energy efficiency

e2

From ecosystems in a bottle to resources from the moon

It's about energy

ENERGY CENTER OF WISCONSIN

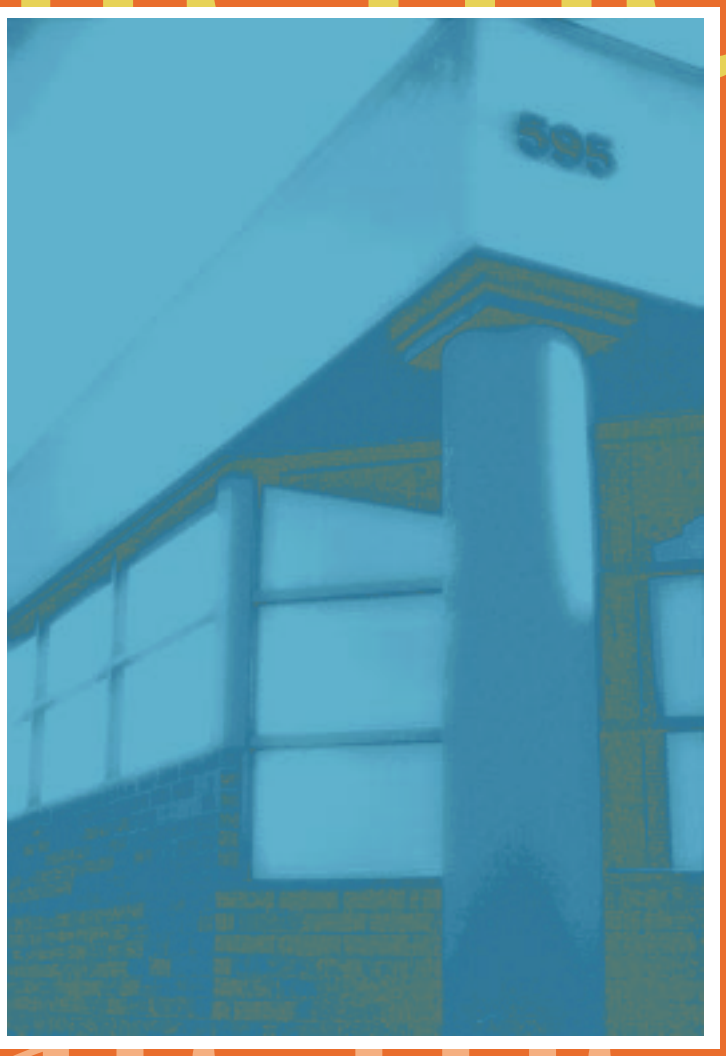
We show you how

Annual Report Issue

Winter 1999 Vol 4 No 1

Mission Statement

To sponsor and conduct research in efficient use and management of energy, and to develop, demonstrate, and transfer the results of that research to Wisconsin's energy service consumers and providers



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OF WISCONSIN
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Special Edition: Annual Report 1998.
A publication of the Energy Center of Wisconsin.
Published January 1999.
Printed at Suttle Press, Waunakee, Wisconsin.

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Photography: Image Studios, Jeremy Kohler, Eric Nelson, Brent Nicastro, Sutter Photography

PRODUCTION NOTES

Printed on French Speckletone paper, a 100% recycled stock containing 20% post consumer waste.

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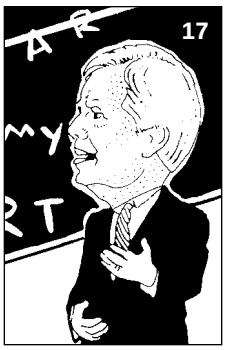


features

Lynn Hobbie
Board President

Sometimes playing it safe is the best route to take. But in the business we're in—and in the times we're in—just the opposite can be true. New approaches to helping people save energy will get the attention necessary to make a difference.

People are looking for more alternatives when it comes to energy efficiency. Energy trends over the past few decades have shown us at the Energy Center that the standard rules of procedure probably won't work down the road. We know that it's going to take a little ingenuity to set ourselves—and our mission—apart.

In this year's annual report issue of e² you'll see how we're just a little more "out there" in terms of the work we take on, who we work with, and the way we work in general. We're bringing in projects like green buildings and daylighting whose goals pose some pretty big challenges. We're working with prolific leaders like teacher Pat Marinac and architects Marty Serena and Bill Sturm whose passion and commitment help us reach out in ways we hadn't before. And the Energy Center is even changing the way we work by partnering with Wisconsin organizations like the American Institute of Architects and the Wisconsin Energy Bureau and collaborating with energy efficiency organizations, equipment manufacturers, and professional associations across the country.

Sure it's not exactly what we're used to but we've learned that the biggest rewards come from taking even the smallest of chances.

Follow our lead. Take a step—even if it's just a small one—outside the "norm," try something new, and see what a difference you can make.

follow our lead

Jet-powered power plants

You might not expect to see jet engines bolted to the floor, but if you walk into a new power plant chances are that's just what you'll find.

The jet engine—or more precisely, the gas turbine—was invented around 1930 as a light and efficient way to generate thrust in an airplane. Today they also drive propeller planes, helicopters, boats, the odd tank, and more recently, electric power plants.

It drives itself

The gas turbine concept consists of nothing more than a hollow tube with spinning fans at either end that are connected to each other by a shaft. The first fan—the *compressor*—sucks air in, forcing it into the center of the tube. Fuel is injected at the center and ignited. The burning compressed air-gas mixture expands forcefully and rushes out through the second fan—the *turbine*—at high speed, causing it to spin.

The outrushing of gases produces thrust while the spinning turbine drives the air compressor in a continuous cycle.

What makes a gas turbine so versatile is that the spinning turbine can also drive other devices—like electric generators.

Burning the candle at both ends...

Coal, oil, conventional natural gas, and even nuclear power plants make high-pressure steam to drive steam turbines which in turn spin electric generators. In a gas-fired turbine power plant, natural gas directly fuels a gas turbine attached to a generator. These turbines are designed to maximize spin, unlike a jet airplane's turbine which is configured to maximize thrust.

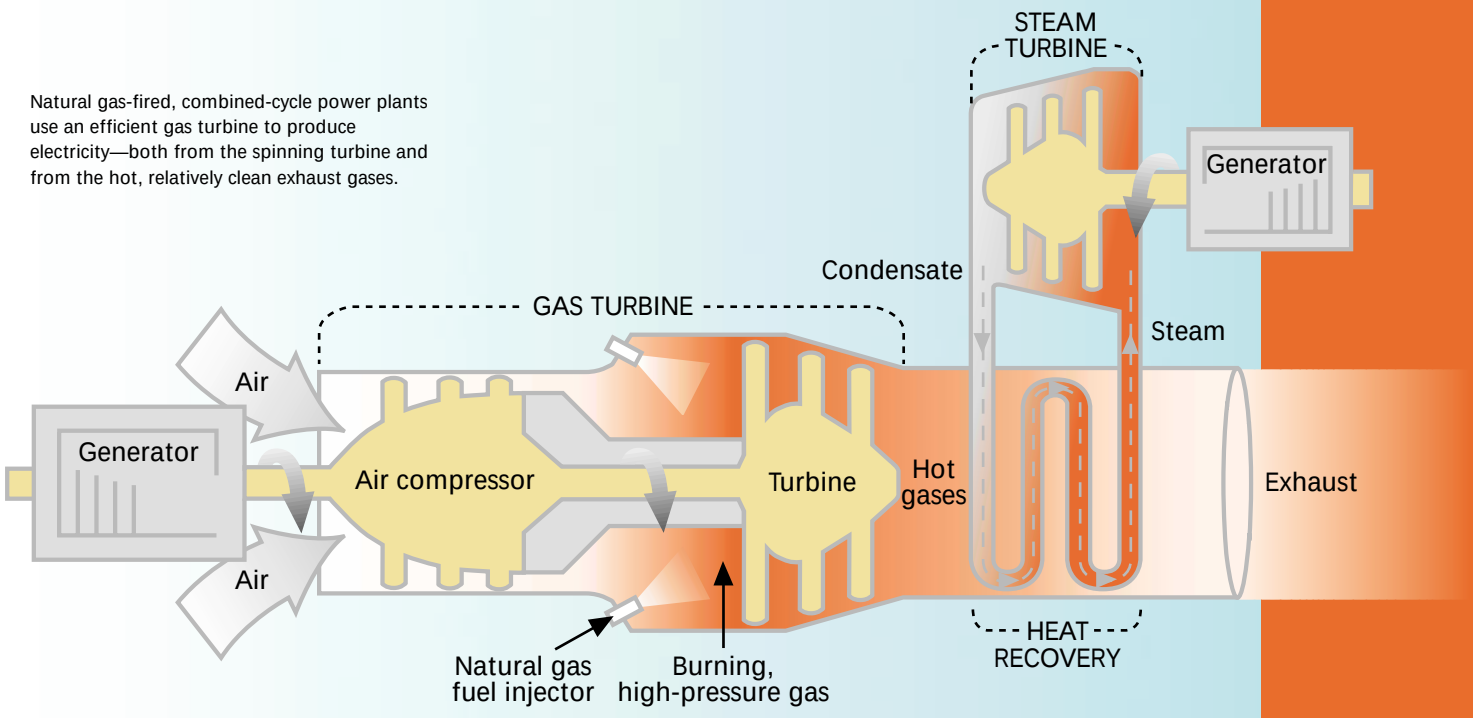
But there's still plenty of hot gas rushing out of a power plant's turbine. Capturing this energy, *combined-cycle* gas-fired power plants use the hot exhaust to generate steam for a conventional steam turbine—spinning a second generator to produce more electricity.

...But with not a lot of smoke

Today gas-fired power plants are a popular choice for new generation because natural gas is plentiful and the technology is relatively clean, cheap, and efficient. Overall efficiencies are at least 50 percent higher than those of modern coal- or oil-fired plants. And when compared to a modern coal plant with pollution control devices, combined-cycle gas-fired plants are smaller, cost less than half as much to build, produce no solid waste, and cut sulfur dioxide and particulate emissions by more than 99 percent, nitrogen oxide by more than 85 percent, and carbon dioxide by more than 50 percent for the same amount of electricity produced.

—Jeremy Kohler

Natural gas-fired, combined-cycle power plants use an efficient gas turbine to produce electricity—both from the spinning turbine and from the hot, relatively clean exhaust gases.



e2 science

Mark Hanson
Executive Director

Whether we're promoting efficient compressed air systems or demonstrating the benefits of energy efficient home building, we're trying to do the same thing—change the way people think about and use energy. And ultimately we're trying to make that a long-lasting change; our goal being to transform markets toward adopting energy efficiency technologies and practices.

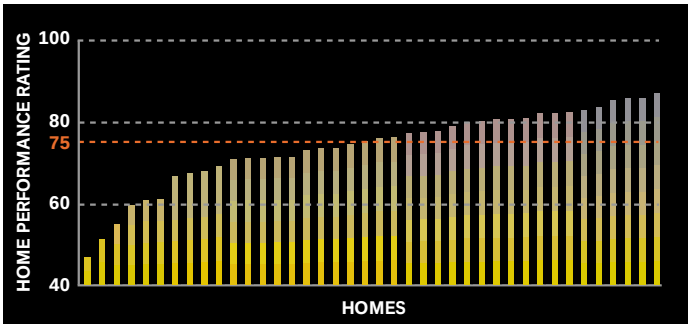
"Market transformation" has become the topic du jour in the energy efficiency marketplace. Whether it serves as an enduring term or a passing fad as a label, the concepts underlying it are sound. Making an energy efficiency difference, however, requires well-targeted and designed efforts over substantial periods of time. The movement of the Wisconsin market to high efficiency natural gas furnaces was a five to ten year effort. The introduction of high efficiency motors was at least a five-year effort.

Given these experiences it may seem daunting to start an effort whose purpose is to change how commercial buildings are built. Yet that is where the Center finds itself at the beginning of 1999 as it puts three commercial sector efforts on the front burner. These interrelated efforts are green buildings, daylighting, and commissioning. On the market pull side, we are hearing a growing interest in improving our building practice from designers and builders; they are hearing from owners. On the market push side, we know we can build premium built environments at the same costs as "conventional" buildings and with energy consumption levels at $0.50 per square foot per year versus national averages of $2.15.

To demonstrate the application of state-of-the-art technologies to the commercial building marketplace, the Center will be moving into a daylit green building by the end of 1999. As a training base, demonstration site, source of information, and living environment, we invite you to watch the progress as we assemble and apply the best information available and push the frontiers of quality building practice.

push the frontiers

What's wrong with this picture?



Of 40 homes tested in the Madison and Milwaukee areas, about half scored below 75 on a standard Home Performance rating. A house meeting the current building code should score a minimum of 75.

The Energy Center is scrutinizing 400 houses for energy efficiency, safety, and homeowner behavior. With the first 40 completed, a preliminary sketch of Wisconsin housing is emerging.

"Half the houses were under-insulated in the walls and ceiling," says project manger Scott Pigg, "and 15 percent had no wall insulation at all." Some of the homeowners, he says, were unaware of the deficiencies.

Pigg says auditors also found furnace or water heater safety problems in a quarter of the homes and some highly inefficient refrigerators and freezers. Half the houses scored below the current building code in terms of their Home Performance rating, a standardized energy efficiency score.

More than a quarter of the houses had high-efficiency furnaces, which is about what you'd expect, Pigg says, given that these systems have dominated the Wisconsin market for about a decade.

When completed in late 1999, the *Residential Characterization Study* will have comprehensive energy data on a representative sample of owner-occupied, single-family homes. This will provide the first statewide energy benchmarks, representing about 63 percent of Wisconsin households.

"The results will be of most use to people who want to design and market energy programs targeted to homeowners," Pigg says, "and in the full-scale study we'll intentionally oversample low-income homes and new homes to get an especially clear picture of low-income housing and current building practices."

A companion pilot study is looking at rental housing.

—Jeremy Kohler

FOR MORE INFORMATION about *Residential Characterization* contact Scott Pigg at (608)238-8276 x38, spigg@ecw.org.

Consumers question our energy future

A panel of experts answered the public's energy questions at the first *Energy Consumers' Forum*, held in Stevens Point, Wisconsin on September 22. The forum was organized by the Energy Center's Public Caucus to hear people's concerns about developments in energy efficiency, renewables, and the energy industry. About 60 people attended, including the general public, utility representatives, and low-income advocates. Meetings are also planned for Milwaukee and La Crosse.

At the Stevens Point forum, one person asked how we could reduce our dependence on fossil fuels.

It's a combination of "individual actions and public actions," answered RENEW Wisconsin's Michael Vickerman. He recommended buying green power and lobbying policymakers to increase the amount of renewable sources in our energy mix.

Chris Schoenherr, Wisconsin Electric Power Company

Chris Schoenherr of Wisconsin Electric Power Company said that compaines might buy green power too—as a marketing tool. Later he noted that distributed generation technologies like wind and solar could change the utility business. "As the technology changes we could all be very surprised with what we end up with," Schoenherr said. "We have to remain pretty flexible."

Afterwards people milled about exhibits like the super-efficient Maytag refrigerator. Energy chatter filled the room.

Marion resident Georgia Sturms had this to say about wind power: "It's the thing of the day—not even of the future—but of the day."

—Eric Nelson

A year in the making

Just a year ago the *Compressed Air Challenge* kicked off its program designed to improve the efficiency of compressed air systems in American industry. Now, through its *Compressed Air Awareness Training*, the CAC is working to raise awareness among facility engineers, operators, and maintenance staff of the benefits of peak compressed air system efficiency—benefits including increased productivity, reduced carbon emissions, and lower production costs.

"Through this entry level workshop, facility staff will be able to implement a seven step action plan that will successfully decrease the costs of the compressed air system at their plants by 15 to 25 percent," says Steve Nelson, Energy Center project manager.

Compressed Air Challenge™
Resources for System Optimization

As administrator of the CAC—which is sponsored by energy efficiency organizations, equipment manufacturers, distributors, electric utilities, and professional associations—the Energy Center is holding five pilot trainings across the US in February and March. "Beginning in March each of the sponsors will likely host compressed air workshops in their given areas," says Nelson.

The Challenge is also planning more advanced training and, in the coming year, will most likely launch other compressed air resources like a website and videos.

—Carolyn Dunn

FOR MORE INFORMATION on the *Compressed Air Challenge* contact Sue Streveler at (608)238-8276 x44, sstreveler@ecw.org.

The hidden side of

When deciding which power sources to invest in, the environment isn't the only hidden factor to consider. There are also questions of energy payback

By Eric Nelson

In 1992 I lived in a cabin in rural Mount Horeb and burned wood for heat. I soon learned what anyone who uses wood as an energy source knows. It's a lot of work.

There were the trips to the wood pile, the hours spent making kindling, and the tasks of making a fire, taking ashes out of the stove, and cleaning soot from the chimney.

All this took energy—my energy—which didn't include the labor of sawing down the trees, splitting the wood, and stacking it to dry. Or the gasoline to power the chainsaw and log splitter and the truck that moved the wood from the forest to my cabin. And in the process, there was pollution from burning that gasoline, not to mention the smoke, soot, and ashes from burning the wood itself.

There are costs to using any form of energy—hidden costs. You pay an environmental price when you use energy. And to use energy, you have to invest energy. To help decide which electricity sources are most promising, we have to understand both these hidden factors.

Hidden costs

Let's begin with the basics. A power plant must be built and run. According to Wisconsin Public Service Commission documents, a modern 500 megawatt coal-fired power plant costs about 900 million dollars to build. Maintenance and operation might add another 50 million dollars per year. Then there are the costs of buying coal, transmitting the electricity, and preparing and mailing bills.

But these costs don't include environmental impacts such as the carbon, sulfur, and nitrous dioxides coming out the smokestack. Carbon dioxide, for instance, is a prime suspect in global warming, which could melt polar ice and flood coastal areas, leading to property loss. Sulfur dioxide reacts chemically to form disease-causing aerosols and acid rain, which harm lakes and trees and corrode buildings.

These so-called externalities are everywhere. Nuclear power, once seen as a clean and cheap source of nearly limitless power, has them—the cost of storing radioactive waste for hundreds of thousands of years and the medical and agricultural price tag of a potential nuclear accident. Green power isn't innocent either. Wind farms produce noise, take up land, and kill birds.

People don't agree on how to price externalities. A 1990 study by the Pace University Law Center estimates the environmental cost of coal-generated power at between 2.5 and 5.8 cents per kilowatt hour, while the Wisconsin Public Service Commission put the figure at 1.5 cents in 1994. There's also disagreement on how to value the hazards of nuclear energy. The Pace study estimates these environmental costs at 2.8 cents per kilowatt hour, while a 1990 study published in *Contemporary Policy Issues* cites a range between 1.7 and 2.7 cents.

The reason for these disagreements is easy to see. Is the external cost of burning coal the price of fixing all possible medical and environmental damage or merely installing pollution control equipment? How do you reliably calculate the probability of a catastrophic nuclear accident

when only one such incident (Chernobyl) has occurred? What price tag do you put on birds killed by whirring rotors?

And as if these environmental conundrums aren't enough, there's a far more fundamental question to ask about power generation. What's the energy cost?

Hidden energy

Fusion sometimes seems like it's light years away from being a source of electricity, but in fact, progress has been made. In 1971, fusion power generated less than one-tenth watt of electricity, according to University of Wisconsin-Madison Engineering Physics Professor Gerald Kulcinski. By 1998 that figure was 16 *million* watts, enough to power about 16,000 homes.

Unfortunately, fusion—the controlled fusing of atomic nuclei to release energy— hasn't "broken even" yet. It takes about twice as much energy to create fusion as a reactor produces in electricity. While researchers work on improving this situation, scientists like Kulcinski are also worried about another, related problem—embodied energy.

Embodied energy is the energy used to make something. For instance, a house has embodied energy in the form of materials and construction. And that energy isn't small either. *Environmental Building News* reports that a Canadian house embodies the equivalent of between seven and 18 years worth of heating energy. Power plants also have embodied energy: the energy to build and operate the plant and mine and transport fuel.

Why care about embodied energy? Efficiency, for one. Less energy is better, whether it's direct or embodied. And using less energy minimizes externalities. This is because, on average, most energy comes from sources that indirectly harm the environment.

But with power plants there's another reason to be concerned. Power sources provide energy in the form of electricity, and to make sense, must produce much more energy than they embody. This has not always been the case. Some early photovoltaics actually had a negative energy payback—they never generated enough electricity to make up for the energy needed to manufacture them. (Don't worry, things are better now. Today it generally takes less than two years for a solar panel to pay back its energy debt.)

The history of photovolatics led to skepticism about green power. Wind power, for instance, requires no fuel. But how much energy does it take to make the turbines and rotors and maintain their moving parts? In other words, how does the *embodied energy* compare to the *generated power*?

The energy behind energy

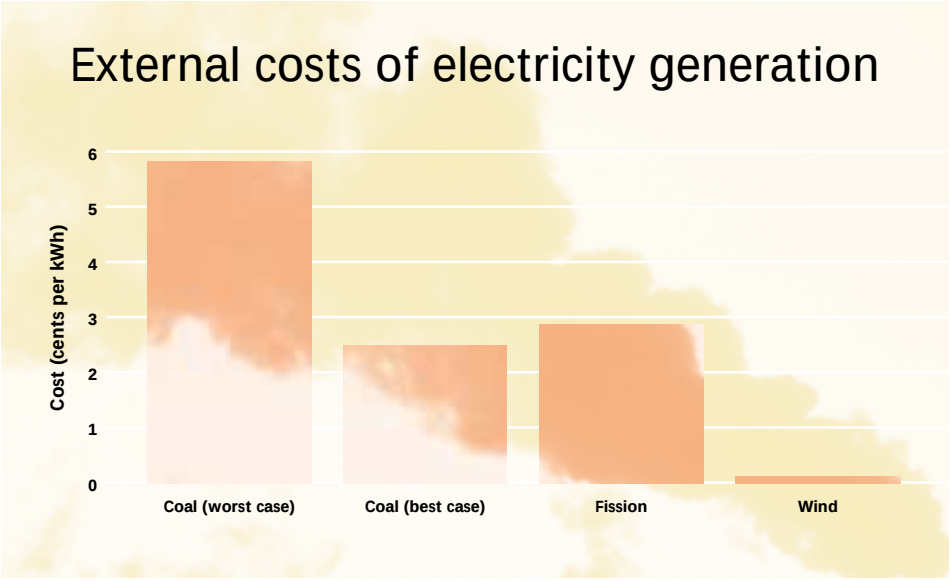
In a study sponsored in part by the Energy Center, Kulcinski and graduate student Scott White set out to answer this question for fission, fusion, coal, and wind power. They added up all energy used to fabricate the metals and concrete used in the power plants. Then they found out how much money was spent on mining and transporting fuel, constructing and operating the plant, and decommissioning. They then converted these dollar values to energy. They also calculated the total emission of carbon dioxide, based on fuel use and total embodied energy.

In their life-cycle analyses, wind power came out looking good, as did future fusion (these plants exist only on paper). Both power sources produced about 23 times more energy than is required to build and run the physical plants. Coal and fission, however, didn't fare nearly as well. They had energy payback ratios of 11 and 16. The reason has to do with fuel. Coal takes lots of energy to mine and transport. And uranium ore must be enriched—a slow energy-intensive process. The wind is free.

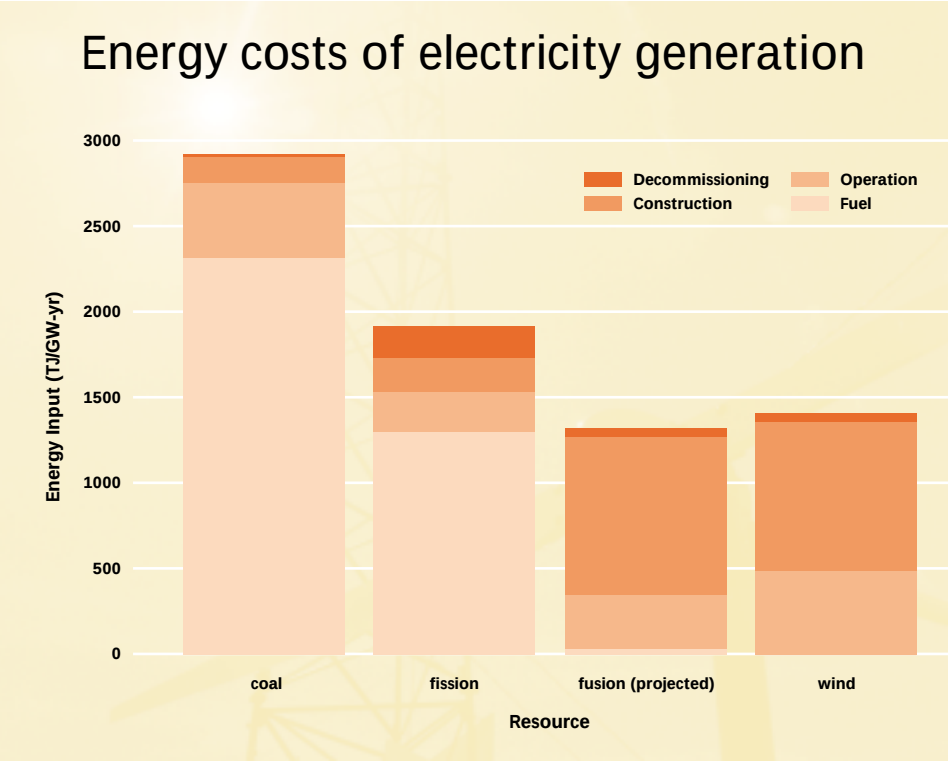
But wind power isn't. A wind farm takes lots of energy to build. The energy needed for operation is also a large fraction of the total, and larger than the operational energy for other power sources.

"There are a lot of moving parts in a wind turbine which need to be serviced and replaced," writes environmental studies graduate student Scott White. "When you factor in maintenance for the turbine, transportation to and from the turbines (which can be remote), lubricating oil, and such, it adds up."

Another reason for the high operational costs is that the study calculated embodied energy per unit of electricity produced. This



Estimated environmental costs of power generation according to a 1990 study by the Pace University Law Center. Other studies cite widely varying costs.



Categories of embodied energy related to power generation according to a 1998 University of Wisconsin-Madison study by Kulcinski & White. Most of the energy investments in coal and fission power sources go towards fuel. For wind and fusion, most energy goes toward construction and operation of the power plants.

Notes: Fuel includes mining, transportation, and processing. Construction includes energy embodied in materials and construction activities. Operation includes maintenance and any energy used by the power plant when it is not producing electricity. Decommissioning includes dismantling the plant, reclaiming land, and disposing of hazardous waste. Input energy in units of terra-joules of energy per gigawatt-year of electricity.

makes it easier to compare energy sources, but also reveals a "weakness" in wind power.

Wind turbines produce power in spurts, not steadily like a coal or nuclear plant. The wind farm White studied generates about 24 percent of the power it could produce if the wind were blowing steadily at an ideal speed. A coal plant, on the other hand, achieves something like 75 percent of its capacity.

"Since wind has a capacity factor one third that of the other power plants," writes White, "all the energy requirements seem higher when normalized per unit of electricity produced."

But while wind power may not be steady, it is nearly guilt-free. Although a wind farm is responsible for some carbon dioxide emissions because of the energy used to build and maintain it, it uses no fuel at all to generate power. This makes wind more than 50 times cleaner than coal.

Moon trip

Embodied energy analysis has been done on coal and wind plants before. "But it's never been done at the same time with the same assumptions," Kulcinski says. "We've got apples to oranges comparison and we're trying to get apples to apples." Future work will analyze natural gas turbines and, possibly, solar.

Kulcinski says that utilities could use embodied energy studies to help them decide what type of power generation to invest in, along with cost and traditional environmental analyses. But he also has a more futuristic use for the research.

Part of White's PhD thesis analyzes the embodied energy of helium-3 (^{3}He) fusion. Fusion, as currently envisioned, will use deuterium and tritium for fuel. Deuterium-tritium fuel is convenient but produces radioactivity when burned in a reactor. This makes the reactor walls radioactive and brittle; they'd probably have to be replaced every couple of years. Fusion using deuterium and ^{3}He, on the other hand, produces much less radiation, saving lots of embodied energy in the form of new reactor walls.

There's just one little problem. The nearest place to get a lot of ^{3}He is the moon.

"It turns out, though, that it balances out," Kulcinski says. "The energy used to mine ^{3}He would balance the energy needed to change out the damaged components in the other type of plant."

Utilities ordering fuel from the moon? According to embodied energy analysis, it just might make sense.

Portable power

Imagine a battery with a gas cap—instead of recharging, you just fill 'er up.

Combining basic chemistry with advanced materials, *fuel cells* put hydrogen and oxygen together to make water—and electricity. As long as a fuel cell has a ready source of hydrogen, it'll keep making electricity.

A matter of chemistry

Free hydrogen has a natural tendency to combine with oxygen, releasing stored chemical energy in the process—fuel cells are designed to capture that energy as electricity.

Hydrogen is the most common element in the universe, consisting of one positively-charged proton and one negatively-charged electron. In a fuel cell oxygen in air attracts the protons through a special barrier that's impervious to electrons. The electrons are released into a circuit that goes around the barrier, producing an electric current.

If you were to run a fuel cell on hydrogen alone, the only emissions would be heat (which can be recovered and used) and water. But most fuel cells get their hydrogen from conventional hydrogen-rich fuels like natural gas, ethanol, methanol, and even ordinary gasoline. A *reformer* converts the fuel into a gas containing free hydrogen along with a small amount of carbon dioxide and other pollutants, depending on the fuel.

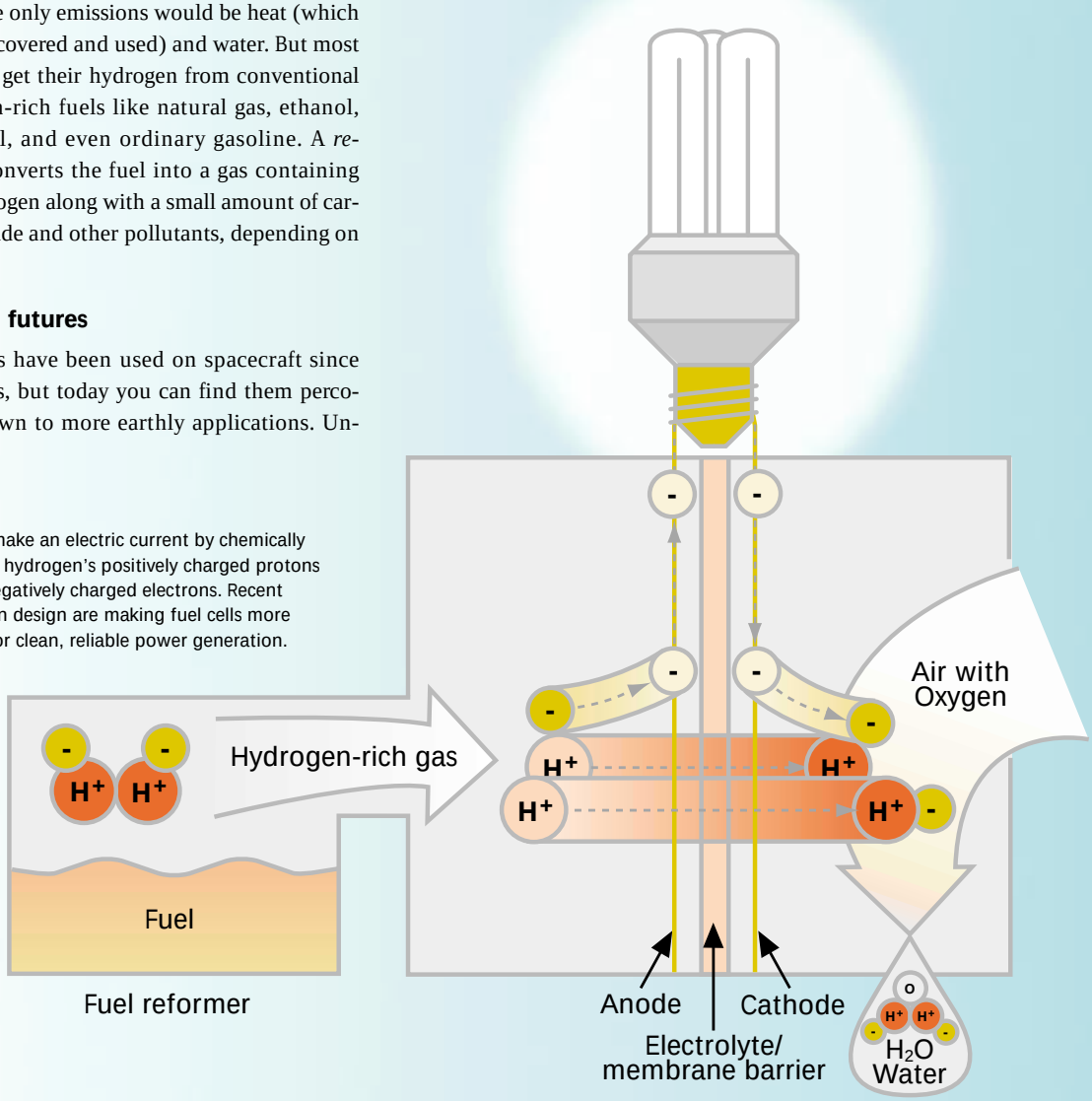
Fuel cell futures

Fuel cells have been used on spacecraft since the 1960s, but today you can find them percolating down to more earthly applications. Unlike most generation processes they don't burn anything, making them relatively clean and efficient. One prototype electric car powered by a gasoline fuel cell had double the gas mileage and 90 percent lower emissions compared to a conventional vehicle.

Another advantage of fuel cells is that, like batteries, several units can be "stacked" together to create any size power plant. Their versatility has attracted the interest of utilities because fuel cells can provide reliable supplemental power right where it's needed, rather than shipping electricity long distances from a central power plant, which is costly and inefficient.

A number of US and foreign companies are intensely developing fuel cell technologies, experimenting with various designs and fuel types. Prototype and commercially available fuel cells are now powering cars, busses, homes, and industries.

—Jeremy Kohler



Fuel cells make an electric current by chemically separating hydrogen's positively charged protons from its negatively charged electrons. Recent advances in design are making fuel cells more practical for clean, reliable power generation.

It transcends architecture

Two men balance the work they love with the earth they revere

"The beauty of our relationship is the way we work together to design and implement our projects," says Marty Serena (right) of Prisco Serena Sturm Architects in Northbrook, IL. The sustainable architectural team of Bill Sturm (left) and Serena is designing the Energy Center's green building scheduled for completion in late 1999.

By Carolyn Dunn

The seeds were planted in their childhoods.

Growing up in rural Indiana and Illinois, surrounded by nature, Bill Sturm and Marty Serena began forming their vision. A vision of respect, awe, sensitivity, reverence, and balance. Of designing better structures, of integrating man with nature, of creating a sustainable built environment.

Marty Serena's dad, who worked as a building contractor, used to take him to work on Saturdays when Serena was just a kid. "Dad would take us to the construction site to help. A big family ethic was not to waste," says Serena. "If you had a four-foot piece of plywood you wouldn't cut off one foot and toss it if you needed three feet. You'd find a way to use it all. I learned that waste is not something you want to promote."

Bill Sturm remembers nature surrounding his childhood community. "I developed a comfort level with the woods. And an idea of how to be considerate of green areas."

Neither Sturm nor Serena can shake the past; and don't want to either. It's made them the advocates they are today.

But unlike some environmental zealots, Serena and Sturm don't go into their projects at Prisco Serena Sturm Architects in Northbrook, Illinois as raging green crusaders. When they are encouraging clients to go green it's usually without the clients' knowledge. "We get under their skin without them knowing it. By promoting quality," says Sturm. For example, Sturm explains to his clients that a well-insulated building (that saves energy) means you don't have to put on a sweater; and good glazing on windows (less heat loss) means it's quiet. "We promote a better way of building rather than a mission to save the world."

"It's not fashion we're into. We're into developing an aesthetic that fills a purpose," says Bill Sturm. Members of the Prisco Serena Sturm team are: (Top L/R) Bob Graybosch, Len Sciarra, John Stryker, Suzan McQueen, Jackie Clawson, Dan Niewoehner, Pat Dolan, (Btm L/R) Marty Serena, Bill Sturm, Dave Dankert, Janet Serena, Ed Webb (Absent) Guy Prisco, Lynn Boeke, Dante Domenella, Jan Karp, Arlene Serrano.

When you're working on the design of a village hall, he says, with 12 committee members ranging from nurses to bankers you try to convince them it's not the most square footage for the dollar, it's the best square footage for the dollar. Serena adds that he gives their clients credit for latching onto this idea of green building and taking it even further by choosing more and more sustainable features.

For Sturm and Serena working on public and corporate buildings has conditioned them to be good listeners. Self-described as sincere designers, they want to get to know people and their needs. Serena continues, "Each building has to fit a true purpose. And we want it to be a reflection of our clients."

As they knit nature and these buildings, they say they feel the needs of nature are satisfied because their buildings use less resources and just plain last longer than conventional buildings.

But some days it can be a struggle to live by your convictions. "Often a church is not concerned about a new-fangled wall. So when you get letters threatening liability because you're doing things differently it makes you want to default so quickly to standard rules of procedure," says Sturm. But they resist, he says, because he knows their work has a pretty significant impact. "This is the way we want to practice for the next 20 years."

They started Serena and Sturm Architects in 1983, literally two guys in a basement, not really knowing their designs were sustainable. They came out of Notre Dame during the 1970's energy crisis with a heightened awareness of environmentalism and say that's what steered them to the environmental aspect of architecture. In 1993 their practice was merged with their partner Guy Prisco, assembling a dedicated staff whose operation depends on collaboration and teamwork.

Serena and Sturm first designed environmentally-friendly residences for family and friends. "When we designed residences we weren't affected by the preconceptions of corporation," Sturm recalls. "We could look someone in the eye and convince them that green is better."

Much of their work today involves designs for churches, municipalities, and office buildings. Sturm recognizes that building in suburbia, where much of his work happens, is not an environmental solution. "But are they going to build there? Unfortunately, yes. My goal is to leave the building in better balance with its surroundings."

What draws attention to these two men is their respect for what is beyond them. It's not an ego thing. Sturm's recollection of an influential college project illustrates. "I remember a competition for the Solar Energy Research Institute. Our design had to be twisted for use with a natural force, not formed from an ego. You put your ego further behind you as you design for the needs of nature."

Sturm says that starting with simple sustainable ideas and working through to more complex ones has been their success. Serena agrees, adding, "You take little pieces and show them what you're doing. It's about setting an example."

Take Serena's home. He stopped mowing his lawn and started a prairie restoration in the middle of a city block. He received letters from the city and scared his neighbors, says Serena, "but you have to start doing small projects, then a little bigger, on up."

This idea of green building is far from common in the world of architecture. In fact, Sturm points out there are precious few architects in the Chicago area who look at design from an environmental aspect—although the idea is catching on. He's seeing it grow in the number of young people coming out of college with an interest in green building.

It's an idea that's evolved at Prisco Serena Sturm. And it seems to have permeated the firm. "We not only assert this environmental interest in our work," Serena says, "we all share this balance in our lives: family, nature, respect for each other. It transcends architecture."

As they think about the changes that need to happen to take green mainstream, both men come back to the notion that sustainability has to come through education—on all levels. The first being children.

Serena and Sturm recognize the power of children and how their early wisdom and sensitivity begin teaching sustainability.

Sturm concludes, "A child that respects nature will also be sensitive to the needs of their neighbor."

e2 CRYPTOQUOTES

One letter stands for another, as in HYAAHQ AYBQZ = LITTLE TIGER. Each quote uses a different code. Decipher the quotes using clues like repeated letters, letter and word patterns, letter frequencies, and word lengths.

JCTCO VKYNU UAMU M DHMGG ZOKYL KX

BKHHSUUCV BSUSQCJD BMJ BAMJZC UAC RKOGV.

SJVCCV, SU'D UAC KJGW UASJZ UAMU AMD.

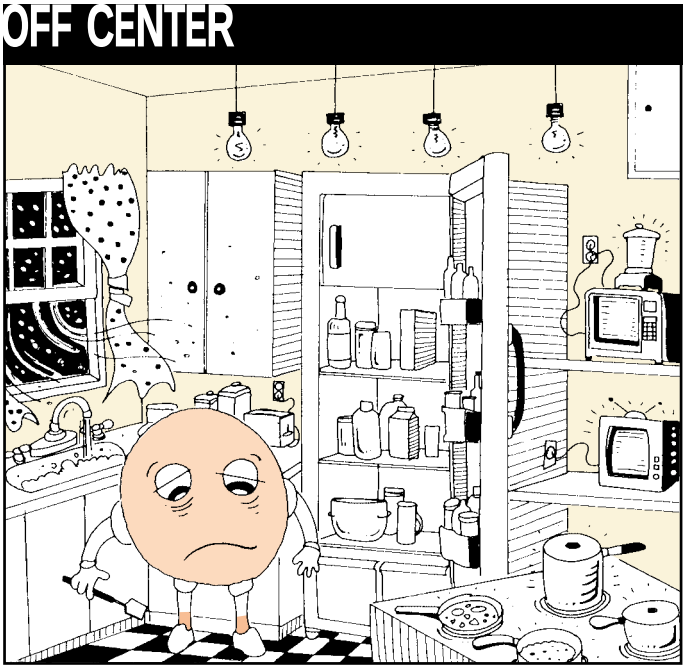
—HMOZMOCU HCMVC

U FNPWW QPBM CNM MWMOCTUO WUJNC FY

ONMPG CNPC YAWS CNM TUON XUWW LM PLWM CY

LRTA OPAKWMF.

—CNYQPF P. MKUFYA



Mid-life energy crisis.

CRYPTOQUOTE ANSWERS

Never doubt that a small group of committed citizens can change the world. –Margaret Meade
Indeed, it's the only thing that has.
I shall make the electric light so cheap that only the rich will be able to burn candles. –Thomas A. Edison

HOUSE OF ENERGY

Think of a house and the people who make the house
the plumbers, the carpenters, the brick layers.
How much energy does that take?

Now think of the boards that made the house
and the truck that moved them there.
How much energy does that take?
And think of the board at the lumberyard
and what came before the board
the chainsaw that cut the tree
the truck that pulled it
the saw that sawed it
and the sun that made it grow.
How much energy does that take?

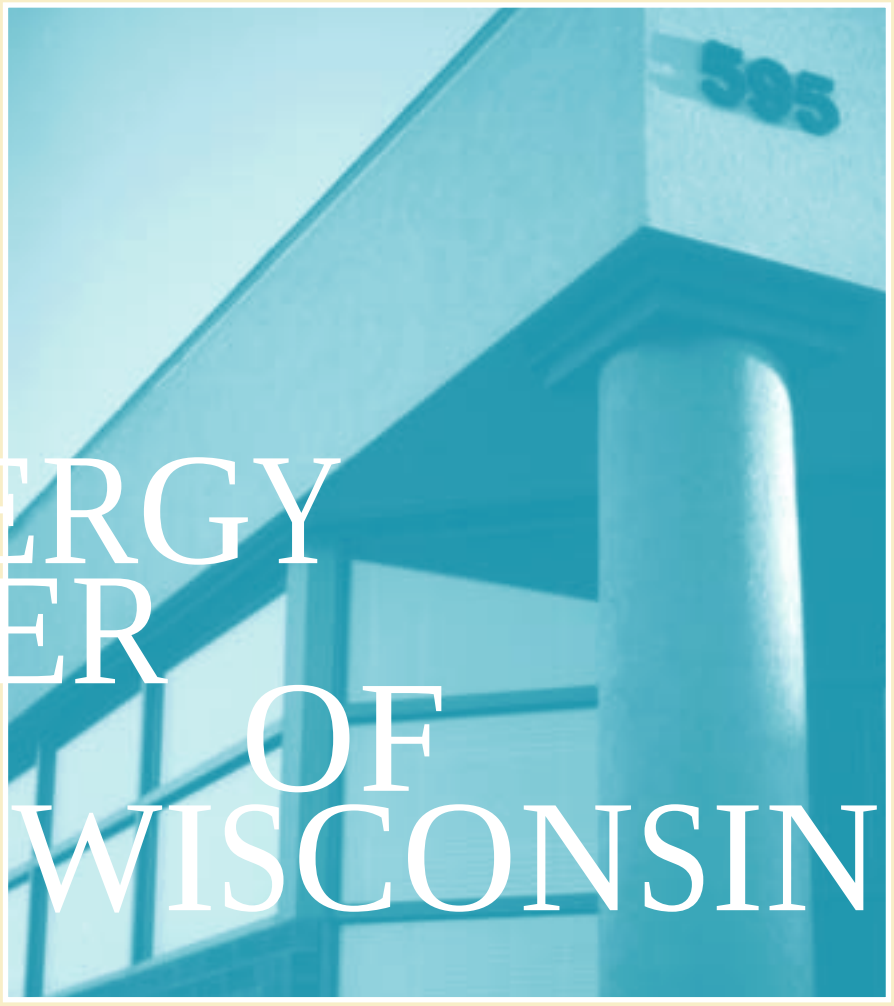
Now think of the steel that made the truck
and made the saw and made the nails
and all the heat to melt the old steel and make the new.
How much energy does that take?

Energy within energy within energy
a long chain of labor spiraling down without end.
Now think of shortening the chain.
And how much energy would that take?

Anonymous

1998

FINANCIAL REPORT



ENERGY CENTER OF WISCONSIN

ENERGY CENTER
OF WISCONSIN
We show you how

The Energy Center of Wisconsin is a private non-profit organization funded primarily by voluntary contributions from Wisconsin's utilities. The Center's Board of Directors oversees the selection of projects and programs. The Advisory Committee—along with several area committees—works with Center staff to guide Center activities. Member organizations provide much of the Center's financial support. Representatives from both member and participant organizations serve on committees and on the Board of Directors.

We invite participation, collaboration, and support from any organization that shares the Center's mission. Contact the Center for information on how to participate or become a member.

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Wisconsin Power & Light Company

financial summary

Revenue Fiscal Year 1998

for the year ended June 30, 1998

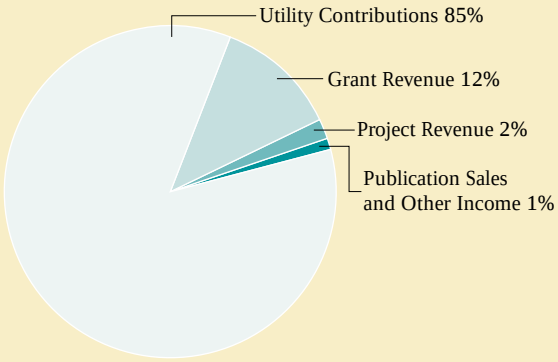
Utility Contributions	$3,862,050
Grant Revenue	539,032
Project Revenue	65,849
Publication Sales and Other Income	50,626
Total Revenue	$4,517,557

Expenditures Fiscal Year 1998

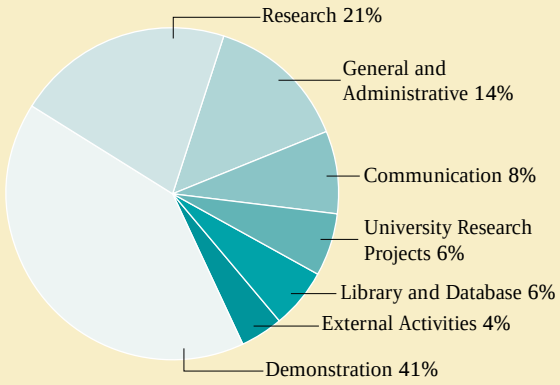
for the year ended June 30, 1998

Program Services	$3,880,617
Research	959,532
Demonstration	1,835,936
Library and Database	271,507
Communication	357,838
University Research Projects	269,215
External Activities	186,589
General and Administrative	636,940
Total Expenditures	$4,517,557

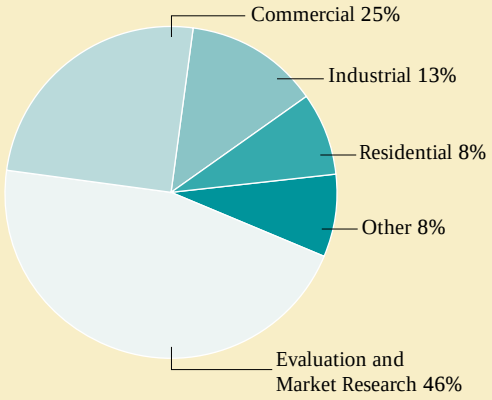
Sources of Income



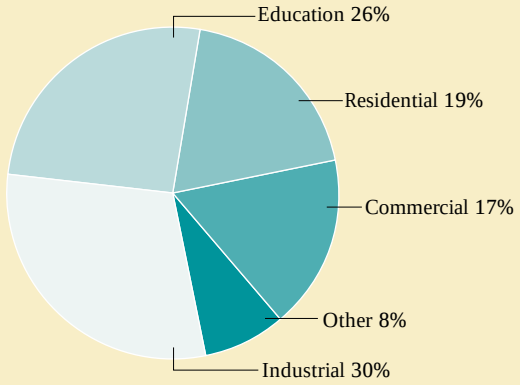
Application of Funds



Distribution of Research Funds

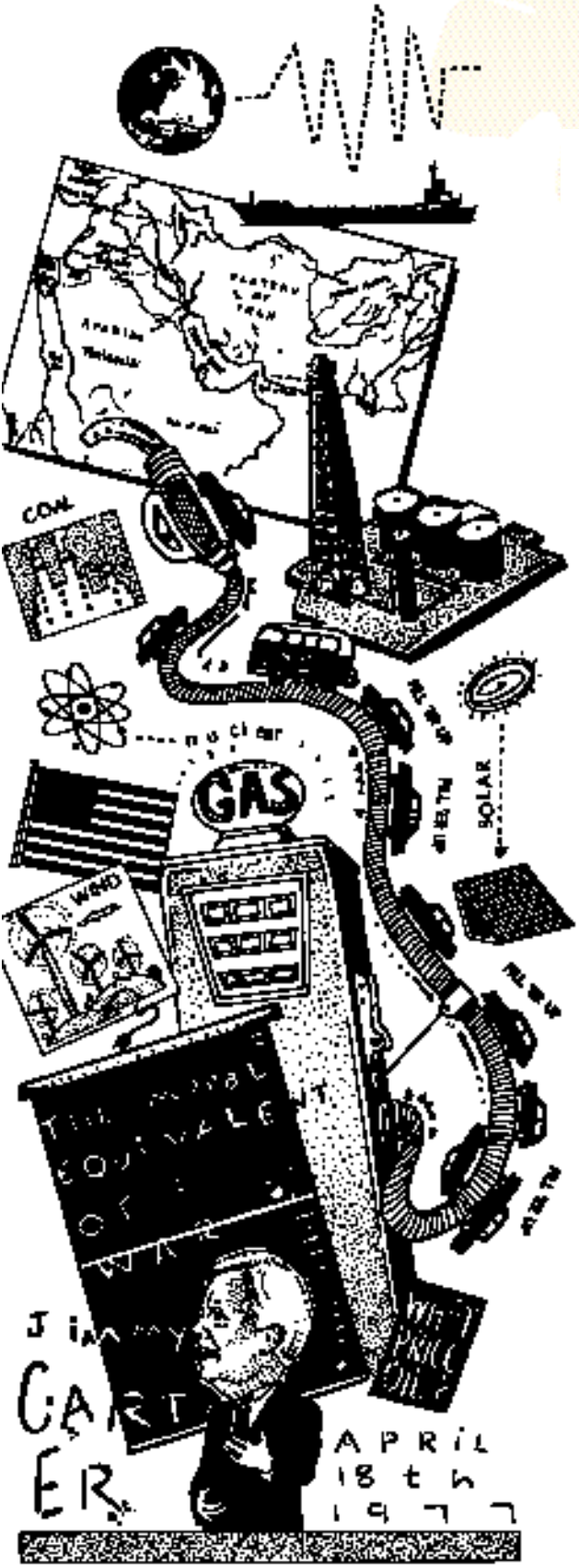


Distribution of Demonstration Funds



Trendy energy

The ups and downs of energy efficiency



By Carolyn Dunn

Illustrated by Brian Strassburg

The Arab Oil Embargo thrust energy into the spotlight in 1973. Not before then had many Americans thought about how much energy they used. Energy efficiency stayed in the mind of most Americans until about 1985—when the price of energy fell considerably and America's interest in conserving it waned.

Despite a drop in the popularity of energy efficiency, progress is still being made in the way of the technologies Americans use. Consumer choice may ultimately be driving a nation's efficiency, but behind the scenes manufacturers and policymakers are making advances that save energy.

In the height of energy conservation it was the price of energy and the threat of oil shortages that moved Americans to save. In the midst of cheap energy what will motivate a country to stay on track with energy efficiency? Perhaps environmental concerns or resource projections. Or the continuation of energy efficiency programs.

Energy efficiency advocates see a role for government, power companies, and the average consumer.

THE AVERAGE U.S. HOUSE SIZE IN 1998 WAS 2500 SQ FT, IN 1977 IT WAS 1900 SQ FT.

The big scare

On April 18, 1977 President Carter declared that combating the energy problem was the "moral equivalent of war," and if the nation did not learn to prudently manage its shrinking energy supplies, it was flirting with disaster.

Not long after, the Department of Energy came into being with the order of developing federal government policies and programs in the field of energy. Energy conservation hit the big time.

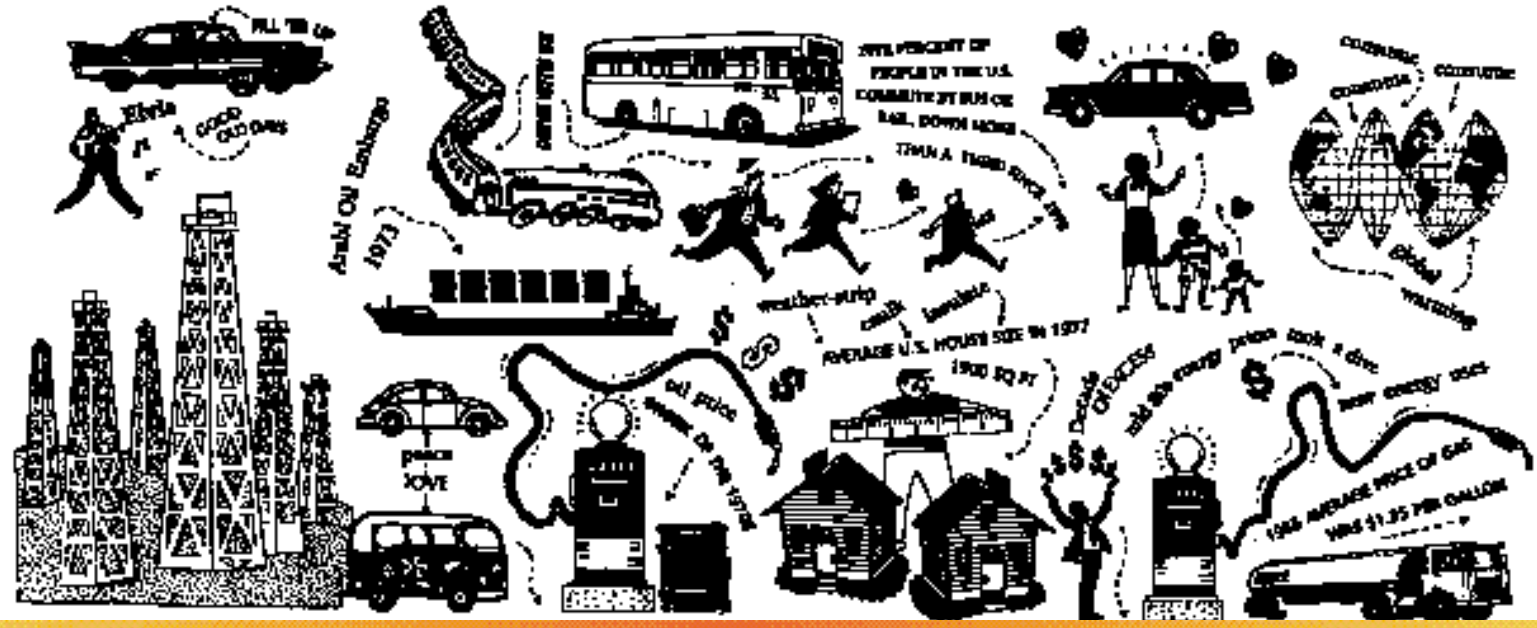
In 1980, 68 percent of Americans said a potential energy shortage was one of the top two or three things they were most concerned about. At the time higher energy prices and more energy-efficient technologies contributed to a wide array of energy-saving measures in all sectors of the economy. People purchased more fuel-efficient cars and appliances, insulated, caulked, and weather-stripped their homes, and adjusted thermostats; they were generally more aware of their opportunities to conserve energy.

But once energy prices took a dive in the mid 80s people weren't so keen on making sacrifices. An attitude of 'energy is cheap, why not use it' re-emerged and the term energy conservation took on a stigma.

"In response to energy conservation's tarnished image," explains Mithra Moezzi of Lawrence Berkely Laboratory, "policymakers turned to the concept of energy efficiency as the centerpiece of their strategies."

The focus turned to improving the efficiency of technologies like refrigerators and cars.

Moezzi says the idea of energy efficiency through technology was strategically deployed by the US energy policy community in the 1980s in order to disassociate energy conservation with pain, sacrifice, the to-the-soul national trauma of the energy crisis era, and the fact that dire supply shortage predictions of that time did not come true.



With a new name the wise use of energy stayed alive and energy efficiency improvements continued, albeit at a slower pace, in most sectors of the economy.

Following trends

The DOE has been watching energy efficiency trends and began publishing a series of reports in the late 80s. In their most recent report, the 1993 *Energy Conservation Trends*, they found that in 1991 the US used only about 14 percent more energy than it did in 1973, yet there were over 30 million more homes and 70 million more vehicles. According to the DOE report energy consumption in the US is substantially lower now than it would have been had energy intensities not changed after the oil price shock of the 1970s.

ONLY FIVE PERCENT OF PEOPLE IN THE U.S. COMMUTE BY BUS OR RAIL, DOWN MORE THAN A THIRD SINCE 1970.

One of the major lessons of the period since 1973, the DOE reports, is that the economy will respond to energy price changes. "Consumers and businesses respond in predictable ways to higher relative energy prices by using energy more efficiently, by shifting to less expensive energy sources, or, where the options exist, by substituting alternatives for energy."

According to the DOE, these improvements persist for a while, even after energy prices decline. Unfortunately, they also found that lower prices eventually slow or reverse efficiency improvements.

A peek at the decisions of car and home owners—as well as policymakers and manufacturers—over time gives us some idea of why we're in the energy state we're in, and what's ahead.

On the road

Once again fuel prices are propelling the efficiencies Americans choose. With cheap gasoline, drivers are buying more fuel-hungry cars, especially large sport utility vehicles, minivans, and pickup trucks than they did a decade ago. In 1994, 41 percent of all vehicles bought in America were light truck (into which category SUVs fall); in 1984 the percentage was 24.

Although the fuel efficiency of manufactured new vehicles increased by 63 percent between 1975 and 1993, the efficiency of onroad vehicles increased from 13.1 miles per gallon in 1975 to 19.3 mpg in 1993, an improvement of only 47 percent. More efficient cars were being made, but people weren't buying them. In 1992, and again in 1993, the Federal Highway Administration reported decreases in the onroad fuel economy of both cars and trucks.

Fuel efficiency statistics for 1998 car models aren't any better—they show efficiency at a standstill. While a handful of small cars get high mileage, nine of every ten vehicles get less than 30 mpg and nearly one fifth get less than 20 mpg.

At home

On the homefront, the energy efficiency picture has been a mix of bigger homes, higher efficiency appliances, and more ways of using energy.

While the energy efficiency of most household appliances improved between 1980 and 1990, there was also an increased saturation of selected appliances. More people owned more dishwashers, microwaves, VCRs, color televisions, and central air conditioners. For example, in 1980 most people didn't own more than two color TVs, but today one fourth of Americans own more than two sets.

THE U.S. WILL EMIT 15 PERCENT MORE CARBON DIOXIDE IN 2000 THAN IT DID IN 1990.

Between 1995 and 2015 US households are expected to increase their overall energy consumption by 17 percent, according to projections from the Energy Information Administration of the US DOE. The increase is anticipated despite huge improvements in the energy efficiency of heating and cooling units, and of many major household appliances.

GLOBAL ENERGY PRODUCTION IN 1993 WAS 40 PERCENT GREATER THAN THAT IN 1973.

Beginning in 1993, federal regulations required that all new refrigerators sold consume no more than 690 kilowatt-hours of electricity per year—30 percent less energy than used by previous models. As recently as 15 years ago, home refrigerators used up to 1200 kWh a year. Another round of regulations takes effect in 2001 that require an additional 30 percent increase in refrigerator efficiency.

As far as heating and cooling goes, room and central air conditioners showed about a 50-percent efficiency improvement between 1972 and 1993; water heaters and furnaces improved between five and 30 percent.

In its 1993 report the DOE states, "The continuing trends toward improved energy efficiency, however, appear to be largely or wholly offset as a result of new energy uses—new energy using equipment in homes—and/or increased energy intensity—increased home size, which almost always increases energy use per household."

Destined to rise again

Less efficient cars on the road. More energy use at home. No energy price jumps in

sight. One could say the energy efficiency future isn't too bright. Luckily energy efficiency devotees are working to keep it an American priority.

In *Trends* the DOE recognized a need for an energy efficiency pick-me-up. "With the continuing concerns for the adverse environmental effects of fossil fuel consumption, the challenge for energy policy in the 1990s is to establish policy measures that stimulate investment in energy efficiency even during periods of low energy prices."

Environmental concerns—especially concerns related to air pollution and the potential for global warming—have heightened public awareness about the importance of energy conservation in the economy, says the DOE, and have committed us, as a nation, to reductions in criteria pollutants like sulfur dioxide and greenhouse gases, many of which are associated with energy consumption.

The World Wildlife Fund and Environmental Working Group in their recently published report *Unplugged: How Power Companies Have Abandoned Energy Efficiency Programs* are also looking to keep energy efficiency going. But they found that between 1993 and 1997 a main source of energy efficiency research and programs for consumers—US utilities—cut their combined investment in energy-saving programs by 45 percent, or $736 million.

The study reports in 1992 utilities projected investing $2.4 billion on conservation in 1997. In fact, they spent only $894 million. "Fully funded efficiency programs would have saved customers $1 billion in 1997, and those investments would have continued to save customers money for the next 10 to 15 years," the groups write.

According to *Unplugged*, the efficiency programs that utilities cut range from home energy efficiency audits and other forms of consumer education to rebates for the purchase of new products such as efficient water heaters, lights, and air conditioners.

Without some way to reintroduce efficiency into energy policy, the public and environment will lose, the two groups conclude. "To reverse this trend and restore the nation's investment in energy efficiency, the federal government and the states must insure that future funding is available for energy efficiency programs." They say this can best be achieved through the use of a public benefits fund. Public benefits funds charge customers a small amount—generally two to five percent—to fund energy efficiency and other consumer and environmental programs (see *The Uncertainty Principle* on p. 24).

It's clear that this fund is just one part of a larger effort needed to rejuvenate energy efficiency. But together with strengthened appliance and fuel efficiency standards—and a little consumer commitment—the country could reverse the downward trend in energy efficiency, save some money, and ultimately significantly reduce air pollution and greenhouse gas emissions.

IN 1985 THE AVERAGE PRICE OF GAS WAS $1.35 PER GALLON. THE 1998 AVERAGE HOVERS BELOW $1.00 PER GALLON.

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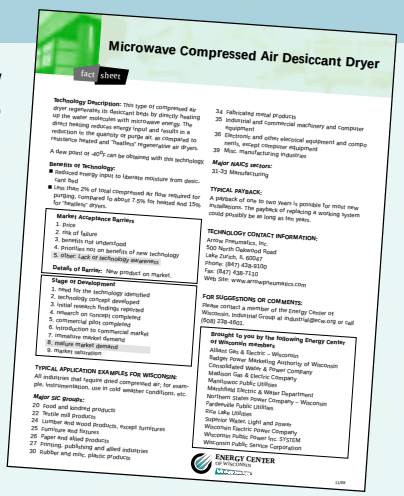
If you'd like to learn more about other cutting-edge technologies, suggest a technology by contacting us at (608)238-8276 x47, industrial@ecw.org


Microwave Compressed Air Desiccant Dryer

fact sheet

Laying the foundation for change

For Appleton teacher Pat Marinac, the basis for sound environmentalism is science

Appleton environmental sciences teacher Pat Marinac believes in hands-on learning. *Below left:* Marinac helps her students maintain their bottle systems. These pop bottle greenhouses demonstrate ecology concepts, such as the importance of plants in converting solar energy into food. *Middle:* A daily doubling of pebbles illustrates population growth.

By Eric Nelson

Environmental science is serious business for high school teacher Pat Marinac, but that doesn't mean it can't be fun. And her classroom is full of cool stuff to prove it.

Fish tanks bubble. A live boa constrictor lies coiled in an aquarium. A hornet nest hangs from the ceiling in front of a mural of the cloud-shrouded earth painted by a former student.

Marinac is an active, hands-on teacher. She strides in front of her 8:40 a.m. Environmental Sciences class, sweeping her hands from side to side, never hiding behind the black lab table. Already this hour, she's lead a discussion of sustainability in prehistoric, agricultural, and modern times; shown her students how to improve their plant distribution maps; and pointed out a news story about PCBs in the Fox River.

Now she sends the 21 juniors and seniors in her class to look in on their bottle systems. A tray of the pop bottle greenhouses basks under grow lamps near the door. Their assignment: keep the plant habitats alive for an entire year.

"You might want to go out and find another plant for this one," she says, pointing to a bottle in need of attention. "Remember," she tells them, "this is a learning experience. You've never built an ecosystem before."

Later, Marinac, who has taught in the Appleton district for 18 years, explains the connection between ecosystems and energy in a conference room overlooking the grounds of Appleton East High School.

She tells me that students want to save energy. "But what they don't understand is why," she says. "Why should we be energy aware? Why should we look at our lives in terms of energy?"

Marinac prefers to take an ecological approach. When she starts her unit on ecology she puts a big sign with the letter "E" for energy in front of the room.

"It's the whole foundation to understanding ecosystems. Whether an ecosystem works or not is entirely founded on the energy dynamics of the system," she says. The bottle systems point out the importance of plants, which convert sunlight into food. As Marinac puts it, "If we don't have green we have nothing."

"The flow of energy from producers to consumers is very inefficient," she continues. When I ask her to explain, she leaps to her feet and walks to the white board, drawing what looks like a stacked wedding cake. She labels the three layers producers, primary consumers, and secondary consumers.

"A common example that's given is grass, cows, and humans. You know this—it's the food chain," she says. "Consider that only ten percent of the energy at a given level is available to pass on. That's not much."

Marinac lived through the oil crisis of the 70s and knows from experience that energy is a precious resource. But nowadays, with energy prices low, students don't see a looming problem. So she makes the point with pebbles.

Each day she asks a student from her class to double the number of pebbles in a small glass dish. The pebbles represent people who use energy and other resources, and the doubling, exponential population growth. Within a couple of weeks, the experiment has to be stopped because the dish is overflowing.

She draws the unavoidable conclusion. "Even with conservative users, you have to supply more and more energy."

Marinac devotes much of her free time to improving science education. Besides developing the environmental education curriculum for the district, Marinac serves on the Wisconsin Science Standards Task Force, the Wisconsin Environmental Educational Board, and several other committees. She also sits on the K-12 Energy Education Program (KEEP) Advisory Board as a representative of the Wisconsin Association of Environmental Educators.

Marinac cites KEEP (an Energy Center program to help students ages five to 18 to understand energy and how it influences their lives) as a success story, praising the program for its background information and well-planned Activity Guide.

"Teachers often go to workshops looking for ideas," she says. "And they get lots of showy, glitzy activities. Unfortunately, when they get home and try to teach using the activities they realize they have no connection to what they're teaching."

KEEP avoids this problem, she says, by anchoring activities in a framework of ideas. But equally important is that those ideas are based on science.

"Science is understanding how the world works," she says. "You can't even read a newspaper or listen to the evening news without understanding science."

She cites the polluted Fox River as an example. Because of PCBs released from paper plants in the 60s, the river may be declared an EPA Superfund Site, and this has led to lots of media coverage. "People are asking, 'Should we dredge? Let nature take its course? Do you eat fish out of the river?'"

Science can help people decide what to do—and why. "Environmental education is important for developing a framework for why we take these actions. Because we'll never have ownership in them if we don't," she says.

Marinac returns to her philosophy of active learning as we discuss the Earth Club, a student environmental club she advises. She points out that the trees and shrubs outside were planted by them.

"Books are wonderful, but books stay on the shelves. How often will you be driving along, see something and have a book in the car to answer your question?" she says. "I want students to come out of my class able to discover something on their own—and confident that they can."

When I ask her what kids bring to the future, she leans toward me, smiling.

"Enthusiasm. And hopefulness—in the sense that there won't be these blockages that often seem to get in the way of policy today," she says. Her students are excited about wind and solar power and don't understand why these non-polluting resources aren't more common. "These kids have lived with so much change. Change is not scary for them. Change is scary for us. I don't think they'll accept 'we can't do it that way' quite as readily as it has been."

Not if Pat Marinac can help it. Her students might not realize it now, but with pop bottle greenhouses and pebbles, she's giving them the tools for change.

Seeking the wind

What's the difference between a seven and a ten mile per hour wind? To a wet finger lifted to the wind, not much. But those three miles per hour could be the difference between a sensible investment and an expensive mistake.

Tapping the wind

Wind turbines harness the power of the wind with spinning rotors that drive electrical generators. These rotors act somewhat like airplane propellers. Wind flows over one side of the blade faster than the other, creating a pressure difference called lift that pulls the blade around the hub.

Faster winds create more lift and thus more power. But there's a little surprise lurking in the physics. It turns out the wind's power increases with the *cube* of the speed. This means that a ten mile per hour wind has nearly *three times* the power of a seven mile per hour wind.

Seeking out these extra three miles per hour is well worth the effort. Wisconsin wind expert Mick Sagrillo of Sagrillo Power & Light recommends an average wind of at least ten miles per hour at hub height if you're planning on being connected to the electrical grid. Ideal sites are the tops of smooth hills, where the wind speeds up due to funneling.

Raise 'em high

Most wind turbines are mounted on tall towers to take better advantage of the breeze. Because friction decreases away from the ground, wind speeds at 100 feet are about 25 percent higher than at 30 feet.

Hoisting your turbine high also helps avoid turbulence. Turbulence occurs when wind spills and whirlpools around obstacles like houses and trees, leaving a wake of chaotic air. These choppy uneven winds buffet the rotors, putting stress on the tower and turbine.

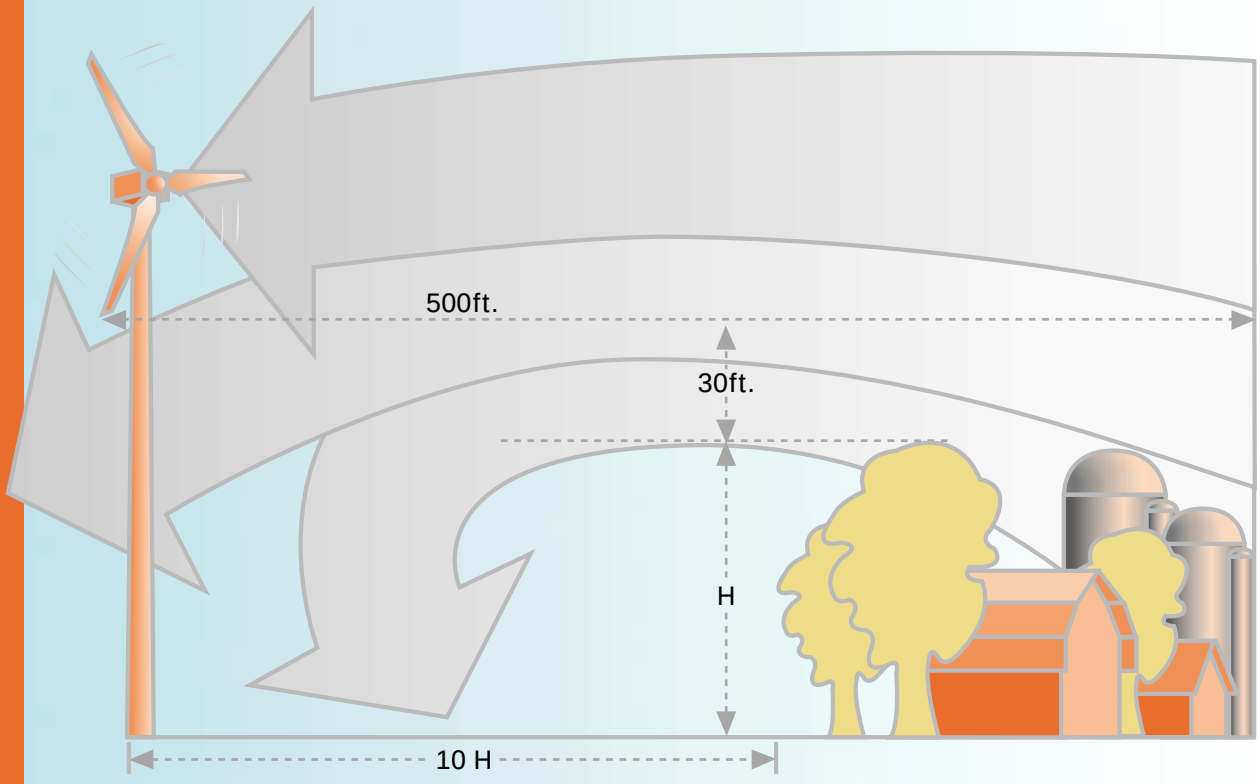
To find a smooth flow, Sagrillo recommends keeping the rotors at least 30 feet above anything within 500 feet. Another way to avoid turbulence is to site the turbine at least ten times as far away as the height of the tallest obstacles.

Wind of plenty

Many parts of Wisconsin have good wind resources. In the Door County Peninsula, for instance, the average wind speed at 110 feet is 13 miles per hour, fast enough for utility-sized wind farms. Even Madison boasts average wind speeds of about 11 miles per hour.

For more information on wind power, visit the American Wind Energy Association's web site at www.igc.org/awea.

—Eric Nelson



Turbulence is the archenemy of wind power. Two rules for avoiding it: 1) Keep the rotors at least 30 feet above anything within 500 feet. 2) Site the wind tower at least 10 times as far away as the height of the tallest obstacle.

Better buildings from better oversight

Building owners have come to expect that when an organization moves into a new building it's going to take awhile to get the bugs out. It's too hot or too cold; the indoor air quality is below par; or energy bills are sky-high.

But there's one process that helps ensure that a building's systems perform in accordance with the design intent and the occupants' operational needs—right off the bat. They call it commissioning.

The Energy Center along with the Association of State Energy Research and Technology Transfer Institutions, the US Department of Energy, and Wisconsin Gas Company has set out to tell building owners about the benefits of commissioning. With workshops being held throughout Wisconsin, the sponsors hope to motivate building owners to include commissioning in existing and upcoming projects.

"It's true you're not going to have commissioning without extra cost," says Center project manager Dan York, "but it will reduce costs during construction, help give you a building that's ready for occupancy on time, and will reduce maintenance and operation costs in the long term."

At one of two sold-out workshops held this past fall, a building owner commented, "Rarely is this subject considered in the design or construction process of actually building a building. I feel it should; and seminars like this can only help this need."

Check out the education programs on p. 27 for upcoming commissioning workshops.

—Carolyn Dunn

FOR MORE INFORMATION about commissioning contact Dan York at (608)238-8276 x42, dyork@ecw.org.

ESCOs to the rescue?

As deregulation takes hold in Wisconsin, some utilities are gradually moving away from energy efficiency services, creating a potential void in the market. Is anyone taking up the slack?

According to a new Energy Center report titled *ESCO Market Research*, the answer is, "Not yet."

The study defined energy service companies (ESCOs) as firms that design, implement, and/or finance energy efficiency projects, such as lighting upgrades, and absorb some of the customer's risk. In states like California and New York that are more deregulated, ESCOs are providing some of the services that utilities once provided.

More ESCOs may come to Wisconsin as deregulation opens opportunities here, but it's not certain. Wisconsin already has heavy investment in energy-efficiency, especially in commercial lighting, a key product for ESCOs. This, and relatively low electric rates, may make the state a less attractive market.

And what about the little guy? Most ESCOs are only interested in customers that spend at least $100,000 per year on energy. The reason is high "transaction costs," such as sales leads, proposals, and measurement and verification. Because these costs tend to be fixed, smaller projects just don't pay.

For project manager Craig Schepp these facts point out the need for someone to step in and help homeowners and small businesses. "There probably won't be serious efforts to service those markets if utility programs taper off," he says. "There is still unrealized potential out there."

—Eric Nelson

FOR MORE INFORMATION about *ESCO Market Research* contact Craig Schepp at (608)238-8276 x16, cschepp@ecw.org.

Gas use on the decline

Wisconsin residents are using less natural gas.

"Residential gas use had been in relatively slow decline statewide since the early 1980s, after the energy crisis," explains Energy Center project manager Scott Pigg, "but since 1993 it seems to have been declining more dramatically."

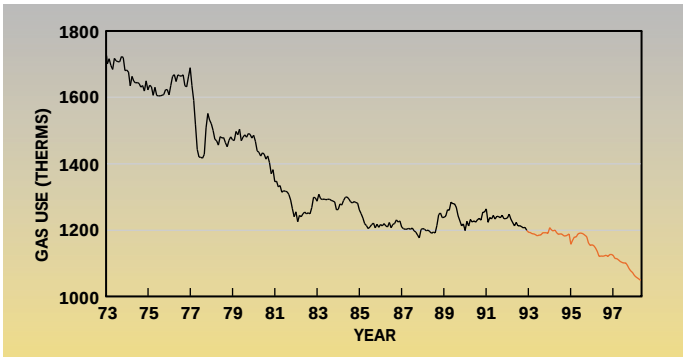
He says average gas use per residential household, most of which is for heating, has dropped at least six percent.

Several Wisconsin utilities reported that gas use was consistently below their long-term forecasts. To manage gas purchases and set rates, utilities need to know in advance how much gas their customers will need.

To confirm the decline, the Center compiled publicly available gas use data and then corrected it for weather variation.

The study briefly explored possible reasons for the decline:

- Changing heating systems—The proportion of high-efficiency systems is increasing as units get replaced, but this is probably not enough to account for such a dramatic decline.
- Changing housing mix—New houses are more energy efficient. However, new houses are also bigger on average, which tends to cancel out the savings.
- Increased electric appliance use—People may be using more heat-generating devices. But preliminary investigation found no statewide increases in household electric use.



Natural gas consumption by Wisconsin Gas residential customers—corrected for weather variation—declined around the time of the energy crisis, leveled off somewhat until 1993, and now may be on the decline again. The data represent about a third of Wisconsin residents with gas heat and mirrors a statewide trend.

The Center is considering further research to investigate the causes more fully. One area of concern, Pigg notes, is how recent equipment upgrades at weather monitoring stations may have affected the results.

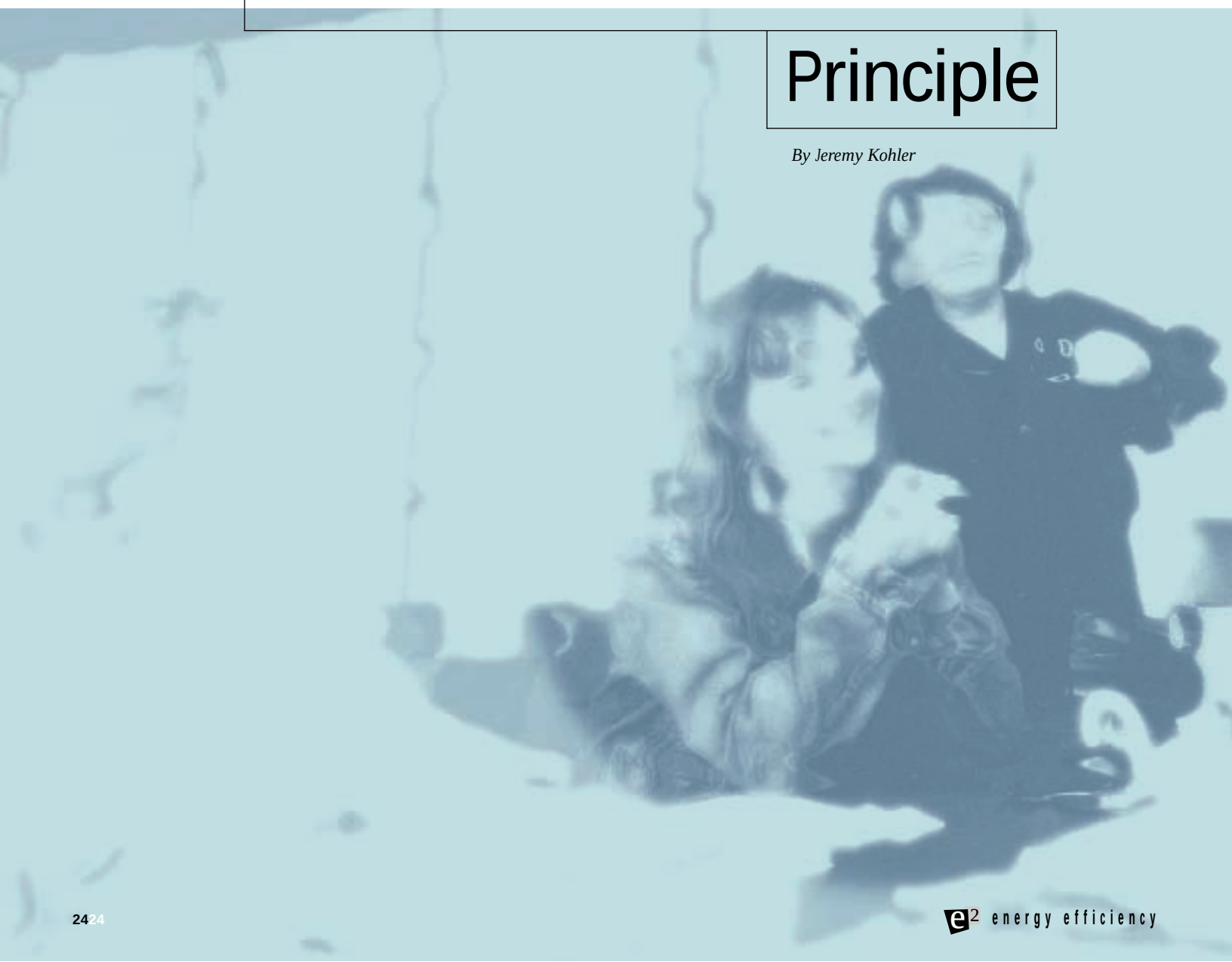
—Jeremy Kohler

FOR MORE INFORMATION about the *Gas Use Decline Study* contact Scott Pigg at (608)238-8276 x38, spigg@ecw.org.

Wisconsin faces the challenge of keeping energy public benefits programs afloat

The Uncertainty Principle

By Jeremy Kohler



They say the fundamental nature of matter and energy is inherently uncertain.

The same might be said about the energy industry. With deregulation looming on the horizon, just about everything you can think of is up in the air. This time last year many of us thought that by this time this year public benefits programs would have landed—someplace, we didn't know where.

The system is about to change

We still don't. But when we scan the horizon now we see something that's making every effort to appear as though it just *might*—remember, uncertainty is the rule—be preparing to land.

Let's see what it looks like.

Certain benefits

A *public benefit*, or a public good, is something that provides a broad benefit for society, but isn't something that businesses can profitably sell. To fill the gap, governments provide a variety of public benefits like roads, schools, police, and welfare.

Utility regulations in many states mandate energy-related public benefits like energy-efficiency education and research, environmental protection, and bill-payment assistance for low-income residents.

Usually regulated utilities provide most of these benefits, with regulated rates set up to cover not only the cost of delivering energy to the customer, but also the utility's cost of delivering public benefits to society. Public benefits are a relatively small expense overall, adding not more than five percent to utility rates depending on the state.

The future may already be here

In recent years Wisconsin utilities combined have spent up to nearly $200 million per year on public benefits (which includes support for the Energy Center), with oversight provided by the Public Service Commission of Wisconsin.

But the system is about to change.

Uncertain chemistry

The reason utility-provided public benefits are up in the air is that they may not mix well with utility competition. Most states considering or enacting deregulation have realized this, citing a number of concerns:

- Helping customers save energy may conflict with the best interests of a utility competing to sell energy on the open market.
- A new regulatory framework would be necessary to integrate utility public benefits with a free market system.
- Energy providers could use their public benefit programs to obtain unfair competitive advantages; by the same token, utilities forced to provide public benefits could be at a competitive disadvantage if other energy providers in the region are free from this responsibility.

Opinions vary on the relevance of these issues, but many utilities and policymakers agree that as industry restructures to embrace market competition, much of the responsibility for public benefits will need to shift away from utilities.

Now there's the tricky part.

A study

Something tricky landed at the Joint Legislative

On the drawing board

Some states are just beginning to study deregulation, while others have already passed new legislation. Most have expressed a desire to preserve energy public benefits, but their proposals for achieving that are hardly universal.

Depending on what state you're in, public benefits program administration might shift from utilities to any number of entities such as public service commissions, existing or new government agencies, state or regional public benefits boards, distribution utilities, energy centers (like the Center), and private corporations. The proposed funding mechanism is usually some sort of ratepayer surcharge designed to be competitively neutral.

Wisconsin naturally has its own unique plan—outlined in a proposal by the Public Service Commission of Wisconsin to the Wisconsin Legislature. After months of public debate the PSC delivered its *Enunciation of Policy and Principles* (05-BU-100) in December 1997. This docket is one of many pieces of information now under study at the Joint Legislative Council. The final outcome of legislation is anything but certain, but the PSC's recommendation could have a major influence.

The recommendation divides public benefits into two separately funded categories: *low-income* programs and *energy* programs. Low-income programs include services like weatherization, bill payment assistance, emergency repairs, and consumer education. The state would raise $59 million per year for these efforts, complemented with an additional $46 million in anticipated federal funding. These programs would continue indefinitely.

Energy programs include promotion of energy efficiency and conservation, energy efficiency research and development, support for renewable energy, and environmental research. The goal of energy programs is to transform the energy services market so that eventually, the market would provide many of these benefits without—or with less—government support. The state would raise $107 million annually for a five-year term, after which the state would reevaluate program needs in light the success of market transformation efforts.

The PSC also recommends shifting oversight and financial responsibilities for all public benefits programs from the PSC to the Department of Administration and/or the Department of Commerce. These agencies would then select administrators to implement the programs under contract.

To raise funds, energy providers—in exchange for the right to sell natural gas or electricity in Wisconsin—would pay a public benefits fee based on the amount of energy (in BTUs) they sell. An unregulated utility would then have the option of itemizing this assessment on customer bills, just like any other expense.

To learn more, read the *Utility Public Benefit Programs Staff Brief 98-2* issued September 25, 1998 by the Wisconsin Legislative Council Staff. Download it from www.legis.state.wi.us/lc/UTIL/utilmats.htm, or call the Council at (608)266-1304.

—JK

Council in September 1998 when the Special Committee on Utility Public Benefit Programs was created. Officially the committee is studying "a means to preserve and enhance, in a restructured environment, various public benefit programs currently provided by electric and natural gas public utilities, including provision of services to low-income customers, promotion of energy efficiency and renewable energy resources, environmental protection, and related research, development and demonstration activities."

According to John Stolzenberg, member of the nonpartisan Council staff supporting the committee, they'll be looking at a detailed recommendation by the Public Service Commission of Wisconsin (see *On the Drawing Board*), previously introduced legislation, and information from a wide variety of sources like state agencies, national experts, service organizations, utilities and cooperatives, and other states' experiences.

"We'll go to wherever we feel we need to go for information," Stolzenberg said just after the Committee's first meeting in October. "We're starting to roll up our sleeves now."

Those sleeves are being worn by legislators and 15 public members from utilities, community programs, businesses, environmental organizations, law firms, and public interest groups. They plan to issue a recommendation—which is typically in the form of a draft bill for the legislature to act on—by May 1, 1999.

But the future may already be here.

An experiment

The Department of Administration's *Wisconsin Focus on Energy* program resembles in some ways what the PSC has envisioned for the future of public benefits.

DOA is overseeing a two-year, $17 million pilot program using funds transferred directly from existing utility public benefits programs. It includes primarily energy-efficiency initiatives aimed at demonstrating "market transformation"—the goal being to develop infrastructure in the marketplace to eventually support provision of these benefits without government assistance.

Program coordinator Michelle New says the pilot could provide a model for preserving public benefits in Wisconsin and other states.

"We'd like to show that you can achieve measures of public benefits without new taxes or significant increases in bureaucracy," New says. "We also want to demonstrate that market transformation is possible."

The pilot program, run through the DOA Wisconsin Energy Bureau, is exploring a variety of approaches including energy efficiency demonstrations, financial incentives for saving energy, promotion of high-efficiency construction, assistance for customer-based renewable energy, and consumer education on the importance of public benefits. WEB is contracting with a number of program administrators, including the Energy Center.

"Working with WEB will supplement and enhance the Center's own market development activities," says Center executive director Mark Hanson. "There are a lot of opportunities to work the pilot's objectives into our consumer outreach and professional training programs."

Hanson notes the focus on market transformation creates a special challenge for the pilot program, which is to be completed by June, 2000 after only 18 months of work.

"We're always hoping to get more and more out of the market side and get as much energy efficiency into the system as is economical, but we don't think the marketplace by itself will be able to do it all. Public benefits will need to be an ongoing and evolving activity."

But New says a lot can be learned even from a short-term effort.

"In such a small timeframe we're not going to change the world, but hopefully we'll have a chance to influence the debate and say something about public benefits on a national level."

And closer to home, New says, they'll be keeping the state legislature informed of the pilot program's progress—even though the legislature could act well before the program is complete and evaluation results are in.

the pilot could provide a model for preserving public benefits

"As the project winds to a close we'll be looking to get the information out," New says, "but the future of any program will depend on what happens in the legislature."

Top Ten Recent Library Acquisitions

The following publications are now available at the Energy Center Library. FOR MORE INFORMATION contact Andrea Minniear at (608)238-8276 x26, library@ecw.org.

Aggregating Low Income Customers: Can Market-Based Solutions Fix Market-Based Problems? (1998) / by P. Marshall and R. Colton. Energy CENTS Coalition, Minneapolis, MN. Access #6522

Electric Utility Industry Restructuring: A Primer (1998) / published by the National Association of State Energy Officials (NASEO), Washington, DC. Access #6579

The Energy Crisis: Unresolved Issues and Enduring Legacies (1996) / by D. Feldman. Johns Hopkins University Press, Baltimore, MD. Access #6551

Keeping the Lights On: A Resource Guide for Local Governments on Utility Industry Restructuring and Competition (1996) / published by Public Technology, Inc.(PTI), Washington, DC. Access #6533

Native Power: A Handbook on Renewable Energy and Energy Efficiency for Native American Communities (1998) / by J. Busch, et al. Lawrence Berkeley Laboratory (LBL), Berkeley, CA. Access #6567

Photovoltaics in the Built Environment (1997) / by S. Strong. U.S. Department of Energy (DOE), Washington, DC. Access #6250

The Role of Market Transformation Strategies in Achieving a More Sustainable Energy Future (1998) / by S. Nadel and L. Latham. American Council for an Energy-Efficient Economy (ACEEE), Washington, DC. Access #6539

Sustainable Building Technical Manual: Green Building Design, Construction, and Operations (1996) / by L.E. Abraham, et al. Public Technology, Inc., Washington, DC. Access #5977

An Updated Status Report of Public Benefits Programs in an Evolving Electric Utility Industry (1998) / by M. Kushler. American Council for an Energy-Efficient Economy (ACEEE), Washington, DC. Access #6546

The Wealth of Cities: Revitalizing the Centers of American Life (1998) / by J. Norquist. Addison-Wesley, Reading, MA. Access #6553

Professional Education Programs and Conferences

January 19

How to Achieve Top Performance in Your Building: Commissioning Benefits, Process and Performance
Chippewa Falls, WI

Contact Marge Anderson, (608)238-8276 x32, education@ecw.org

January–February

Uniform Dwelling Code—Energy and Other Changes
Madison, Eau Claire, Brookfield, Green Bay, WI

Contact Renee Abel, (608)238-8276 x54, education@ecw.org

February 2

How to Achieve Top Performance in Your Building: Commissioning Benefits, Process and Performance
Madison, WI

Contact Marge Anderson, (608)238-8276 x32, education@ecw.org

February 9

Energy Research Highlights
Madison, WI

Contact Mark Hanson, (608)238-4601, mhanson@ecw.org

February 17–18

Regional Affordable Comfort Conference
Green Bay, WI

Contact Marge Anderson, (608)238-8276 x32, education@ecw.org

February–March

Compressed Air Training
Atlanta, Chicago, Dallas, Las Vegas, New York

Contact the Compressed Air Challenge, (800)862-2086

April 19–23

Affordable Comfort Conference
Chicago, IL

Contact Marge Anderson, (608)238-8276 x32, education@ecw.org

April 21–22

American Institute of Architects Wisconsin Convention
Madison, WI

Contact Bill Babcock at AIA Wisconsin at (608)257-8477

Selected 1998 Energy Center Publications

To order a publication contact Sherry Benzmiller at (608)238-8276 x59, orders@ecw.org.

Fan System Efficiency: Make It Better
Fact Sheet
Save money and boost productivity by improving your fan systems. This brochure explains five ways to improve efficiency, in an easy-to-understand, nontechnical format. *303-1*

Energize Your Library—Build a Utility-Library Partnership
Fact Sheet
This resource guide helps librarians discover new ways to share energy resources between utilities and libraries; and also helps utilities connect with libraries to increase community knowledge about energy and energy conservation. *309-1*

Product Catalog
Our catalog describes available research reports, program evaluations, videos, software, case studies, fact sheets, professional education programs, library services, and other products the Center has to offer.

Wisconsin Commercial Building Code
Training Modules
These training modules focus on Wisconsin's Energy Conservation and HVAC Commercial Building Codes for lighting, HVAC, and building envelope design. Each contains a presentation, speakers' notes, relevant portions of the Building Code, and submittal forms. *501-1* (lighting), *501-2* (building envelope), *501-3* (HVAC)

Biopulping: Back to Nature
Video
Learn about biopulping, an energy-saving technology that uses a fungus to soften wood chips prior to papermaking. This video explains biopulping and describes a recent 50-ton demonstration that achieved 30 percent energy savings. The video also provides economic information on set-up costs and payback periods. *603-1*

Compressed Air System Screening Tool
Software Version 1.2
This software tool for Windows helps people quickly evaluate industrial compressed-air systems and decide if there are significant savings to pursue. Version 1.2 adds a new air compressor/modulation model. *156-1, 156-2*

Wind Power Program Participation
Developing Predictive Models
This university study identifies characteristics of customers who are willing to pay a premium for "green" electricity. It also refines a method to predict actual participation in a voluntary green power program. *179-1*

Natural Gas Vehicles
Ways to Stimulate the Market in Wisconsin
This report analyzes Wisconsin's natural gas vehicle market and recommends strategies for market development. *178-1*

Two steps backward, one step forward

In my idealistic youth I joined the Peace Corps and soon found myself in rural Nepal. Being up in the Himalayas a hundred miles from the nearest road or power line gives one a glimpse of what life was like in preindustrial society. In village Nepal most everything happens by virtue of the muscles of people or animals. Our lifestyle here in the US, however, is dependent on vast amounts of energy moving through our daily lives.

The best way to appreciate the difference between these two cultures is to hop on one of the Center's energy cycles. If you've never seen an energy cycle, picture a stationary bike attached to a generator. How much electricity can a person produce on an energy cycle? Enough to light up a house? Power a microwave? Hardly. The average human can pedal up just enough electricity to keep a single incandescent light bulb going. The bargain of the millennium is that the local utility will keep that light burning continuously for less than 15 cents a day. At that price no wonder compact fluorescent bulbs are still sitting on the store shelves, even though everyone who tries out the energy cycle is amazed at how much less leg power it takes to power one.

And think about this: There are about five million people living in Wisconsin today. If we put every single person on an energy cycle, we would only be able to generate about six percent of the electricity used in an average day in Wisconsin.

One irony in all this is that—having successfully eliminated almost every reason to use our own muscles to go anywhere or get anything done—we now carve time out of our frantic schedules to stair step and treadmill our way to fitness. The greater irony though, is that despite the fact that energy is one of the fundamental pillars supporting our way of life, we have managed to banish most evidence of it to distant power plants. Because energy today is both everywhere in our lives and nowhere in most people's top concerns, those of us trying to research or change how people use energy face a formidable challenge.

Our best bet may be to focus on areas where our energy culture has taken away things that people cherish. As a case in point, consider that decades of cheap, reliable energy have resulted in acres of office buildings that are sealed boxes with vast amounts of artificial lighting—so much lighting that they must be artificially cooled almost year round, even in cold places like Wisconsin. But most office workers crave access to fresh air, natural light, and a view to the outdoors—qualities that are pretty much taken for granted in places like Nepal. In fact, buildings that use natural light were the norm only a century ago. By reviving these practices from a less energy intensive time, people can be happier and more productive—and we can save a lot of energy. Sometimes a step backward can actually be a step forward.

Scott K Pigg

Scott Pigg
Project Manager

promoting efficiency

At the Energy Center of Wisconsin we're promoting the latest developments in commercial energy efficiency. Through our workshop program we're showing Wisconsin businesses how to profit from new lighting technologies, sustainable design, and building commissioning.

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