

Marketing

Presenter: Doug Seiter

The challenge:

How do we capture the attention of the homebuyer market so that people:

- ❖ Ask for the energy efficient/renewables package, and
- ❖ Pay for it.

Possible solutions:

- ❖ The "hero" builder:
  - ➢ Takes the lead,
  - ➢ Passionately promotes energy efficient/renewables packages,

- Reaps the benefits of increased sales.

❖ A national promotion that moves the market:

- Creates sense of urgency in home buying public, or
- Presents benefits that are compelling for now and the future.

❖ ZEB is not an option but is standard:

- (If you don't want it we'll give you a credit.)

❖ Use focus groups to come up with a better name.

Economics

Presenter: Randy Folts

❖ Economics and marketing are joined at the hip.

❖ Efficiencies first. Create a favorable package of measures that increase value of home.

❖ Emphasize positive cash flow as opposed to "payback".

❖ Economic argument may be augmented by non-monetary benefits; comfort, security, reliable power supply, etc.

❖ Economics must consider future risks and trends.

❖ Utility rate structures (gas and electricity) will greatly influence economics.

❖ More R&D to lower costs.

Technology

Presenter: Les Nelson

❖ Information development, transfer and display will help to overcome several barriers to the adoption of more efficient building practices, particularly in the following areas:

- Planning/guidelines (tools for educating local and state building officials regarding building techniques and practices needed to achieve Zero Energy Buildings),
- Glazing (Builders are frequently overridden by local building officials who can dictate the quantity and placement of windows, frequently requiring

more than the builder would prefer and good energy efficiency practices would dictate, facing in non-optimal directions for the purposes of passive solar gain; i.e. significant north facing window area, for example)

- Legal documents (Covenants, Codes & Restrictions (CC&R's) and other requirements such as bylaws may restrict the installation of features required to achieve the ZEB goal, such as solar energy systems on roofs),
- Siting (ZEB homes will almost certainly require a passive solar heat gain component, with a significant south facing window exposure, and conventional housing development layout practices do not take this need into consideration. Rather, the same model home will typically be situated facing all four points of the compass in order to accommodate as many homes as possible on a given piece of land)
- Architecture (interior wall, window and space conditioning ducting placement, as well as exterior roof configuration, including adequate south facing roof space not broken up by gables and hips, should be incorporated into the building design),
- Aesthetics (To the extent possible, ZEB homes should not appear significantly different than conventional homes built today. Solar systems should be as unobtrusive as possible, and passive solar building techniques should not result in a significantly different exterior appearance)
- Materials, durability (Products used in ZEB construction must not have unusually high failure rates, as one of the biggest headaches for builders are call-backs for repairs, and in some cases lawsuits over perceived or real construction or product defects)

❖ Pilot program(s):

- Testing (How close to a ZEB can a pilot building get, and what are the building techniques and systems/appliances needed to get there. Pilots should produce hard data in these areas)
- Material science (Pilots should highlight the use of materials needed for ZEB, if any, which are not currently used by the building industry in significant quantities, and carefully document the advantages and disadvantages associated with their installation and use)

- Durability(Pilots should carefully document the durability and longevity of the various non-conventional building techniques and appliances/systems used in ZEB structures)

- Multiple climate zones (ZEB building practices will differ considerably based on the geographical location. Any pilot program should involve projects incorporating the features needed to achieve ZEB based on warm and cold, sunny and cloudy, and humid and dry climates, in order to demonstrate the techniques required for each situation)

Infrastructure/Institutional

Presenter: Mike Hogdson

Issues:

- Lack of political will.
- Lack of integration between disciplines.
- Mainstream into codes and standards:
  - Suppliers,
  - Installers.
- Local jurisdictional requirements.
- Risk assumption:
  - Builders,
  - Financial,
  - Insurance,
  - Utilities,
  - Home owners.
- Utilities:
  - Competition,
  - Safety net.
- Define ZEB.

Recommendations:

- Define/consensus on what ZEB is. Change name.
- To address lack of political will, develop coordinated advocacy for ZEB driven by private parties.
- Identify model to integrate disciplines involved in new home construction; e.g. Build America for ZEB.
- Mainstream ZEB into codes and standards:
  - Educate local inspectors,
  - Develop action plan to implement favorable codes,
  - Develop training and certification for existing suppliers and installers in the home construction industry.

Incentives/Drivers

Presenter: Brad Oberg

Primary:

- Awareness/education of buyers, builders, inspectors, appraisers, realtors, etc.
- State, federal or local buy downs.
- Tax incentives.
- Net metering, capturing "time of day" value.
- Real estate industry recognizing value of energy efficiency and renewable energy.

Secondary:

- Pre-plumbed, pre-wired houses; solar-ready.
- State Renewable Portfolio Standards.
- Permitting incentives.
- Incentives for local generation.
- Emission credit system for energy efficiency and renewable energy.
- Negawatt credit.

- Simplify the complexity of SHW, PV systems.
- Insurance incentives.
- Cash back to buyer.

Mid-Session Questions

At the end of the first day, the entire audience was asked what issues should be addressed in support of the ZEB goal. The following inputs were offered and incorporated in plans for the second day of the meeting:

- Discuss market and technology issues.
- Discuss market transformation and education.
- Discuss a high-visibility pilot program.
- Develop list of 5 issues to solve for builders that, if solved, would greatly increase the use of SHW and PV equipment in new home construction.
- Define what would be needed for a builder to support a decision to put SHW and/or PV in a 20-home subdivision as a standard feature.
- Develop recommendations on how to spend DOE resources.
- Discuss and plan for a small working group to both continue development and to promote the concept of ZEB.

ZEB Tasks

At the beginning of the second day of the meeting and building on the inputs from the first day, Tex Wilkins (DOE) outlined a proposed series of tasks in support of ZEB.

Task #1: Design – Pilot Projects

Goals:

- Year 1 – Establish 4 ZEB "partnerships" in different parts of the country.
- Year 1 – Design "best" ZEB that is practical. Must be X% better than best state building code (or Energy Star) and must include SHW and PV.
- Year 2 – Implement pilot projects on 1 – 2 homes/builder. Evaluate pilot project home performance.
- Year 3 – Expand project to 10 – 20 homes/builder. Evaluate home performance. Plan next step(s) to ZEB.
- Year 10 – Nationally, X thousands/year of ZEB homes are built.

Input from Group:

- "Hero" builders – if a select group of builder will take the lead, other builders will follow.
- Pilot projects – a good target would be 10 – 30 homes in 2 – 4 locations.
- Need to lower risk to builders, buyers.
- Possible option is to joint venture with a state government or municipalities. Mainstream the pilot home in 3 – 4 locations and use as a model for further technical and market development.
- Need to educate homebuyers, realtors, appraisers, etc.
- Need to market SHW, PV (now) and ZEB (future) as a package.
- Ideally, ZEB should be standard on every home.

Approach to Task #1:

- DOE lets 3 – 4 competitive contracts to industry teams (builders, developers, suppliers, etc.) for ZEB designs. Teams *may* partner with states and/or local municipalities.

Task #2: Market Research

Goals:

- Year 1 – Develop new name for ZEB that can be used in future branding efforts. Research future building trends that will impact ZEB. Define "benefits" that will enable ZEB to be broadly adopted in new home construction.
- Year 1 – Establish "value" of first step ZEB homes. Provide input to Design team.
- Year 2 – Develop promotional materials suitable for ZEB (generic).

Input from Group:

- Need national promotion that moves the market.
- Can use focus group to develop new name.
- Consider future risks, trends.
- Define ZEB.
- Awareness and education of market participants is critical. (Home buyers, builders, inspectors, realtors, appraisers, etc.)

Approach to Task #2:

- Use focus groups and/or public relations firms.

Task #3: Analysis

Goals:

- Year 1 – Determine "best" mix of technologies and design for 4 representative sites.
- Year 1 – Develop modeling tools, or modify existing models, to be used with ZEB.

Input from Group:

- Determine best package of measures.
- Emphasize cash flow.
- Develop tools and guidelines for design.
- Integrate disciplines (e.g. technologies, design).
- Work with "Building America".

Approach to Task #3:

- Use National lab(s) and select external sub-contractors to obtain necessary expertise.
  - Tie results to Design task.
  - Evaluation of "old" systems to determine present value. Provide information to appraisers relevant to Design task.

Task #4: Coordination

Goals:

- Change name.
- Define goals for ZEB.
- Create 5-year roadmap.
- Establish 2 – 4 comprehensive partnerships.

Input from Group:

- Develop partnerships with states, municipalities.
- Create mechanism for integration of disciplines.
- Mainstream codes and standards.
- Change name of ZEB.
- Coordinate advocacy at DOE, Congress.
  - Tax incentives
- Coordinate with "Building America".

Approach to Task #4:

- All interested parties work to create strategic partnerships.

Builders Panel

One of the revisions to the original agenda was the addition of a moderated[2] "Builder/Supplier Panel" on Tuesday morning. The intent of the panel was to provide a forum for discussion between builders and suppliers of renewable hardware. The panel members consisted of:

Randy Folts; Pulte Homes	Ryan Green; Shea Homes
Mike Hodgson; Consol	Brad Oberg; IBACOS
Doug Seiter; Built Green Colorado	Joe Lstiburek; Building Science Corp.

Jerry Comer (moderator)

The panel was asked to think in terms of 1 – 2 years and what it would take to install as much SHW and PV "current technology" as possible as a *step* on the way to a ZEB future. Questions posed to the panel to initiate conversation included:

- What do **builders** need to install:
  - SHW?
  - PV?
  - Energy efficiency?
- What do **PV and SHW manufacturers** need from builders to facilitate the purchase and installation of PV and SHW in new home construction?
- What **other entities** could/should be involved in ZEB effort?

[2] Each panelist had 2 – 3 minutes for opening comments. Questions were then posed to the panel by the moderator and the audience was invited to ask questions and engage in dialogue.

Key points from the *builder perspective*:

- The home building industry is highly competitive. It looks at $/square foot to produce a home. Anything that drives that up is bad. This is a "big issue".
- When asked what cost a builder would need to see for PV and SHW, Ryan Green suggested that for a $300K home, he would need to see:
  - PV: installed net cost (to builder) = $4,000
  - SHW: installed net cost (to builder) = $1,000
- Builders *can't* sell energy efficiency and they *don't* sell PV and SHW.
- Builders try to sell a *systems approach*: comfort, health, durability, security.
- The building industry wants help from the PV and SHW industry:
  - Do something to prove you can facilitate sale of 2 houses/week.
  - Run focus groups. *Prove* the market for PV and SHW exists.
- Selling PV and SHW means selling, (in order of importance):
  - Consumers[3],
  - Sales and marketing people at home builder,
  - Home builder upper management.
- Regarding the Essential Energy (EE) home concept:
  - Panel could not specify what price might be acceptable to consumers.
  - Suggested that California would be a good place to introduce EE concept.
  - To be successful, EE package must be standard part of offering.
- Should incentives go to homebuyers or homebuilders?
  - Home buyers (Ryan Green),
  - Home builders (Joe Lstiburek).
- The proliferation of complex roofs is a problem for adoption of SHW and PV technology. Factors driving such roofs include customer demand and the regulations imposed by municipalities. Each have roughly equal influence on the design and build process. A significant municipal factor is the level of sophistication of the local jurisdiction for building codes and inspections.

[3] There was general consensus that the mindset of the consumer must be changed. Consumers must *demand* SHW and PV for broad application of these technologies.

Key points from the SHW and PV *manufacturer perspective*:

- Need a "solar-ready" roof.
- Need a "solar-friendly" mechanical room for installation of hardware.
- Need a champion (visionary) in builder management.
- SHW and PV equipment manufacturers need insight as to how to get their products into the mix of products offered by homebuilders.
- Suggestion: offer a home that has, as an option, design features that make it ready for solar technology; brand as "Designed Home for Solar".

Miscellaneous points:

- An important catalyst for the use of SHW and PV technology exists if a favorable business climate is established. The example of what has been done at the Sacramento Municipal Utility District (SMUD) was offered. The existence of a "champion" in such a situation was viewed as critical.
- Other entities that could/should be involved in expanding demand for SHW and PV and, ultimately, ZEB include:
  - Architects, home designers,
  - Utilities,
  - Financing community,
  - City and county building officials,
  - Appraisers,
  - Realtors,
  - Building industry marketing expert(s),
  - Insurance,
  - State Office of Energy,
  - Federal government.
- Suggestion: pick a few places (San Diego?) and run a comprehensive and detailed pilot program involving EE participants. Let the core team members (builders, hardware suppliers, government lab representatives) decide on who else needs to be involved and how to involve them.

- Ideally, the broader adoption of PV and SHW and the ultimate acceptance of EE or ZEB concepts would follow a national "buy down" program or some form of national mandate or leadership effort in this area.

Pilot Project RFP

It was suggested that an important contribution that DOE could make to the ZEB effort would be to issue a Request for Proposal seeking competitive proposals for the design of ZEB homes. Elements of the RFP might/should include:

- Broad team approach.
- Selection criteria based on:
  - Team members (qualifications, industries represented),
  - Technologies used,
  - ZEB design proposal (technical merit and expected performance),
  - Inclusion of a near-term, first-step construction proposal to demonstrate feasibility,
  - Leveraged funds/partners (state, local, utilities, etc.),
  - Number of homes,
  - Market sustainability.
- RFP must define public information requirements.
- Allow respondents approximately 2 months to respond.
- Create web site for interested team members to connect and partner.
- Include technology and market analysis elements.
- Iterative RFP approach.

Committees

Coordinating Committee

The ZEB effort is being led by a coordinating committee consisting of:

Tex Wilkins; DOE	John Gallagher; Pulte Homes
Randy Folts; Pulte Homes	Les Nelson; Western Renewables Group
Tim Merrigan; NREL	Rose McKinney-James; Faiss Foley Merica
Craig Christensen; NREL	

In anticipation of ongoing activity in support of ZEB, meeting participants were asked to express their interest in advisory committees that *may* be formed. Participants signed up for the following possible committees.

Analysis Committee

Dick Bourne; Davis Energy Group	Brad Oberg; IBACOS
Wendy Bensley; Millennium Energy	Danny Parker; FSEC
Mike Hodgson; Consol	Byard Wood; SRCC
Josh Plaisted; Sun Earth	Joe Bourg; Millennium Energy

Pilot Project Committee

Mac Moore; BP Solar	Brad Oberg; IBACOS
Steve Strong; Solar Design Assoc.	Danny Parker; FSEC
Pat Osborne; COSEIA	Ryan Green; Shea Homes
Scott Anders; San Diego Energy Office	Tom Bohner; Sun Systems
Mike Hodgson; Consol	Byard Wood; SRCC
Josh Plaisted; Sun Earth	Joe Bourg; Millennium Energy
Dick Bourne; Davis Energy Group	Rick Reed; Sun Earth

Wendy Bensley; Millennium Energy	Ray Kosanke; Kyocera Solar

Marketing Committee

Pat Osborne; COSEIA	Joe Bourg; Millennium Energy
Wendy Bensley; Millennium Energy	Ray Kosanke; Kyocera Solar
Mike Hodgson; Consol	

Partnerships Committee

Pat Osborne; COSEIA	Doug Seiter; Built Green Colorado
Tom Bohner; Sun Systems	Terri Walters; NREL
Joe Perkowski; NREL	

Other committees suggested for consideration included:

• Roadmap to ZEB	• Technology R&D
• Political	• Codes and Standards

Appendix

Information

This report was prepared by Comer & Associates, LLC. Additional information can be obtained by contacting:

Jerry Comer
3450 Penrose Place, Suite 240
Boulder, CO 80301
303-786-7986
888-950-3190 (toll free)
Jerry@ComerAssociates.com
www.ComerAssociates.com

Meeting Agenda

Next Steps on the Road to Zero Energy Buildings

Monday, October 23, 2000 and Tuesday, October 24, 2000

Marriott Hotel – 1717 Denver West Blvd. – Golden, Colorado (303) 279-9100
I-70 Exit 263 Denver West Boulevard
Dress: Business Casual

Objectives:

- Acquaint attendees with the Zero Energy Buildings goal
- Determine the most cost effective methods of incorporating solar technologies in production-built homes
- Identify "make or break" areas to focus on
- Outline 6 month, 1 year, 5 year strategies and tactics
- Create action plan with designated responsibilities

Facilitator: Jerry Comer – Energy Alliance Group

Monday October 23, 2000

Time	Event	Who	
7:30 AM	Continental Breakfast		30 min
8:00 AM	Agenda/Introductions	Tex Wilkins/All	15 min
8:15 AM	Welcome/ Desired Outcome/DOE role	Jim Rannels	15 min
8:30 AM	Viewpoint from Pulte Homes	John Gallagher	20 min
8:50 AM	ZeroEnergy Buildings – What are they and how they would work	Craig Christensen	40 min
9:30 AM	The Systems Approach to Value Analysis/Value Engineering	Randy Folts	40 min
10:10 AM	Break		15 min
10:25 AM	Solar Thermal technologies (water heating, space heating)	Les Nelson	30 min
10:55 AM	Photovoltaic technology (electricity)	Marc Roper	30 min
11:25 AM	Whole Building Concept and Process	Danny Parker	35 min
12:00 Noon	Lunch (Provided)		60 min
1:00 PM	Identification of barriers to using and integrating renewable technologies into home construction	Group Discussion and Brainstorm	60 min

(Continued on Next Page)

2:00 PM	Breakout Sessions – Ways to overcome barriers	All	60 min
3:00 PM	Break		15 min
3:15 PM	Breakout Sessions Reports (Spokesperson appointed by Breakout Group members)	Individual Spokespersons	90 min
4:45 PM	Wrap up	All	15 min

5:00 PM Reception at NREL Visitor Center
Appetizers Sponsored by Astropower
Refreshments Sponsored by Louisiana Pacific

6:00 PM Dinner following Reception (for those interested, on your own) at The Old Capital Grill, 1122 Washington, Golden, CO (Corner of 12th and Washington, 303-279-6390)

Tuesday, October 24, 2000
(as revised based on inputs collected at end of 10/23 session)

7:30 AM	Continental Breakfast		30 min
8:00 AM	FY01 Preliminary Goals and Plans	Tex Wilkins	60 min
9:00 AM	Break		15 min
9:15 AM	Builder/Supplier Panel: What do Builders Need?	All	90 min
10:45 AM	Break		15 min
11:00 AM	Identification of Goals	All	60 min
12:00 Noon	Lunch		60 min
1:00 PM	Breakout Sessions: Committee Organization	All	90 min
2:30 PM	Reports from Breakout Sessions	All	45 min
3:15 PM	Concluding Comments	Tex Wilkins	15 min
3:30 PM	NREL Facility Tour	Anyone Interested	