

# ENERGY MATTERS

OFFICE OF INDUSTRIAL TECHNOLOGIES

Summer 2002

**ISSUE FOCUS:**  
Reaching Emerging Managers

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## The Human Side of Energy Efficiency: The Value of Training

By Rachel Madan  
Industrial Program Associate  
Alliance to Save Energy

When pursuing energy efficiency projects, what is the best way to proceed? On the one hand, it is fairly easy to demonstrate payback times for technical solutions, such as installing heat economizers, back-pressure turbines, or efficient motors.

On the other hand, many plant managers concentrate their efforts largely on technical improvements. This sometimes may leave untapped a part of the savings

that can be gained through the low-risk, low-tech solution of training for proper maintenance and operation.

Plant managers have often focused on technical innovations. These generally have led to greatly improved energy efficiency since the 1973 oil embargo. In fact, energy intensity (energy use per unit of production) in the manufacturing sector fell steadily from 1973 to 1985, when it stabilized. Reductions in energy intensity increased again in 1993.

*(continued on page 2) ▶*



David Parsons, NREL/PIX 07267

**To make training successful, managers must be committed, proactive, and supportive, with both their attitudes and their funding.**

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## The Value of Training *continued from page 1*

Even with this remarkable track record, facility managers can rely on technical solutions to solve only some energy use problems. Many problems stem from a lack of training related to system optimization or from ineffective training programs. Establishing an effective, low-cost, low-tech training and maintenance program within a plant can have a fast payback and lasting results.

The true value of training (not only for improving energy efficiency but also for improving the bottom line) can sometimes be underestimated if it is perceived as a cost, rather than an investment. However, investing in a training program may improve energy efficiency, minimize costs, increase profit, and improve productivity and reliability, not to mention enhance operational safety.

A study conducted by the American Society for Training and Development found that training investments across all sectors could yield favorable financial returns for firms and their investors. This study found that an increase of \$680 in a firm's training expenditure per employee generated, on average, a six-percentage-point improvement in total shareholder return the following year, even after controlling for other factors.

To help managers break through barriers when trying to implement training programs, it is important to extrapolate the benefits of any energy-efficiency improvements to other areas of the company. For instance, training staff to implement a steam trap maintenance program will increase the efficiency of a steam system—but more importantly, it will save the company money through increased reliability and productivity of the system.

Perhaps the most obvious and important benefit of training is improving a plant's safety record. For example, beginning

in 1998, Weirton Steel Corp. undertook a series of training initiatives, including safety-awareness training, hands-on workstation training, and certifying all plant supervisors in the Occupational Safety and Health Administration's (OSHA's) General Industry Standards. As a result, recorded incidents fell 63% from 1997 to 2000. Other intangible factors, such as attitude, improved. In 1997, 15% of Weirton Steel Corp. employees surveyed believed that their own actions could protect their co-workers. In 2000, 60% believed this to be true.

A properly trained staff is also key to maintaining reliable equipment, which

also increases productivity. For example, in 1990, U.S. Steel began a comprehensive predictive maintenance program to improve maintenance practices and lower maintenance costs. The program focused on employee involvement, training, and team activity. Misalignments of rotating equipment dropped from 15% in 1990 to 1% in 1996. Success such as this led to

the company receiving the 1993 and 1995 National Maintenance Excellence Award for maintenance and equipment reliability.

In essence, while energy efficiency may be a key goal of a training program, the value of safety, reliability, productivity, and cost savings need to be emphasized to those who have the power to implement such a program. To execute a successful training program, managers must be committed, proactive, and supportive, with both their attitudes and their funding. Training must be treated as a fundamental requirement of comprehensive management. The rewards are great for such support. ●

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**INVESTING IN A TRAINING PROGRAM MAY IMPROVE ENERGY EFFICIENCY, MINIMIZE COSTS, INCREASE PROFIT, AND IMPROVE PRODUCTIVITY AND RELIABILITY.**  
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*For more energy-efficiency information, visit Energy Matters Extra at [www.oit.doe.gov/bestpractices/energymatters/emextra](http://www.oit.doe.gov/bestpractices/energymatters/emextra)*

## IACs Benefit Industry and Young Engineers

By Bill Clark

Executive Director

University City Science Center

The Industrial Assessment Center (IAC) program, funded by the U.S. Department of Energy, provides small- and medium-sized manufacturers with no-cost individual assessments of their plant's energy, waste, and productivity efficiency, followed by recommendations for specific cost savings.

These assessments are conducted by engineering faculty and students of IACs hosted by 26 universities across the United States. OIT sponsors the program as part of its efforts to transfer energy-efficient and environmentally sound practices and technologies to U.S. industry.

Assessments are provided at no direct cost to participating manufacturers, who are under no obligation to act on any recommendations. On average, recommended actions from an assessment result in annual cost savings of about \$55,000. The university-based IAC team typically conducts the assessment during a 1- or 2-day site visit. Within 60 days they will send a report to the client detailing their analyses, findings,

- Universities interact with local industry to maintain a practical orientation in their engineering curriculum and develop productive relationships.

- Faculty benefit by receiving hands-on experience in the application of technical education in a working industrial environment, and often incorporate lessons learned into the curriculum to benefit additional students. Faculty have also developed ideas for research from their studies of manufacturing processes by

- implementing IAC team recommendations, the program also generates opportunities for energy service companies, equipment manufacturers, vendors, and suppliers
- implementing energy efficient technologies, reducing green house gases, and reducing waste achieve environmental benefits.

### A Vital Role

But perhaps the greatest long-term benefit is the effect on engineering students who will utilize the skills learned from IAC experience throughout their careers.

Many IAC graduates credit their experience with the IAC program as having shaped their career paths. Greg Kelleher, a recent graduate from the IAC at Oregon State University, wrote to his former Director in a letter of appreciation: "I went to work for the Industrial

Assessment Center to get practical engineering experience. I got much more out of the IAC than what I had expected.... The IAC played vital roles both in funding my education and in helping me land an excellent career position in the energy management field. In short, nothing from my graduate study at Oregon State has influenced my life more positively or profoundly than my experience as a student worker at the IAC."



David Parsons, NREL/PIX 05562

*Since its inception, in 1976, more than 2,000 students have participated in the IAC program.*

Other follow-up contacts also indicate that the education offered through the IAC program is invaluable. Interviews performed with IAC alumni show that a disproportionately large segment pursue careers in energy fields and continue to make significant contributions in the energy, waste, and productivity areas.

### High Retention Rate

A recent survey completed by Oak Ridge National Laboratory shows that one out of every four graduates of the IAC program stays in the field and continues to help manufacturers save energy and reduce costs. Recently, program management has begun to track the accomplishments of IAC alumni. In 2000 it was estimated that all program graduates combined saved more than 15 trillion Btu during that year. The alumni have also made significant contributions by identifying clients who can benefit from an IAC assessment, providing valuable feedback to program management on how the program and educational value can be improved, and by acting as mentors for the current class of IAC students.

The program provides engineering students valuable hands-on training and experience in energy, waste, and productivity management. Students are involved in almost all components of center operations with primary focus on conducting

*(continued on page 4) ►*



*An IAC student helps perform a plant energy efficiency assessment.*

and recommendations. In 6 to 9 months, follow-up calls are made to the plant manager to obtain implementation results.

The program benefits many parties.

- Manufacturers receive unbiased technical assistance at no direct cost that helps them become more competitive in the global marketplace as a result of implementing cost-saving measures recommended by the IAC teams.



assessments (under the supervision of engineering faculty) and preparing engineering reports for the clients served. Students who participate in the program receive practical experience in a variety of manufacturing settings. They develop improved communication and teamwork skills and also a heightened awareness of energy efficiency, pollution prevention, and productivity enhancement. Finally, the students employed by the IACs are able to earn income to help defray their educational expenses.

Since its inception in 1976, more than 2,000 students have participated in the IAC program. Currently, about 250 students are trained each year. The training each student receives augments his or her traditional engineering education. Prior to their first industrial assessment, students are trained in assessment methodologies, instrument use, safety, and common industrial energy uses, such as air compressor systems, motors, boilers and steam systems, pumping systems, and lighting. Potential energy-conserving and cost-saving recommendations are highlighted and methods to estimate the potential conservation and cost savings are presented.

### New Training

Throughout their employment with the IAC, students acquire training in a variety of energy efficiency topics and learn how to apply that training to solve problems encountered in a variety of manufacturing settings. Students are provided the opportunity to hone the skills employers seek, such as working independently as well as in groups, communicating in both written and oral forms, and applying knowledge and available technology to solve real world problems. In addition, this summer, the majority of IAC students will receive formal BestPractices training. The IAC students regularly utilize OIT's BestPractices Software Tools in completing their assessment work. This training will make the students even more proficient in using these tools.

To find out if your company is eligible to benefit from the IAC program, check the IAC Web site at [www.oit.doe.gov/iac/](http://www.oit.doe.gov/iac/). ●

## New Steam Sourcebook Guides Users to Improved Performance, Lower Costs

If you would like to improve your industrial steam system's performance and access some practical guidelines and helpful resources, check out a new OIT publication—*Improving Steam System Performance, a Sourcebook for Industry*. It offers valuable performance-enhancing information to both the novice and experienced steam system manager.

Often, operators are so focused on the immediate demands of the equipment, they overlook the broader question of how system parameters affect the equipment. This sourcebook shifts the focus from individual components to total system performance. In this systems approach, steam managers analyze the supply and demand sides of the system and how they interact.

The sourcebook has three sections, covering the following topics.

### Steam System Basics

To help users become more familiar with the basics of steam systems, or for users seeking a refresher, a brief discussion of the terms, relationships, and important system design considerations is provided. It describes four basic components of steam systems: generation, distribution, end use, and recovery.

### Performance Improvement Opportunities

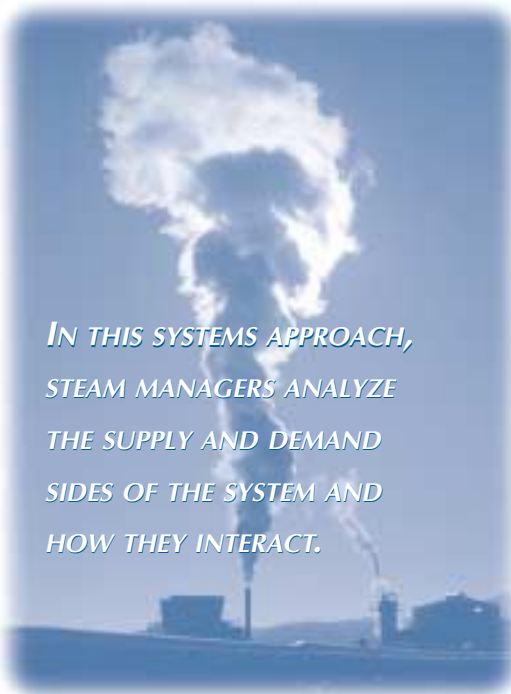
This section discusses specific opportunities to improve steam system performance and to lower operating costs. It also provides an overview of the finance considerations related to steam system improvements. Topics include understanding corporate priorities, measuring the dollar impact of steam efficiency, financing steam efficiency improvements, and relating steam efficiency to corporate priorities.

Additionally, this section discusses several resources and tools developed by the U.S. Department of Energy's BestPractices Steam Program to identify and assess steam system improvement opportunities. These include:

- Steam System Scoping Tool—a spreadsheet program that helps assess steam systems
- Steam System Survey Guide—a reference document that gives technical guidance on identifying and assessing many potential steam improvement opportunities

- 3E Plus Insulation Appraisal Software—a program that teaches the benefits of insulation and assists in assessing insulation opportunities
- Steam Tip Sheets—documents that provide concise descriptions of common steam system improvement opportunities.

In addition, the sourcebook covers the National Insulation Association's (NIA) Insulation Appraisal Program. It offers certification to professionals who conduct insulation appraisals or specify insulation requirements.



*IN THIS SYSTEMS APPROACH,  
STEAM MANAGERS ANALYZE  
THE SUPPLY AND DEMAND  
SIDES OF THE SYSTEM AND  
HOW THEY INTERACT.*

### Programs, Contacts, and Resources

In this section, OIT has listed associations and other organizations involved in the steam system marketplace. Plus, it provides a description of the BestPractices Steam Program, a directory of contacts, and a listing of available resources and tools, such as publications, software, training courses, and videos.

So don't delay! The sooner you learn about the available steam system improvement opportunities, the sooner your company could begin improving the bottom line. *Improving Steam System Performance, a Sourcebook for Industry* can be ordered by calling the OIT Clearinghouse at 1-800-862-2086. A PDF version of the sourcebook is also available on the BestPractices web site at [www.oit.doe.gov](http://www.oit.doe.gov).

## Steam System Awareness Tool in Development

BestPractices Steam is developing a new tool that will assist those responsible for steam system improvements to demonstrate key steam system improvement opportunities in terms of energy savings and emission reductions.

In many companies, the benefits of improved steam system efficiency are calculated using an established in-house price for steam. This value is often an average price for steam so that over the course of a fiscal year the books can be balanced and the cost of steam generation recovered.

Such a charging structure, however, may not be the most appropriate for system improvement project evaluation. When evaluating potential improvements to the steam system, it is essential that the true incremental cost of steam be used. The most accurate way to analyze potential

steam system savings is to build a model that accurately represents what takes place when changes are made to the system. With such a model, any number of what-if steam system improvement scenarios can be evaluated.

The Steam System Awareness Tool (SSAT) model will be a graphic representation of a generic steam system containing key features and variables to be analyzed. The model will contain a number of potential steam system improvement projects including:

- Real cost of steam
- Steam quality
- Boiler efficiency
- Alternative fuels
- Cogeneration opportunities
- Steam turbine vs. PRV
- Boiler blow down
- Condensate recovery

- Steam trap operating efficiency
- Heat recovery
- Vent steam
- Steam leaks
- Insulation efficiency
- Actual emission calculations
- Next step action list.

BestPractices Steam is developing the Steam System Awareness Tool through a cost-sharing partnership with Spirax Sarco and Linnhoff March. An initial version of the tool, suitable for technical review, was to be completed in July. The final release version of the SSAT model, including a detailed users instruction manual, is anticipated for early in the fourth quarter of 2002. For more information, contact the Information Technologies Clearinghouse at 1-800-862-2086, or Fred Hart, BestPractices Steam Systems, at [fred.hart@ee.doe.gov](mailto:fred.hart@ee.doe.gov). ●

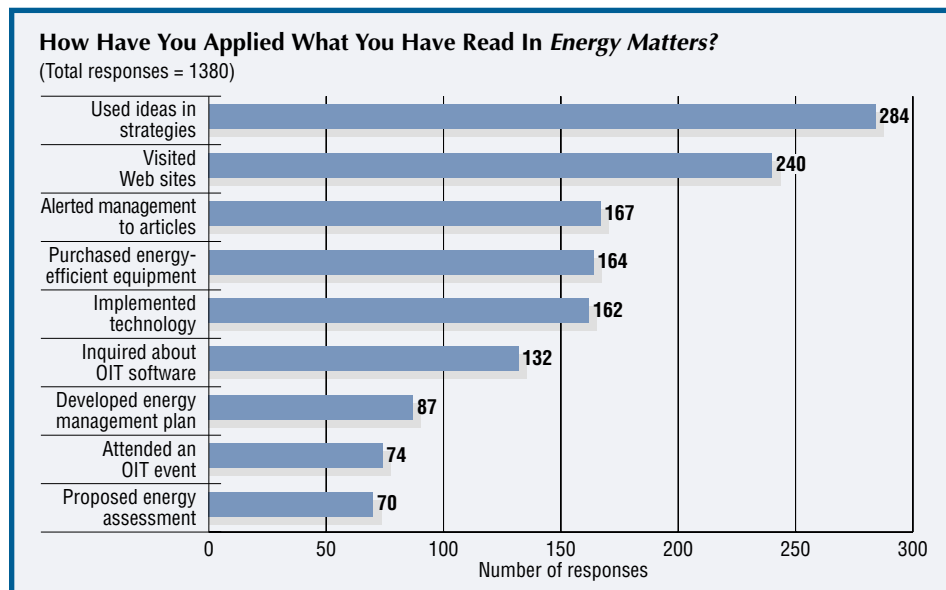
## We Asked, You Responded That Energy Matters Matters

Earlier this year, *Energy Matters* invited readers to fill out a questionnaire to help the editors ensure that the publication remains an informative and relevant part of readers' energy efficiency strategy.

More than 900 of you took part, answering questions designed to tell us how relevant *Energy Matters* articles and features are to your work.

Here are some highlights:

- Readers told us that the Top 5 *Energy Matters* articles and features that were most relevant to their work related to energy efficiency case studies (505 responses), products/tools (485 responses), technical issues (483 responses), emerging technology (473 responses), and technology implementation (458 responses).
- A separate question asked readers to tell us if the information in the newsletter's articles was "too technical", "not technical enough" or "about right." Of those who responded, 90% said that *Energy Matters'* article content was "about right."
- Readers also told us they consider *Energy Matters* to be an information resource worth keeping and even sharing with colleagues. One third of the readers who answered this question said they typically pass along issues to one or more colleagues. Another 48% said they keep issues for future reference.



Just over half of the readers who said they visited the *Energy Matters* Extra web site on a regular basis said they stopped by to find links to other energy efficiency topics and links; 33% said they visited to research topics from previous issues; and 11% said they visited to download the most current issue's PDF.

When asked whether or not they had achieved energy savings as a result of articles in *Energy Matters*, 63% of those responding said they had achieved some energy savings.

The editors wish to thank everyone who filled out the *Energy Matters* questionnaire. Your participation helps us deliver to you a newsletter that meets your information needs.

To view an electronic version of the questionnaire results, visit the *Energy Matters* Extra web site at [www.oit.doe.gov/bestpractices/energymatters/emextra/energy\\_matters.shtml](http://www.oit.doe.gov/bestpractices/energymatters/emextra/energy_matters.shtml). ●

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## Guide Now Available to Selecting Low-Emission Boiler and Combustion Equipment

Boiler owners and operators who need additional generating capacity face a number of legal, political, environmental, economic, and technical challenges. Their key to success requires them to select an adequately sized, energy-efficient, low-emission boiler and combustion equipment that can be operated in compliance with emission standards established by state and federal regulatory agencies.

Recognizing that many issues are involved in making informed selection decisions, the U.S. Department of Energy (DOE) OIT program sponsored efforts at the Oak Ridge National Laboratory (ORNL) to develop a guide for choosing low-emission boilers and combustion equipment. To ensure that it covers a broad range of technical and regulatory issues of particular interest to the commercial boiler industry, the guide was developed in cooperation with the American Boiler Manufacturers Association (ABMA) and the Council of Industrial Boiler Owners (CIBO).

The guide presents topics pertaining to industrial, commercial, and institutional (ICI) boilers. Background information about various types of commercially available boilers is provided along with discussions about the fuels they burn and the emissions they produce. Also included are discussions about emissions standards and

compliance issues, technical details related to emissions control techniques, and other selection considerations. Although information in the guide is primarily applicable to new ICI boilers, it may also apply to existing boiler installations.

Use of the guide is primarily intended for those involved in either expanding current steam or hot water generating capacity, or in developing new capacity. Potential users include owners, operators, plant managers, and design engineers who are involved in selecting low-emission boilers and combustion equipment that comply with established emissions requirements. Regulatory authorities who deal with emission issues and boiler permit applications may also find the guide to be useful.

The guide addresses many fundamental concerns encountered in planning a new steam or hot water boiler system. An overview of boilers, fuel feed systems, fuels, and emissions, which are fundamental considerations in the planning process, is presented. Discussions about firetube, watertube, cast iron, and tubeless boilers that burn fossil or nonfossil fuels are included along with issues pertaining to solid, liquid, and gaseous fuels commonly fired in these boilers.

Following the fuel discussions, the guide takes up the topics of solid and gaseous emissions that are regulated under

the Clean Air Act. The four principal emissions from combustion boilers that are regulated under this act are nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), particulate matter (PM), and carbon monoxide (CO). Mechanisms by which these emissions are formed are briefly described as an aid to understanding various control techniques for reducing emissions.

Techniques that are effective in reducing NO<sub>x</sub>, SO<sub>2</sub>, and PM emissions are divided into three general categories, depending on which stage during the combustion process they are applied. The categories include precombustion, combustion, and postcombustion emission control techniques. Descriptions of each technique are presented and emission control options for 14 of the most popular boiler and fuel combinations are identified. Information presented in this guide is also intended to help owners and operators prepare permit applications that address the principal concerns and legal requirements of the regulatory authority.

The guide was prepared by C. B. Oland from the Oak Ridge National Laboratory (published as ORNL report ORNL/TM-2002/19). To obtain a copy, contact the OIT Clearinghouse at 1-800-862-2086. ●

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## DOE Announces Technology Deployment Solicitation

Energy efficiency leaders in the petroleum refining and chemicals industries will be interested to learn that the DOE Idaho Operations Office (ID) is currently soliciting proposals to install and field-test technologies to reduce energy consumption, enhance economic competitiveness, and reduce environmental impacts. The

solicitation is targeted specifically toward the petroleum refining and chemicals industries. The objective is to find ways to mitigate the risk of accepting and using emerging technologies.

Almost any U.S. company that owns and operates a petroleum refinery or chemical plant where the technology will be installed and field-tested is eligible to apply.

For more information, visit the Best-Practices solicitation web site at [www.oit.doe.gov/bestpractices/solicitations.shtml](http://www.oit.doe.gov/bestpractices/solicitations.shtml). Hurry, because solicitation applications are due October 11, 2002.



## Ask the Clearinghouse

### “Plant Air” and “Instrument Air”

This column highlights key questions from industrial customers to the OIT Clearinghouse—your source for the full portfolio of OIT resources and technical advice about motor, steam, compressed air, combined heat and power, and process heating systems.

Clearinghouse engineers and technical staff expertly answer industrial efficiency questions, 11 hours a day, Monday through Friday. The Clearinghouse also has access to industry experts around the country. Call the OIT Clearinghouse at 800-862-2086, or go to [www.oit.doe.gov/clearinghouse/](http://www.oit.doe.gov/clearinghouse/).

**Q:** For a compressed air system, what are the definitions of “plant air” and “instrument air”?

**A:** The Instrument Society of America has published its Quality Standard for Instrument Air (ANSI/ISA-S7.0.01-1996). The purpose of the standard is to provide a definition for instrument-quality air. The scope of the standard includes:

- Limits for moisture content
- Limits for entrained particle size and oil content
- Establishing an awareness of possible sources of corrosive or toxic contamination entering the air system through the compressor suction
- Establishing standard air supply pressures, limit values, and operating ranges for pneumatic devices.

**TABLE 1. ISO 8573-1 AIR QUALITY CLASS STANDARDS**

Air Quality Class	Solid Contaminants	Solid Contaminants	Max. Pressure Dew Point °F	Max. Oil Content oz/ft <sup>3</sup>
	Max. Particle Size Microns	Max. Concentration oz/ft <sup>3</sup>		
1	0.1	0.1	-94.0	0.01
2	1.0	1.0	-40.0	0.1
3	5.0	5.0	-4.0	1.0
4	15.0	8.0	37.4	5.0
5	40.0	10.0	44.6	25.0
6	—	—	50.0	—

**TABLE 2. TYPICAL AIR QUALITY CLASSES**

Application	Solid Contaminants	Water	Oil
Plant Air	Class 4	Class 4	Class 5
Instrument Air	Class 2	Class 2	Class 3

The standard establishes a set of specifications for instrument-quality air. First, the pressure dew point measured at the dryer outlet shall be at least 18°F below the minimum temperature to which any part of the instrument air system is exposed. Second, the pressure dew point shall never exceed 39°F at line pressure. Third, a maximum particle diameter of 40 micrometers is designated as generally acceptable. Pneumatic control devices that require instrument air with less than 40 micrometer particle sizes shall be equipped with additional filtration to meet the particle size limits for the device.

Lubricant content in instrument-quality air should be as close to zero as possible, and under no circumstances exceed 1 part per million by weight or volume. Instrument air shall also be free of corrosive contaminants that may be drawn into the air system intake due to painting, chemical cleaning, or engine exhaust.

#### Plant Air

The International Organization for Standardization has established a standard (ISO 8573-1) that designates air quality classes (shown in Table 1). Classes are based upon the maximum particle size and concentration of solid contaminants, maximum pressure dew point, and maximum oil content.

The ISO standard contains a set of typical air quality class recommendations. Recommendations for plant and instrument air are shown in Table 2. ●



## Letters to the Editor

Energy Matters welcomes your typewritten letters and e-mails. Please include your full name, address, organization, and phone number, and limit comments to 200 words. Address correspondence to:

David Wagman, *Letters to the Editor*  
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We publish letters of interest to readers on related topics, comments, or criticisms/corrections of a technical nature. Preference is given to articles that appeared in the previous two issues. Letters may be edited for length, clarity, and style. ●



Read more about the benefits energy efficiency training can bring to your organization in Energy Matters Extra. Learn about the multiple benefits a steam champion can provide by serving as a link between senior management and plant operations. Read Don Casada’s thoughts on how appropriate energy efficiency training can help nurture the next generation of engineers. Find out how your company could be eligible for matching funds for a plant-wide assessment that could save your company energy and money, and possibly reduce environmental impacts. Check out the latest industrial energy efficiency publications released by OIT. And, read the full results of the recent *Energy Matters* reader questionnaire.

Log on to Energy Matters Extra at [www.oit.doe.gov/bestpractices/energymatters/emextra](http://www.oit.doe.gov/bestpractices/energymatters/emextra). ●

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## Coming Events

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### OHIO TECHNOLOGY SHOWCASE AND ENERGY FAIR

■ September 24–26, 2002

For more information, call Sara Dillich at 202-586-7925

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### GLASS PROBLEMS CONFERENCE

■ October 22–23, 2002, Columbus, OH

For more information, contact Elliott Levine at Elliott.Levine@ee.doe.gov

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### ENERGY EFFICIENCY WORKSHOPS IN PARTNERSHIP WITH AIChE

■ November 6–8, 2002, Indianapolis, IN

For more information, contact AIChE customer service at 800-242-4363

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To keep up-to-date on OIT training and other events, check the calendar regularly on Energy Matters Extra at [www.oit.doe.gov/bestpractices/energymatters/emextra](http://www.oit.doe.gov/bestpractices/energymatters/emextra).

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## BestPractices

The Office of Industrial Technologies (OIT) BestPractices initiative and its *Energy Matters* newsletter introduce industrial end users to emerging technologies and well-proven, cost-saving opportunities in motor, steam, compressed air, and other plant-wide systems. For overview information and to keep current on what is happening office wide, check out the newsletter—The OIT Times—at [www.oit.doe.gov/oit-times](http://www.oit.doe.gov/oit-times).



### INFORMATION CLEARINGHOUSE

Do you have questions about using energy-efficient process and utility systems in your industrial facility? Call the OIT Information Clearinghouse for answers, Monday through Friday 9:00 a.m. to 8:00 p.m. (EST).

**HOTLINE: 800-862-2086**

Fax: 360-586-8303, or access our homepage at [www.oit.doe.gov/clearinghouse](http://www.oit.doe.gov/clearinghouse).

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