Today's Energy Choices for a Cleaner Environment

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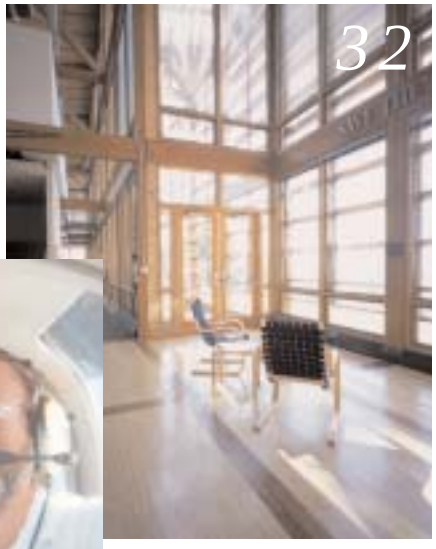
SOLAR TODAY® Features

VOL. 17, NO. 1 JANUARY/FEBRUARY 2003

Warren Gretz, NREL

Angus Duncan

Drew Gillett



Robb Williamson

Consumers Go Solar

"Back to the Future" feature

On Our Cover

Lynn M. Lickteig

Zeke Yewdall (left), a student in the College of Engineering and Applied Science at the University of Colorado at Boulder and Glenn Cashmore (right) a student in the College of Architecture and Planning at the University of Colorado at Denver, join Assistant Professor Julee Herdt, faculty advisor for the Architecture team, in front of their house, which took first place in the Solar Decathlon.

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SOLAR TODAY® Contents

VOL. 17, NO. 1 JANUARY/FEBRUARY 2003

In Our Next Issue

In developing countries, governments and non-governmental organizations are providing energy services with distributed renewable energy systems rather than going to the expense of extending the utility grid. In our next issue, we'll report on some of these projects and the economic, social and environmental impacts on local populations.

Columns

Departments

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Chair's Corner

Revisiting "Jaws"

In 1990, the U.S. consumed about 83 quads of energy. In September 1990, Michael Davis—then Assistant Secretary for Energy Efficiency and Renewable Energy (EERE) at the U.S. Department of Energy (DOE)—addressed attendees at an ASES Roundtable. In his remarks, Davis explained that if U.S. energy consumption patterns continued unchecked, consumption would grow to alarming levels—100 quads by 2000, in excess of 130 quads in 2010 and 206 quads by 2030.

Assistant Secretary Davis, a Reagan appointee, stressed the importance of EERE research and development (R&D) and the role DOE could play in stimulating the renewable energy market. He suggested that our country's goal should be to restrict growth in energy demand to less than 1 percent per year while simultaneously increasing the use of energy efficiency and renewable energy technologies.

In this scenario—which he enthusiastically referred to as "jaws"—the U.S. would implement strategies intended to hold consumption to the Energy Information Administration's (EIA's) "Conservation Strategy" levels. This meant consumption would amount to 108 quads in 2030 and the government would fund the R&D efforts necessary to raise the contribution of renewable energy technologies to 20 percent in 2010, 28 percent in 2020 and 38 percent in 2030. He felt that we could cut energy consumption in buildings, industries and transportation by 30 percent and, through "accelerated renewable R&D," achieve this objective.

The EIA's current projections, released this year, indicate that by 2005—three years from now—energy consumption in the U.S. will reach 108 quads—25 years ahead of Michael Davis' "jaws" strategy. With our 2000 consumption at 99.3 quads, we have clearly not implemented the necessary strategies to either control demand or increase the use of renewable energy technologies. Worse yet, without significantly enhanced deployment of renewables, carbon dioxide emissions will (according to EIA) be increasing at rates even greater than overall consumption. With 2000 emissions already at 1562 million metric tons, it is imperative that we assess what went wrong and fix it. If EIA's older "business-as-usual" numbers hold, by 2030 energy demand will double and carbon dioxide emissions will reach 3240 million metric tons.

The reason the contribution from renewable energy technologies has not followed Davis' trajectory is that the renewable energy research and development budget that was a key element of his scenario never materialized. The lack of consistent congressional and presidential support has produced predictable results—near-market technologies have been delayed and many previously funded technologies (because of DOE's resultant strategy to eliminate support and focus on fewer and fewer technologies) never advanced. As it stands today, even if the remaining funded technologies are successful, it is unlikely that we could achieve 38 percent renewable energy by 2030.

Mike Nicklas

Renewables *can* reach this level of contribution, but not if funding is concentrated on just a couple of technologies. To most cost-effectively achieve this goal, we must be committed to a more comprehensive strategy that captures the benefits of all our promising renewable energy technologies. Renewables can meet 38 percent of our energy needs in 2030, but only if funding levels are adequate.

There are many renewable technologies that have, over the years, fallen to the political budget ax. Today, for example, concentrating solar power (CSP) is on the Administration's chopping block, despite hundreds of megawatts of operating systems and incredible promise. It is difficult to understand the rationale behind eliminating support for CSP.

Another technology that lost favor early on was daylighting. Today, retrofitting simple daylighting strategies into our buildings could reduce energy demand by three-quarters of a quad. And the savings possible over the next twenty years from well-designed daylighting systems in new buildings—with paybacks of less than two to three years—is conservatively estimated to be in excess of an additional quarter of a quad. Excluding all the existing contributions from daylighting, that amounts to one quad of potential. Here is a technology that can reduce a building's daytime lighting demand by two-thirds, cut cooling loads by a quarter, increase the productivity and improve the health of the occupants, pay for itself in a couple of years and reduce U.S. energy demand by 1 percent. What a missed opportunity.

One could certainly argue that because daylighting is such a great investment for building owners it doesn't need support. From a system cost subsidy standpoint, I would agree.

But from a practical standpoint, unless all the technological barriers are understood and addressed, we won't come close to realizing daylighting's potential. In fact, we could actually be hurt more than helped. Good daylighting, simply put, is more design than product. Good daylighting requires well-trained designers and accurate design tools that can integrate continually changing daylighting conditions into energy models.

Although demand for daylighting is at an all-time high, the tools and skills do not exist within the design community to meet this demand. The result is that there are too many "daylit" buildings being designed that actually increase energy consumption. With just a little help, the benefit could be enormous. We would be much further ahead today if DOE had not pulled back its support of passive solar and daylighting technologies more than a decade ago. But it's not too late to do something about it now.

Over the years, DOE has dropped many promising technologies that, if support had continued, would have resulted in a radically different energy and environmental picture for our country. It is imperative that DOE return to a comprehensive "accelerated renewable R&D" approach. We cannot afford to lose any more promising technologies. ✲

Mike Nicklas
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Voting with Our Dollars

The mid-term elections were not good news for clean energy advocates. The Administration and the members of Congress that rode in on their coattails clearly intend to dance with them that brought them—the oil, coal and nuclear industries.

In an interesting twist, these industries are spending millions of dollars to position themselves as "clean" energy choices. You've probably seen the ads touting nuclear power as the "clean air alternative," or "clean" coal as the environmentally responsible fuel choice for generating electricity. If you haven't, you will.

Unfortunately, you probably won't see many expensive ads extolling the virtues of renewable energy technologies any time soon. Although the industry is maturing, most renewable energy companies are not large or flush enough to fund the kind of "image" advertising we're seeing from the fossil and nuclear folks. In fact, we are being outspent by orders of magnitude.

The effort by mature, polluting energy industries to reframe themselves as "clean" tells us something about their perception of the American consumer. As the traditional energy companies' marketing departments have correctly surmised, there is a large and growing group of Americans who have money to spend and who are concerned about the environmental consequences of their purchasing decisions.

We're seeing a number of indicators of consumer interest in solar and other clean energy technologies. For example, by some estimates, the Solar Decathlon, held last fall in Washington, DC ("Bringing Solar into the Mainstream," by Stuart Price, page 24), drew 100,000 visitors. Events like the Solar Decathlon offer wonderful opportunities to familiarize large numbers of people with sustainable technologies and products. Some of the visitors to the Decathlon might even get inspired and decide to "solarize" their homes.

But many people can't afford to buy solar equipment for their homes. Is there anything they can do to mitigate the environmental impact of the energy they use?

As Blair Swezey and Lori Bird tell us in "Buying Green Power—You really Can Make a Difference," page 28, the answer is an unqualified "yes." Americans can now decide to have all or some portion of their power needs supplied from green power sources—at a very modest price premium. An industry is developing that sells the environmental attributes of electricity generated from renewable sources (solar, wind, biomass, etc.) separately from the electricity itself. By purchasing green power or renewable energy certificates, consumers support the development of more new renewable energy projects.

Some people take the process a step further. Not only do these stalwarts purchase enough green power or renewable energy certificates to offset all the electricity they use, but they also buy extra to compensate for the other environmental impacts they cause by driving their cars, flying to distant cities, etc.

Of course, human environmental impacts go beyond energy use. In "Demonstrating a Sustainable Path," page 32, Alex Wilson describes both the process and outcome of designing and building a very "green" building. The Chesapeake Bay Foundation's Philip Merrill Environmental Center is a model of sustainable building, from its minimal footprint to its extraordinary water conservation strategies—the 31,200 square foot building uses about half the water of a typical home!

As clean energy advocates, we may not be happy about the direction the federal government is going, and we can and should try to steer the Administration and Congress toward a more sustainable course. But we can also effect change by "voting with our dollars" and supporting clean energy technologies at home, at work and in our communities. And although we don't have the luxury of big advertising budgets, we all have networks of neighbors, co-workers and friends. Let's encourage them to consider the consequences of their energy choices.

I have to admit that I admire the Administration's ability to stay on message and rally public support for its programs and perspectives. We can learn from their successes.

As Joel Stronberg points out in this issue's *View from Washington* ("What Now?" page 14), "If the November election has taught us anything, it is that good organization and cooperative action can change the course of history! Now it's our turn." ✲

Maureen McIntyre
mmcintyre@solartoday.org

Letters to the Editor

Outreach

Editor:

The purpose of this letter is to ask SOLAR TODAY readers how ASES can do a better job of meeting the needs of three main groups of present and potential members. The first group is the 5000-6000 current chapter members who are now ASES affiliate members. These members will soon be receiving a first-ever, bi-monthly electronic newsletter from ASES that will contain national and chapter news. This new membership category was approved by both the ASES Board and the ASES members who attended the annual membership meeting at SOLAR 2002 in Reno, Nevada, in June.

The second group includes members of ASES who are not members of any ASES chapter. We are trying to reach ASES members who want a closer relationship with a local group that shares their concern about national and international energy policy. What ideas do readers have for a stronger ASES approach to forming new local chapters? Is there a real need? Where else can these individuals go for group support? Should ASES chapters be forming more links with other groups? Which ones? Should we develop joint fee structures?

The third and final group we are addressing in this query is the much larger number of people who have never heard of ASES or SOLAR TODAY, but who should. How do we reach this third group?

Any and all ideas are welcome.

Ron Larson
Chapters Representative
to the ASES Board
(303) 526-9629
e-mail: ronallarson@qwest.net

Help!

Editor:

I live 50 miles north of New York City in the Hudson River Valley. Our small hamlet (about 900 families) has a big problem. We were once a small bungalow colony made up of seasonal homes. Over the years, most of these homes became year-round residences. Most of us are on private wells, but about 130 families rely on the seasonal water system to supplement their wells when they go dry or to provide seasonal water for their vacation homes. Our community is dense. Many homeowners cannot drill wells because of the proximity to their septic systems. Because of water quality issues and the breakdown of the seasonal distribution system, the Department of Health has mandated that we either shut down the seasonal system or repair the pipes. They have indicated that we must trench the seasonal pipes to a depth of 24 inches. We' d like to comply, but the community is on very rocky terrain in the foothills of the Hudson Highlands. Trying to sink this pipe to a minimum depth of 24 inches is going to be extremely costly and could threaten the foundations of our homes and existing wells and septics.

I asked if perhaps it would be possible to heat these pipes so that it would not be necessary to lay them 24 inches deep. It is possible, I was told, but the distribution system is 17 miles long—the general consensus is that the electrical cost would be prohibitive.

We are considering drilling 4 or 5 community wells that will supply us with ground water. Is there a solar or other sustainable energy technology that we could use to heat these distribution pipes and keep them from freezing in the winter? Any help—resources, suggestions and guidance for alternative energy grants (we're also a modest income community) would be greatly appreciated.

Mary Beth Becker
15 Point Drive North
Lake Peekskill, New York 10537
(845) 528-0369
e-mail: mbbecker@bestweb.net

What's in a Name?

Editor:

Joel Stronberg makes what I think is a very good suggestion—that ASES reconsider its name ("What's In a Name?" *View from Washington*, November/December 2002). It may seem like a radical idea to change the society's name, but in fact we have done it in the past.

The people who founded ASES in 1954 called their organization the Association For Applied Solar Energy, AFASE. It kept that name until its leaders reorganized it as the Solar Energy Society in 1963. Shortly after that it became the American chapter of the International Solar Energy Society, what we now call ASES.

While the name has always had "solar" in it, that word has changed in its meaning. From the 1950s to the 1970s, many books and articles about "solar" energy had sections in them about biomass, wind and hydro. By the late 1980s, the term was changing, and people began referring to renewable or sustainable energy. The U.S. Department of Energy caught on and adapted to those changes when it changed the name of its relevant division from "solar energy" to "renewable energy." It also changed the "Solar Energy Research Institute" to the "National Renewable Energy Laboratory" when SERI was upgraded to national lab status.

But ASES has not kept up with this change in terminology. Forty years ago, people would have looked at our name and thought of all the different forms of sustainable or renewable energy. Today the name might make them think of a more narrow organization than we are. A new name could help everyone understand how diverse ASES really is. We have changed the name before and could do it again.

Frank N. Laird
ASES Board Member

Editor:

I support Joel Stronberg's position on renaming the American Solar Energy Society. I'm a big fan of solar (we're very close to completing our solar home just north of Charlotte, North Carolina), but it will require a portfolio of renewable sources to meet the world's needs. As Stronberg points out, ASES already embraces and promotes other green energy sources, so a name change would simply reflect that reality. Changing our name will give us a broader reach, facilitate relationships with other like-minded organizations and prevent sustainable energy systems from being perceived only as "niche" technologies. Let's put it to a vote!

Jeff Martin
ASES Member

Editor:

I strongly endorse Joel Stronberg's suggestion that we change our name to the "American Sustainable Energy Society." This name change would make the breadth of our advocacy clearer to our audience. It would assist us in drawing in members with non-solar interests. It would reflect the importance that wind energy and bio-fuels have in supplying our future energy needs. All this, and we get to keep the same acronym (ASES) and the internet domain that goes with it.

John Richter
ASES Member

Editor's Note: We received lots of mail in response to Joel's column—all of it in favor of the name change. Anybody have a dissenting view? ✲

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Another Successful Tour

The American Solar Energy Society, host of the 2002 National Tour of Solar Buildings, reports another successful solar tour this year. Numbers are still coming in, and many tour organizers are reporting record attendance and heightened interest. In response to the growing number of commercial and institutional buildings on the tour, ASES has changed the name of the event to the "National Tour of Solar Buildings." In the past the tour was known as the "National Tour of Solar Homes."

This year, ASES provided tour participants with a free copy of SOLAR TODAY magazine as a tour program. ASES also developed several new programs for the tour this year. Participants could call on solar professionals to discuss projects and ask questions. They received discounts on solar related products and services, and licensed architects had the opportunity to receive continuing education credits through the American Institute of Architects (AIA) for attending the tour.

ASES hopes you will consider participating as a volunteer or tour organizer in your community in 2003! For more information, contact Cindy Nelson, ASES, 2400 Central Avenue, Suite G-1, Boulder, Colorado 80301, (303) 443-3130, FAX (303) 443-3212, e-mail: cnelson@ases.org, web site: www.ases.org.

ASES Fellows

On June 20, 2000, at SOLAR 2000 in Madison, Wisconsin, ASES announced the first group of ASES members to be named Fellows of the Society. This new title recognizes longtime ASES members who have provided exceptional service to the Society. To acquaint SOLAR TODAY readers with these capable and dedicated ASES members, we periodically feature brief biographies of ASES Fellows in SOLAR TODAY.

Chuck Kutscher

Chuck Kutscher is a Principal Engineer and Team Leader in the Center for Buildings and Thermal Systems at the National Renewable Energy Laboratory, where he has worked since 1978. His projects have included: the design and construction of a solar cooling test laboratory; the production of NREL's solar industrial process heat design handbook; the development of SOLIPH (a computer model of solar industrial process heat systems); leadership of NREL's research efforts on stretched-membrane parabolic dishes and low-cost solar collectors; and initiation of a polymer collaborative for low-cost solar hot water systems. His research on the fundamental behavior of transpired solar air collectors, which involved a collaboration between NREL and Conserval Systems, Inc., led to a 1994 *R&D 100* Award and a *Popular Science* "Best of What's New" award.

Dr. Kutscher served as the U.S. representative on the International Energy Agency's Advanced Solar Heating Task. He has also served as an Adjunct Professor at the University of Colorado at Boulder and the Colorado School of Mines and is a member of the Industry Advisory Council for the University of Colorado Mechanical Engineering Department. Recently, the Department of Energy Office of Science presented Dr. Kutscher with an Outstanding Mentor award for his work with student interns.

Chuck Kutscher, Ph.D.

Currently, Dr. Kutscher is developing an advanced air-cooled condenser for geothermal power plants, an effort for which he was just awarded a patent. He has been an active member of the American Solar Energy Society Board of Directors for the past 7 years, including a two-year term (2000-2001) as Chair. He has published over 30 papers and chapters in several books and is an Associate Editor of the *Solar Energy Journal*. He has a BS degree in Physics from the State University of New York at Albany, a MS degree in Nuclear Engineering from the University of Illinois at Urbana-Champaign and a Ph.D. in Mechanical Engineering from the University of Colorado at Boulder.

Award Nominations Due

Each year, the American Solar Energy Society (ASES) presents awards to people who have made outstanding contributions to the Society or to the solar energy community.

- *The Charles Greeley Abbot Award* goes to an individual who has made a significant contribution to the field of solar energy or to ASES.
- *The Passive Pioneer Award* acknowledges a person or group whose creative and original thinking and research have led to new developments in the passive solar energy field.
- *The Rebecca Vories Award* honors a volunteer whose efforts have significantly advanced the ability of ASES to accomplish its mission.
- *The John and Barbara Yellott Award* recognizes an outstanding graduate student working the solar energy field and includes a $500 scholarship.
- *The Hoyt Clarke Hottel Award* goes to an individual who has made a significant contribution in any area of the solar energy field.

This year's winners will be honored at an Awards Banquet at the SOLAR 2003 Conference in Austin, Texas, June 21-26, 2003.

Nomination forms are available on the ASES web site (www.ases.org) or from Dona McClain at ASES, 2400 Central Avenue, G-1, Boulder, Colorado 80301, (303) 443-3130, ext. 106, FAX (303) 443-3212. Nominations must be received by March 15, 2003.

New ASES Staff

The American Solar Energy Society (ASES) has hired Becky Campbell-Howe to work at the headquarters office in Boulder on a full-time basis. As many of you know, Campbell-Howe previously worked at ASES in the role of Conference Director and Home Tour national organizer. For the past few years, Campbell-Howe has served as editor of the Conference Proceedings and has a broad background in renewable energy technologies. She will assist in a variety of assignments but most notably she will be the staff lead for the Annual Solar Conference.

For more information, contact Becky Campbell-Howe at ASES, 2400 Central Avenue, G-1, Boulder, Colorado 80301-2843, (303) 443-3130, ext. 103, FAX (303) 443-3231, e-mail: bchowe@ases.org. ✲

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What Now?

by Joel Stronberg

The November elections brought Republican majorities to both the House and Senate and are likely to have a negative impact on the sustainable energy sector. Although not quite a referendum on the Bush Administration, the President devoted a great deal of time and energy to the mid-term campaign and is likely to see the results of the election as an opportunity for pushing his core agenda. Having raised $140 million dollars at 67 fundraisers and logged thousands of miles on the campaign trail, stumping for candidates in close races, Mr. Bush has earned a great deal of political capital with the incoming Republican members of Congress.

I doubt the President will be the least bit shy about reminding the new Republican majorities in Congress that they owe their victories in large part to his popularity and performance. It is likely, therefore, that agenda items defeated by a Democratic Senate during the 107th Congress will be reintroduced into the 108th, with the realistic expectation that they will become law.

It is of course impossible to predict with certainty what will happen over the next two years. However, it is possible to talk with certainty about what has already happened during the Bush Administration and to draw some conclusions based on those events. For sustainable energy technologies, the picture is not pretty.

The bottom line is that the Administration has shown little support for domestically available sustainable energy technologies. Whether in its national energy plan, budget proposals, regulatory initiatives or administrative practices, the Bush Administration, at best, has shown an indifference to clean energy sources. At worst, it has shown hostility towards global warming theories, an unwillingness to join with other developed nations in efforts to curb greenhouse gases, a reluctance to increase research and development budgets for clean energy technologies, a willingness to exempt defense and other federal activities from environmental protection laws and an expressed desire to increase the use of fossil and nuclear energy sources—even if that means digging up coal-rich states and drilling in environmentally sensitive areas.

This is an Administration firmly aligned with the interests of the petroleum, coal and nuclear industries. It is an Administration that chooses not to recognize the relationship of petroleum dependence to national security, one that is quick to attack Iraq but slow to defend the nation against the threat at home of crippled power plants and exploded pipelines, an Administration that believes what is good for the oil patch is good for the country.

President Bush has two years in which to push through as many of his core policies as he can. It is rare for the party of a sitting President to gain Congressional seats in a mid-term election. It's happened only once in the 20th century, during Franklin D. Roosevelt's tenure. Having defied history, the President and his advisors are now intent on making some of their own.

Quite naturally, the Administration is going to propose policies, programs and regulations promoting the energy sources it favors, while giving minimum lip service to the environment. Is there a more oxymoronic phrase than *"clean" coal?* Well, perhaps *arming for peace.*

The point is that the recent Republican mid-term election victory will be used to push the agenda of fossil and nuclear energy interests. Moreover, it is likely that during the next two years the President will bomb Iraq, political unrest in the Middle East will increase and terrorist activities will heat up. It is a sure thing that the Administration—with the support of Congressional leaders—will respond to any interruptions in foreign petroleum with emergency legislation to increase domestic production of petroleum, use of "clean" coal and nuclear power.

> For sustainable energy technologies, the picture is not pretty.

Although I don't like the picture I see, I certainly can't begrudge the President or the Republican party their victory. The President and his party worked hard to achieve success and they deserve it. In any event, the real culprits in the election were the Democrats. Their inability to define themselves and their issues was probably more responsible for the outcome of the November elections than anything the President and his party did or didn't do along the campaign trail.

With an Administration not particularly friendly to sustainable energy technologies and a Democratic party unable or unwilling to oppose the President, the next two years will be difficult ones for renewable energy. These are years, however, that cannot be written off in hopes that the next election will bring a different result.

Shortly after the election, Senator Trent Lott, (R-MS) said one of his domestic policy priorities, as majority leader, would be energy policy. Congressional pundits fully expect Lott, with the cooperation of senior Republican Senators like Domenici (R-NM) and Inhofe (R-OK), to pass legislation more closely in line with the production-heavy bill that passed the House in August 2001. We can also look for efforts to federalize the nation's electric transmission grid, enact the Clear Skies Initiative, reform (downward) motor fuels standards and revive the $34 billion in tax breaks offered in the House energy bill.

To withstand the backward momentum of traditional energy sector interests and to create a forward momentum of its own, the sustainable energy sector is going to have to rethink its approach to government. Rather than relying on political leaders, the sector must work more closely with community leaders.

Although the next two years are likely to be an uphill battle for sustainable energy advocates, it is a battle that can be won. To win the policy battle in Washington, it is going to be necessary for the sustainable energy sector to plead the case for its technologies directly to voters.

A national grassroots campaign in support of sustainable energy sources is an immense undertaking. To accomplish this goal, all of the sector's organizations must work together. We must develop effective strategies to support individuals and organizations at the state and local level who see the need for a balanced national energy plan and are not afraid to tell those in Washington that this must be a core priority of any administration and Congress.

If the November election has taught us anything, it is that good organization and cooperative action can change the course of history! Now it's our turn. ✲

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NCSEA News

The North Carolina Sustainable Energy Association (NCSEA) recently received a $30,000 grant from the Z. Smith Reynolds Foundation to provide support for marketing of the North Carolina GreenPower program to the environmental community and the general public. Several members of NCSEA sit on the Advisory Committees formulating the green pricing program, which have an expected launch date in mid-2003.

NCSEA also received a total of $12,500 in funding from Advanced Energy and the State Energy Office North Carolina Department of Administration for expanded distribution of the quarterly newsletter, the *Carolina Sun*. NCSEA can now add an additional 2100 recipients, including the North Carolina State Legislature, Public Utilities Commission and Staff, environmental organizations, libraries, engineers, builders and architects interested in sustainability.

In March, NCSEA will host a statewide Green Building Tour, in cooperation with several Million Solar Roof Initiative communities, North Carolina State University (NCSU) Solar Center and the Western North Carolina Green Building Council. NCSEA continues its endeavors as an active participant in the North Carolina Public Benefits Fund Coalition, the Clean Cities Program and the North Carolina Wind Power Working Group.

In collaboration with other groups, the chapter has been successful in promoting the passage of Clean Smokestacks legislation to mandate cleanup and new pollution abatement measures at the 14 coal-fired plants in North Carolina.

For more information, contact NCSEA (see pages 18 and 19 for list of ASES Chapters).

Successful Roundup

The Texas Solar Energy Society (TXSES) was delighted to have American Solar Energy Society (ASES) Executive Director, Brad Collins, join them for their annual Renewable Energy Roundup, September 20–22, 2002, in Fredericksburg, Texas. Collins spoke on the topic of "Energy and Grassroots Advocacy." He commented on the high level of knowledge and interest fair visitors brought to the Roundup. Other speakers included Charles Walters, founder and executive editor of *Acres, USA*, the monthly journal of ecological agriculture; Robyn Lawrence, Editor of *Natural Home* magazine; and Randy Udall, director of Colorado's Community Office for Resource Efficiency. Visitors could choose from over 70 tent talks, 20 in-depth workshops, 80 exhibits, organic food vendors, music and on-going kids activities, all set in a delightful park filled with wildflowers and sunshine.

Steve Weikal, WeikalMedia

Entrance to the Renewable Energy Roundup

For more information, contact TXSES (see pages 18 and 19 for list of ASES Chapters).

Solar Fiesta

It rained during set up, the caterer forgot to show up for the volunteer dinner and a small carnival took up residence in what was supposed to be the main parking area for the event. Nonetheless, the New Mexico Solar Energy Association (NMSEA) hosted their Annual Solar Fiesta, September 28-29, 2002, for a record crowd of 2563 at the Indian Pueblo Cultural Center in Albuquerque. The Fiesta featured 46 speakers and classes, 50 booths, a Kids Solar Scavenger hunt and a Solar Silent Auction.

Participants were able to get hands-on experience building with straw bales, as NMSEA constructed a privacy wall on the premises under the guidance of Joe Matesi, owner of Holistic Habitats. In another part of the exhibit grounds, Richard Levine of New Mexico Earth Adobes helped participants make adobe bricks and then build a curved wall. Marlene Brown of Sandia National Labs PV Department demonstrated putting together a simple PV/battery combination to show how easy it is to make your own power.

Exhibits included alternative building structures and styles, solar water distillers, heaters and pumps. Electric cars, a hybrid and a biodiesel vehicle were on hand along with the frame of the solar racecar being developed by the New Mexico State University (NMSU) Sunburn Racing Team.

Richard Perez, editor of *Home Power Magazine*, spoke on how renewable energy brings personal, local and national freedom to people everywhere through reducing our dependence on foreign oil and fossil fuels.

The Solar Fiesta was enhanced through cultural participation by the Indian Pueblo Cultural Center (IPCC). They showcased performances by Native American Dancers in the courtyard of the beautiful adobe style building. The IPCC building is powered by a 10-kilowatt PV system.

For more information, contact NMSEA (see pages 18 and 19 for list of ASES Chapters).

Maine Solar Primer

The Maine Solar Energy Association (MESEA), a chapter of the Northeast Sustainable Energy Association (NESEA), recently published a sourcebook, *Maine Solar Primer*, for solar and other alternative energy resources in Maine. The booklet includes:

- Maine and nearby vendors of photovoltaics, solar thermal and other renewable independent power systems equipment;
- Plans for building a solar oven from a MESEA solar oven building workshop; and
- MESEA workshop plans for building a rooftop solar hot water heater, appropriate for use in Maine's northeastern climate.

For more information and to order, contact MESEA, or send $5.00 plus $1.00 (shipping and handling) to Maine Solar Primer, RR 1, Box 7751, Jonesport, Maine 04649. Make checks payable to the Maine Solar Energy Association.

For more information about NESEA, see pages 18 and 19 for list of ASES Chapters. ✲

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Solar Marketing—
Quality Customer Service Is Priceless

by Mark McCray, Ph.D.

In the September/October 2002 issue of SOLAR TODAY, I wrote about the power of benefits in bringing potential clients to your company. Benefits are those emotional connections or feelings customers develop about your products and services, and about their relationships with your company. One of the most valuable, and often over-looked benefits, is customer service. Good customer service makes customers happy, improves your reputation and improves overall profitability.

Traditionally, people believe customer service starts after the sale. Actually, customer service begins when prospects first contact your company, and continues as long as clients have relationships with your company. The length of this relationship—and the mutual benefit derived from it—is determined by the quality of your customer service.

To get a feel for how important customer service is, think about the last time you had a frustrating or negative buying experience. You probably don't have to think back very far. Have you ever had to get help with computer software or hardware? How much time did you waste on the phone, on hold, spending your time and money for a long distance call, ending up with information that didn't solve the problem?

Now ask yourself, "What's it like getting customer service from my company?"

Customer service problems have a direct relationship to factors such as a company's commitment to quality service, staff attitudes about customers, resources the company has to provide service, employee knowledge of products and services and how well the company staff knows its customers.

What is your company's commitment to quality customer service? An owner or manager's attitudes and beliefs about the value of customer service set the standard for the whole company. If he or she values long-term customer relationships above sales and profits or company growth, and feels it is important to determine and fulfill customer needs, then inevitably sales, profit and company growth will follow. Others in your company will convey your attitudes to customers.

Has your company identified resources needed to provide quality customer service? You may believe in the value of customer service, but you must provide staff, time and financial resources to support these services. It is a very important investment in your company. A portion of profit must be set aside to ensure the success of these services.

Are your employees committed to quality customer service? Make sure your sales and service employees maintain a positive attitude about customer service. When employees are not responsive, or hold negative attitudes about customers and service, it reflects badly on the company and frus-

trates customers. Even when a customer is challenging to work with, it is in your best interests to provide the needed support.

Do you and your employees have the necessary human relationship knowledge and skills to provide quality customer service? Some people don't understand what's needed to develop effective relationships, or don't know how to apply this knowledge when working with customers. People who lack effective human relationship skills may become confrontational or argumentative with customers. When this happens, both parties usually lose, and it will cost your company business in the long term. Reading books, taking classes and listening to self-help recordings on customer service go a long way toward improving the services you provide.

Good human relationship knowledge and skills will help you and your employees understand customer needs and behaviors. Correctly identifying customers' needs and knowing how to respond can prevent long-term problems and increase sales.

Is customer service part of your sales process? Are you and your sales staff responsive to inquiries? The more quickly your company responds to requests for information, the more likely customers are to feel you care about their needs. Providing timely quotations and following up to see if there are questions or concerns also shows you care.

Do you and your employees have the necessary product knowledge to support your customers? This is one of the most common customer service failures for new companies. Most solar electric systems we design and install are fairly complex. Overlooking standard design practices and procedures at any given stage can cause poor system performance or failure. Occasionally, a component may perform poorly or not at all. Recognizing problems and reassuring customers that problems will be resolved in a timely way helps make customers feel comfortable with your company. This sense of comfort means more future business and positive referrals.

Do you work with manufacturers and suppliers who value customer service? Some suppliers rank customer service as a low priority, especially if they feel they can monopolize the market. Some may be greedy, or have very low profit margins on their products. Either way, they do not develop the necessary systems to support either you or your customers. This can be extremely frustrating, but ultimately, customers hold you and your company responsible. Do your best to keep your suppliers responsive. If your customer needs help, make certain he or she gets it. Ultimately, you are accountable. You sold the product.

Some suppliers have a customer service division, and you may find that the quality of customer service varies depending on which factory representative you work with. It is important for you to know service representatives who have good product knowledge and people skills.

Increase your customers' satisfaction and sales and profits will grow. Keeping your customers happy by providing quality customer service has great value to your company. Studies show it is far easier and more cost effective to keep an existing customer than to find a new one. Studies also show most customers will do business with your company again if you resolve problems in a timely manner. Quality customer service is truly priceless.

In the next article I will give you examples of great customer service and offer ideas for solutions to specific challenges and problems. ✲

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Transportation Bill—
A New Market for Solar

by Glenn Hamer

An Energy Bill still remains the solar industries' best opportunity to improve its market situation in the U.S. Tax credits, a favorable Renewable Portfolio Standard, model Federal language for net metering and interconnection and increased authorization for appropriations research and development (R&D), are all likely elements in any comprehensive package. But as desirable as it is, the Energy Bill is not the be-all and end-all—there are other bills that provide opportunity to help create new or expand existing solar markets. Working with organizations such as the Environmental and Energy Study Institute, Solar Energy Industries Association (SEIA) secured language in the new Farm Bill to provide a five-year, $115 million fund for farmers and rural small businesses to deploy renewable and energy efficiency technologies. Title IX, Sec. 9006 (www.usda.gov/farmbill/). We continue to work diligently with the U.S. Department of Agriculture to ensure that many of these funds are released for high-value, high visibility agricultural applications (remote residential power, water pumping, fence electrification, etc.). Following the model of the Farm Bill, we plan in the next Congress to use the reauthorization of the $200 billion Transportation Bill to encourage expansion of the most market-ready of relevant solar technologies via aggregation, bulk purchasing, targeted R&D and, where required, selected buydowns.

The Transportation Bill is routinely derided as a collection of pork-barrel projects, and there is a tendency to look down on any attempt to include earmarked funding within it. However, this is not opportunistic behavior on our part. We are carefully targeting those areas of legislation where solar technology can stand on its own as the best option, including financial incentives where necessary to spur rapid adoption of competitive solutions. And pursuing initiatives on bills like the Farm Bill or Transportation Bill also is smart because these bills undergo major reauthorizations every five or so years. Comprehensive energy legislation is much more unpredictable. Because most of the measures in it do not sunset, it takes remarkable external pressure—gas prices, war with Iraq, California meltdown, etc.—to spur action.

The Transportation Bill is ripe for a strong renewables provision. The powerful ranking member of the Committee, Jim Oberstar of Minnesota, is one of the strongest supporters of photovoltaics in the Congress. But even more important than personalities is the good-government case we can make for an energy title that is solar-centric. The wonderful, modular nature of photovoltaic (PV) technologies makes it ideal for so many different functions funded through the Transportation Bill.

The most obvious and intuitive addition to the highway bill is to find a way to encourage new streetlights, signs, etc., to use solar technology. For security and economic reasons, this is more than sensible. Streetlights and signals are frequently most critically needed during the sorts of disruptions that cause grid failure. Power outages can cause accidents, and these outages can them-

Glenn Hamer

selves become more extensive than need be when, for instance, a large vehicle tears up underground cabling. Independent, modular lighting is immune to this concern. Moreover, the *initial* cost of highway solar devices is usually less than the cost of extending the grid for roadway devices that require electrical current. A payback time of zero is a powerful argument.

As exciting as the lighting and signaling issues are, however, they are not the only opportunity. Scores of buildings of various kinds—visitor centers, dispatch buildings, repair facilities, terminals—are specified in the Transportation Bill. There is a growing trend within the government to specify some level of the U.S. Green Building Council's LEED™ standards for new government construction. (The Governmental Services Administration now uses LEED™ for all new government buildings and the Navy uses Silver LEED™. Visit www.usgbc.org for more information.) To meet the stringent and comprehensive LEED™ requirements, many choose highly visible and low-cost solar technologies for at least part of their requirements. One proposal is therefore to require Silver LEED™ ratings for all new structures funded with highway dollars—a proposal, by the way, which will certainly save taxpayers a great deal of money in the long term.

Perhaps most exciting are research concepts, such as using PV to help refrigerate loads in trucks and to offset diesel emissions when trucks are idling. A few years back, Sandia National Laboratories completed an interesting paper on the use of PV for mobile refrigeration. Undoubtedly a cleaner option than using a fully diesel-powered compressor, it was at the time slightly more expensive. However, the study did not include depreciation or tax credits, nor could it have foreseen later developments in PV cost and performance or the new EPA diesel emissions regulations. We feel that a rapid research program, coupled with a temporary consumer rebate or buydown program could immediately "tip the scale" on the economics and make a market—much as the California rebates have done for grid-connected PV.

These small compressors, whether driven by the truck's idling engine or by a separate genset, are an extremely dirty way to produce cold air. They have frequently drawn the ire of environmentalists and public health groups, especially as they are frequently operated in already dirty and/or congested areas.

There are other opportunities as well, and we are currently in the exciting period of gathering new ideas that we can try to make into reality. Please feel free to contact us with any other ideas on language that could be added to the Transportation Bill. ✲

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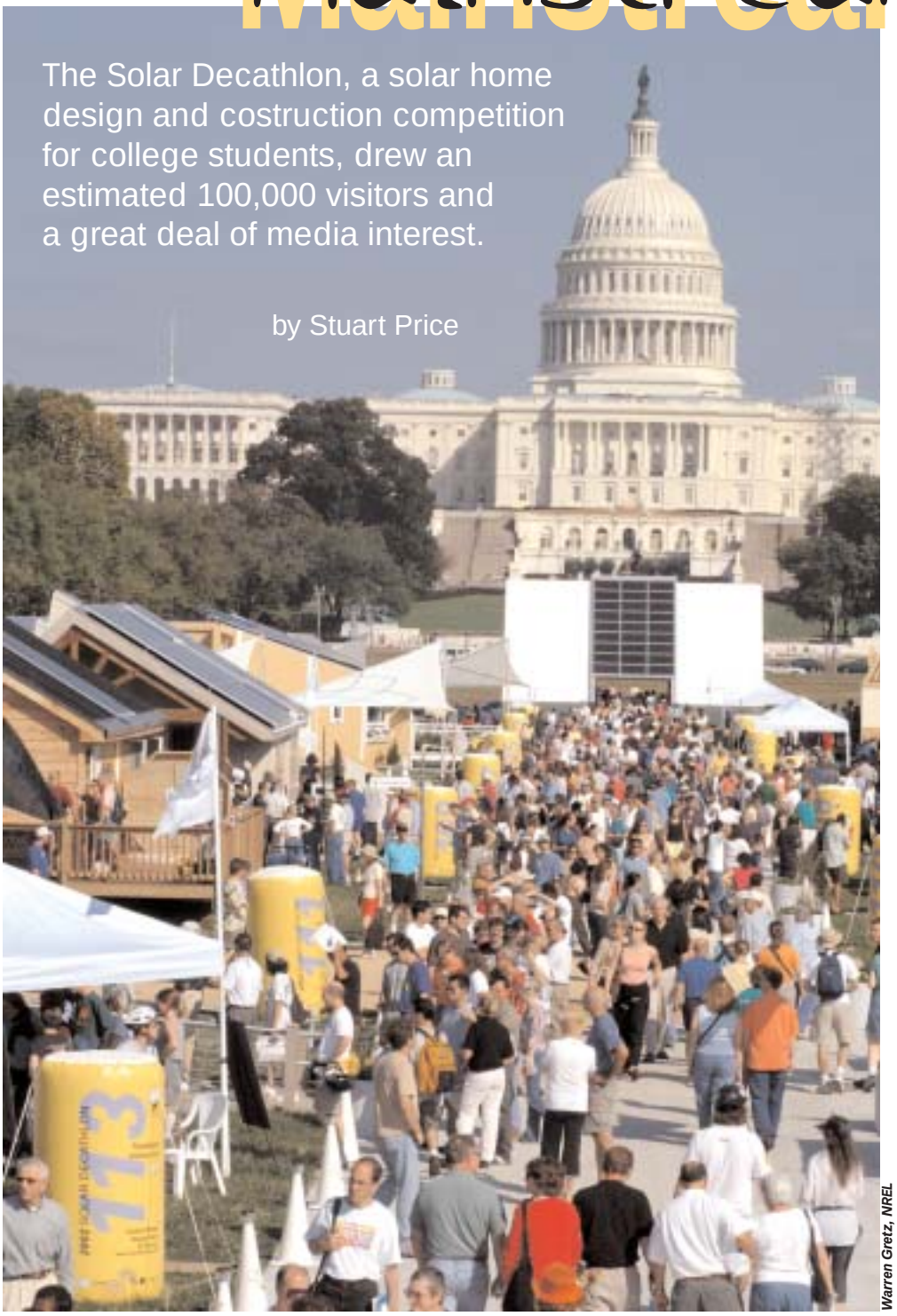
Bringing Solar Into the Mainstream

The Solar Decathlon, a solar home design and costruction competition for college students, drew an estimated 100,000 visitors and a great deal of media interest.

by Stuart Price



Warren Gretz, NREL

The teams competing in the Solar Decathlon transported their houses to the National Mall in Washington, DC, and hosted thousands of visitors from September 26 through October 6, 2002.

Encouraging more people to join the solar energy clan means letting more people know that solar power technologies are right here, right now. It means using the media to broadcast how solar energy is not just reserved for pocket calculators, roadway signage and research and development laboratories anymore.

Solar in the Spotlight

The Solar Decathlon—held from September 26 through October 6, 2002, on the National Mall in Washington, DC—placed a national spotlight on the solar energy industry and how it can support residential housing today (see www.solardecathlon.org).

This competition challenged university teams made up of architecture, engineering and construction students to build houses powered entirely by the sun. Each house, sized at about 500 to 800 square feet, had to generate enough electricity to provide heating, cooling, hot water and lighting as well as power appliances, computer systems and a personal electric-powered vehicle.

Each participating university was charged with blending aesthetics and modern conveniences with maximum energy production and efficiency during the ten-day competition. To support their efforts, the teams received $5000 stipends along with tutorials on solar energy and building design. Each university also had to reach out to specific donors for designated financial support.

Interested universities submitted design plans to Decathlon officials. In the end, fourteen universities were invited to enter the contest. These qualifying schools finalized their plans and transported their houses to the National Mall for final construction and public display.

Each participating university contributed to the success of the Solar Decathlon. A few teams designed their houses with extra creativity and direction to highlight how solar technologies can be integrated into houses and lifestyles today.

Warren Gretz, NREL

Several members of the University of Colorado team—first place winners of the Solar Decathlon—stand on their porch with Colorado Congressman Mark Udall.

Dr. Larry Kazmerski, Director of the National Center for Photovoltaics at NREL, said that the competition depicted a realistic use of photovoltaic (PV) technologies. "After touring the houses on the National Mall," said Kazmerski, "I saw more than I had expected. These teams showed how solar power can be used in the real world."

And the Winner Is...

The judges chose the University of Colorado as the final winner of the competition. The University of Virginia placed second while Auburn University took third. But everyone recognized that all the teams were winners, and the 100,000 or so visitors to the Solar Decathlon seemed to agree.

University of Colorado

One of the most significant hurdles to making solar houses more attractive to the mass market involves improving their appearance. After all, typical solar houses look different than average neighborhood residences—largely because of their "cheese wedge" shapes that maximize southern exposures and their standout solar panels. The University of Colorado recognized this challenge and designed their entry to have "curb" appeal as well as superior energy performance.

The CU Solar Decathlon project was a collaboration between the College of Architecture and Planning and the College of Engineering. Professor Michael Brandemuehl was the engineering faculty advisor, and Assistant Professor Julee Herdt, Architect, was the architecture faculty advisor for the project. Students from both colleges worked together on the project from planning through construction.

Warren Gretz, NREL

Zeke Yewdall (left), a student at the University of Colorado (CU) at Boulder, shows Richard King of the U.S. Department of Energy, director of the Solar Decathlon, a model of the solar house designed by CU students.

The Colorado team developed a sustainable housing design that could be applied to mass-market homes. The team used a construction methodology that featured:

- Two prefabricated modular wings, built with structural insulated panels and high-performance windows, joined by a unique central space
- Green building products (like recycled materials, engineered lumber and rapid-growth wood)
- Efficient appliances and integrated systems

Warren Gretz, NREL

Students from the University of Colorado assembled their house at a local Home Depot and got it ready to ship to Washington, DC. Note the use of structural insulated panels to build the walls.

- Overall energy performance without conformance to the traditional solar aesthetic.

This modular house featured systematized wall, floor and factory-produced Structural Insulated Panels ceiling components. The electricity generating system included a building integrated PV (BIPV) design with solar panels placed in the roof. The system generated more than enough electricity to power household needs. To meet the hot water design criteria, the Colorado team used rooftop solar thermal collectors.

"I think that part of the reason that we won was that we did have an interdisciplinary team that worked well together," said Zeke Yewdall, a student with the Colorado team. "Some houses had problems getting mechanical or electrical systems to work properly because they were largely architectural efforts, while others functioned well from an engineering standpoint but were discounted in the architectural judging. Ours was one of the few that performed well on both counts."

University of Virginia

The University of Virginia (UVA) entry stood out on the Mall. As Dave Click, Team Leader from the School of Engineering and Applied Science, explained, "Our house was shaped like a trailer—14 feet wide and 48 feet long, divided roughly into four 12-foot segments lengthwise.

"The solar panels attached to the south wall via a parapet. We placed thermal collectors along the bottom of the south wall and in the northeast corner. We also built a deck on the south wall, and glazed a large portion of the south wall. We divided the structure into two segments—the south side for living, dining, bedroom and sunspace, and the north side for kitchen, office, bath, laundry and mechanical elements."

The UVA team used the "Energy-10" software system to help design their house. (In fact, one of the judges, Dr. Doug Balcomb, helped develop this simulation software and more Decathlon teams used this software system than any other.)

"In reviewing the entries, it was gratifying to see that half of them had used the 'Energy-10' building design software system," said Dr. Balcomb. "I hope that more building designers will choose to incorporate this kind of software to design houses that are more efficient and energy friendly."

Participating Universities

Auburn University (Auburn University, Alabama)
Carnegie Mellon University (Pittsburgh, Pennsylvania)
Crowder College (Neosho, Missouri)
Texas A&M University (College Station, Texas)
Tuskegee University (Tuskegee, Alabama)
University of Colorado (Boulder and Denver, Colorado)
University of Delaware (Newark, Delaware)
University of Maryland (College Park, Maryland)
University of Missouri—Rolla (Rolla, Missouri)
University of North Carolina at Charlotte (Charlotte, North Carolina)
University of Puerto Rico (Mayagüez, Puerto Rico)
University of Texas at Austin (Austin, Texas)
University of Virginia (Charlottesville, Virginia)
Virginia Polytechnic Institute and State University (Blacksburg, Virginia)

Warren Gretz, NREL

Auburn University decathlon team members Wesley Driver, Apryl Tarrant and Matt Edmundson stand in front of their house, which took third place in the Solar Decathlon.

Auburn University (Alabama)

Auburn's Decathlon entry took advantage of high technology features and traditional housing designs. "Our tiled central hallway" said Lesley Hoke with the Auburn team, "was reminiscent of the dirt-floored breezeway that linked the two living areas in southern dog-trot homes."

This house, like traditional southern homes, worked with nature to create beneficial air flows. It also included many natural materials in conjunction with contemporary solar technologies, energy-efficient windows and daylighting features. These elements came together to create a comfortable, high-performance house.

The Auburn University team also wanted to demonstrate that it is easy to be energy efficient, and that solar energy can power conventional households. To support this concept, all of their appliances were off-the-shelf models. Also, team members showed that solar electric panels can be incorporated into common household

Warren Gretz, NREL

The University of Virginia house took second place at the Solar Decathlon. The student team used the popular Energy-10 software system to help design their house.

Judging Criteria

A six-member jury of judges evaluated the entries and awarded points for ten distinct contests:

- Design and livability
- Design presentation and simulation
- Graphics and communication
- Comfort zone
- Hot water
- Refrigeration
- Energy balance
- Lighting
- Home business
- Transportation

designs, and that they can add to the attractiveness of the home.

According to the Auburn team, "The whole design of our house was geared toward broad consumer acceptance."

University of Texas at Austin

The University of Texas at Austin team focused on the everyday qualities of solar designs. They emphasized that a home handyman could replicate just about everything they did and that most of their components could be purchased at a home furnishings store. They stressed that there was nothing overly technical about their design or building process.

"This event lets us reach out to a large national audience," said Pliny Fisk, Faculty Advisor with UT-Austin's College of Architecture and Planning. "After all, we expected about 100,000 persons to attend the Decathlon."

University of Delaware

The Delaware team chose a 4.8 kW solar electric system for their house that produced more than enough power. "The average consumer should seek out expert help and design a solar electric system that can provide most of your needs most of the time—not all of the needs all of the time," advised the team. "You'll still make a significant environmental difference."

"People may not want to take away every aspect of our design for their houses, but the walls, the radiant floor heating, the ground-source heat pump and solar thermal and electric systems can go into any house right now," according to team members. "You can just go out and buy it for the most part. We did not come up with too many crazy contraptions."

Solar is Ready

While the U.S. Department of Energy has not yet decided when or where to sponsor the next Solar Decathlon, the kickoff event was an unqualified success. The Solar Decathlon clearly demonstrated that we are ready to use existing technology to take advantage of our most plentiful energy resource—the sun—to power our daily lifestyles.

This showcase event proved that our universities, federal government and private companies can work together to provide the requisite tools to build sustainable houses. The U.S., after all, is committed to showing the world that we can make the best use of our native energy resources, that we are dedicated to building more reliable energy infrastructures, that we encourage energy options less dependent on foreign resources and that we support environmentally friendly energy systems.

The premier Solar Decathlon delivered these messages on the national stage. Judging from the innovative solutions Decathlon participants developed, today's solar technologies are ready to meet our energy challenges. ✲

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Solar on TV

The Do-It-Yourself Network (DIY)—a cable television service based in Knoxville, Tennessee—covered the housing design and construction phase of the Solar Decathlon. The Do-It-Yourself audience includes home enthusiasts who want to learn more about doing projects around the house.

The service will broadcast a one-hour special on the Decathlon in January 2003. DIY will also feature a five-part series on solar energy options for homeowners. This will include step-by-step projects and will discuss solar power generation, cooling/heating a solar home, solar hot water and installing solar lighting.

Warren Gretz, NREL

The University of Texas at Austin team took third place for Design and Livability. The design includes an Airstream RV trailer that cleverly houses the kitchen, laundry room and bathroom, and is docked right in the middle of the house. The modular design can be assembled, disassembled and reassembled numerous times without damaging the materials.

Shopping for Solar?

Have you ever been to a Home Depot® store to stock up on electrical cords, batteries, light fixtures or any other do-it-yourself gear? Probably. This company is one of the world's largest home improvement retailers and, to show company support for solar energy, Home Depot helped sponsor the Solar Decathlon along with the U.S. Department of Energy, the National Renewable Energy Laboratory, BP Solar, EDS and the American Institute of Architects.

Home Depot also offers its customers access to solar powered products at stores in southern California, Delaware, southern New Jersey and Long Island, New York. While these Home Depot stores do not actually sell PV systems, they do provide product displays and a referral service to AstroPower—another leading solar energy company.

According to John Simley, Home Depot's Manager of Public Relations, "Installing a residential PV system is a major installation project that may cost $15,000 to $25,000, so Home Depot does not offer solar panels or inverters in our off-the-shelf product line. At certain stores, however, we do refer our shoppers to solar electric power systems and to corresponding local utilities. Also, technicians affiliated with Home Depot are available to help install these advanced distributed generation systems."

AstroPower

Select Home Depot stores offer AstroPower photovoltaic systems.

Green Mountain Energy Company

The Green Mountain Energy℠ solar installation at The Winston School in Dallas, Texas, generates pollution-free, renewable electricity.

Buying Green Power— You Really *Can* Make a Difference

Regardless of where you live, you can purchase green power to encourage greater use of renewable energy technologies.

by Blair Swezey and Lori Bird

The electricity that we use in the U.S. is primarily generated with coal (52 percent), nuclear (20 percent) and natural gas (16 percent), with the remainder coming from hydropower (7 percent), oil (3 percent) and other renewable sources (2 percent). The environmental repercussions of this generation mix are considerable. According to the U.S. Environmental Protection Agency (EPA), electricity generation is responsible for two-thirds of the sulfur dioxide, one-third of the mercury and one-quarter of the nitrogen oxides emitted annually in the U.S. In addition, use of fossil-based energy sources contributes significantly to emissions of fine particulate matter and carbon dioxide, a leading greenhouse gas.

For many years, concerned members of the public and the renewable energy industry have worked diligently in regulatory and public policy arenas advocating for greater attention to energy efficiency and the development of our abundant domestic renewable energy sources. And there have been many successes.

For example, federal energy legislation passed in 1978 required electric utilities to purchase power from independent generators using renewable fuels and both federal and state governments have offered various types of financial incentives to encourage the development of renewable electric projects. More recently, 13 states have now passed renewable portfolio standards that require power suppliers to obtain a portion of their electric energy—ranging from 1.1 percent in Arizona to 30 percent in Maine—from renewable energy sources. And 16 states have established renewable energy funds, for which fees are collected from electricity customers to fund renewable energy projects.

Yet for all these successes, non-hydro renewable energy sources still only account for little more than 2 percent of total electricity supply. And with electricity demand continually growing, the challenge of substantially increasing this share remains daunting.

Do I Have a Choice?

As consumers of electricity, we write checks every month to a utility or other power supplier to pay for the electricity we use to light, heat and cool our homes and to power our appliances. And whether we realize it or not, by making these payments, we give our tacit approval to the manner in which this electricity is generated. But do we really have any choice in the matter?

Yes we do! Over the last several years, a new industry has been developing around the notion of giving customers the choice of buying power generated from more environmentally benign energy sources. The term "green power" has come to signify electricity generated in whole or in part from renewable energy sources like wind, solar, geothermal and biomass. Customers can decide to have all or some portion of their power needs supplied from green power.

Because of some basic laws of physics, the green power is not directed to each individual customer's house and no, the color of the electrons really isn't any different. Rather the renewably generated power is added to the mix of power that serves all customers. The key point to understand is that every electron generated from a renewable energy source is an electron that need not be generated from fossil or nuclear sources.

Tennessee Valley Authority

The 2-MW Buffalo Mountain Wind Project in Oliver Springs, Tennessee, features three 660-kW turbines that are part of the Tennessee Valley Authority's Green Power Switch energy program, which lets consumers buy a portion of their power from renewable energy sources. TVA plans to add 20 MW of wind power by October 2003.

So What's the Catch?

Unfortunately, in spite of the research and commercial development that has occurred over the last two decades, tapping our renewable energy sources is still a bit more expensive than using more conventional energy sources. Of course, the price we pay for today's electricity does not properly account for the environmental damages and other "externalities" associated with our use of fossil and nuclear fuels. Rather, we end up paying these "hidden" costs in the form of federal and state expenditures on environmental remediation and increased health care costs associated with the growing incidence of lung and other types of respiratory diseases among the general public.

So, as a result, green power costs a little more in the market. Think of it as buying premium gasoline instead of regular gasoline to make your car run better. Or in this case, paying a premium for an electricity product to make your body and the environment run better.

But, in comparison to other household expenditures, green power really isn't that costly. Utilities generally offer green power in blocks of 100 kilowatt-hours (kWh) of monthly consumption at a rate premium of from $0.01/kWh to $0.03/kWh. Or, typically, you can choose to buy all of your electricity as green power. An average U.S. residential customer who uses about 850 kWh per month and pays a green power premium of $0.02/kWh could power an entire household with renewable energy for only about $17.00 more per month or about the cost of a movie for two.

How Can I Buy Green Power?

About 40 percent of electricity customers across the U.S. today have the option of purchasing green power directly from a retail electricity supplier. This supplier may be your local utility or, if you live in a state that has "restructured" its electricity market, a competitive retail electricity supplier.

More than 300 utilities in 31 states, including investor-owned utilities, rural electric cooperatives and other publicly owned utilities, offer a voluntary "green pricing" option to their customers or are in the process of developing such a program. Green pricing is a separate tariff designed specifically for the utility to sell green

power. In most cases, these programs are open to commercial and industrial customers as well as residential customers.

In states with restructured (or competitive) electricity markets, retail electricity customers can often choose from among multiple electricity suppliers, some of which may offer green power. Electricity markets are open to competition in nearly a dozen states with green power marketers active in many of these.

However, even if the local utility does not offer green power and competitive retail options are not available, you can still purchase green power from regionally or nationally based companies that offer "renewable energy certificates." These certificates represent the environmental attributes of electricity generated from renewable energy sources. While the physical electricity is sold into the regional market where the power is generated, the certificates can be sold anywhere in the country—or the world for that matter.

An important virtue of certificate products is that the marketer avoids the cost of physically delivering the power to the customer over transmission and distribution lines, and instead delivers only the environmental benefit, which helps hold down costs. About a dozen companies are actively marketing renewable energy certificates in the U.S.

Comparing Product Options

In the case of a utility program, you may have few, if any, choices among green power products, although a handful of utilities do offer more than one product. In competitive markets, there may be more than one green power supplier and multiple products to choose from. And whether or not your retail supplier offers green power, you can choose from among several renewable energy certificate products that are available nationwide.

To help with comparisons between green power and traditional product options, about 20 states now require retail power providers to divulge certain information about the fuel sources used to generate electricity. Some states, such as California, only require disclosure of the fuel mix, while others, such as Texas, also require disclosure of environmental impacts, such as air pollutant emissions and nuclear waste creation. Most states require use of a standard reporting format, enabling consumers to easily compare product offers.

How Do I Know It's Really "Green?"

Because customers cannot individually meter or otherwise monitor the flow of these green electrons, it is appropriate to ask what assurances utilities and marketers can provide that the premiums being paid are actually being used to support increased renewable energy production.

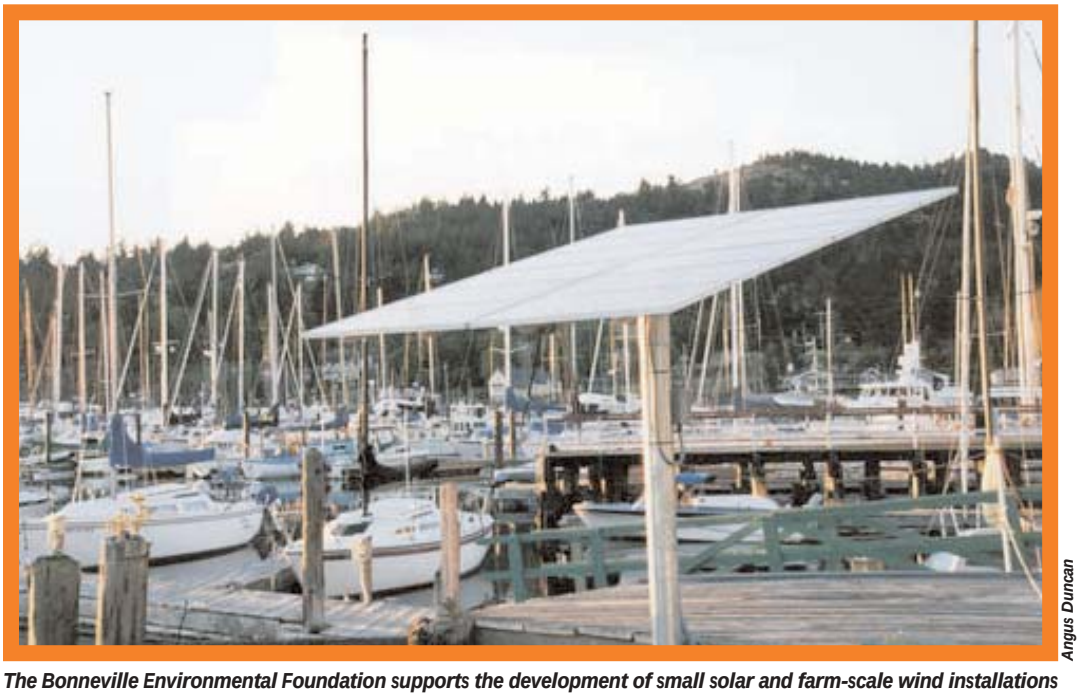
Certification programs can help verify the claims made by utilities and marketers that green power is delivered to the grid from the specified sources and in the proper amounts. Green-e is the leading national certification and verification program for environmentally preferred electricity products offered in competitive power markets. It is administered by the Center for Resource Solutions (CRS), a nonprofit environmental organization based in San Francisco. For a green power product to be eligible for Green-e certification, at least half of the energy supply must come from renewable resources such as wind, solar, geothermal, biomass or small hydro. The product must also contain a percentage of recently developed (new) renewable resources.

Any non-renewable portion of the product mix must be as clean or cleaner than the overall system power mix and also must not contain any more nuclear energy than the system mix. In addition, certified suppliers must disclose their power sources to customers and agree to an annual third-party audit to verify their marketing claims. Green-e certifies retail and wholesale green power products in California, Connecticut, New Jersey, Pennsylvania and Texas.

The Center for Resource Solutions Green-e logo.

CRS also administers a national Green Pricing Accreditation Program for green power programs offered by utilities in non-competitive markets. The program is designed to recognize utility programs that use "best practices" in offering green electricity options to customers. Utility green pricing programs can become accredited if they meet or exceed stringent standards regarding renewable resource content, product pricing, marketing activities and information disclosure. Accredited utilities are also required to undergo an annual, independent verification process to document their green power deliveries. Accredited utilities are able to use the Green-e logo. In addition, CRS recently launched a certification program for renewable energy certificates.

Renew 2000 is a certification program available for green power products offered in the Pacific Northwest. Green power products are eligible for certification under the program if they meet certain criteria regarding resource content, including newly developed renewables, program design, fuel mix disclosure and



Angus Duncan

The Bonneville Environmental Foundation supports the development of small solar and farm-scale wind installations like this solar electric system at the Westsound Marina in Westsound, Washington, by purchasing the environmental attributes of the renewable generation.

Jim Schroeder

Xcel Energy has installed a total of 60 MW of wind energy generating capacity at two sites, including this new project near Peetz, Colorado, to serve green power customers in Colorado.

marketing. The product standards were developed by a regional coalition of environmental groups, utilities and governments.

Although not a certification program per se, another available tool for evaluating the environmental impact of different electricity products is the Power Scorecard, a web-based information tool created by a coalition of environmental groups. The Power Scorecard rates electricity products on a scale from "excellent" to "unacceptable" using two measures—the environmental impact on air, land and water, and the amount of energy generated from recently developed renewable, low-impact sources. Currently, the Power Scorecard is available to compare competitive retail products offered in Pennsylvania and New Jersey.

Are There Other Benefits?

One of the biggest challenges to the success of green power marketing is that utilities and marketers are essentially asking individual customers to pay a premium for a product that benefits the public at large. That is, if you choose to pay more for green power but your neighbor does not, he still benefits from the cleaner air that results from your purchase decision.

To help overcome this "free rider" problem, utilities and marketers have tried to create additional value for green power purchasers. In some cases, green power customers are treated to special events or receive service or merchandise discounts from participating retail establishments. Business customers may be recognized in utility advertising or newsletters. Some utility programs have focused on installing solar systems on public schools, which provide "free" electricity to the school and educational benefits to students. And a limited number of utilities and marketers offer a fixed-rate product that protects green customers from fluctuations in the cost of the fuels that are used in the utility's regular electricity product.

In addition to solar schools programs, green power marketing is also being used to support the development of small-scale, localized systems. For example, Chelan County Public Utility District in Washington State uses customer donations to support the development of grid-connected solar and wind energy projects within the county. The Bonneville Environmental Foundation is supporting the development of small solar and farm-scale wind installations by purchasing the environmental attributes of the renewable generation. And in Texas, in addition to receiving 100 percent wind energy, customers of Green Mountain Energy Company can help support the installation of new solar projects by joining the Big Texas Sun Club for a $5.00 monthly membership fee.

Can I Really Make a Difference?

Finally, when all is said and done, are green power purchases actually resulting in increased renewable energy development? Although the industry is still in its formative stage, data that we collect at the National Renewable Energy Laboratory shows that more than 400,000 electricity customers are now buying green power. The market demand created by these customers has resulted in the actual or planned development of more than 1000 megawatts (MW) of new renewables-based generating capacity compared to an installed renewables base of about 19,000 MW nationwide.

One of the more encouraging trends in the industry is that cities, state and federal agencies, and both large and small companies are increasingly making green power purchase commitments. The State of Maryland, which in 2001 established a state-level green power purchasing goal of 6 percent, recently solicited bids to increase this percentage to 20 percent. In addition, more than 140 MW of new wind energy capacity is under development in Pennsylvania and surrounding states to meet the demand of a number of large customers, including private businesses, government agencies and colleges and universities. As a result of these and other commitments, nearly one-third of all the green power being supplied by utilities is now purchased by non-residential customers.

While public policy decisions at both the state and federal levels are likely to remain the most important drivers of future renewable energy development, it is becoming increasingly clear that by using the power of our pocketbooks, we, as individual consumers, can also influence how our electricity is produced. ✲

Blair G. Swezey (e-mail: blair_swezey@nrel.gov) is Principal Policy Advisor and Lori A. Bird (e-mail: lori_bird@nrel.gov) is a senior energy analyst with the National Renewable Energy Laboratory, 1617 Cole Boulevard, Golden, Colorado 80401, web site: www.eren.doe.gov/greenpower. Both authors purchase green power to meet 100 percent of their household electricity needs. For up-to-date lists of utilities and marketers offering green power, please refer to the Green Power Network web site at www.eren.doe.gov/greenpower.

For More Information

For up-to-date lists of utilities and companies offering green power, visit these web sites:

Table of Utility Green Pricing Programs
www.eren.doe.gov/greenpower/summary.shtml

Table of Green Power Product Offerings in States with Competitive Retail Markets
www.eren.doe.gov/greenpower/mkt_summ.shtml

Table of Renewable Energy Certificate Offerings
www.eren.doe.gov/greenpower/certificates.shtml#gcertTable

Demonstrating a Sustainable Path

The Philip Merrill Environmental Center of the Chesapeake Bay Foundation serves as a model of sustainable development and a demonstration project for resource protection/restoration, environmental advocacy and education.

by Alex Wilson

Robb Williamson

The Chesapeake Bay Foundation's Philip Merrill Environmental Center overlooks the Chesapeake Bay, the nation's largest, most diverse and most productive estuary.

Robb Williamson

Generous glazing in the lobby of the Philip Merrill Environmental Center provides daylighting all year and passive solar gain in the heating season.

The Chesapeake Bay in Maryland and Virginia is the nation's largest, most diverse and most productive estuary. More than 3600 species of plants and animals call the Bay home, and more than a million waterfowl winter here. Thousands of "watermen" make their livelihood from the Bay's bounty, which includes oysters, striped bass and more than a third of the nation's blue crab. Many more make their living on the tourism spawned by the region's rich natural and cultural history. The Bay itself is 200 miles long with nearly 12,000 miles of shoreline, and it drains 64,000 square miles of land including parts of New York, Pennsylvania, West Virginia, Delaware, the District of Columbia, Maryland and Virginia.

Robb Williamson

Clerestory windows on the north side of the building provide daylighting for the second floor offices of the Chesapeake Bay Foundation's Philip Merrill Environmental Center. Three cisterns collect and store rainwater, which is used for most of the building's non-potable water need.

The ecological and economic importance of the Chesapeake Bay is tremendous, yet dramatic pollution and development pressures over the past 50 years have taken a heavy toll. Oyster harvests plummeted from roughly 35 million pounds per year in the 1950s to less than 3 million pounds per year today. A prime culprit in the declining fisheries has been nutrient pollution, and while significant progress has been made in reducing nitrogen and phosphorous loading of the Bay since the early 1980s, nutrients from fertilizer runoff, stormwater pollution and septic systems remain a very significant problem.

So too is sprawl. The population of the Chesapeake Bay watershed is approximately 16 million people—nearly 40 percent more than in 1970. In Loudoun County, Virginia, 30 miles northwest of Washington, DC, the population grew 97 percent just from 1990 to 2000! Loss of wetlands, increased automobile use, agricultural runoff, deforestation and overfishing are just a few of the problems facing the Bay.

Since the 1960s, dozens of federal and state agencies, government commissions, academic programs, and nonprofit organizations have been working to rescue the Chesapeake Bay from these problems and restore it to the healthy, vibrant ecosystem it once was. The Chesapeake Bay Foundation (CBF), founded in 1967, has been leading the charge. Facing the need for more space in the mid-1990s, CBF trustees first considered expanding in downtown Annapolis, Maryland, where they were based, but they couldn't find the right building. Then the organization was approached about protecting a 31-acre property on the Bay itself that was slated for housing development. Could they protect that land by building on it?

From Vision to Reality

CBF purchased the land and hired SmithGroup, Inc., an architecture firm in Washington, DC, to design a new headquarters building that would be in keeping with the organization's mission of resource protection/restoration, environmental advocacy and education. Because the site is located on the Bay, it was clear right from the start that this needed to be the greenest of buildings. William Baker, president of the organization, noted in a New York Times article about creating a green building that "if we didn't do it, how can we ask other people to do it?" Clearly, the use and management of water and protection of the 31-acre site would be very high priorities, but so too would low energy use, reliance on renewable energy sources and selection of materials that don't, themselves, result in significant environmental burdens during their manufacture.

With a $7.5 million gift from newspaper publisher, Philip Merrill, the Foundation had the freedom to incorporate a wide range of leading-edge green building technologies, even those that increased construction cost. A decision was made to seek certification of the building through the fledgling U.S. Green Building Council's LEED™ (Leadership in Energy and Environmental Design) rating program. In fact, the Foundation's trustees decided to strive for the very highest level of green for the building. A visioning charrette, organized by the Sustainable Buildings Industry Council with support from the U.S. Department of Energy, identified a wide range of strategies for greening the project. Those ideas were refined by SmithGroup, and the Philip Merrill Environmental Center was completed in December, 2000.

In serving as a model for sustainability, the building has succeeded admirably, and in 2000 it was awarded the first-ever LEED version 1.0 Platinum rating (the very highest). The building also received recognition from the AIA Committee on the Environment as one of the Top-Ten Green Project in 2001 and in the same year won an ASHRAE Technology Award.

The Greening of a Building

For starters, construction of the Merrill Center had minimal impact on the 31-acre site. Only those portions of the property that had previously been developed were affected by construction—the 31,200-square-foot building occupies roughly the same footprint as the beachhouse and swimming pool it replaced. The need for excavation was minimized by placing the building on piers, which also allowed parking underneath the building, thereby downsizing the parking area required around the building. Parking needs—and the environmental impacts of commuting by single-occupancy vehi-

For more information

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(202) 842-2100
web site: www.smithgroup.com

High-Performance Buildings
www.eren.doe.gov/buildings/highperformance/case_studies
(Extensive case study information, including this project)

cles—are also kept in check through efforts by CBF to promote other means of transportation, including carpooling, bicycling, walking, even kayaking by the building's 100 employees. Alternative-fuel vehicles (electric, hybrid and natural-gas) are available for use during the day by employees who don't drive to work.

Undeveloped portions of the site are being restored to the native ecosystems appropriate to the Chesapeake Bay shoreline. With a little help from human stewards, native grasses and wetland plants are quickly establishing themselves on the site, as are oysters in reefs just offshore.

The overall building geometry at the Merrill Center is simple—basically a large rectangular box with a shed roof for the main building. A conference center on the south side is separate from the main building, allowing either building to be shut down when not in use, thus saving energy. The shed roof with galvanized steel roofing allows easy and effective collection of rainwater. The south façade is mostly glazed, with an exterior sun shade system to minimize solar heat gain during the cooling season. In addition to supporting the shade structure, an exterior timber frame on the south side of the building also supports a photovoltaic (PV) array, although the timber structure results in some shading of the PV panels. On the interior, an open floor plan provides superb daylight distribution, significantly reducing the need for electric lights.

The building was designed to use very little energy. Structural insulated panels (SIPs) with four to eight inches of expanded polystyrene, provide insulating values of R-24 in the walls and R-30 in the ceilings. The floors are insulated to R-20. Window glazings have a fairly low U-factor of 0.32 and a solar heat gain coefficient of 0.49, which is considerably higher than in a typical office building. The solar gain provides passive solar heating as well as natural daylighting, which allows lights to be turned off in some zones during the day.

In addition to the passive solar and daylighting, renewable energy sources account for approximately 13 percent of the building's overall energy load. Flat-plate solar collectors provide 100 percent of water heating (saving as much 120 kilowatt-hours [kWh] of electricity per day), and a 4-kilowatt (kW) PV system offsets a small portion of the building's electric load.

Heating and cooling are provided with a ground-source heat pump system. Vertical wells were drilled for this ground-source system to minimize land disturbance and erosion that would have occurred with horizontal piping. A total of 48 wells, 300 feet deep were installed. An energy recovery wheel with desiccant dehumidification on the heat pump's ventilation system also saves energy. Natural ventilation supplements mechanical ventilation when outdoor climate conditions permit. All this is controlled by a sophisticated energy management system, which even indicates to employees when it makes sense to open windows for natural ventilation.

Alex Wilson

Composting toilets save water at the Chesapeake Bay Foundation's Philip Merrill Environmental Center.

Alex Wilson

Bamboo flooring and formaldehyde-free fiberboard trim and casework are among the green building materials incorporated into the Chesapeake Bay Foundation's new headquarters.

Alex Wilson

The exterior timber framework of the Philip Merrill Environmental Center is constructed of parallel-strand lumber, which is made from small-diameter trees.

Efficient and careful management of water is a hallmark of the Merrill Center. A combination of water conservation strategies has reduced water consumption by 90 percent, compared with a typical office building. Measured water consumption is 58,000 gallons per year—about half that of a typical home! These strategies include composting toilets (used exclusively in the facility), water-conserving faucets and showerheads, water-efficient laundry and sinks used by research staff and minimal irrigation needs for the native vegetation around the building. The rainwater catchment system satisfies most of the non-potable water needs and provides a reservoir for fire suppression. In this system, rainwater passes through sand filters and is stored in cisterns made from pickle barrels salvaged from an abandoned pickle factory in the region. During the first year, rainwater provided 38,000 gallons of water—two-thirds of total water consumption. Potable water comes from a well on the property.

Stormwater is also managed very carefully on the site. Runoff from the parking lot is channeled into "bioretention" swales that use carefully selected soils, filtration media and wetland plants to remove pollutants from stormwater before it is channeled to an area where it can infiltrate into the ground or, in the event of a large storm, flow into Black Walnut Creek and the Bay.

Finally, green building materials were very carefully selected for the entire project. Most of the building products were produced within 300 miles of the site. A few of the more innovative products include bamboo, cork and natural linoleum flooring, shade louvers made from salvaged lumber, metal siding and roofing with high recycled content and formaldehyde-free fiberboard trim and casework on the interior. Concrete salvaged from the previous building on the site was crushed and used for the road beds. The exterior timber framework is constructed of parallel-strand lumber, which is made from small-diameter trees. (One concern some have expressed is how well these exposed timbers will hold up over time.)

Building Performance

Overall energy use, measured from August 2001 through July 2002 by the

The National Renewable Energy Laboratory's (NREL's) Paul Torcellini and Ron Judkoff provide technical oversight for these articles. The U.S. Department of Energy, through NREL, provides architects, engineers and other designers with design practices, field-tested and proven technologies and design tools that together produce cost-effective, high performance buildings. The benefits of applying sustainable energy principles to building design and construction include increased affordability, more jobs, improved health, reduced energy consumption and less environmental impact.

Here's how the Philip Merrill Environmental Center of the Chesapeake Bay Foundation stacks up:

Energy

The Merrill Center complex is using approximately 19 percent less energy than a comparable facility built to the most recent ASHRAE standard (90.1) would use. This translates into total annual savings of approximately 78,000 kWh (270 million Btu).

Affordability

The Merrill Center construction costs were $199 per square foot ($6.3 million), not including the property, landscaping and furniture. An estimated $46 per square foot of this cost (23 percent) was for green features, including the various water and materials features. The estimated payback on these extra costs (accounting for the energy savings alone) is seven to eight years.

Jobs and Economy

Approximately 100 employees work at the Merrill Center and thousands tour the building each year. The effort to source materials locally (within 300 miles) should have had a beneficial impact on the regional economy.

Health and Productivity

Significant attention was paid to material selection and building practices relative to indoor air quality (low-VOC paints, for example). Extensive use of natural daylighting helps create an attractive, visually comfortable work environment, which the Chesapeake Bay Foundation management believes will translate into somewhat higher productivity among the staff.

Environment

Energy savings at the Merrill Center results in an annual reduction in CO_2 emissions of 160,000 lbs (82 tons), based on emission factors from electricity generation in Maryland of 2.096 lbs. CO_2 per kWh.

This is one in a series of articles funded by the National Renewable Energy Laboratory (NREL) Center for Buildings and Thermal Systems and the U.S. Department of Energy (DOE) as a part of the High-Performance Building Initiative (www. highperformancebuildings.gov). The High-Performance Building Initiative is striving to transform the energy use of commercial buildings through research.

Philip Merrill Environmental Center Project Details

Project description: Office building
Owner: Chesapeake Bay Foundation
Architect: Tom Eichbaum, AIA, SmithGroup, Inc.
Energy consultant: Expert support provided by the Sustainable Buildings Industry Council (with funding from the U.S. Department of Energy)
Location: Annapolis, Maryland
Size: 31,200 square feet (2972 m^2)
Construction cost: $6.3 million (not including property, landscaping, furniture)
Date completed: December 2000
Heating Degree Days (65°F): 4910
Cooling Degree Days (65°F): 1130

ENERGY PERFORMANCE
Annual Energy Use—Kilowatt-Hours (kWh)*

	Lighting	Equipment	Plug Loads	Total
Base case	121,400	152,800	139,100	413,300
Merrill Center	87,800	108,400	139,000	335,200
Percent Savings	28 percent	29 percent	0 percent	19 percent

* Based on data from August 2001 through July 2002. The simulation of the base-case building was done in accordance with the proposed addendum to the ANSI/ASHRAE/IENSA Standard 90.1-2001. Source: National Renewable Energy Laboratory

Energy Use Intensity—Entire Building*

	kWh/ft^2	Btu/ft^2	$/$ft^2$
Base case	13.2	45,000	$1.47
Merrill Center	10.7	37,000	$1.07
Percent Savings	19 percent	19 percent	27 percent

*Source: National Renewable Energy Laboratory

Renewable Energy Production

Renewable energy system	Energy production		
	Predicted	Measured	Difference
Photovoltaic array[1]	6396 kWh/year	2695 kWh/year	-58 percent
Solar thermal water heating	N/A	40,970 kWh/year[2]	N/A

1. Based on data from November, 2001 through October, 2002. Source: National Renewable Energy Laboratory
2. The solar hot water produced in the Merrill Center may not equate to actual savings, because of the very low water consumption. NREL estimates the savings in the Merrill Center to be 1/3 to 1/2 as large as this figure.

Annual Energy Cost—Dollars*

	Lighting & Equip	Plug Loads	Total
Base case	$35,000	$10,800	$45,800
Merrill Center	$22,700	$10,800	$33,400
Percent Savings	35 percent	0 percent	27 percent

* Based on data from August 2001 through July 2002. Source: National Renewable Energy Laboratory

National Renewable Energy Laboratory shows a 19 percent savings compared with a similar building designed to meet the ASHRAE 90.1 (2001). Energy savings of 28 percent are achieved with lighting and 29 percent with equipment for heating, cooling and ventilation. Savings with energy costs are even greater (27 percent total energy and 35 percent for lighting and equipment), reflecting the higher value of saved electricity. On a per-square-foot basis, the total annual measured energy use is 37,000 Btu/ft^2 or 10,700 kWh/ft^2, and the annual energy cost is $1.07/$ft^2$.

The PV system generates approximately 2700 kWh per year, and the solar-thermal water heating system reduces water heating energy consumption by an estimated 41,000 kWh per year. The PV system output is only 42 percent of the predicted output, due largely to shading by the timber frame structure on the south side of the building. ✲

Alex Wilson is president of BuildingGreen, Inc. in Brattleboro, Vermont and executive editor of Environmental Building News, (800) 861-0954, web site: www.buildinggreen.com.

Solar Heat in Snow Country

In our **Back to the Future** offering for this issue, an active solar heating system designed by the late Harry Thomason provides two-thirds of the space heating for the Pinnacle Road U.S. Customs border station in Richford, Vermont, on the U.S.-Canadian border.

by Nick Pine

Nick Pine

The Richford Customs House is located on a windy hill on the Vermont-Canadian border, an area known for its frigid winters.

Buckminster Fuller said he was taught in school that bees can't fly, notwithstanding millions of counterexamples. For years, academic and government scientists believed that Harry Thomason's trickle collectors wouldn't work, even as they heated hundreds of houses.

Thomason trickled water between a dark metal roof and a single layer of glazing, and some of the water evaporated from the roof and condensed on the underside of the glazing. Many believed the resulting heat loss would make these "trickle collectors" so inefficient as to be useless. William A. Shurcliff questioned this belief and gave "reasons for believing H. E. Thomason's decision was a wise one" in his 1979 book **New Inventions in Low-Cost Solar Heating**. (See "Thermal Misunderstanding" by Frank de Winter, page 38.)

The Pinnacle Road U.S. Customs border station in Richford, Vermont, is located on a windy hill on the Vermont-Canadian border, where temperatures often fall below zero. Harry Thomason's trickle collectors have been providing two-thirds of the building's heat since 1984.

Nick Pine

This 704 square feet of Harry Thomason's trickle collectors have been providing two-thirds of the Richford Customs House's heat since 1984.

Thomason licensees Ronald G. Howitt and Robert E. Grenier of Woonsocket, Rhode Island (who installed dozens of Thomason systems—both now live in houses heated this way) were chosen to install the solar heating system in the Richford building in 1981. The project was part of a U.S. Department of Energy (DOE) "Solar in Federal Buildings" program to solar heat customs houses along the U.S.-Canadian border. As Howitt tells it, however, the installation was delayed for three years, because NASA scientists believed the Thomason system would not work.

From 1981 until 1984, scientists from NASA, Rockwell International and DOE studied the working system on Walter Karasak's house in Blackstone, Massachusetts, using 75 temperature sensors. They came away in disbelief, wondering if there were hidden heaters or other shenanigans. The Richford installation finally began in 1984, after a long battle with U.S. Customs. Engineer George P. Fors, PE, finally convinced them that it could work by pointing out that the earlier approved systems were failing, the simple system he sought for the Richford station had a track record of good performance since 1959 and the bid for the simple system was nearly $10,000 lower than the next lowest bid.

The installation was completed in the winter of 1984 with an acceptance test. Before the public dedication, government skeptics sent the installers home, turned off the backup heating system, opened the windows, let the building cool off to about 40°F, then closed the windows and watched as the Thomason system warmed it back up to 70°F over a few days. It appears that the skeptics were satisfied.

By 1984, most of the other 21 systems in the DOE program (trackers, evacuated collectors and so on) had failed. Richford is the only one working today. The original bid specifications required a "solar furnace" located some 75 feet away from the building and connected by pipes, but Thomason convinced Fors that locating the collectors and heat storage on and in the building was a better idea. Grenier and Howitt also increased the pitch of the roof that supports the 704 square feet of collectors to collect more heat in the winter.

Describing the Richford system in 1995, Port Director Amos Hamilton wrote Thomason saying: "'Truly remarkable' is an understatement; year after year your solar system has provided ample and reliable heat... like the Maytag repairmen, we have nothing to do because your system runs so well." Acting Chief Jim Alexander says "We were delighted that we could take off our coats in the winter!" The building (one of few owned by Customs rather than the General Services Administration) was constructed in 1975, and the original forced air heating system was very uncomfortable,

Nick Pine

The solar system uses simple, reliable hardware, such as these two Grundfos pumps installed in series that move water from two 700 gallon tanks in an insulated rock bin up to the roof ridgeline above the collector.

Nick Pine

Acting Chief Jim Alexander appreciates the solar heating system, because he and his staff can take their coats off inside the building.

and subjected the occupants to wide temperature swings.

The solar system uses simple, reliable hardware, such as the two Grundfos pumps installed in series that move water from two 700 gallon tanks in an insulated rock bin up to the roof ridgeline above the collector. The water trickles back down into the tanks in this drainback system. Air forced through the bin of stones, which increase the effective heat transfer surface of the tank and provide additional thermal mass, actually heats the building. A new building might have a polycarbonate instead of a glass collector cover, which might lower the cost, and an efficient hydronic floor instead of the bin of stones, which might raise the COP significantly. An oil-fired water heater provides backup heat as needed via a water-air heat exchanger in the upper airpath leaving the tank.

Albert Desautels is the Maytag repairman in Richford. He recalls fixing a small leak in an outside gutter "maybe 4 or 5 years ago." The Richford system has performed well for 18 years with almost no maintenance, although it needs a little now. On a recent visit, we noted a clogged air filter and an apparent control malfunction. But overall, this system is a remarkable success story. ✲

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Nick Pine

Albert Desautels, the Maytag repairman in Richford, recalls fixing a small leak in an outside gutter "maybe 4 or 5 years ago." The Richford system has performed well for 18 years with almost no maintenance.

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A Thermal Misunderstanding

by Frank de Winter

I think a revisit of the Thomason houses is a great idea. Many of the solar energy old guard made fun of the Thomason collectors, claiming that the water condensation on the collector glazing would cause great heat losses. What they did not realize is that they were working with collector forced convection heat transfer coefficients (from the glazing to the outside ambient) that were about four times higher than the actual ones. This was because the flat plate collector field was, until quite recently, based on the forced convection heat transfer coefficients of A. Jurges in 1924. This is the basic reference found in McAdams and later throughout the flat plate collector literature, in the 1942 Hottel and Woertz classic paper and in solar energy textbooks right through the 1970s into the 1980s.

The Jurges numbers were based on a vertical, sharp-edged 50 cm by 50 cm plate, heated to 100°C, and then subjected to the wind. Collectors are never that small, they never have sharp edges, they are never vertical and they never have outside surfaces at 100°C.

I felt the Jurges numbers were quite inappropriate, and when I wrote my Copper Development Association "do-it-yourself" booklet on solar swimming pool heating in the 1970s, I ignored Jurges altogether. Instead, I calculated forced convection heat transfer coefficients using the boundary layer theory calculations from the Schlichting book. My results were half as high as the Jurges values. According to the recent literature reported by Noam Lior, the values for full size collectors that do not have sharp edges, are not vertical and are not at 100°C are lower by still another factor of two—four times lower than the Jurges values.

Because many thought the outside forced convection heat losses were so high, they automatically concluded that the Thomason collectors were hopeless. Their reasoning went that the inside insulation effect of the "stagnant air" mechanism was reduced greatly because of the evaporation-condensation mechanism. They thought the Thomason collectors would automatically "short-circuit" out most of the solar energy, yielding a pathetically low collection efficiency.

Steve Baer of Zomeworks initially pointed this out to me. I had never thought of it, but it instantly made sense. It is in this context that a careful and well-documented technical review of the Thomason equipment can be really valuable. ✲

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Richford Customs House Project Details

by Drew Gillett

Background

What started as a simple request for information from a client interested in building an active solar space heated home in Vermont mushroomed into two visits to the U.S.-Canadian border—one by auto and one by air—to the site of an interesting design pioneered by Dr. Harry Thomason in 1959 and installed at a number of sites by builders in the 1970s and 1980s.

Description

This design, commonly called a trickle collector, incorporates a collector cross section of single or double glazing (single in this case), a simple corrugated aluminum roof painted black and conventional back and side insulation. Water to be heated is pumped to the peak of the collector and distributed through a manifold to be trickled down the face of the corrugated absorber and then collected in a gutter and returned to a storage tank. An integral part of the Thomason Solaris design is that the storage tank is imbedded in a box of rocks, through which air is blown to distribute the heat to the building as needed. A backup system (in this case an oil-fired water heater) is used to add heat to the air through a water-to-air heat exchanger in the distribution duct.

In some installations (although not in the Richford system) a hot water coil is placed in the tank to provide domestic hot water. Some installations also run the system in summer for cooling—not required on the northern border of Vermont, but useful where Dr. Thomason lived in Maryland.

The system uses inexpensive simple materials combined in a clever way to obtain heating, cooling and hot water from the sun. It is low-cost, large area and well-integrated into the building. On the down side, there have been concerns about corrosion from the open water in the system, higher pumping costs than closed loop systems (because the water must be pumped to the top of the collector for each circuit) and possibly lower efficiency due to evaporation and condensation on the glass. (See "Thermal Misunderstanding" by Frank de Winter, this page.)

The Richford system has 88 panes of glass approximately 2 feet by 4 feet arranged 11 wide by 8 high covering most of the south roof for a collector area of about 700 square feet. Note the glass does not need to be particularly well sealed, because there is a durable corrugated metal roof below it. The system also includes two 700 gallon stainless steel storage tanks in a room in the NW corner of the building, two collector pumps installed in series, a differential controller to turn the system on and off and several Btu and kWh meters for manual data collection. Some kind soul had dutifully recorded data occasionally thru 1994 and left the data sheet in place.

Cost and Initial Performance

R.L. Grenier Associates of Woonsocket, Rhode Island, installed the system in 1984. I have no current information on costs—Dr. Thomason estimated $3-4 per square foot of collector in 1970 dollars for the entire system including backup, distribution and labor. My best estimate is that a system today would run $20-$40 per square foot depending on materials and labor costs and location.

After the initial installation, a winter 1988 article on the project (which pointed out that 11 of 12 differently designed active systems had already failed) noted that this project had resulted in a reduction of fuel oil usage from an average of 855 gallons per year in prior years to 298 gallons in 85-86 and 263 gallons in 86-87 or a savings of about 550 to 600 gallons per year. Recent data from Jim Alexander, Acting Chief of the facility, shows continued low usage for the site, especially compared to a similar but slightly larger non-solar facility nearby—Morse's Line.

Table 1

OIL USAGE (gallons)	FY 00 Warm	FY 01 Normal	FY02 Warm
Pinnacle (solar)	527	294	~500
Morse's Line (non-solar)	1309	1510	N/A

Electricity Usage

A review of the power meter data provides some interesting insights into performance. The system included four kWh meters and four Btu meters—one for the solar pumps, one for the blower, one for the backup circulator and one for "other."

Table 2	Annual kWh Use	
	Pre 1994	Post 1994
Solar pumps 2 x 225 watts	948.9	743.6
Blower 1/2 hp 800 watts	2842.6	1098
Backup circulator 1/6 hp 200 watts	340.1	573.6
Other	1847	1247

Drew Gillett

Nick Pine (left) and Drew Gillett are off on their excellent adventure to visit the Thomason solar system at the Richford Custom House.

It's somewhat difficult to be sure of the following, because no measured data was taken on the loads connected to the kWh meters and the wattages are approximate. However, the solar pumps seem to be operating fewer hours per year lately (perhaps because of the sensor problem noted below) and the backup circulator is operating more hours. One thing it does show is that the approximately 800 kWh consumed per year in electricity bring in about 550 therms or the equivalent of 550 gallons of oil (as delivered by the backup system) resulting in a COP of over 22. It also shows that air distribution systems are relative energy hogs, and that an effort to reduce the flow resistance and horsepower of the blower would be in order.

Btu Meter Information

The Btu meters of interest were on the solar collection circuit and the backup oil heating delivery circuit.

Table 3	
100,000 Btu (therms) delivered annually for 18 years (this data derived from simply taking the total Btu indicated on the recording Btu meters and dividing by the 18 years)	
Collection	556
Oil backup delivered	114

The solar energy collected compares reasonably with the oft-repeated 1 gallon of fuel oil delivered for each square foot of collector each year for a good active space heating system. An average system might be more like 3/4 gallon, and a solar domestic hot water system (which is useful year round) might be as much as 1-1/2 gallon per square foot per year.

The oil heat energy delivered indicates that the backup is fairly inefficient (as oil-fired water heaters are because of low demand, infrequent use as a backup, high standby losses, high delivery temperatures and high inlet air temperatures at the backup heat exchangers). The oil-fired water heater is probably delivering less than 50 percent of the heating energy in the oil to the air system. Note, however, that some of the losses do go usefully into the mechanical room.

Drew Gillett

The heat exchanger was as clean as a new one after over 18 years of use.

Update

This fall, the oil backup water heater fortuitously failed, triggering a "no heat" call that resulted in an effort to completely check out and overhaul the pumps, controls etc. of the system. Maintenance and repairs included replacing a failed sensor, repairing a small leak (harmless because it's outdoors, but fixed anyway) in the gutter and the usual cleaning of filters and strainers. It's interesting to note that all the glass is intact, the paint appears in very good condition, the pumps worked—even the exterior pipe insulation is in good shape. Of particular interest was the cleanliness of the backup water-to-air heat exchanger (see photo).

Conclusion

Site-built integrated active solar space heating systems do function in Vermont (where it is cold and cloudy) and some even have a nearly two decade record of reasonably trouble-free, cost-effective performance. This system has been in service to our country guarding its borders and keeping our customs officers warm using solar energy for over 18 years. If more of our buildings reduced their fossil fuel use by two-thirds, perhaps we wouldn't have to double the number of guards. ✲

Drew Gillett, Professional Engineer and an MIT graduate twice, is a long time ASES member, 2000-hour instrument pilot and father of twin daughters who may actually save the world. He can be reached at 33 Holbrook Road, Bedford, New Hampshire 03110, (603) 668-7336.

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A Solar Pioneer

Dr. Harry E. Thomason was a graduate of Catawba College in Salisbury, North Carolina (Bachelor of Arts degree in physics), and the Georgetown University School of Law (J.D.). Dr. Thomason was a determined man. After five coronary bypasses in August 1996 and the death of his wife Hattie in September, he wrote in January "I am recovering, slowly, and I am now working about 80 hours per week." Before his death in April of 1998, he had received 36 patents and 4 registered trademarks related to solar energy.

Dr. Harry Thomason looks down the grooves of his trickle-flow collector.

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Ten Shades of Green

The AIA Las Vegas Committee on the Environment (LV-COTE) recently presented Ten Shades of Green, an exhibition on architectural excellence and environmental responsibility, organized by the Architectural League of New York.

The exhibition, curated by architect and writer Peter Buchanan, made its debut in Spring 2000 at the Urban Center Gallery in New York City. It has since traveled to numerous universities and museums throughout the U.S. and is now open through January 11, 2003, at Neonopolis in downtown Las Vegas at the 3rd Floor Gallery, 450 Las Vegas Boulevard, Suite 310, Las Vegas, Nevada 89101.

Ten shades refers to ten key issues that need to be considered to create a fully green architecture—low energy/high performance, replenishable sources, recycling, embodied energy, long life and loose fit, total life cycle costing, embedded in place, access and urban context, health and happiness and community and connection.

Christian Richters

A glass roof tops the energy-efficient Beyeler Foundation Museum in Riehen, Switzerland. (Renzo Piano Building Workshop, Architect)

The exhibition seeks to help move the issue of environmental responsibility in architectural design to the center of American discussion and debate. Ten Shades of Green demonstrates to both architects and laypeople the necessity of thinking about the environmental implications of design, and the new forms that can arise from that thinking.

Ten Shades of Green illustrates ten types of environmentally responsible architecture exemplified by nine buildings of varying typology from Europe and Australia, and four American houses that serve as significant examples of regionalist architecture and that together illustrate the link between the American tradition and current work. All the buildings are distinguished by the way that environmental responsibility has become integral to both their form and function.

For more information, contact Lance Kirk, Chairman, Las Vegas Committee on the Environment, (702) 263-7111, e-mail: ljkirk@lgainc.com or visit www.lv-cote.org or www.archleague.org/tenshadesofgreen. The exhibition is free and open to the public.

Expanded GreenSpec® Directory

GreenSpec® Directory, the premier printed source for information on green building products, has been revised and expanded.

The 416-page third edition includes detailed information on more than 1650 carefully screened products—from access flooring to zero-VOC paint—along with guideline specification language, all organized in the industry-standard 16-division CSI MasterSpec™ system. The directory, prepared by the editors of *Environmental Building News*, is the most comprehensive green product resource available for architects, designers, specifiers, builders, developers, building managers and homeowners.

GreenSpec© Directory

The criteria for inclusion in GreenSpec are explained in the Directory and available online. "We adjust our standards periodically to reflect changes in technology and standard practice," said editor Alex Wilson. "More than 250 products have been added to the third edition, and 128 were removed, either because they are no longer available or because they no longer qualify."

The product information in *GreenSpec Directory* is also available online with a subscription to BuildingGreen's Premium Web Content. Online access to GreenSpec offers expanded and more up-to-date listings, greater search flexibility—including a new search by LEED™ credit—links to products details on manufacturer's web sites and links to many product reviews.

For more information and to order, contact BuildingGreen, Inc., 122 Birge Street, Suite 30, Brattleboro, Vermont 05301, (802) 257-7300, e-mail: info@buildinggreen.com, web site: www.greenspec.com and request the GreenSpec Directory, ISBN 1-929884-09-5. The cost is $79.00 plus shipping.

This Renewable House

A home video version of *This Renewable House*, a program originally aired across California on public television (PBS) stations, is available as a free video rental and is sold through the American Solar Energy Society (ASES). *This Renewable House*, by Scott Cronk and Bob Andruszkiewicz, is an extended version of the original program.

Using a format similar to the popular PBS series, *This Old House*, the video covers a variety of topics for home or building owners interested in installing solar electric systems. A special announcement from

Continued on page 44

Resources

Continued from page 43

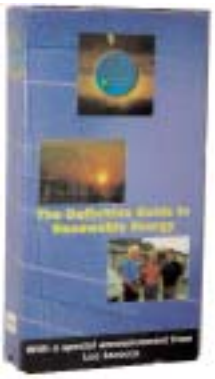
Lee Iacocca is included, together with perspectives from contractors, homeowners and building owners who have installed and lived with solar and wind energy.

Topics covered include how to determine if solar or wind energy is right for you, how the technologies work, purchase incentives available, tips for selecting a contractor and what to expect before, during and after your installation.

The program is hosted by Donald Aitken and Brooke Erdman.

A free video rental is available through Wherehouse Music (www. wherehouse. com) and Bradley Video (www. bradleyvideo.com) stores.

For more information about the video, contact Scott Cronk, Executive Producer, (707) 546-6919, e-mail: scott@ calenergy. org, web site: www.calenergy.org. To order, contact Dona McClain, American Solar Energy Society, 2400 Central Ave., G-1, Boulder, Colorado 80301-2843, (303) 443-3130, FAX (303) 443-3212, web site: www.ases.org. The cost is $15.00.



This Renewable House

Energy-10 Update

The Sustainable Buildings Industry Council (SBIC) recently announced the release of the new *Energy-10* Version 1.5 CD-ROM and installation manual.

Developed by the National Renewable Energy Laboratory (NREL), with the support of the U.S. Department of Energy, *Energy-10* Version 1.5 is the first full release since Version 1.3 in November 1999. SBIC is providing the Version 1.5 upgrade at no charge to all registered users. There are major updates in Version 1.5 including life cycle costs, an up-to-date compiler, more wall layers and new graphs and reports.

For more information and to order, contact the Sustainable Buildings Industry Council, 1331 H Street, N.W., Suite. 1000, Washington, D.C. 20005, (202) 628-7400, FAX (202) 393-5043, e-mail: sbic@sbicouncil.org, web site: www.sbicouncil.org. New users can purchase the *Designing Low Energy Buildings with Energy-10* package; cost is $250.00 (professional), or $50.00 (student/academic).

Small is Profitable

A new book called *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size* shows the electric power industry why appropriately sizing (and siting) electrical production can be more profitable than building large, centrally located power plants.

Small Is Profitable, recently released by Rocky Mountain Institute, describes 207 ways in which the size of "electrical resources"—devices that make, save or store electricity—affects their economic value. It finds that properly considering the economic benefits of "distributed" (decentralized) electrical resources typically raises their value by a large factor, often as much as tenfold. These gains are realized through improved system planning, utility construction and operation, service quality and by avoiding societal costs.

Written by a team of energy experts who back up their assertions with years of research, *Small Is Profitable* introduces its readers to the new opportunities presented by considering these economic benefits. These opportunities will be of interest to

engineers, financial practitioners, business managers and strategists, public policy makers, designers and concerned citizens.

The authors point out that many of the assumptions informing decisions in today's electrical markets are no longer valid. While the industry still behaves as though generation expenses are the deciding factor in the consumer cost of electricity, transmission and distribution and grid maintenance costs are now in the driver's seat. This switch has brought with it vast new business opportunities that power suppliers and others in the industry should begin taking advantage of.

For more information and to order, visit www.smallisprofitable.org and request *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*; ISBN 1-881071-07-3. The cost is $60.00.

PCA Launches Web Site

The Partnership for Climate Action (PCA), which consists of eight leading corporations and the advocacy group Environmental Defense, recently announced the launch of their web site, www.pca-online.org. The PCA members include Alcan, BP, DuPont, Entergy, Ontario Power Generation, Pechiney, Shell International and Suncor Energy.

The PCA's goals are to reduce greenhouse gas emissions, employ market mechanisms, report emissions performance and share its learning. The web site furthers these goals by providing information about the PCA's activities and each member's greenhouse gas management programs and emissions information. The web site features publications by the PCA that are available for download as well as links to each PCA member's web site. The site will publish the PCA's work on actual emissions trades, project-based emissions reduction credits and emissions reporting issues, among other topics.

For more information, visit www.pca-online.org.

Clean Energy Markets

State clean energy funds are slated to collect nearly $3.5 billion from 1998 to 2012 for investments in renewable energy markets, making state policies and practices a key market driver for clean energy technologies. In a remarkably short time and almost under the collective radar, states have emerged as leaders in developing clean energy market solutions, according to a new series of case studies by the Lawrence Berkeley National Laboratory and Clean Energy Group. *Innovation, Renewable Energy, and State Investment: Case Studies of Leading Clean Energy Funds* highlights innovative practices across the U.S.—cutting-edge efforts to bring renewable and clean energy technologies into the American marketplace.

The 21 initial case studies in the series cover emerging clean energy program and administrative practices at the state level. They focus on practical, local solutions to clean energy market barriers and explore strategies to spur economic development and make clean energy markets work. Some also describe novel international renewable energy programs that could serve as models for future state actions.

For more information contact Lew Milford, Clean Energy Group, (802) 223-2554, web site: www.cleanenergygroup.org or Mark Bolinger, Lawrence Berkeley National Laboratory, (510) 495-2881, web site: www.lbl.gov. The individual case studies and the longer compilation report can be downloaded at http://eetd.lbl.gov/ea/ems/cases or www.cleanenergyfunds.org. ✲

Crash Programs and Renewable Energy

by Frank N. Laird

In the November 1 issue of *Science*, a group of scientists reviewed the possibilities for deploying energy technologies that did not produce greenhouse gases and for research topics that could make such technologies a reality. The article covered the waterfront, from carbon sequestration and nuclear fusion to diverse renewable energy sources, concluding that creating such technologies would require "intensive research and development." They were trying to change the terms of the debate about global warming. (*Science*, vol. 298, 1 Nov. 2002, quote from p. 981).

As interesting as the article itself was the way the press reported it. In its opening sentence, an article in the *New York Times* claimed that the scientists had called for an "effort as ambitious as the Apollo project to put a man on the moon." As far as I can tell, the article nowhere mentions the Apollo project or, for that matter, the World War II Manhattan project to develop nuclear weapons, the other famous crash program often mentioned as the best way to develop a new technology. Yet the press routinely interprets any call for intensive research and development (R&D) as a call for a crash program modeled on one of these famous historical precedents. And I have heard many renewable energy advocates say similar things, that if the government would get serious about renewable energy they would have a Manhattan project for solar, wind, biomass and so on.

A proposal for a crash program certainly appeals to our notion that renewable energy is both hugely important and largely ignored. And for scientists and engineers, the Manhattan and Apollo projects mark glorious times when government policy assembled the best minds and poured in unlimited resources to accomplish some urgent national goal. Moreover, those policies actually succeeded. They accomplished what they set out to do, despite daunting technological obstacles, making it look like scientists and engineers could do anything with enough money from the government. For decades after the Apollo project, discussions of numerous social problems started with the phrase "If we can go to the moon, why can't we…?"

As tempting as such glamorous and well-funded crash programs are as models, I have thought for some time that they are a bad idea for renewable energy. (At the moment, they are also a political nonstarter, but leave that problem aside for the moment.) To renewable energy advocates, this may sound a bit like heresy. Most of us think that renewables deserve much more generous policy support from the federal government, a sentiment I share. Indeed, in an earlier column I criticized the U.S. Department of Energy's proposed budget for R&D for being too modest. I strongly support a steady increase in federal R&D for a diverse portfolio of renewable energy technologies. But just because "more" is better does not mean that "most" is best.

Government-funded crash programs on new technologies have only worked under special circumstances. In both the effort to develop nuclear weapons and to put a human on the moon, the federal government's policy was to develop a new technology for which there was a single buyer, the federal government itself. Because of the urgency created by international politics, the agencies of the government buying

those technologies had what seemed like unlimited funds. The government was determined to develop those weapons and put a person on the moon, and money was no object.

For renewable energy, money is very much an object. Our community wants to and must promote technologies that will succeed in a civilian marketplace. Contrasts with the Manhattan and Apollo projects suggest that crash programs will not help our cause. The government banned nuclear weapons from commerce, for obvious reasons. The major civilian spinoff, nuclear power, has been a financial disaster, despite, according to one estimate, government subsidies that totaled $195 billion. Human space flight has never found a civilian market, again despite massive government subsidies. We want renewable energy technologies to do better than that.


Frank N. Laird

If we are looking for a model for the commercialization of renewable energy, I suggest we consider the integrated circuit chip invented in the late 1960s. Chip manufacturers made incremental but steady and rapid improvements, constantly shrinking the size of the features etched on the chips, making it possible to cram more transistors, diodes, etc. onto each chip. The result was the extraordinary microelectronics market that we have today. The most sophisticated new chips are direct descendents of the original models, not recent qualitative breakthoughs. However, they have, through incremental improvement, become so powerful that we can use them in qualitatively different products, making them almost ubiquitous in modern life.

Contrary to the popular myth, government policy played a huge role in the microelectronics revolution, putting billions of dollars into the effort. Government procurement bought these chips by the boatload for numerous technological purposes, helping to create a nice cash flow for the manufacturers. Government-funded R&D carried out in both firms and universities has helped to pave the way for the steady technological improvements the industry has enjoyed, and continues to do so today. Government fellowships and assistantships have paid for the graduate education of generations of computer scientists and engineers, making possible the remarkable workforce that populates that industry. Thus, government policy has been deeply involved in the commercialization of chip technologies, not through a crash program, but through supporting the infrastructure and research that makes the industry possible.

Government policy should do the same for renewable energy. That is why I sometimes write in this column about what might seem like small part of the picture, such as rules for regulating utilities or renewable portfolio standards of only a few percent. These small parts can build the mosaic that combines market environment, technological infrastructure and government R&D support that together can support the steady and rapid spread of renewable energy sources into society. Crash programs won't get us there. Let's instead be the integrated chip of the 21st century. ✲

Frank N. Laird is chair of the American Solar Energy Society's Policy Committee. He can be reached at the Graduate School of International Studies, 2201 South Gaylord Street, University of Denver, Denver, Colorado 80208, (303) 871-4462, FAX (303) 871-2456, e-mail: flaird@du.edu.

Investing in Wind

by Rona Fried

Wind energy is the world's fastest growing energy source, growing at about 35 percent annually for the past 5 years. It is expected to continue growing between 22-30 percent per annum over the next five years.

Through favorable legislation and an early commitment to renewable energy, Europe opened the door to the wind industry. Two-thirds of the world's installations are in Europe, as are 90 percent of the world's wind turbine manufacturers.

NEG Micon

Wind energy has been growing at about 35 percent annually for the past 5 years.

Riding a tax credit-driven wind rush, the U.S. added 1600 megawatts (MW) of new wind power in 2001, a 90 percent jump from the previous year. Texas alone installed 900 MW. With some 1100 MW in place, Texas now has as much wind power as many countries, surpassed only by Germany, Spain, Denmark and India. Another boom is expected in 2003 before the U.S. tax credit expires again.

The U.S. has tremendous wind resources, lots of land and lots of coast. The on-again, off-again tax credit feeds a boom/bust cycle in the U.S., but all the major wind turbine manufacturers are planning to expand into the huge U.S. market, intensifying competition and putting pressure on prices. Vestas is currently the leading wind turbine manufacturer in the U.S. with almost a 40 percent market share, followed by GE WindPower (formerly Enron Wind) with a 26 percent market share.

The only "pure plays"—companies for whom wind is their predominant product—are the wind turbine manufacturers. The four public wind companies, all European—Vestas (www.vestas.com), NEG Micon (www.neg-micon.com), Gamesa (www.gamesa.es) and Nordex (www.nordex.dk)—dominate the market. Since 1997, they have installed over half of all new capacity.

The wind industry is growing by leaps and bounds. But does that mean the companies are good investments?

I recently asked a group of investment advisors to join me in a conversation about investing in the wind industry. The participants are **Jack Robinson**, Principal & Portfolio Manager, Winslow Management Co., Green Growth Fund; **Ken Scott**, Portfolio Manager & Social Research Analyst, Walden Asset Management's SmallCap Innovations funds; **Carsten Henningsen**, Co-Founder & Principal, Portfolio 21 mutual fund; **Terry Foeke**, Principal, Materials Productivity, Inc., a 20-year old clean manufacturing consulting firm and **Cary Wasden**, Principal, Reed Wasden Research, an independent research firm focused on energy.

Do you consider the wind industry a good investment?

Jack Robinson: Yes. Demand is picking up for environmental and economic reasons. There's good reason to be interested in wind, because you can invest in companies that are profitable today and are likely to grow their profits at a rate equal to the industry growth at 25 percent.

Carsten Henningsen: Yes. We're definitely very supportive and see wind as a growth industry over the next 5-7 years.

Cary Wasden: Yes. If you asked me this question 5-6 months ago I would've said the wind stocks look expensive. Now, they've come down to realistic valuations.

Terry Foeke: No. You have all the earmarks of things traditional investment advisors avoid, such as dependence on government subsidies and high valuations. The whole alternative energy sector is hard for me, because I work a lot in conventional energy—coal-fired power plants especially. They're not only cleaning them up, but they're getting cheaper. It's old and stodgy, but they know what they're doing. Alternative energy is new and has a lot of perceived risk.

Ken Scott: Yes. We like the outlook for alternative energy companies in general and wind power in particular. We believe wind is a good investment as part of a diversified portfolio. All forms of energy are subsidized, it's just that it has a different name for wind power—it's called a production tax credit.

How would you recommend that people invest in the wind industry?

Jack Robinson: The only way to invest in the wind industry is to buy shares in the wind turbine manufacturers. They are the only "pure plays." All the major brokers can easily buy internationally. The Winslow Green Growth Fund holds both Vestas and NEG Micon in wind.

Carsten Henningsen: Our style is to pick a couple of the best companies in a sector that we think are positioned to take advantage of the growth. We invest in Vestas and NEG Micon.

Ken Scott: We only invest in Vestas in the wind sector. We believe the most potential for wind expansion is in the U.S. and Vestas stands to benefit the most. Also they're integrated—they make a lot of their own components.

Cary Wasden: We recommend buying

all four companies. Their valuations are close to parity now.

Terry Foeke: Vestas would be the first choice among the turbine manufacturers, but again, I caution people to think hard about whether this is the best place for their money. Gamesa is diversified, which is a good thing. They own wind farms as well as manufacture turbines.

How does investing in wind compare to the other alternative energies like solar and fuel cells?

Carsten Henningsen: If I only had enough money to buy 3 positions, I'd want a company in each alternative energy sector—Ballard in fuel cells, AstroPower in solar and Vestas in wind. If I had a bit more money I could diversify further and get Plug Power in fuel cells and NEG in wind.

Ken Scott: Vestas and other wind power companies are profitable now. That's not true except for AstroPower for solar companies, and it's not true for the fuel cell companies yet.

Terry Foeke: I don't like any of them. I think they're set up for some terrific problems as conventional energy industry gets its head on straight and starts to deal with this.

Jack Robinson: It's important to understand that these companies are all small cap growth stocks, the segment of the market that's been hurt the most. We have a significant commitment to alternative energy. Besides holding Vestas and NEG Micon in wind, we have Fuel Cell, AstroPower, Quantum and IMPCO.

Cary Wasden: Once fuel cells become commercially available, the world of wind will fade. Fuel cells generate electricity 24 hours a day, they're clean and they're much more efficient. But that's at least 20 years down the road, so for the next 5-10 years you're safe investing in wind power. ✲

Rona Fried is the President of SustainableBusiness .com. Contact her at rona@sustainablebusiness .com. This article is an edited excerpt of several articles from the wind issue of The Progressive Investor*, an electronic newsletter available by subscription at www.sustainablebusiness.com. Each issue includes conversations among world-class sustainable investment analysts on viable green business investments.*

New Products

Roof-Integrated PV

AstroPower, Inc. recently introduced a new line of residential solar electric power systems featuring solar power arrays that fully integrate into a home's roof. Benefits of the new systems include faster installation time, reduced installation cost and enhanced aesthetics when compared with traditional rooftop-mounted solar power systems. AstroPower's new products will be offered initially to homebuilders as part of the company's SunChoice™ program.

The key component of AstroPower's new systems is a solar power array that aligns with existing roof shingles to create a seamless roof appearance. Unlike traditional solar panels that are "standoff-mounted" above the roofline, AstroPower's new solar power arrays directly replace conventional roof tiles. Not only does this approach simplify installation and reduce installation cost, it also enables the resultant solar power array to blend into the finished roof on a continuous plane.

AstroPower, Inc.

AstroPower's new solar array aligns with existing roof shingles.

AstroPower worked with Premier Homes during the development stages of the rooftop-integrated product, fitting several homes as test sites in the Sacramento area.

SunChoice™ Solar Electric Home Power Systems with rooftop-integrated modules include everything a homebuilder needs to share the benefits of solar electric power with its homebuyers, including plug-and-play wiring and power electronics. The systems feature all necessary components for ease of installation and operation, including a power meter so homeowners can easily monitor system performance. SunChoice™ systems enable homeowners to generate their own clean, quiet electricity while spinning their meters backward and driving their utility bills toward zero.

For more information, contact Colleen Gourley, AstroPower, Inc. 300 Executive Drive, Newark, Delaware, 19702, (302) 366-0400, web site: www.astropower.com.

SunWize® PowerPort PV Systems

The SunWize PowerPort represents the latest SunWize product offering for grid-connected PV applications. The photovoltaic (PV) array is located on the roof deck of a canopy structure that provides shade for various purposes such as vehicle parking, park visitors and sports spectators. The low tilt angle of the deck and array reduces wind loading and maximizes power output to coincide with peak electrical load periods.

The systems transform direct current power produced by the solar modules into 480 VAC, 60 Hz, 3-phase utility-compatible power. In this grid-interactive configuration, the PV system operates in parallel with the utility power plants to provide power to the grid during daylight hours.

For more information, contact SunWize Technologies, 1155 Flatbush Road, Kingston, New York 12401, (845) 336-0146, toll-free (800) 817-6527, FAX (845) 336-0457, e-mail: sunwize@besicorp.com, web site: www.sunwize.com.

Inverter/Charger

The OutBack FX2000 is a 2000-watt continuous rated modular sine wave inverter/charger, which can be used for both small and large power systems. The FX2000 features low idle power consumption and high power conversion efficiency, which is very important for renewable energy applications. Each FX2000 is a complete power conversion system—a DC/AC inverter, battery charger and an AC transfer switch system integrated together as one system component.

The FX2000 incorporates a unique die-cast aluminum sealed housing, which keeps the electronic components cool while protecting them from the major causes of inverter failure—corrosion, dust, insect and animal damage—even temporary submersion and pressure washing. The modular feature of the FX2000 allows up to eight units to be connected together in combinations of parallel (120 VAC), series (120/240 VAC) or three-phase (120Y208 VAC).

The operation of one or multiple FX2000s can be programmed and monitored by the "MATE," OutBack's system control and display unit. The OutBack MATE also allows the system users to monitor the performance of the FX2000 while providing a simple, single-screen display of the system's status and operation using words and symbols. A personal computer, using third party software, can be connected to the MATE to allow monitoring of the system and for remote control.

For more information, contact Marty Spence, OutBack Power Systems, Inc., 19009 62nd Avenue, NE, Arlington, Washington 98223, (360) 435-6030, FAX (360) 435-6019, e-mail: mspence@outbackpower. com, web site: www.outbackpower.com.

Kelln Solar Roto Pump

The Roto Pump by Kelln Solar Ltd. is a non-submersible, positive displacement, rotary vane pump that delivers up to 200 gallons per hour. Each pump is quiet in operation and requires no lubrication or maintenance during its life span.

Applications include remote domestic water pressure systems, remote water transfer systems, solar livestock watering systems and heat collector transfer pumping for solar water heating applications.

For well applications, the pump is hung on a rope 5 feet above the static water level, and 15–24 feet of suction hose is attached to the pump. The life expectancy on wearable parts is 5-10 years and completely serviceable 12 and 24-volt DC models are available.

Kelln Solar Ltd.

Kelln Solar Roto Pump

For more information, contact Kelln Solar Ltd., Box 94, 55 James Street, Lumsden, Saskatchewan, Canada S0G 3C0, (306) 731-2224, toll-free (888) 731-8882, FAX (306) 731-2774, web site: www.kellnsolar.com. ✲

On Intimate Terms With A Wind Generator

by Mick Sagrillo

You don't often hear about a do-it-yourself renewable energy system that has run successfully for long time. Many homeowner-installed projects are abandoned after only a few years. The owners lose interest. Or they move. Or severe weather damages the system, which is deemed not worth fixing or replacing. Once in a while, however, you come across a persistent tinkerer who is in it for the long haul. Carl Berger is one of those people. Carl lives in East Aurora, New York., with his wife, Gail, and a wind generator, but not always in that order.

A card-carrying do-it-yourselfer, Carl is not intimidated by concrete work, electrical repairs or tower heights. In 1985, Carl decided to install a 4-kilowatt utility-intertied Whirlwind Wind Generator on a 120-foot guyed tower. Installing a wind electric system seemed like a great project back then, with all the tax credits available.

Because there are a number of 80-foot trees that surround his property, Carl decided to install a 120-foot tower. Anything lower would have compromised the output of the wind turbine and caused additional wear and tear on the machine due to turbulence. Guyed towers, like many communications and cell towers along our highways, use guy cables stretched in three directions to keep them upright. At about half the price of a freestanding tower, guyed towers are a common choice for budget-conscious wind system shoppers.

Carl's wind system installation was done in a cooperative arrangement with the local wind generator dealer. Carl did the work on the concrete footings and all of the electrical wiring. The dealer showed up when it was time to raise the tower and mount the wind turbine on top. In October 1985, Carl finished up the final details of the installation of his wind system and started producing energy, back-feeding excess electricity into the utility grid.

Carl also added two components to his system that every wind system should have—a kilowatt-hour meter (so that he would know exactly how much electricity the wind system was producing) and a wind logger manufactured by NRG Systems (so that he could document long-term average wind speeds and peak gusts at his site). These two pieces of equipment have proved invaluable to Carl's record keeping, as well as his documenting of service and repairs.

Six months after Carl's system was installed, the dealer went out of business. Shortly thereafter, the turbine manufacturer also went out of business, a casualty of the Reagan Administration's decision to allow the renewable energy tax credits to expire.

It didn't take long for Carl to realize that if his wind system needed any repairs, he would be the person doing the work. With his wife or a neighbor working as his ground crew, Carl has become quite adept at climbing the 120-foot tower to do repairs.

The first 10 years of operation saw only three major repairs, two of which involved removing the wind generator from the tower. Once the turbine was on the ground, Carl did all the repairs himself. Carl has strong mechanical and construction skills,

and he worked in a machine shop at the time and had access to a complete line of machine tools after hours. His ability to do the maintenance and repair work himself saved Carl both time and money, and gave him an intimate knowledge of how his wind turbine works.

The system also had many minor glitches, all of which Carl took care of himself. For example, the underground wiring from the tower to the house developed a fault in the insulation on one of the wires. Another glitch was caused by a burned terminal in the lockable disconnect switch that the utility required to be installed between the synchronous inverter and Carl's house circuit breaker box. While these problems are not directly related to the wind system, they can result in considerable down time. In addition, problems like these can drive you wild if you do not have the proper troubleshooting equipment.

Warren Berger

Carl Berger and his wind generator.

During its first 10 years of operation, the system was available to generate electricity 95 percent of the time. This is comparable to the availability of a large turbine on a wind farm maintained by a service crew. During the next seven years, system availability dropped to 85 percent. This was due to additional maintenance that was necessary on the aging wind generator, plus delays in getting the inverter repaired. During one unfortunate period of time, the synchronous inverter—the device that couples the turbine to the grid—spent eight weeks at the manufacturer's repair facility, only to have the manufacturer determine that there was nothing wrong with it.

One of the wisest moves Carl made was to purchase a duplicate wind system in non-working condition, including the synchronous inverter. Carl reasoned that the availability of spare parts and a spare inverter would greatly reduce the system's down time.

Carl completely rebuilt the duplicate wind turbine, and in May 2002, he replaced the original Whirlwind with the rebuilt unit. He has since rebuilt the original as well so that he has parts, or even a complete replacement, when the currently operating Whirlwind needs any major repairs.

In October 2002, Carl and Gail celebrated their wind system's 17th birthday. During that period of time, the wind turbine has produced 20,200 kilowatt-hours of electricity. This represents about 24 percent of Carl and Gail's electricity use during that time period. Carl points out that the figures would look a lot better if he lived at a good wind site.

Being a hands-on person with good mechanical skills and a healthy respect for heights has served Carl well and resulted in a system that produces close to its potential. One of the biggest lessons Carl has learned about renewable energy systems is that if you don't rely on yourself to do the repair work, it may indeed never get done. ✲

Mick Sagrillo is with Sagrillo Power & Light, E3971 Bluebird Road, Forestville, Wisconsin 54213, (920) 837-7523, e-mail: msagrillo@itol.com.

Dispersed Generation Benefits Farmers

by Kathy Belyeu

Some developers in the Midwest do not believe that bigger is better, and they are pioneering a "dispersed generation" model that could distribute some of the assets and more of the profits from electricity generation to farmers. Wind power offers farmers a new product to market, much like agricultural crops. At the same time—in addition to environmental benefits—wind projects large and small increase the tax base for the local economy and infuse the community with jobs and other economic activity.

As these models become more commonplace, some of the earlier hurdles of obtaining power purchase agreements from the local utility and arranging the financing are being overcome. A problem that is plaguing these small projects is the same one that wind power projects across the country are facing—transmission rules that were written with dispatchable, central-station power in mind, and an inadequate infrastructure in the places where wind is the strongest.

Kas Brothers Wind Farm

Living in Minnesota in the shadow of two of the country's largest wind farms, the 107-megawatt (MW) Lake Benton project and the 104-MW Pipestone County project on the Buffalo Ridge, the Kas brothers realized that a good wind resource blew across their farm as well. They also knew that they were located close to a good transmission system and—because they had done electrical contracting—they knew that they could do some of the work themselves.

The Kas brothers' wind farm was completed in 2001, and consists of two NEG Micon 750-kilowatt (kW) turbines. Consultant Dan Juhl, who has worked with a number of farmer groups to develop their own wind farms, reports that it was built for $850/kW, a price comparable to large projects. The farmers saved on development costs by performing some of the electrical and construction work. Juhl asserts that the project now yields $30,000-$40,000 annually for the first 10 years of operation while the loan is being paid off, and could yield $110,000-130,000 annually thereafter, depending on the amount of electricity produced. Although the farmers incur greater risk by owning the project themselves rather than leasing land to a large project developer, they also have the opportunity for greater reward.

The financial viability of the farmer-owned projects depends on receiving the federal production tax credit. In addition, Minnesota has a production incentive of 1.5 cents/kWh for the first 10 years of operation for qualifying projects under 2 MW.

Xcel Energy has contracted to purchase the power from the Kas brothers' wind project. Local banks provided the financing. Juhl reports that it took some education of the bankers to get the first loan, but after the Kas brothers' wind farm was up and running, the banks started coming to him.

Dan Juhl

Farmers reap financial benefits by siting wind turbines on their land.

The banks reportedly feel that the turbine and the power contract as security make the loans less risky than they first thought.

In 2002, Juhl worked on seven farmer-owned projects in Minnesota, each with two NEG Micon 950-kW turbines. He plans to install 10 more like that before the federal production tax credit expires at the end of 2003, for a total of 34 turbines with an installed capacity of 32.3 MW.

MinWind I & II

Farmers are also getting into the ownership act—without having to foot the entire bill themselves—by organizing cooperative organizations. Four NEG Micon 950-kW turbines belonging to the two MinWind limited liability corporations (LLC) started generating electricity in September 2002.

Structuring the organization as an LLC allows the organization to receive the federal production tax credit. Tom Arends, president of MinWind II estimated that, with the tax credit, the farmers could expect a 17 percent annual return on investment.

Sixty-six farmers raised 30 percent of the $3.6 million cost of the four turbines. They raised the remaining 70 percent through local banks.

Like the Kas brothers' turbines, each is expected to generate about $15,000 to $20,000 per year, after debt service. The profit will be distributed based on the number of shares each participant owns. No individual can own more than 15 percent.

Getting Power to Market

Obtaining transmission capacity to get the power into the network is the biggest barrier that Juhl sees to the development of farmer-owned projects. Operators of the regional transmission grid agree that small projects are not likely to have a system-wide impact until many more such projects are built in the same area. However, small projects must spend an inordinate amount of time and money to submit to an impact study—a process designed for large central-station projects—before receiving permission to interconnect the project.

The Federal Energy Regulatory Commission (FERC) is in the middle of a process to simplify and expedite the transmission interconnection process for small projects. Technical workshops and negotiations are underway to determine criteria for projects under 2 MW to "plug and play," or gain automatic interconnection rights after meeting some standard electrical criteria. FERC is also proposing a separate track for projects between 2 and 20 MW in size, subjecting them to more scrutiny than the smallest projects, but expediting the transmission application process compared to the several-hundred-megawatt "industry standard" projects. The final rule is expected in the spring of 2003. ✲

Kathy Belyeu is in Strategic Communications at the American Wind Energy Association, 122 C Street, NW, Suite 380, Washington, DC 20001, (202) 383-2500, FAX (202) 383-2505, e-mail: kathy_belyeu@awea.org, web site: www.awea.org.

Education News

Faculty Position Open

The Environmental Resources Engineering Department at Humboldt State University in Arcata, California, is inviting applications for a full time, tenure track faculty position in renewable energy systems beginning in August 2003. A Ph.D. in environmental engineering, mechanical engineering or a related engineering or science field is required.

Richard Engel, Schatz Energy Research Center

Humboldt State University's Renewable Energy Power Systems class installs a PV array at the Wolf Creek Outdoor School in Redwood National Park.

This is an exciting career opportunity for the right person. The department offers the nation's largest Bachelor of Science program accredited under Environmental Engineering and is one of the few to incorporate the study of renewable energy. The successful candidate will have the opportunity to teach courses such as Renewable Energy Power Systems, Solar Thermal Engineering and Building Energy Analysis as well as take advantage of start-up funding to participate in fuel cell research at the Schatz Energy Research Center (www.humboldt.edu/~serc).

Humboldt State University is located in the small college town of Arcata, 300 miles north of San Francisco in the heart of California's beautiful north coast.

For more information, contact Charles E. Chamberlin, Chair, Search Committee, Environmental Resources Engineering Department, Humboldt State University, Arcata, California 95521, (707) 826-4345, FAX (707) 826-4347, e-mail: cec2@axe.humboldt.edu, web site: www.humboldt.edu/~ere_dept. A full position announcement can be found at www.humboldt.edu/~facpers/vac_announce/030411Energy.htm.

Solar on Schools

The New Hampshire Governor's Office of Energy & Community Services, Solar Works, Inc. and the University of New Hampshire Office of Sustainability Programs sponsored the 2nd Annual Solar on Schools Conference. Participants from public and private schools learned about the economic and environmental benefits of pollution-free solar electricity, and answered questions from schools interested in installing their own solar electric systems.

As natural learning centers for communities, schools are excellent hosts for renewable energy systems. Over the past four years, Solar Works has collaborated with over forty schools throughout the Northeast to install solar electric systems.

For more information, contact Richard Eidlin, Solar Works, P.O. Box 577, Wilton, New Hampshire 03086, (603) 654-6619, FAX (603) 654-5020, web site: www.solarworks.com. ✲

Zero Energy Habitat House

The U.S. Department of Energy (DOE) Building America program's first zero energy building (ZEB) Habitat for Humanity house was recently featured in the American Solar Energy Society's 2002 National Tour of Solar Buildings, conducted in the Knoxville, Tennesee, area by the Southern Alliance for Clean Energy. This marks the first attempt in the U.S. to attain zero net energy consumption in a Habitat house. If all of the energy saving features deliver the designed energy-efficient performance and the solar photovoltaic (PV) system works as intended, the total average monthly electricity bills will average around $21.00.

The house features a number of energy-efficiency technologies and appliances, including air-tight structural insulated panels, energy-efficient windows, a highly reflective metal roof, a heat pump water heater that has been uniquely integrated with the heating, cooling and mechanical ventilation systems and a heat exchanger that recovers shower drain water heat. The home's 2-kilowatt (kW) grid-connected PV system uses a utility interactive inverter for net metering,

Big Frog Mountain Corporation

The first Zero Energy Habitat house.

The airtight construction permits efficient mechanical ventilation. Filtered fresh air is automatically delivered to each room whenever someone is in the house. Many of the features help control mold, mildew, moisture and soil gas from entering the house through the crawlspace. The house earned a U.S. Environmental Protection Agency (EPA) Energy Star score of 90.2.

For more information, contact Big Frog Mountain Corporation, 100 Cherokee Boulevard, Suite 321, Chattanooga, Tennessee 37405, (423)265-0307, toll-free (877) 232-1580 , FAX (423) 265-9030, web site: www.bigfrogmountain.com.

Navy Deploys PV System

Navy Region Southwest recently announced that it has deployed one of the largest federal solar photovoltaic (PV) systems in the nation. This system is a unique solar electric carport at Naval Base Coronado in San Diego, California, that makes innovative use of existing parking space. The installation consists of two con-

Continued on page 58

Continued from page 57

tiguous solar arrays, covering a half-mile long parking structure that serves U.S. Navy personnel. In addition to providing shade for parked cars, the 750-kilowatt (kW) solar electric system will reduce the demand on California's power grid, as well as improve air quality by avoiding thousands of tons of polluting nitrogen oxide, sulfur dioxide and carbon dioxide emissions.

The 750 kW solar electric system was implemented as part of an Energy Savings Performance Contract (ESPC) project developed by NORESCO of Westborough, Massachusetts. The PV system, designed, manufactured and installed by PowerLight Corporation of Berkeley, California, will produce approximately 1,244,000 kilowatt-hours per year and is expected to save over $228,000 in annual operating costs by avoiding purchases of expensive peak electricity.

This system is the latest renewable or distributed generation system deployed by Navy Region Southwest. Other installations include three solar electric systems totaling 130 kW, wind generating capacity of 675 kW on San Clemente Island, 120 kW of microturbine technology at Naval Base Coronado and several fuel cell demonstration programs.

For more information, contact Mary Markovinic, U.S. Navy, (619) 532-1937, e-mail: markovinovic.mary@cnrsw.navy.mil.

Solar Joint Venture

RWE Solutions AG and Schott Glas have consummated a manufacturing and marketing joint venture of their solar photovoltaic (PV) subsidiaries to form RWE Schott Solar. The joint venture, which received final government approval in November 2002, joins RWE Solar GmbH of Alzenau, Germany, its subsidiary ASE Americas Inc. of Billerica, Massachusetts, and Schott Applied Power Corporation, of Rocklin, California. ASE Americas, Inc. is changing its name to RWE Schott Solar, but will continue selling its flagship solar module under the ASE 300 brand name. Schott Applied Power will retain its current name.

The European Commission has granted antitrust clearance for the joint venture, which becomes the leading solar company in Germany and the sixth largest worldwide. RWE currently has PV manufacturing operations in Alzenau Germany, Putzbrunn Germany, and Billerica, Massachusetts, which together will have a capacity of over 100 megawatts. Schott Applied Power is an industry leading marketer and distributor of PV components and integrated PV systems based in Rocklin, California.

For more information, contact Tom Hunton, RWE Schott Solar, Inc., 4 Suburban Park Drive, Billerica, Massachusetts 01821-3980, toll-free (800) 977-0777 or international (978) 667-5900, e-mail: thunton@rweschottsolar.us, web site: www.asepv.com.

Xantrex Upgrade Program

Xantrex Technology Inc. recently announced an upgrade program for its SunTie and SunTie XR grid-connected solar inverter product lines sold under the Xantrex and Trace brands. The upgrade will improve its grid-connected inverters' ability to harvest energy during periods of rapidly changing solar irradiance caused by mixed, fast-moving cloud cover. With the upgrade, SunTie and SunTie XR inverters installed in areas where this type of cloud cover is common will deliver noticeably more solar-generated kilowatt-hours to the utility grid.

At press time, Xantrex expected to complete the upgrade development by the end of December. It will be available at no cost to all current Xantrex customers who have purchased a SunTie or a SunTie XR product. Xantrex will also offer the no cost upgrade to all Xantrex dealers and

distributors for units they currently have in inventory.

"While our SunTie and SunTie XR products undergo rigorous testing and meet all necessary regulatory requirements including UL-1741, we acknowledge that under certain conditions, some customers have seen performance that falls below what we would consider industry-leading. This is particularly true for customers living in climates prone to cloudy conditions throughout the day," said Greg Brown, Xantrex' president and chief operating officer.

"Our primary objective for this upgrade program is to ensure that our customers are satisfied with the performance of their Xantrex product. Customer feedback is essential to our product development process and we are committed to standing behind our products and our customers," Brown added.

Customers interested in the upgrade will need to register on the Xantrex web site. Registration began on October 30, 2002, and upgrades will be processed on a first-in, first-out priority basis. Customers and dealers can register and receive periodic updates about the upgrade program by visiting www.xantrex.com.

For more information, contact Xantrex, 8999 Nelson Way, Burnaby, British Columbia. Canada V5A 4B5, (604) 422-8595, FAX (604) 420-1591, e-mail: customerservice@xantrex.com, web site: www.xantrex.com.

Greenhouse Gas Trades

Partnership for Climate Action (PCA) members DuPont and Entergy recently traded accumulated emissions reductions to demonstrate that market-based trading can address global climate change.

The demonstration trade transferred 125,000 metric tons of CO_2-equivalent verified emission reductions from DuPont to Entergy. The greenhouse gas involved in the transaction was nitrous oxide (N_2O). The specific N_2O reductions in the trade were achieved in 2001 at the DuPont Sabine River Works adipic acid plant, Orange, Texas. In 1997, DuPont voluntarily installed a company-designed catalytic control process that accounted for the reduced emissions. This process decomposes the N_2O generated in the production of adipic acid into two inert gases, nitrogen and oxygen.

Entergy and DuPont established targets and timetables for reducing or capping greenhouse gas emissions associated with their operations. The DuPont target was to reduce its global CO_2-equivalent emissions by 40 percent below a 1990 baseline by the year 2000. Entergy established a target of stabilizing CO_2 emissions from its U.S. power plants at 2000 levels through 2005.

Through actions, including investing more than $50 million in facility retrofits, DuPont has been able to achieve reductions in excess of its target. In early 2002, DuPont and Entergy began discussing a demonstration trade to show that DuPont could benefit from its surplus greenhouse gas reductions, while assisting fellow PCA member Entergy in achieving its target. Entergy and DuPont estimate that their trade will fall within the estimates of a recent analysis by emissions brokerage firm Natsource, which indicated that verified emission reductions currently trade in the range of $1.00 to $5.00 per CO_2-equivalent ton.

For more information, contact DuPont, Corporate Information Center, Chestnut Run Plaza 705/GS38, Wilmington, Delaware 19880-0705, (800) 441-7515, e-mail: info@dupont.com, web site: www.dupont.com or Entergy, Mail Unit L-ENT-8A, P.O. Box 61000, New Orleans, Louisiana 70161, (504) 576-5785, web site: www.entergy.com. ✲

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27-March 7, Online
Solar Home Design Online Course. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

30-31, Washington, DC
Education for a Sustainable and Secure Future. Contact the National Council for Science and the Environment, IMMS, 2000 L Street, NW, Suite 200, Washington, DC 20036, e-mail: conference@ncseonline.org, web site: www.ncseonline.org/conference.

February 2003

3-8, Tucson, Arizona
PV Design & Installation Workshop. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

11-13, Essen, Germany
E-World Energy & Water International Fair and Congress. Contact E-World Team, 49-201-1022-210, e-mail: mail@e-world-of-energy.com, web site: www.e-world-of-energy.com.

21-23, Ashland, Oregon
Successful Solar Businesses Seminar. Contact Richard Perez, Home Power, P.O. Box 520, Ashland, Oregon 97520, (541) 941-9716, e-mail: richard.perez@homepower.com, web site: www.homepower.com.

26-27, San Francisco, California
Green Construction & Ecological Design. Contact the International Quality & Productivity Center, 150 Clove Road, P.O. Box 401, Little Falls, New Jersey 07424-0401, (800) 882-8684, (973) 256-0211, FAX (973) 256-0205, e-mail: info@iqpc.com, web site: www.iqpc.com.

26-March 1, Lyon, France
Renewable Energy Exhibition. Contact Christophe Guillemet, 33-472-22-3260, e-mail: cguillem@sepelcom.com, web site: www.energie-ren.com.

March 2003

1–2, Deschutes, Oregon
Conscious Living Expo. Contact Green Guides, 557 NE Quimby Ave., Bend, Oregon 97701, (541) 388-9040, FAX (541) 318-6169, web site: www.colivingnow.com.

3-8, Santa Cruz, California
Women's PV Design & Installation Workshop. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

8-9, Sacramento, California
Utility Interactive PV Systems. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

10-15, Grass Valley, California
PV Design & Installation Workshop. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

19-23, Bologna, Italy
Sunweek 2003 & Saiedue 2003. Contact Solar Energy Group Srl, Via Gramsci, 63, 20032 Cormano (MI), Italy, 39-02-66-301754, FAX 39-02-66-304325, e-mail: info@solarenergygroup.it, web site: www.solarenergygroup.it.

24-29, Austin, Texas
PV Design & Installation Workshop. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

29-30, San Diego, California
Utility Interactive PV Systems. Contact Solar Energy International, P.O. Box 715, Carbondale, Colorado 81623, (970) 963-8855, FAX (970) 963-8866, e-mail: sei@solarenergy.org, web site: www.solarenergy.org.

April 2003

10-12, Naples-Campania, Italy
Offshore Wind Energy in Mediterranean and other European Seas Seminar. Contact Dr. Tamara Sacco, Fondazione IDIS Citta della Scienza, Via Coroglio 156, 80124 Naples, Italy, 39-081-7352446, FAX 39-081-2301044, e-mail: sacco@cittadellascienza.it.

May 2003

18-21, Austin, Texas
Windpower 2003. Contact American Wind Energy Association, 122 C Street NW, Suite 380, Washington D.C. 20001, (202) 383-2500, FAX (202) 383-2505, e-mail: conference@awea.org, web site: www.awea.org/conference.

27-30, Boston, Massachusetts
XIVth Global Warming International Conference & Expo. Contact GWXIV, P.O. Box 5275, Woodridge, Illinois 60517-0275, (630) 910-1551, FAX (630) 910-1561, web site: www.GlobalWarming.net.

June 2003

8-11, Vancouver, BC, Canada
Hydrogen and Fuel Cells 2003. Contact Advance Group Conference Management Inc., 1444 Alberni Street, Suite 101, Vancouver, BC, Canada V6G 2Z4, (604) 688-9655, toll-free (800) 555-1099, FAX (604) 685-3521, e-mail: hfc2003@advance-group.com, web site: www.hydrogenfuelcells2003.com.

16-19, Sioux Falls, South Dakota
International Fuel Ethanol Workshop & Trade Show. Contact BBI International, P.O. Box 159, Cotopaxi, Colorado 81223, (719) 942-4353, FAX (719) 942-4358, e-mail: conferences@bbiethanol.com, web site: www.bbiethanol.com.

July 2003

29-August 1, Rye Brook, New York
Energy Efficiency in Industry. Contact American Council for an Energy-Efficient Economy, 1001 Connecticut Avenue, NW Suite 801, Washington, D.C. 20036, (202) 429-8873, FAX (202) 429-2248, e-mail: info@aceee.org, web site: www.aceee.org. ✲

Holding Government to Corporate Standards

by Scott Sklar

Large corporations have been in the headlines lately for structuring their balance sheets in ways that make their companies appear to be performing better then they actually are. Government regulators have moved in to insure that U.S. investors have a transparent window into their potential corporate investments, and to stop these CEOs from playing games with their investors' money.

Unfortunately, the U.S. Department of Energy (DOE), a multibillion-dollar entity, plays the same game. And in this case, we—the U.S. taxpayers—are the investors. Both political parties share the blame for this charade, as do we who allow it to continue. Just as the Securities and Exchange Commission (SEC) is putting the kabash on corporate misrepresentations, it's time we end the DOE gaming once and for all.

To hear our U.S. government representatives talk at the World Summit on Sustainable Development in Johannesburg, South Africa, last September, it would appear that U.S. budgets for clean energy are growing. But definitions of "clean" energy have become muddied, and this practice of mislabeling "renewable energy" and "clean energy" was condoned not only by the Bush Administration, but the Clinton Administration as well.

A typical example is a Clean Energy Export Initiative announced early in the Bush Administration, for which they had panels on "clean" coal, nuclear and—oh yes, at the end—renewable energy.

Within the environmental community, "clean" energy usually refers to renewable energy (solar, wind, biomass, etc.) and energy efficiency, often including combined heat and power and advanced natural gas technologies (fuel cells, heat engines, microturbines). However, others in the political arena cast a wider net and include nuclear energy, "clean" coal and advanced engine technologies (diesel, reciprocating engines). Never is this so clear as it is in tax policies and appropriations.

The clean energy community has allowed this ambiguity to continue. Congressional tax committee press releases report that the government plans to spend nearly $8 billion for "clean" coal, nuclear and "clean" fossil subsidies, with only $4 billion going to new efficiency and renewables assistance.

No one should be surprised that no studies have been done to determine whether government subsidies paid to mature energy companies with mature technologies in mature markets will have an adverse market impact compared to subsidies paid to newer renewable energy companies with emerging technologies in evolving markets. In other words, if our country provides a few billion dollars of subsidies for the more mature technologies, doesn't that skew the marketplace against the higher-cost emerging technologies—even if they are subsidized equally, which they are not?

The trends in supporting cleaner traditional energy sources in Federal Research, Development and Demonstration (RD&D) programs rather than renewable energy technologies are even more stark. And the trend toward incorporating non-renewable RD&D in the federal renewable RD&D program has grown considerably.

Superconductivity, a great efficiency RD&D program, is not a renewable energy program, and is now included as a significant percentage (over 10 percent) of the federal renewable RD&D program. Distributed energy systems RD&D is predominantly geared towards reciprocating engines and older fuel cells, not renewable-based distributed generation, and this RD&D program is also growing to about 5 percent, and possibly up to 15 percent of the renewable RD&D program.

Hydrogen RD&D, which could have a significant renewable energy basis, is now almost entirely focused on infrastructure delivery (primarily with natural gas), with some RD&D involving fuel cells. At a recent DOE Hydrogen RD&D program review, the nuclear and coal industries were well-represented, and are working to integrate themselves into the program in a major way. Only about 10 percent of the Hydrogen RD&D program—which accounts for about 7 percent of the renewables program—has any relationship to renewable energy.

This "Inside the Beltway" game has serious consequences, because both the Administration and Congress (in many cases unwittingly) believe that actual federal renewable RD&D is significantly increasing. Between 1986-2002, the renewable energy RD&D program has grown by 50 percent and during the same period, the non-renewable section of the renewable RD&D budget has grown faster, increasing by about 15 times.

Using budget intervals beginning in fiscal year 1984, the DOE renewable energy program was $207.6 million with only $7 million allocated to non-renewable activities, or approximately 4 percent. By fiscal year 1990, the non-renewable portion of the renewables research budget hit 5 percent but the renewables budget was much smaller. By fiscal year 1993, $45 million of the $257 million renewable energy budget was earmarked for non-renewable activities, or almost 20 percent.

By fiscal year 2001, the $314 million renewable RD&D budget had $80 million directed conservatively to non-renewable activities, or over 25 percent. The fiscal year 2003 budget may even be higher, as electric energy systems, distributed generation, non-renewable hydrogen, international and a series of Congressionally-directed line-items drive non-renewable RD&D within the renewable program to above 30 percent. The Administration even paid for the printing of its National Energy Strategy, a document that promoted and covered far more than renewable energy, out of the Renewable RD&D budget—a small sum, but symbolic of the problem.

These non-renewable programs may have very worthy benefits, but they should be moved into the areas where they belong—fossil, efficiency and cross-cutting programs. And the end-of-year funds that remain unspent, which are higher than ever, need to be openly announced and quickly redirected towards the renewable energy RD&D for which they were intended. These funds can be mysteriously redirected without public input or knowledge, and it is time that clean energy advocates ask for a detailed review and an appropriate allocation.

The national organizations that track the budgets should stop playing the "inside game" of capitulation because they are afraid of rocking the boat. Just as large corporations must be compelled to report their finances and activities honestly, so should DOE. Congress hasn't helped, and we all must be emphatic that renewable energy RD&D money must be spent on renewables, and other worthy programs must go where they belong. ✲

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