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SOLAR TODAY

LEADING THE RENEWABLE ENERGY REVOLUTION

solartoday.org **June 2010**

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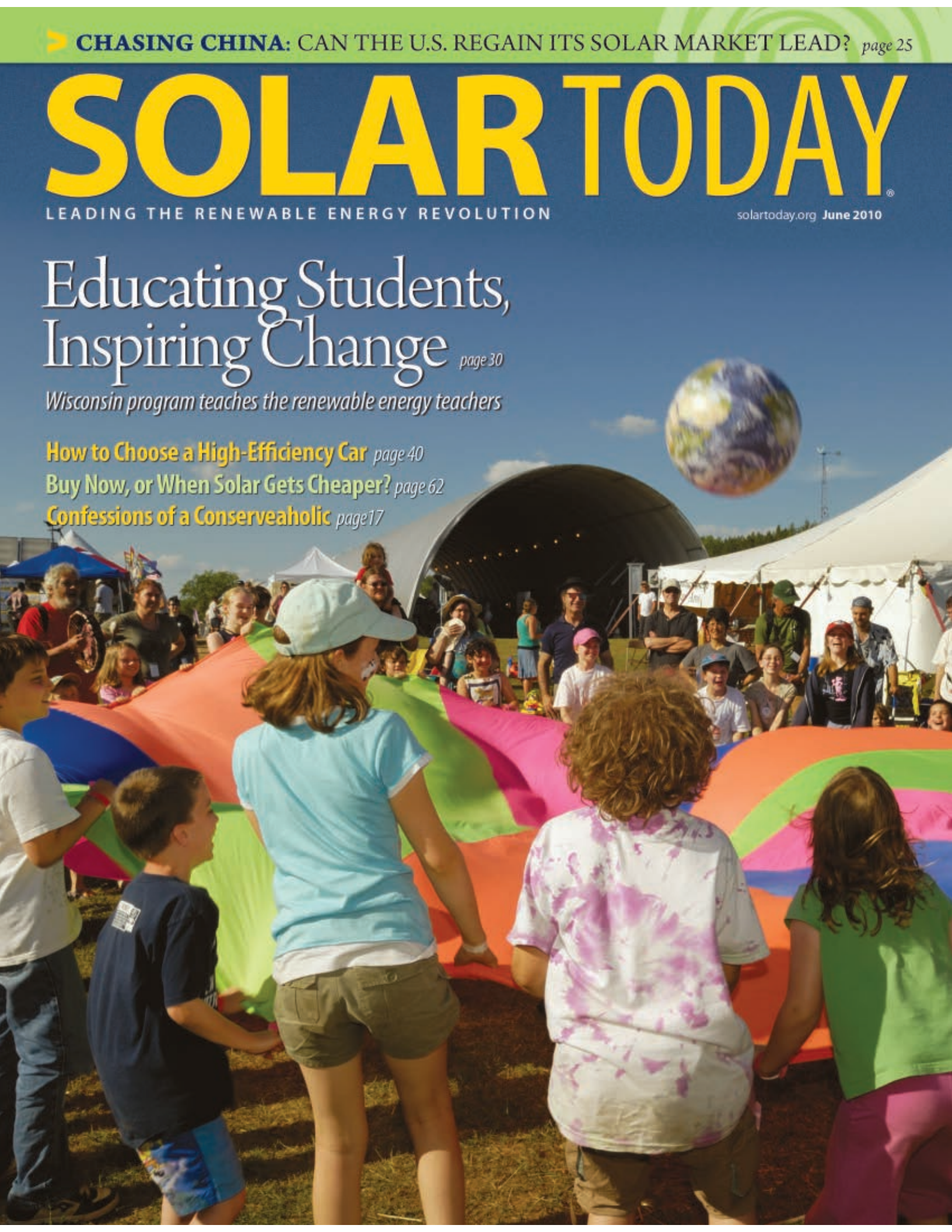

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ON THE COVER: Comprehensive energy education that inspires students to action is key to a sustainable future. While kids play at the Midwest Renewable Energy Association's (MREA's) 2009 Energy Fair, teachers earn graduate credits through the Wisconsin K–12 Energy Education Program. Story on page 30.

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Articles appearing in this magazine are indexed in Environmental Periodicals Bibliography and ArchiText Construction Index: afsonl.com.

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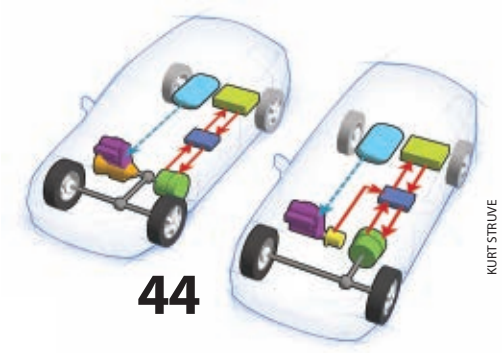

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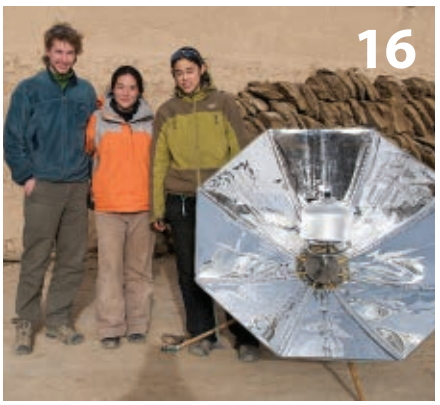

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Installer Alert!

The *Get Started 2011* issue of *SOLAR TODAY*, published for the American Solar Energy Society's National Solar Tour, will include the third annual Solar Buyers' Guide, a national listing of solar installers. If you'd like to be listed, register now at pros.findsolar.com or contact smasia@solartoday.org.

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An Off-Grid Escape

By Ben Dodge

For the outdoor enthusiast, what could be more appealing than a backcountry hut in the Colorado Rockies, far from even the electricity grid? Dodge tells the story of how these huts went solar.

PHOTOS BY SCOTT MESSINA

INSIDE THIS ISSUE: Clicks for Web Extras

Expanded from "Out of the Running," page 25 > See a video interview with Kate Gordon on the *SOLAR TODAY* blog: solartoday.org/blog.

Expanded from "Teaching by Example," page 35 > Access a detailed cost analysis: solartoday.org/PISP.

Expanded from "High-Efficiency Cars," page 40 > Download the complete high-efficiency cars spreadsheet: solartoday.org/transportation.

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Solar Marketing: An Uphill Battle?

Members of the American Solar Energy Society's (ASES') LinkedIn page recently discussed the many reasons marketing solar can be tough. Listen in, and then be sure to find ASES on LinkedIn:

Jyl Safier, director of marketing, Conergy: "In my nearly five years as a solar marketer, I've seen it all, two years of module supply issues, then, when that seemed resolved, we had to wait a year for the extension of the federal tax credit. Guess what? Just as we got the extension, BOOM — global economic collapse and no tax appetite from investors or low-cost credit for homeowners and all the rest. Then we got all these great incentives in the [American Recovery and Reinvestment Act], but module oversupply kept everyone waiting around to sign contracts to see how low prices would get. What next? Can't wait to find out!"

Mark C. Walters, professional electrical engineer: "I think it is mainly a case of consumers being afraid of the unknown. Most consumers do not yet understand solar basics, the economics, the finance, incentives or tax issues surrounding solar. I mainly see lack of knowledge or misinformation spread by noninformed entities as the chief push-back. Upon simple explanation of the issues, individuals are amazed and then the only issue presenting a 'pushback' is availability of upfront capital, not lack of enthusiasm to go solar."

Daniel Simon, president, 3D Solar: "I think there is a misplaced perception that solar payback needs to be 'super fast,' like three to five years, before people/companies buy it. It would/will be awesome when prices get down to that level. But anything less than 20-year simple payback provides an excellent investment. A solar system that provides a 20-year simple payback is like buying a solar bond that pays 5 percent (tax-free) interest year after year without ANY risk. Think of it as buying your own dividend-paying utility company, but one with a 4.5 billion year operating history and no competition. ..."

ED WANSING

One reader writes that Ed and Carly Wansing, who added photovoltaics to their Ashland City, Tenn., home, would have gotten more for their money by choosing solar thermal instead.

Should Have Gone Solar Thermal?

Nice [photovoltaics featured in "Going Solar Step by Step," April issue], but [that's] not [the way to go when considering] "bang" for your money. [Authors Ed and Carly Wansing], you note your system averaged about 2,600 kilowatt-hours (kWh) for 2008/2009. That is the same as approximately 8.9 million British thermal units (Btu) a year. With two people in the house, [using] 20 gallons of hot water a day per person [on] average, that works out to about 7.4 million Btu or 2,155 kWh per year. That is just your domestic hot water (DHW) load.

You already had the 80-gallon tank [from an electric water heater], which could have been very effectively turned into a solar DHW boost tank for $4,000 to $5,000 total cost, after rebate. This would have given you about 80 percent of the energy now delivered by your PV at about 40 percent of the cost.

You [write] you now pass DHW off to your gas usage with little concern expressed in the article. A unit of energy is a unit of energy whether a Btu from gas or a kWh from the grid. Rather than installing inefficient PV for a little bit of energy, in that climate, it would have been far smarter to put the money into solar thermal DHW and maybe even attacked space heating a bit. You could have produced far more energy, dollar for dollar invested, and still taken away the electric DHW load. Solar thermal [should] always [be] first, PV a distant second.

William H. Fitch III
Berwick, Pa.
fcfcfc@prolog.net

Author Ed Wansing's response:

Thanks for your comment on the article. I agree that it is good to always consider all options to determine what is best for each particular situation. I think you will see that, in our case, the solar PV actually [offers] the bigger bang in terms of Btu and carbon equivalent (CO_2e) emissions. I disagree with your thought that a unit of energy is a unit of energy, regardless of where it comes from. In terms of efficiency, it is much more efficient to burn a Btu of gas on site than to use a Btu of electricity on site. As I am sure you know, power plants, mostly [powered by] coal in the Tennessee Valley, lose 70 percent of their Btu input up the stack as heat before the electricity even leaves the plant. Then you have to factor in transmission losses and the fact that coal is a much dirtier fuel than natural gas to begin with.

We have a very small hot water usage, as you have noted. I am not sure of the total gallons [used] per month, but I do know that we only use 1 or 2 therms of gas to run our tankless water heater. Let's call it 2 therms per month, or 24 per year. This is only 2.4 million Btu. As you have noted, our PV system is putting out about 8.9 million Btu of electricity. If we talk about CO_2e emissions, you are looking at 1.623 tons of CO_2e emissions if we were to still purchase those 2,600 kWh from the grid, instead of producing [them] with our system. Burning those 24 therms on-site to heat our water is only 0.142 tons CO_2e emissions. We also get a production incentive from the Tennessee Valley Authority that pays us 12 cents per kilowatt-hour for everything we produce. We would not be getting [that incentive] if we were producing hot water with a solar thermal system.

Correction

In the May feature, "Bold, Decisive Times for Concentrating Solar Power," the list of major CSP technology providers active in the United States should have included Acciona Solar Power, not Acciona North America. We apologize for the error.

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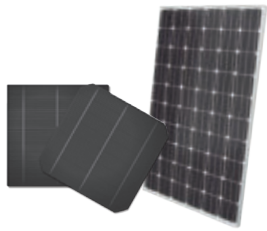

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Others Lead While the United States Slips

In per capita investment in clean energy, we're not even in the top half.

By **BRAD COLLINS**

Brad Collins is the executive director of the American Solar Energy Society (ases.org).

For some years, we've urged in this column progress toward energy independence, a healthier environment and a sustainable economy, through the broad and aggressive deployment of renewable energy technologies, energy-efficiency measures, smart transportation and energy-conscious urban planning. Much of our recent work at the American Solar Energy Society has been designed to help inform decision makers of these issues. Our "Tackling Climate Change in the U.S." and multiple green jobs reports have been influential.

The jobs reports have clearly identified the three elements that help states (and provinces) attract and hold green jobs and businesses. First, they create a ready internal market for renewable energy and energy-efficiency (RE/EE) products, driven by renewable portfolio standards and comparable policies. Second, they offer state incentives for researchers, manufacturers and installers to locate there. And third, the governor takes strong leadership in marketing the state to RE/EE businesses.

This summer, stakeholders in Washington, D.C., will discuss changes in U.S. energy policy and possible action on climate legislation. Two recent reports, from the Pew Charitable Trusts and the Center for American Progress, show what is at stake economically for the United States.

In March, the Pew Charitable Trusts published "Who's Winning the Clean Energy Race?" (tinyurl.com/y9gchaq). It forecasts that global clean energy investments will grow this year by 25 percent, to $200 billion, dominated by spending in the G-20 countries. This continues a recent trend of greater emphasis in the developed world on renewable energy research, manufacturing and deployment, all of which help to create exports.

As in the leading states and provinces in North America, the countries winning the global race for green jobs have three elements in common: First, they have adopted comprehensive energy policies and thus created internal markets for renewable energy deployment (Germany, Spain, China, India and Japan, for example). Second, they provide incentives for manufacturers and exporters to compete globally. All the G-20 countries, absent South Africa, have RE/EE tax incentives. Finally, the leaders of these countries promote the economic promise of broad RE/EE deployment.

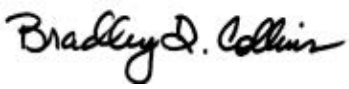
The United States has now implemented these elements, but is still falling behind in the race to lead the green economy revolution. Why? Research has shown three additional factors leading to competitive success. First, a comprehensive strategy for development of a low-carbon economy is needed. The United States needs to engage in a long view of how best to move from a high-carbon to a low-carbon energy economy.

Second, there needs to be active support for national, binding carbon emissions reduction targets. In "Out of the Running? How Germany, Spain, and China Are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind," the Center for American Progress (tinyurl.com/ydy4vzp) reports that countries that have signed onto the Kyoto Protocol are significantly outpacing the United States in clean technology innovation, as measured by such indices as green-tech patents. (See page 25.)

Third, the level of investment in RE/EE technology ultimately drives markets. The United States is second in the world, behind China, in low-carbon energy investment. We invested $18.6 billion last year compared to China's $34.6 billion, so we're trailing by 45 percent. In terms of investment intensity (investment per capita), in the G-20, we are not in the top half.

In a global race to lead the green economy, we've accelerated to 40 mph, while the pack has hit 70 mph. They'll be out of sight soon, and we will never catch them unless we pick up the pace.

We can lead the renewable energy revolution, or we can import it. The choice is ours to make.



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Brad Collins: Executive Director/Publisher
publisher@solartoday.org

Editorial
Gina R. Johnson: Editor/Associate Publisher
editor@solartoday.org
Seth Masia: Deputy Editor
Corey Dahl: Managing Editor
Dona McClain: Sales Coordinator/Editorial Assistant
Richard Haight: Proofreader

Solartoday.org
Brooke Simmons: Manager of Online Publishing

Design
Allison J. Gray: Art Director
Peggy Doyle: Designer
Dan Bihn: Photojournalist

Contributors
Richard Crume, Rona Fried, Chuck Kutscher, Joseph McCabe, Liz Merry, Mick Sagrillo, Ken Sheinkopf, Robert Ukeiley

Advertising Sales
Annette Delagrange: Director of Sales
adelagrange@solartoday.org
Kris Ohrenick: Northern U.S., Calif. and European Sales Manager
kohrenick@mcneill-group.com
800.394.5157, ext. 31
Stefanie Lauff: Southern U.S. and Asian Sales Manager
slauff@mcneill-group.com
800.394.5157, ext. 26

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A Party Girl Awakens

By **PAUL ROGAT LOEB**

As a freshman, Angie De Soto picked her classes almost at random. Like her friends, she didn't bother to vote in the 2004 election. But midway through a resources geology lecture course, her professor discussed global warming. Angie was stunned. "I just kept asking myself why I hadn't heard about something this important, and why more people weren't doing anything about it," she said. "Didn't they know? Didn't they care?"

Virginia Tech had a student group called the Environmental Coalition (EC), but its presence was negligible on the politically disengaged campus of 28,000. After one of the group's members asked Angie to sign a petition, she started going to EC meetings. She liked the people and their ideas but felt they weren't making much impact. Then she got a scholarship to a climate conference at Yale. "They taught us everything about how to organize: how to recruit people, plan events, run effective meetings, develop leadership, raise money and lead large-scale campaigns," she said. She joined a campaign in Sacramento to pass a state cap on climate emissions, working 13 hours a day as a field manager.

California passed its state climate bill, and Angie returned to Virginia "on top of the world," she said. She kicked EC into high gear, setting up a concert with local bands and training members to approach local media, expand the e-mail list and run a table at the student center. She organized an EC effort that brought more than100 Virginia Tech students to Power Shift, a national student climate change conference at the University of Maryland, and helped plan the entertainment. As she looked out from the stage at 6,000 students, she "felt for the first time like we really have a movement," she said. The following year she hosted a Power Shift for Virginia schools.

Working with 18 other student groups, EC built a Coalition for Campus Sustainability. For the campus recycling department, Angie trained a team of 30 student volunteers who educated dorm residents.

EC became one of the school's largest student groups, with a 1,600-name listserv. They asked college president Charles Steger to sign the Presidents' Climate Commitment. He agreed. In April 2008, Steger formed a committee to draft an environmental plan, and Angie spent the summer pulling together specific implementation strategies. The plan was adopted, and Angie was hired to carry it out as university policy. The school adopted recycling procedures, switched to high-efficiency light bulbs, installed energy-saving occupancy sensors in the classrooms and established strong environmental standards for new buildings. The campus saved $200,000 in just one winter month by lowering thermostats to 68˚F (20˚C), and saved even more money by raising summer settings. Dining halls reduced food waste 38 percent by eliminating trays and composting waste. The university also pledged to explore alternative fuels and phase out aging coal-fired boilers.

Angie graduated in December 2009. "I started out just an apathetic drunken party girl, with no clear path in my life," she said. "Now I'm implementing our campus sustainability plan. People change, and even massive institutions can change." ST

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Ohio Farmer Sows Seeds for Renewables

Farmer Ralph Dull is kind of like Kevin Costner in "Field of Dreams." He's learned well over the last six years that if he builds it, they will come.

But for Dull, "it" isn't a baseball diamond; it's an energy center, displaying the latest renewable energy technologies that have cropped up among his fields in Brookville, Ohio, near Dayton. And "they" aren't ghosts of baseball legends, but passers-by, renewable energy enthusiasts and school groups anxious to learn.

BREWSTER RHOADS

Ralph and Chris Dull, left, welcome Ohio Gov. Ted Strickland and his wife Frances to their energy center in Brookville, Ohio. Built on the Dulls' 2,800-acre farm, the center teaches visitors about the various renewable energy technologies found on the farm, including wind, solar and geothermal.

It all started when Dull had knee surgery in 2004. Laid up for the weekend, he read through a binder of notes his friend had brought back from a wind energy conference in Columbus. "I've always been into conservation," Dull said. "Ohio is 85 to 95 percent coal, so I wanted to start looking at ways to get away from dirty energy." It wasn't long before he had installed six 10-kilowatt (kW) wind turbines on his farm, and people driving by were stopping to talk to him about it.

So many people showed interest that Dull decided, when it came time to build a new farm office, he'd include a visitor's center. He also opted to heat and cool those buildings using a geothermal system. Gradually, Dull added even more renewable energy — a hydrogen generator, a biomass-powered corn-drying furnace and, a few months ago, a 22.5-kW photovoltaic array. The farm's trucks, tractors and combines run on soy diesel.

Dull's farm now regularly hosts one to two groups of visitors a week, ranging from school children to prominent politicians, like Ohio Gov. Ted Strickland. It's a result Dull said he never could have anticipated when he kicked back with that binder of notes a few years ago.

"You never really know what's going to happen," Dull, 81, said. "And this is something I didn't really expect."

Yet, education and outreach skills seem to come naturally to Dull and his wife, Chris, both of whom have been peace advocates for decades. In the mid-1980s, they spent some time working with international peace groups in the Soviet Union. At one point, they helped set up an exchange program that sent a Soviet man to work on their farm while they lived on a Ukrainian collective farm for six months, teaching farming techniques. They wrote a book about the experience, and after a more recent trip to Iraq, Dull wrote another book on nonviolence. Both Dulls are founding members of the Dayton International Peace Museum.

Dull welcomes the unexpected popularity of his energy projects. Concerned about dwindling oil and coal supplies as well as global warming, he believes energy education is critical. "If people are better informed, they'll make better decisions," he said. "Some groups that come don't know anything. They're basically like, 'What's electricity?' It's still a mystery to most people."

Dull is sure to emphasize the importance of energy-saving improvements first, he said, because they're often cheap and easy and they can go a long way. "Conservation is something everyone can do, really," he said. "Everybody should have the idea in their head that we need to conserve. It's just an attribute that we need to develop."

Dull helps visitors interested in renewables determine whether they live in an area better suited for wind or solar. And he often shows them how to reap the benefits of state and federal renewable energy incentives (see dsireusa.org). "Most people don't know about them," he said. "When people find out, they get excited and they're ready to do something."

Dull also organizes an information-exchange group for green energy professionals. Anywhere from a dozen to 20-some members meet monthly for programs at Dull's energy center or for field trips to places like algae farms. The group is also helping local colleges develop renewable energy curricula.

And Dull isn't done with his farm yet. His next project? His livestock produce a lot of waste, so he's leaning toward something that uses methane. — **COREY DAHL**

CLICK Nominate your own Solar Hero: **solartoday.org/nominate**

Corey Dahl (cdahl@solartoday.org) is managing editor of *SOLAR TODAY*.

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Innovalight Achieves 19 Percent Efficiency with Silicon Ink Cells

Sunnyvale, Calif.-based Innovalight (innovalight.com) in April achieved a record 19 percent conversion efficiency with silicon-ink processed solar cells. Testing was confirmed using industry-standard size cells at the Fraunhofer Institute in Germany.

Innovalight's proprietary Cougar process allows manufacturers of crystalline silicon cells to improve solar cell performance, reduce cost and boost output capacity by adding a step to already installed manufacturing lines.

In February, the company was awarded a key patent by the U.S. Patent and Trademark Office for the manufacturing of crystalline wafer solar cells with silicon ink. Innovalight has filed for more than 60 patents for silicon ink and high-efficiency solar cells using silicon ink processes.

Teams Picked for 2011 Solar Decathlon

The U.S. Department of Energy (DOE) in April named 20 collegiate teams to compete in the next Solar Decathlon, to be held in 2011 on the National Mall in Washington, D.C. For two weeks that fall, teams of college and university students from across the United States and around the world will compete to build and operate the most affordable, attractive, effective and energy-efficient solar-powered houses.

Teams generally design and partially build their solar homes on or near their campuses, then ship the homes to the National Mall, where the teams have a limited number of days to finish construction. The teams then open their homes to the public while they compete in 10 categories.

RYAN KELLETT

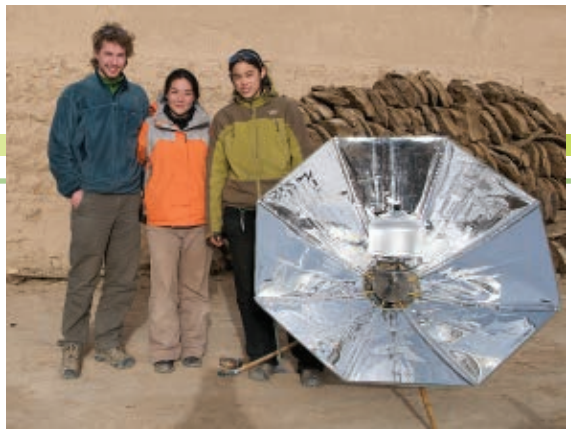
ALEX JOPEK

Top: A newcomer to the Solar Decathlon is Team Middlebury from Vermont, led by architecture junior Addison Godine (far right, in orange cap). Middle: Team Middlebury's model shows the indoor greenhouse, designed to provide vegetables year-round for a family of four. Bottom: Visitors inspect the Virginia Tech house during the 2009 Solar Decathlon.

STEFANO PALTERA/U.S. DEPT OF ENERGY SOLAR DECATHLON

Solar Decathlon teams for 2011 are:

Appalachian State University — Boone, N.C.
City College of New York — New York
Florida State University, **University of Central Florida**, **University of Florida**, and **University of South Florida** — Tallahassee, Orlando, Gainesville and Tampa, Fla.
Stevens Institute of Technology and **The New School** — Hoboken, N.J., and New York
Ghent University — Ghent, Belgium
Tongji University — Shanghai, China
Massachusetts College of Art and Design and **University of Massachusetts at Lowell** —Boston and Lowell, Mass.
Rutgers University and **New Jersey Institute of Technology** — New Brunswick and Newark, N.J.
Middlebury College — Middlebury, Vt.
Florida International University — Miami
Ohio State University — Columbus, Ohio
University of Illinois at Urbana-Champaign — Champaign, Ill.
Old Dominion University and **Hampton University** — Norfolk and Hampton, Va.
University of Maryland — College Park, Md.
Purdue University — West Lafayette, Ind.
University of Calgary — Calgary, Alberta
University of Tennessee — Knoxville, Tenn.
University of Hawaii — Honolulu
Southern California Institute of Architecture and **California Institute of Technology** — Los Angeles and Pasadena, Calif.
Victoria University of Wellington — Wellington, New Zealand
For more information, see solardecathlon.gov



DROLGAR JYID, ONE EARTH DESIGNS

The SolSource design team consists of Scot Frank (MIT), Catlin Powers (Harvard University) and Amy Qian (MIT) of One Earth Designs. They developed the SolSource 3-in-1 in Qinghai, China, on the Tibetan Plateau.

SolSource Team Wins $75,000 Grant

The SolSource 3-in-1 in April won first place in the U.S. National Sustainable Design Competition. Designed collaboratively by students at MIT, Harvard University and Tsignhua University (in China), the device costs $25, weighs 6 kg (13 lb), and concentrates the sun's energy to provide about 11 watts of power for cooking, heating and electricity. The award is a $75,000 grant from the Environmental Protection Agency.

The concentrator is made from yak canvas (just sheared wool, no hide) and Chinese building insulation with specular reflectivity of 86 percent. It incorporates traditional nomadic tent design techniques to create a wind-sturdy fabric parabola that folds like an umbrella for easy transport.

Electricity is generated by a 20-watt thermoelectric device. This costs $2 per watt-peak and provides enough energy to run household lights and charge cell phones. Users have the option of employing a high-efficiency version with an optimized heat sink to enhance the cold side or a slightly less efficient model integrated into the bottom of pots, so users can generate electricity while also cooking.

The team also received an award from the American Institute of Chemical Engineers for a novel phase-change material developed to provide mobile heating for Himalayan nomads. It's recharged by a combination of excess human body heat and solar energy. The material is integrated into traditional fabrics to provide sustained mobile temperature regulation. This material melts near body temperature and stores energy in the transition between liquid and solid. When people overheat during periods of exercise, the material absorbs that heat, and in melting it, stores heat, cooling the wearer. When the body grows colder, the material releases that heat back to the body and solidifies. A variation on the material has a higher melting point and is regenerated on the solar concentrator to store energy for nighttime use. In both cases, the latent heating period lasts for several hours.

The team has been working on human-centered design with rural communities in the Himalayan region since 2005.

viewpoint

Confessions of a Conserveaholic

By **SETH PORTNER**

How one man is coping with Post Traumatic Solar Disorder (PTSD).

With my Coast-of-Maine upbringing, I always enjoyed a cloudy day, a rainstorm or a serious dump of snow. Complaining about the weather Down East was as ridiculous as complaining about the black flies. I mean, what's the point?

Even after I moved west and discovered this glowing orb in the sky called the sun, turbulent weather still brought me great pleasure. A productive Colorado blizzard meant a few days snowed in, ensconced in wintery goodness and enjoying the season's bounty. The furnace churned out warm air, the stereo played some winter songs and the holiday lights softly lit the snow coming down. Ah, those were the days.

Last August, I put solar on our Colorado rooftop. Oh, the joy! I envisioned weeks of gleefully watching from my lawn chair as the meter spun backwards while birds chirped, the garden thrived and I reaped the sun's plentiful energy.

Then came winter. The nights got longer. The days got shorter. A sense of murky gloom began to permeate my formerly cheerful nature.

This winter, we saw unprecedented levels of clouds and snow in Colorado. Weather blocked the sun for days and snow veiled our 3.7-kilowatt photovoltaic (PV) system under a maddeningly dense white blanket. Our production went to zilch for days on end. My irritability amplified.

I now believe that clouds are out to ruin my life.

Before installing the PV system, Colorado weather was something I was vaguely aware of, something that would eventually work itself out. Now, when the meteorologist portends extended periods of cloudy skies, rain or snow, I feel a profound sense of dread, and then resignation. Snow is my nemesis. Even when I use the roof rake — a snow-clearing hoe-with-wheels device on a 20-foot pole — our production suffers, and along with it, my family. They have to deal with grumpy and energy-obsessed me.

"How long did you blow dry your hair?" I ask my wife. She looks at me guiltily, or with deep disdain. I can't be certain. "You washed the diapers and dried them?" I rant. "You used the dryer? What do you think we are? Royalty? Surely the three feet of snow on the ground and sub-zero temperatures won't keep us from snowshoeing out to the clothes line! So what that our clothes will freeze solid. Didn't you see the forecast? Snow! Snow! We are expecting snow! Do you have any idea what that will do to our production?"

And the snow comes, and my wife gently reminds me to shovel the sidewalk lest one of our neighbors falls and breaks a hip. I feel the churnings of Post Traumatic Solar Disorder rising up, ascending from deep inside my guts. "Yes, Dear, I will shovel. Here I go, out to shovel."

And I mutter to myself, "Just as soon as I clear the panels on the roof."

When Seth isn't obsessing about his solar production, he is deputy director of the Colorado Governor's Energy Office. When his wife Nancy isn't using an electric hair dryer, she's a full-time mom to daughter Lettie, five months.

The opinions expressed in "Viewpoint" are not necessarily the views of the American Solar Energy Society or SOLAR TODAY.

Entrepreneurs to the Rescue

The Carbon War Room's Jigar Shah describes why business innovators are key to overcoming climate change.

With the business model that transformed solar energy financing under his belt, Jigar Shah is on to the next big thing: helping to save the planet from climate change. Shah, who as founder of SunEdison introduced the solar power purchase agreement, was tapped last June by Virgin Atlantic founder Sir Richard Branson to run the Carbon War Room. Despite the nonprofit nature of his new CEO gig, Shah sees similarities.

According to Shah, SunEdison's success was about capital. "It happened because we figured out a way to get people the money they needed to be able to promote the infrastructure they wanted," Shah says. "A lot of what the Carbon War Room does is figure out a way to get capital to the right people."

Shah described the Carbon War Room's approach as keynote speaker at Southface Institute's 12th Annual Visionary Dinner March 31 in Atlanta. He elaborated in an interview the next morning.

The problem, Shah says, is that the greenhouse gas challenge has been defined as one of sacrifice — that if everyone sacrifices money or convenience, we can save the planet. That may have worked for acid rain and water pollution, but climate change requires a new approach. "We're actually saying this is one of the greatest wealth-generating opportunities of our generation," Shah explains.

GREG BROUGH, SOUTHFACE

Jigar Shah, CEO of the Carbon War Room, gave the keynote at Southface Institute's Visionary Dinner March 31 in Atlanta.

Central to the Carbon War Room's vision is the entrepreneur. Although many organizations are involved in removing barriers to renewable energy entrepreneurship, only the Carbon War Room views the entrepreneur as essential. As Shah notes, "We think that no matter how well corporations do, without the pressure that's put on them by just the passionate, enthusiastic entrepreneur, there's no way we're going to get to a sustainable shift to clean technologies and clean energy."

Why entrepreneurs? Because they have an urgency no one else does, Shah says. Corporations may dabble in sustainable energy ventures, he adds, "but the entrepreneurs, they're all in. They've got to make it work."

Shah knows something about overcoming the obstacles renewable energy entrepreneurs face. The solar power purchase agreement introduced at SunEdison drove three-quarters of all U.S. commercial and industrial solar sales during the past two years, according to Greentech Media. Often, barriers arise because businesses and governments make poor decisions about energy. The Carbon War Room focuses on reducing these barriers.

As Shah sees it, technology developers, architects, policymakers and others are making strides toward reducing carbon emissions to the level scientists say is necessary to avoid catastrophic climate effects. Where the Carbon War Room can play a unique role, he says, is in focusing on the gap, what's not being addressed. "There's so much energy wasted on illogical decision making that that gap could be filled just with that … just by eliminating energy waste," says Shah. "The data show that 50 percent of all carbon emissions globally can be profitably offset with today's technology."

He describes simple efficiency measures available to the shipping industry, like low-friction paint used on ship hulls to improve fuel efficiency. By providing shippers with data on the potential savings associated with these measures, they could save billions in fuel costs — and reduce their carbon footprints. It's about helping businesses make energy decisions with an eye toward long-term costs and risk management.

The Carbon War Room has identified 25 focus areas in seven arenas — or, as the War Room puts it, "25 battles in seven theaters." Initial efforts focus on biochar, climate intervention, shipping and the built environment.

In addition to opportunities like these, Shah sees a great need for innovators to create the business infrastructure required to get cutting-edge sustainable energy technology installed.

"[Venture capitalists] have done their job and continue to do their job by making sure the best and the brightest on the technology side get the money they need to innovate," he says. He expects these innovations to reduce the cost per kilowatt-hour of solar generated 30 percent during the next 18–24 months. The question, according to Shah, is, will business models evolve quickly enough to disperse these new technologies?

"I think we all are fascinated by technology because we think if solar gets to $2 per watt, then everyone will put it on their roof. But that's not the case," Shah says. "You're still going to need thousands of people … who don't go out of business because they actually know how to run a profitable solar business."

Entrepreneurs need to establish everything from training curricula to accounting software designed for solar businesses. He points out that the potential goes beyond advancing an industry, to mitigating some of the world's greatest problems — from the energy-related water crisis to coal plant-fueled health problems.

"All of these things work in tandem to give people a better life." And, as Shah notes, "There's a lot of money to be made in fixing those problems."

— GINA R. JOHNSON

EPA Launches Greenhouse Gas Regulation

By **ROBERT UKEILEY**

Robert Ukeiley (rukeiley @igc.org) is a lawyer who represents environmental nonprofits in Clean Air Act litigation affecting energy issues.

On April 1, the United States formally began regulating greenhouse gases. While state and regional regulations have existed for years, April 1 marks the signing of the first nationwide regulation. The Environmental Protection Agency (EPA) issued final regulations, under the Clean Air Act, limiting greenhouse emissions from cars and light trucks. The rules apply to model year 2012 vehicles, which manufacturers can begin selling on Jan. 2. The Department of Transportation issued companion regulations the same day that essentially achieve the same results. The regulations are nowhere as protective as they could and should be.

For example, requirements are stricter in China and Europe. Nevertheless, this is a major step forward both in actual greenhouse gas emission reductions and as a statement by the United States that we are committed to actually dealing with the climate crisis.

Under the Clean Air Act as it has existed for decades, if a pollutant such as carbon dioxide is subject to regulation in cars and trucks, then it must also be regulated at stationary sources such as power plants, coal mines, refineries and oil and gas production fields. Thus, on March 29, the EPA issued an official interpretation of the Clean Air Act that effectively subjects new or modified major stationary sources to regulation of their greenhouse gas emissions. Sadly, the EPA let major sources that get their final air pollution permits prior to Jan. 2 continue to emit as much greenhouse gas as they want. This nine-month delay may seem short compared to the years and years we have been waiting for greenhouse gas regulation. But thousands of megawatts of coal-fired power plants and Powder River Basin mines, containing hundreds of millions of tons of coal, will sneak in under the deadline. The EPA is on shaky legal ground in letting these massive sources of greenhouse gas pollution take a pass. Hopefully, a court will overturn this so that all proposed or recently permitted stationary sources will be subject to greenhouse gas pollution regulation.

In any event, after Jan. 2, stationary sources of greenhouse gases will have to use "best available control technology" (BACT). This term includes cleaner fuels and clean production processes. So, for example, a proposed coal-fired power plant will have to justify why it isn't going to burn switchgrass rather than coal and why it isn't using the most efficient technology to generate its electricity, even if that would cause an increase in capital costs. This is something very different from the proposed "cap-and-trade" programs being proposed in Congress, although some congressional proposals would remove this requirement in exchange for the cap-and-trade provisions. Unfortunately, BACT decisions are usually made by state agencies on a very subjective basis. In this context, especially in the South and Midwest, politics often trump science. Stationary sources will also be required to conduct an analysis of how their greenhouse gas emissions will affect soils and vegetation, as well as special places like national parks and wilderness areas.

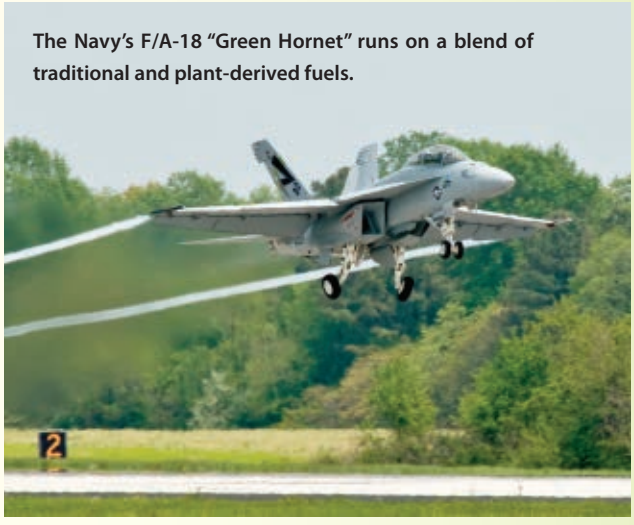
The stationary source regulations are different from the car and light truck rules. Vehicles must meet defined, numeric limits. Requiring BACT for greenhouse gases provides citizens and environmental nonprofits with another tool to challenge dirty sources of energy. It also provides potential investors with another uncertainty they must consider before gambling on antiquated technology to meet our energy needs.

Navy on Fast Track to Veggie Jet Fuel

After four months of ground testing, the Navy launched an unmodified F/A-18 "Green Hornet" shipboard fighter burning a 50/50 blend of JP-5 petroleum-based fuel and camelina-derived biofuel. The supersonic flight demonstration, at Naval Air Station Patuxent River in Maryland, on Earth Day, is part of a plan to certify the fuel blend for regular use roughly by the end of this year. By 2015, the Navy expects to reduce petroleum purchases by half, with at least half its diesel and aviation fuel derived 100 percent from camelina sativa, a weedy plant that can be grown on marginal non-agricultural land.

This isn't greenwashing. The Pentagon is serious about operating at full strength during any future oil embargo or petroleum shortage. In the April issue of *SOLAR TODAY* (see the "Electric Rail" sidebar, page 35), we reported on a Defense Department proposal to electrify 32,421 miles of U.S. railways for the same reason: The military needs to ship equipment, goods and personnel coast-to-coast in an oil crisis and must assume that the Panama Canal may be inoperable. **ST**

The Navy's F/A-18 "Green Hornet" runs on a blend of traditional and plant-derived fuels.



U.S. NAVY PHOTO BY KELLY SCHINDLER

Doubt for Sale

Unfortunately, more Americans are buying it, and it's time to fight back.

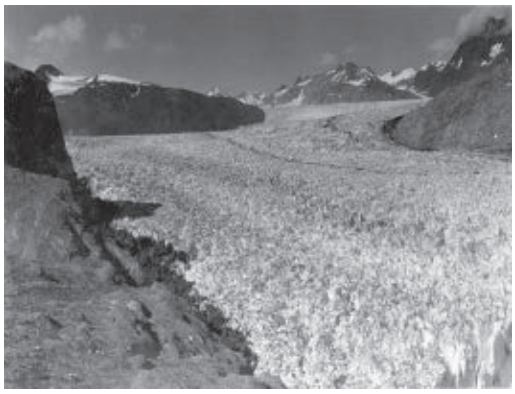
By **CHUCK KUTSCHER**

Chuck Kutscher is a principal engineer and manager of the Thermal Systems Group at the National Renewable Energy Laboratory. He is a past ASES chair and was chair of the SOLAR 2006 conference, which resulted in the ASES report, "Tackling Climate Change in the U.S." (Free download at ases.org/climatechange.)

The opinions expressed here are solely those of the author.

When I decided to write a regular climate change column for *SOLAR TODAY*, my intention was to focus mainly on how we can solve this problem. But technical solutions do us no good if people don't believe we have a problem. And when it comes to public opinion, we're moving in exactly the wrong direction. Following on the heels of a continuous stream of news stories that seemingly support the skeptics' worldview, a March Gallup poll showed that fully 48 percent of Americans now believe climate change is exaggerated by the press, up from 35 percent just two years ago.

Lately, on more than one occasion, I have heard renewable energy proponents say something like, "These days I talk about job creation and energy security, but I don't dare mention climate change." Part of me understands this. In politics, the message is always tailored to suit the audience.



W.O. FIELD AND BRUCE F. MOLINA FOR USGS

Between 1941 (left) and 2004 (right), the Muir Glacier retreated 4.4 miles (7 kilometers). Photos taken from White Thunder Ridge in Glacier Bay National Park, Alaska.

But another part of me wants to scream out in protest: *What we're talking about here is rapidly melting our polar ice caps!* Think about it. The world's top scientific experts on the Earth's climate tell us that we are facing an environmental crisis of unprecedented proportions. And many people are now afraid to even mention it! As I see it, this is an extraordinary indictment on the state of scientific communications in the United States today.

It is no wonder climate scientists are frustrated. They know full well the already overwhelming evidence for serious man-made climate change is mounting, not shrinking. Scientists who have spent their careers in the lab, and who spend only a small fraction of their time talking to the public, suddenly find themselves matched up against lawyers and public relations experts for whom communicating a corporate message is a full-time job. It's not a fair fight, and the shift in public opinion bears that out.

In his 2009 book *Climate Cover-Up*, public relations expert James Hoggan describes the campaign to spread doubt about climate change. Employees of "think tanks," established for the sole purpose of promoting corporate agendas, use focus groups to find out what messaging works. Hoggan quotes Republican pollster Frank Luntz in a 2002 memo to the Bush administration: "You need to continue to make the lack of scientific certainty a primary issue in the debate." Of course, because science is never 100 percent certain, debate can go on *ad infinitum*, and that's the whole idea. As a tobacco industry memo put it 40 years ago, "Doubt is our product since it is the best means of competing with the 'body of fact' that exists in the mind of the general public." That earlier doubt campaign probably cost millions of American lives by delaying anti-smoking regulations. Today's campaign aimed at preventing climate change action will likely exact a much higher price.

Two recent news events loudly touted by the skeptic community are prime examples of the doubt campaign. First, e-mails stolen from the University of East Anglia's Climate Research Unit (CRU) in Great Britain were declared to reveal dishonesty in the climate science community. Dubbed "Climategate" to evoke images of the cover-up at the heart of the Nixon Watergate scandal, the goal was to villainize scientists. CRU Director Phil Jones was the particular target of vicious attacks. (On March 30, an investigation by the British Parliament cleared Jones of any wrongdoing.)

If scientists were partners in an insidious worldwide hoax, as some skeptics claim, surely it would have come out in these private and candid e-mails. These messages

showed instead that scientists are human. Many climate researchers have been angered by all the attempts by the skeptic community to apply political spin to their data, and some of them have become resistant to sharing those data. (In truth, there is a plethora of data readily available on the web. For people with a lot of time on their hands, the Real Climate web site provides links to the various sources at realclimate.org/index.php/data-sources.)

The second event was the revelation that some errors appeared in the 2007 three-volume set of reports from the Intergovernmental Panel on Climate Change (IPCC). In particular, a statement in Volume 2 (which focuses on climate change impacts) cited the likelihood of Himalayan glaciers "disappearing by the year 2035 and perhaps sooner." Here, the IPCC authors admittedly erred by quoting an incorrect date that was used in another publication. It is important to understand that the error appears on one line of one page in the 976-page Volume 2 and does not appear in any of the other sections and volumes covering glaciers. Anyone who has ever worked in an international group (and I am one) will hardly be surprised if a set of three volumes by teams of international authors, each about 1,000 pages in length, is not 100 percent error-free. Discrediting all of the work on the basis of a few mistakes is ludicrous.

Lost in all the righteous indignation at the IPCC's date error was the fact that, according to the World Glacier Monitoring Service, more than 90 percent of the glaciers around the world are disappearing at an alarming and accelerating rate. In the April issue of *National Geographic*, an article entitled "The Big Melt" described the serious social impacts already occurring as a result of the rapid shrinkage of Himalayan glaciers, which provide water to 2 billion people. Closer to home, the U.S. Geological Survey has predicted that glaciers will completely disappear from Montana's Glacier National Park by 2030 or sooner, leaving that area free of glaciers for the first time in at least 7,000 years. (On April 7, the official glacier count in the park dropped to 25, down from 150 in 1850.)

I do not dispute that political reality dictates the use of careful messaging, and I don't expect my congressman to invoke the threat of climate change whenever he pushes for clean energy legislation. Indeed, even a casual observer of the health care debate can see that how information was messaged (from "death panels" on one side of the debate to the highlighting of insurance industry abuses on the other side) had more impact on public opinion than the actual contents of the bill. But I believe it's vitally important that

***Kutscher** continued on page 51.*

Climate scientists find themselves matched up against lawyers and public relations experts for whom communicating a corporate message is a full-time job.

BYD: An Investor's Dream?

Warren Buffet spotted a winner in a fast-growing Chinese battery company.

By **RONA FRIED, Ph.D.**

Rona Fried, Ph.D., is president of Sustainable Business.com, the online community for green business: daily sustainable business and investor news, *Green Dream Jobs, Business Connections* and the sustainable investing newsletter, *Progressive Investor*. Contact Fried at rona@sustainablebusiness.com.

Consult your financial advisor before making any investment.

BYD Co. (1211.HK; BYDDF.PK; byd.com), which stands for Build Your Dreams, emerged from relative obscurity when Warren Buffet's Berkshire Hathaway (BRK.A, BRK.B) spent $231 million for a 10 percent stake in the Shenzhen, China-based company in September 2008.

Founded in 1995 by Wang Chuanfu, BYD has skyrocketed to become the world's largest producer of rechargeable batteries and a major car manufacturer. It also makes handsets and parts for mobile phones. And Wang has become China's wealthiest man.

BYD now employs 130,000 workers, and its market cap has grown to $182 billion. Revenues have risen about 45 percent annually for the past five years, reaching $4 billion in 2008. BYD makes batteries for iPods, iPhones and low-cost computers, and cell phone handsets and parts for several companies, including Nokia and Motorola. In 2003, BYD entered the auto-making business by buying a near defunct state-owned car company. The company went public on the Hong Kong exchange in 2007.

Last year, BYD sold 400,000 cars. The company plans to double that this year through increased exports. Its F3 sedan was the bestselling car in China last year. BYD believes it can become China's top automaker by 2018 and a major global player by 2025.

Driving into the U.S. Auto Market

BYD introduced the F3DM plug-in hybrid in Shenzen in April. It carries a retail price of $24,859, before government rebates for low-emission vehicles. It's said to go 100 kilometers (62 miles) on its electric charge before needing to run its three-cylinder gasoline engine (see page 48 for more details). When it debuts in California later this year, the F3DM will be the first Chinese-designed car sold in the United States. It will undersell the $40,000 Chevy Volt, which is designed to do 40 miles on the initial electric charge.

The E6 electric car, originally planned to launch in the U.S. market this year, has been delayed. Instead, 100 samples are being tested in China. The E6 has a top speed of 87 mph, travels 205 miles on a single charge and only takes about an hour to charge. Some say the car won't sell well in the United States because its design looks outmoded to Americans, and the quality of body panel fit and paint finish doesn't meet U.S. standards. The price tag will be a steep $40,000.

Trying Out Solar

BYD is also leaping into solar, with a vertically integrated manufacturing model. It began building a massive $3.3 billion, 5-gigawatt crystalline silicon plant in 2009, to be completed in 2015. The company claims its proprietary production process can cut polysilicon costs in half.

Future Village, a small complex at its corporate headquarters, runs on eight wind turbines and solar photovoltaics, all made by BYD. There's an energy storage unit that captures excess solar and wind energy, also made by BYD.

BYD's entry into photovoltaic manufacturing is supported by direct government subsidies, by land rights to two silica mines and by direct and indirect government purchase of BYD products.

Buffet Approves

Buffet has already made $1 billion on his investment in BYD. The purchase was viewed as atypical for Buffet, who doesn't often invest in a new, disruptive technology like electric vehicles. He also doesn't invest in technologies he doesn't know much about. But it takes a special person to capture a leading market share in batteries and vehicles in such a short time. Buffet invested in Wang Chuanfu as much as in the company.

How did BYD become the leading low-cost battery producer so quickly? Wang took advantage of China's cheap labor. He turned the capital-intensive battery manufacturing model on its head. Rather than investing in expensive robotic manufacturing, he created a simple production process that relies on labor instead.

But he's also spent far more on R&D than other Chinese manufacturers, improving products and modifying the manufacturing process. And he's attracted leading scientists because of an emphasis on great benefits: free housing, food, health insurance and access to free education for their children.

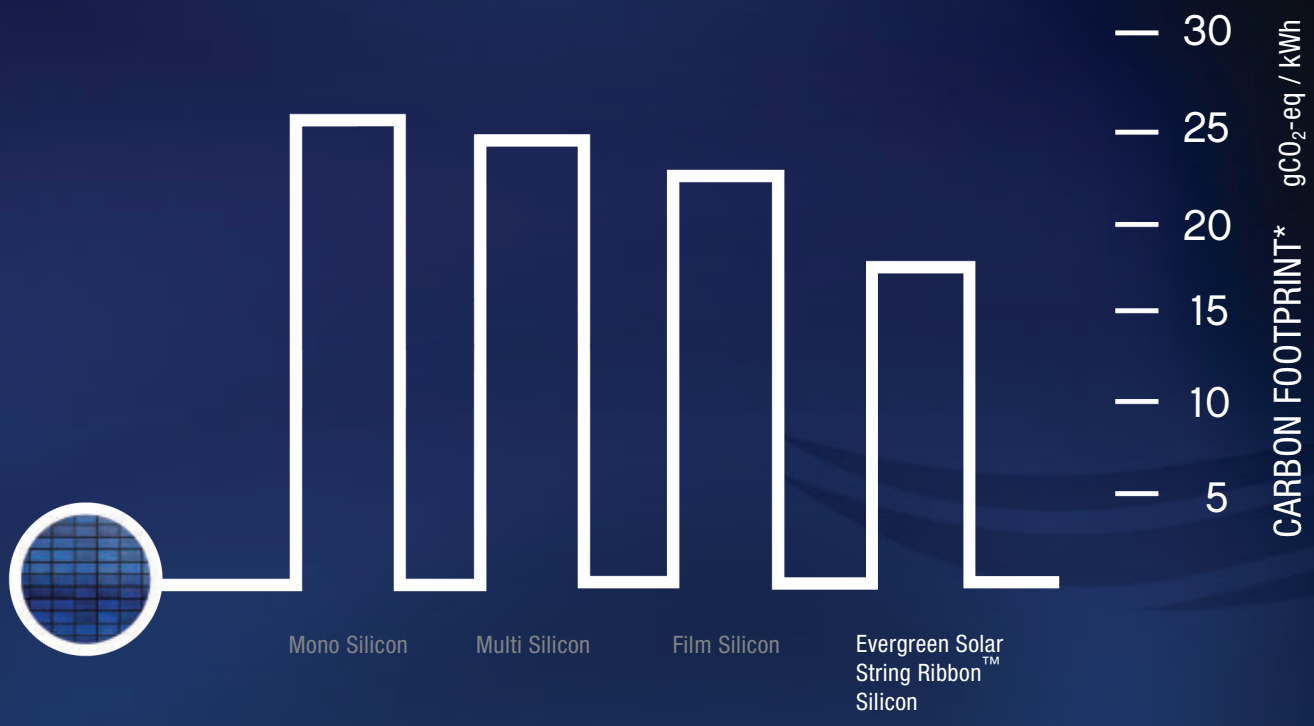
Wang has been called a combination of Thomas Edison and Jack Welch, and, like Henry Ford, is a skilled engineer and scientist as well as an outstanding entrepreneur. He started BYD after raising $300,000 from relatives, then set out to compete with Sony and Sanyo making rechargeable batteries.

Buffet believes that all cars will be electric in 20 years and that BYD may become a dominant supplier of electric vehicle batteries as well as electric vehicles. But the biggest advantage may be access to BYD's energy storage technology. Buffet's utility, MidAmerican Energy Holdings, acquired shares in BYD and has already started using a BYD energy storage system in Oregon.

BYD was one of the top performers on the stock market in 2009, as its shares rose 439 percent. The company will be important to watch. **ST**

You'll see lots of ads with sunflowers, blue sky and little girls in straw hats.

You'll only see one ad with this chart.



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Solar Broadens Its Appeal in California

Policies help make renewables cost effective for more people.

By **KATRINA PHRUKSUKARN**, **BARRY L. BUTLER** and **ELAINE HEBERT**

ELAINE HEBERT

BARRY BUTLER

Katrina Phruksukarn, LEED-AP (katrina.phruksukarn@energycenter.org) is program manager for solar water heating at the California Center for Sustainable Energy. Barry L. Butler, Ph.D. (barry@butlersunsolutions.com), chairs the ASES Solar Thermal Division and is the owner of Butler Sun Solutions Inc. Elaine Hebert (elaine@norcalsolar.org) is president of the Northern California Solar Energy Association, an ASES chapter, and is a program manager with the California Energy Commission.

In California, demand for solar systems continues to grow. The progress is driven by public policy targeted at moving beyond early adopters to a much broader, mainstream customer base.

Solar Initiative Helps Cut Cost

The California Solar Initiative (CSI), created by Senate Bill 1, implemented a statewide photovoltaic (PV) installation rebate program in 2007. It will run to 2016, or until the money runs out. The program incentives decrease in 10 steps over time. The residential CSI program is in step seven, which means the incentives have fallen from $2.50 per watt at the start of the program to 65 cents per watt. To date, the program has installed 750 megawatts (MW). There is continued strong demand for PV, and at the current rate of adoption, the incentive program is on track to end much sooner than 2016.

The solar water-heating (SWH) market, on the other hand, is just beginning to ramp up (again). In January, the California Public Utilities Commission voted unanimously to implement a statewide SWH incentive program called CSI-Thermal, as authorized by SB 1 and Assembly Bill 1470. With a goal of installing 200,000 SWH systems by 2018, the program began accepting single-family residential applications on May 1. Multifamily and commercial applications open on June 1.

Combined with the 30 percent federal tax credit, CSI rebates can cut installed system costs by 40 percent.

More PACE Programs Popping Up

PACE, or AB 811, programs allow eligible property owners to finance renewable energy installations and energy-efficiency improvements through a voluntary assessment on their property tax bills. The assessment stays with the property even if the property changes hands. This allows property owners to avoid the upfront installation cost of renewable energy systems and energy-efficiency measures. It also eliminates property owners' concerns that they will sell the property before recovering the system investment from utility bill savings. Many counties and cities are setting up these programs to help minimize the financial risk of "going green" for building owners.

Berkeley launched its pioneering PACE program two years ago. San Francisco's $150 million Green Finance SF program, which went into effect in April, offers attractive financing for solar panels, water heaters and other eco-friendly improvements for residential and commercial buildings. PACE programs will start in San Diego and San Diego county this summer, and Santa Barbara has begun planning its own PACE program.

In response to the PACE programs, the real estate market has begun to factor solar installations into the value of homes.

Education Options Expanding

To help meet a growing demand for qualified installers, the International Brotherhood of Electrical Workers (IBEW) has established major training centers in San Diego and San Jose. Solar hot water and PV companies have set up their own on-the-job training programs. The North American Board of Certified Energy Professionals, the Solar Rating and Certification Corp. and the Florida Solar Energy Center are helping to provide training and certification for PV and solar hot water installers.

Community colleges are moving to fill the gap. The California Community Colleges Chancellor's Office (CCCCO) got one of nine regional Department of Energy Solar Workforce Development grants. These grants are a part of the DOE Solar Program's Solar Installer Instructor Training Network, which aims to increase the number of qualified local workers needed for the installation of solar systems.

In partnership with several other organizations, the CCCCO and the California Energy Commission are using

Continued on page 49.

Major California Legislation on Renewable Energy

Year	Bill No.	Author	Chapter No.	Summary
2008	AB 811	Levine	159	Authorizes California cities and counties to designate areas within which city officials and willing property owners may enter into contractual assessments to finance the installation of distributed generation renewable energy sources, including solar, and energy-efficiency improvements
2006	AB 32	Nuñez	488	Global Warming Solutions Act of 2006, a landmark bill requiring the Air Resources Board to adopt regulations aimed at severely curbing greenhouse gas emissions
2006	SB 1	Murray	132	The California Solar Initiative requires the California Energy Commission and the California Public Utilities Commission to implement a program to install 3,000 megawatts of solar energy systems on new and existing residential and commercial sites and place solar energy systems on 50 percent of new homes by 2020.

AB = Assembly Bill, SB = Senate Bill
Source: Office of Governmental Affairs, Californwia Energy Commission. For a complete listing go to gosolarcalifornia.ca.gov/news/legislation.html.

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Out of the Running?

By **KATE GORDON**, **JULIAN L. WONG** and **JT MCLAIN**



China, Germany and Spain are early winners in the next great technological and industrial revolution. The United States, which has yet to embrace a growth strategy for the low-carbon future, is not.

By 2020, renewable energy and efficiency will represent one of the world's biggest industries, totaling as much as $2.3 trillion. Over the past year, several countries made huge investments to seize the economic opportunity provided by the shift to renewable, low-waste electricity and fuel. These investments were a result of intentional public policies, which in turn stimulated investment in new renewable energy and efficiency markets, infrastructure and human resources.

China, a country that in some ways is only now experiencing an industrial revolution, has made a serious commitment to building that revolution with low-carbon, low-waste technologies and infrastructure. Several European Union (EU) countries — notably Germany and Spain — have also turned from old energy policies to embrace the new. These three countries understand that the transformation to a low-carbon economy brings strategic benefits, from climate stability to energy security to economic prosperity.

These countries are moving forward decisively. The United States came in second, just behind Germany, in absolute sales in a recent global country ranking of 2008 renewable energy and efficiency technology product sales. But when product sales were expressed as a proportion of respective gross domestic product, the United States was far down the list at 19th, compared to Germany at third, Spain at fourth and China at sixth. The United States also lags on installed renewable energy (RE) per capita as well as per unit of gross domestic product (see Figure 1, page 27).

These countries invested in renewable energy and efficiency for short-term benefits and laid a foundation for economic growth by setting a price on carbon, implementing strong national energy performance standards or both. A 2009 study by the CERNA Research Program on Technology Transfer and Climate Change found that developed countries that ratified the Kyoto Protocol saw a rise of more than 33 percent in green-tech innovation patents (see Figure 2, page 29). Developed nations that didn't initially ratify Kyoto — the United States and Australia — saw no noticeable change in their share of green-tech patents over the same time period.

China, as a developing country, was not obligated to adopt emission-reductions targets under the Kyoto Protocol, but it did embrace the treaty's clean development mechanism (CDM). The CDM allows developed countries to offset their emissions by investing in renewable energy and efficiency projects in developing countries, and China greatly benefitted from the resulting technology transfer, particularly in its wind industry.

The Center for American Progress (CAP) has identified the need for a long-term, comprehensive approach to renewable energy policy that includes three policy pillars: **expanding markets** and driving demand; **financing**, for investing across the full value chain of renewable energy and efficiency solutions; and revitalizing and reinvesting in the physical and human capital **infrastructure**.

Germany, Spain and China have taken just such an approach to the emerging new energy economy (see table on page 26). Here, we examine how these policies and programs are creating jobs, boosting industries and spurring innovation in the three countries.

Our purpose here is not to provide an exhaustive survey of the renewable energy policies of these countries. Rather, it is to show how they have become top competitors in the emerging global renewables market by adopting a strategic policy approach — and to demonstrate what is at stake for the United States if we fail to learn from their example.

Kate Gordon (kgordon@americanprogress.org) is the vice president for Energy Policy at the Center for American Progress (CAP). Julian L. Wong (jwong@americanprogress.org) is a senior policy analyst with the Energy Opportunity team at CAP. JT McLain (jmclain@americanprogress.org) is a contributing author for the Energy Opportunity team at CAP. This article is adapted from their March report, "Out of the Running? How Germany, Spain, and China Are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind." Access the full report at americanprogress.org/issues/2010/03/out_of_running.html.

Germany: An RE Industrial Power

Germany, the world's fifth-largest economy, is a key player in the global new energy arena. The country has a large industrial sector that makes up 30 percent of its GDP. It has emerged as a leader in wind and solar production because of this industrial infrastructure and the country's historic dominance in high-skill, precision manufacturing. At the same time, Germany has aggressively invested in domestic solar energy installation, making it the global leader in installed solar energy capacity. Germany is unusual in the EU in that its unemployment rate is below 10 percent.

RE deployment in Germany. Wind energy dominates the country's renewable electricity production, but other renewable sources such as hydropower and biomass are gaining market

share. Germany's installed wind capacity was 23,903 megawatts (MW) in 2008, making it second only to the United States. Wind energy generated 40,000 gigawatt-hours (GWh) in 2008, accounting for 6.6 percent of Germany's final energy consumption.

The photovoltaic (PV) sector receives the most public support of any RE technology in Germany, and even though solar PV makes up a relatively small share of Germany's final energy consumption — 2,220 GWh, or 0.7 percent, in 2006 — the country is No. 1 in the world in grid-connected installed PV. Germany has attracted significant foreign investment in PV and is home to Q-Cells (q-cells.com), the world's largest manufacturer of PV cells.

Renewable energy innovation. The Federal Ministry of Economics and Technology established its High-Tech Strategy in 2006 to transition Germany to a sustainable energy future through innovation. The program commits about $1.67 billion in investments for 2009 and 2010. It relies on strategic alliances with government agencies and the private sector to create

Energy Policies in Germany, Spain, China and the United States

Germany, Spain and China are pursuing national policies for markets, financing and infrastructure.

		Germany	Spain	China	United States
Markets	**Carbon pollution reduction commitment**	40 percent below 1990 by 2020	20 percent below 1990 by 2020	40 to 45 percent decrease in carbon intensity by 2020	No binding national policy, although a political commitment to 17 percent below 2005 by 2020
	National renewable electricity standard (RES)	20 percent by 2020	30 percent by 2020, with carve-outs for specific technologies	15 percent non-fossil energy by 2020, with additional policies for specific technologies that effectively strengthen the goal	No comparable national policy, although 29 states have mandatory RES policies and six more states have goals for renewable energy use
	National energy-efficiency plan	EU goal of reducing energy use to 20 percent below business-as-usual projections by 2020. Building codes have increased demand for low-energy houses 900 percent from 1999 to 2007.	EU goal of reducing energy use to 20 percent below business-as-usual projections by 2020. National plan has already reduced energy intensity by 11 percent from 2004.	20 percent decrease in energy intensity from 2005 to 2010	No comparable national policy, although 21 states have energy-efficiency resource standards. The United States will invest $28 billion in efficiency programs as part of American Recovery and Reinvestment Act (ARRA).
Financing	**Feed-in tariffs**	Tariff targets emerging technologies, with a total subsidy of $4.6 billion	Tariff amount tied to market growth for specific technologies	Tariff is 7 to 9 cents per kWh for wind, with solar moving toward a similar structure	No comparable national policy, although there are a few state and local feed-in tariff experiments
	Government-run "Green Bank"	Government-run KfW provides loans and other financing supports for renewable energy and energy efficiency	Multiple programs, including loan programs for specific technologies and support for strategic projects from government-run IDAE	Government-run CECIC will have a portfolio of roughly $15 billion in assets consisting of energy-efficiency, renewable energy and pollution-control technologies by 2012	No comparable national policy, although DOE's loan guarantee program provides low-cost financing that leverages private capital and DOE-run ARPA-E supports earlier stage innovation
	Tax benefits	Tax incentives for bioenergy and fuel-efficient vehicles, in addition to a generally low corporate tax rate	Tax exemptions for biofuels	Value-added tax reduction for wind generators and value-added tax rebate for raw materials imports used in wind turbine manufacturing	Production Tax Credit for wind and Investment Tax Credit for solar
	Other government funds	Market Incentive Program provides $308 million annually in grants to renewable projects	Funding for energy R&D via multiple government institutions (ENCYT, CIEMAT and CENER)	Multiple technology R&D programs and large equity investments from the state wealth fund	No permanent national policy, although ARRA has $6.3 billion for research, including advanced batteries, carbon capture and storage and ARPA-E develops new renewable energy technologies
Infrastructure	**Workforce and manufacturing infrastructure**	Provides grants and interest-free loans with goal of reducing number of young adults without vocational training by half by 2015	National renewable energy job-training center has programs for all sectors and skill levels	Strong domestic content laws and incentives to use domestically produced inputs	No permanent national policy on green workforce development, but related programs include $500 million for renewable energy jobs training and "Buy America" provisions in ARRA, the Workforce Investment Act and the Green Jobs Act
	Grid construction and improvements	Coordinating with neighboring countries to build a "supergrid" for offshore wind power	Upgrading grid with new technologies specifically for renewable energy, including use of electric vehicles as a stability tool	Mandates that grid companies must build interconnections for renewable projects and has plans for smart grid by 2020	No permanent national policy, but ARRA includes $17 billion for grants and loans for transmission and smart grid, which will leverage private capital

new and more efficient RE technologies.

The High-Tech Strategy has led to many policy initiatives that promote innovation and create a friendlier environment for startups. Financing for the initiatives is often provided by Kreditanstalt für Wiederaufbau, a federally owned financial institution.

RE exports and jobs. Germany was the No. 1 RE system exporter in the world from 2003 to 2008. In 2008, exports accounted for 47.2 percent of its GDP. Germany's most lucrative RE export, wind towers and turbines, had a staggering global export share above 70 percent in 2006. The PV sector export share in 2006 was 30 percent.

In 2008, 278,000 workers were employed in RE industries compared to 238,000 in conventional energy. This represents a 73 percent increase from 2004.

New energy policy tools. Germany set policy based on the understanding that every part of the renewable energy value chain affects every other part. Cultivating this chain requires a policy approach that invests in every part of our three-pillar model: markets, financing and infrastructure.

Expanding markets. Clear policy signals create investment certainty. Germany recently committed to reducing emissions levels to 40 percent of 1990 levels by 2020. The EU commitment, by comparison, is just a 20 percent reduction of 1990 levels by 2020. Germany also passed building codes containing robust energy-efficiency standards tied to financial supports for implementation.

Financing. Germany has developed public and private financing tools to build its renewable energy industries.

Germany adopted its first feed-in tariff in 1991. A feed-in tariff typically requires a utility to buy electricity generated from RE sources via long-term contracts and at prices that reflect the relatively higher cost of generating that electricity. Germany's law established the ambitious goal of doubling Germany's 1997 RE share to 12.5 percent by 2010.

German subsidies to renewable electricity generators ranged from 65 to 80 percent of the average retail rate. A 2007 Ministry of the Environment study concluded that while the subsidies cost the government $4.63 billion, the savings from taking conventional plants off the grid were $7.24 billion.

The German and Spanish tariff systems have been criticized for establishing an initial rate that was too high. Although German feed-in tariffs for solar were expected to be reduced by 15 to 17 percent this spring, the modified starting tariff level will still be well over 40 cents per kilowatt-hour — at least five times higher than wholesale electricity rates in the United States.

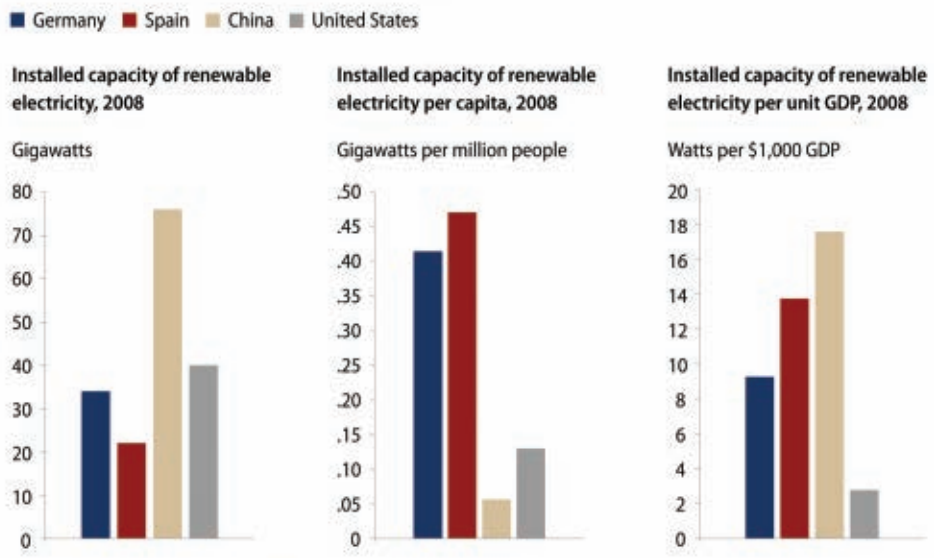
Building infrastructure. Germany acknowledges it cannot efficiently capitalize on its growing renewable energy supply without modernizing its grid.

E-Energy (e-energy.de) is an energy supply project that will optimize Germany's energy distribution network, resulting in reduced transaction costs and increased use of RE. The German government will provide $86.9 million of the $202.7 million in total equity capital needed to mobilize the project.

Human capital infrastructure is also critical to a booming renewable energy sector. Germany's system of standard education and vocational training equip youth with needed skills.

FIGURE 1

Comparison of Renewable Electric Power Capacity in Germany, Spain, China and the United States
The United States trails these countries on capacity.



Source: Center for American Progress, REN21, International Monetary Fund.

Spain: Forging a New Economy

Like the United States, Spain recently experienced the bursting of a major real estate bubble, leaving the country with unemployment rates over 13 percent. But the country is emerging as an RE powerhouse, particularly in wind and solar technologies. Spain is investing in innovation, manufacturing, deployment and basic worker-training strategies, and it clearly views renewable energy and efficiency technologies as its ticket into the new economy. It is among the top 10 global economies, with a GDP of $1.6 trillion.

RE deployment in Spain. Since 2004, Spain's energy policy has focused on three objectives: sustainability, competitiveness and supply security. The Spanish government has paid particular attention to energy efficiency and RE.

In 2008, RE sources covered about 7.6 percent of Spain's primary energy and 20.5 percent of its net power generation. Wind is by far the most common renewable source used in Spain's power sector. More than 16,546 MW were installed at the end of 2008 and at least another 1,500 MW were installed in 2009, making Spain fourth in the world in wind energy. Solar is the next largest piece of Spain's renewable electricity mix (3,270 MW for PV and 61 MW for concentrated solar power at the end of 2008).

The country is also serious about energy efficiency and conservation. The Spanish Energy Efficiency Strategy 2004–2012 reduced Spain's energy consumption per unit of GDP by more than 11.3 percent from 2005 through 2008.

RE innovation. Spain's public spending on renewable energy and efficiency R&D has increased each year since 2004, rising to nearly

An Investment Agenda for the United States

The Center for American Progress (CAP) finds that a comprehensive approach to developing a low-carbon economy would include three major elements: expanding markets and driving demand, providing financing and investing in physical and economic infrastructure. Here's a sample of CAP's recommended policies for the United States in these three areas:

1. Expanding markets

- Limit emissions of global warming pollution
- Enact an energy-efficiency resource standard for utilities
- Update codes to increase building efficiency
- Provide performance-based incentives to reduce carbon emissions

2. Providing secure financing

- Provide production and investment tax credits for renewable energy
- Establish a Green Bank to provide upfront capital or credit enhancements for renewable energy and efficiency projects
- Provide incentives for states and cities to pass Property-Assessed Clean Energy bonds

3. Reinvesting in our infrastructure

- Rewire the electrical grid by resolving the planning, siting and cost-allocation gridlock, providing incentives and increasing grid security
- Develop incentives and standards to encourage investment in alternative-fuel vehicles
- Strengthen public funding support for the Workforce Investment Act

See full recommendations in CAP's report, "Out of the Running?" at americanprogress.org issues/2010/03/out_of_running.html. Download "ASES' Policy Recommendations for the 111th Congress" at ases.org/policy2009.

$128.5 million in 2008. In 2006, Spain's government approved a National Strategy for Science and Technology, or ENCYT, which sets medium-term goals through 2015 for science and technology. ENCYT includes energy and climate change as one of its five strategic actions. In addition, Spain's RE sector invested about 6.6 percent of the nation's overall GDP in 2007, or $450 million, in R&D.

Renewables manufacturing. The country is home to Iberdrola (iberdrola.es) and Acciona (acciona.com), the world's two largest RE companies. The presence of these large wind developers guarantees a market for wind turbine manufacturing.

Spain is also the solar thermal power manufacturing capital of the world. More than 800 MW will be in operation in Spain in 2010. In the solar thermal sector for heating applications, Spain has a production capacity of more than 1.9 million of square meters.

Overall, the Spanish RE sector exports about $5.3 billion each year. The country exports wind energy equipment worth $3.6 billion every year, according to the Global Wind Energy Council, and it exports 80 percent of its solar technology to Germany.

RE jobs. The Labour Union Institute of Work, Environment and Health, or ISTAS, found that Spain's RE sector had 89,000 direct jobs at the end of 2007, along with another 90,000 or so indirect jobs. ISTAS indicates the country will host more than 270,000 direct jobs in RE industries by 2020.

Energy policy tools. Spain worked hard to create the markets and financial incentives necessary to develop the renewable energy and efficiency sector, and it fostered the necessary infrastructure supports.

Expanding markets. Spain committed to reduce its carbon emissions by 20 percent of 1990 levels by 2020 in line with the EU target. And it committed to achieving 20 percent of its own consumption and 10 percent of its transport energy needs from renewable sources by 2020 under the EU directive that promoted the use of RE. In Spain's own 2005–2010 Renewable Energy Plan, it committed to using RE to meet 12.1 percent of its primary energy needs, 30.3 percent of electricity needs and 5.83 percent of transportation fuel.

Further, Spain's groundbreaking 2005 Technical Building Code requires installing solar hot water systems in all new and some refurbished buildings.

Financing. Spain's government R&D programs (some described above) channel public finances into energy R&D.

Spain's feed-in tariff was enacted in 1997 through the Electric Power Act. The country reduced its feed-in tariff for PV systems in 2008 due to the rapid growth of PV installations under the original tariff. The new royal decree for PV implemented a 500-MW solar PV capacity annual cap. The cap will increase each year, while tariffs will decrease annually.

Building infrastructure. Spain's government has invested in the infrastructure that ensures RE can get to market. Spain's National Investment Plan, the national power system plan, takes into account the Spanish Renewable Energy Plan 2005–2010, which establishes a target of 30.3 percent RE. On the labor side, the government of the Navarre region created the Centro Nacional Integrado de Formación en Energías Renovables in 2001, a national center dedicated to RE job training.

China: Emerging Factory of the RE World

China's leaders fully grasp climate change's threat to the country's water and food security and the economic and energy security benefits provided by mass deployment of renewable and energy-efficient technologies.

China's GDP in 2008 was $4.3 trillion — less than one-third that of the United States in absolute terms and just 7 percent of U.S. GDP in per capita terms. China's strong manufacturing and industry sectors, aided by an undervalued currency, resulted in a global trade surplus of more than $400 billion in 2008.

China eclipsed Germany in 2009 as the world's largest exporter. A dramatic dip in its exports caused by the economic downturn prompted China to consider rebalancing its growth with increased domestic consumption. This rebalancing would also diminish China's trade surplus.

RE deployment in China. China boasts the most installed renewable electricity capacity of any country in the world. At the end of 2008, its 76 GW of installed capacity of renewable electricity (excluding large hydropower) was nearly twice the amount installed in the United States. While the EU aims to produce 20 percent of its energy from renewable sources by 2020 and the U.S. Congress considers adopting a 20 percent renewable electricity standard by the same year,

CLICK See a video interview with Kate Gordon on the *SOLAR TODAY* blog: **solartoday.org/blog**

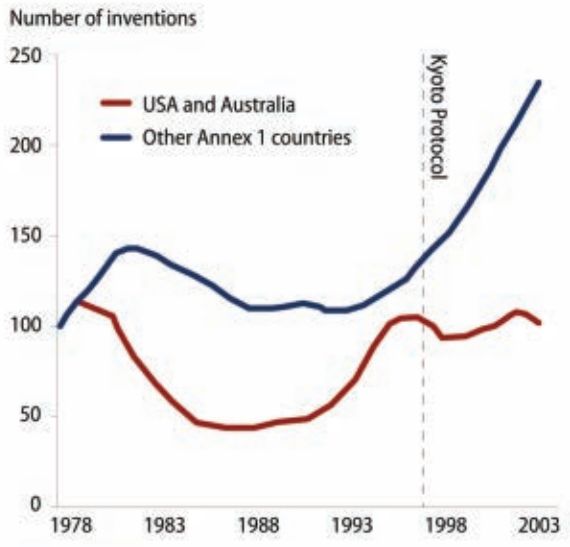
China produced 16 percent of its electricity from hydropower and wind power alone by the end of 2009. Non-fossil fuel sources are expected to account for as much as 30 percent of China's overall power supply by 2020.

The country possesses more than 20 GW of wind capacity, which gives it the third-largest installed wind power fleet behind the United States and Germany. PV accounts for only about 0.3 GW of installed capacity, compared to a total installed capacity (renewable and non-renewable) just over 800 GW. The solar sector, however, is poised to grow to 20 GW by 2020 as a result of major incentives announced in 2009 for domestic deployment.

FIGURE 2

Innovation Trends by Number of Inventions, Among Annex I Developed Countries Under the Kyoto Protocol

Kyoto signatories saw more inventions.



Source: CERNA, Mines ParisTech.

RE innovation. Innovation and R&D have not been traditional strengths of Chinese industry. However, the central government views science and technology as key drivers of a more modern economy and demonstrates a commitment to sustained programmatic funding. Fostering "indigenous innovation" is a long-term strategy of China's.

The Medium- to Long-Term Science and Technology National Plan, unveiled in 2006, established the Chinese government's role in innovation activities through 2020. It identifies five targeted growth industries, with priority given to technologies relating to "energy, water resources and environmental protection."

Renewable energy manufacturing. China is the world's leading supplier of PV panels and solar water heaters, producing a third of the world's solar panels. Almost all of these are exported. China's top three wind turbine makers have combined annual production capacity of 4 GW, and total annual manufacturing capacity by Chinese makers may reach as high as 20 GW by 2010.

RE exports and jobs. Employment in the Chinese RE sector reportedly numbered 1.12 million by the end of 2008. A Global Climate Network report concluded that the hydropower, wind power and PV sectors alone could create up to 2.88 million jobs by 2020 solely by meeting domestic demand. Any concerted renewables export strategy will lead to even more new jobs.

New energy policy tools. China also invests in every part of our three-pillar model.

Expanding markets. China's latest five-year economic development plan (2006–2010) contains the country's most ambitious environmental targets to date, including reducing energy consumption per unit of GDP by 20 percent from 2005 levels.

In support of this five-year target, the Medium- and Long-Term Energy Conservation Plan released in 2004 sets extensive targets for efficiency across two dozen industrial sectors and equipment types and identifies 10 priority energy-conservation projects.

Under the Medium- and Long-Term Development Plan for Renewable Energy, China aims to generate 15 percent of its primary energy from non-fossil fuel sources by 2020. A range of complementary policies support these national goals.

Financing research. Government investments are made through various channels, including state-owned investment vehicles and financial institutions, economic stimulus programs and financial and tax policies.

Building infrastructure. China's government announced a $586 billion economic stimulus plan in November 2008. Some $100 billion of this will be allocated to infrastructure, particularly to the country's rail and transmission grid systems.

Lessons for the United States

China, Germany and Spain have vastly different political economies, but each is seizing the opportunity with a comprehensive approach. Every year the United States fails to chart similar strategies, it falls further behind.

CAP has outlined a set of policy actions that will propel the United States toward a prosperous low-carbon economy (see sidebar on page 28). Like the American Solar Energy Society's federal policy recommendations, they focus on limiting carbon emissions, establishing RE and efficiency standards and investing in needed infrastructure.

While the EU aims to produce 20 percent of its energy from renewable sources by 2020, China produced 16 percent of its electricity from hydropower and wind power alone by the end of 2009.

Through this approach, we can revitalize our manufacturing industries, bolster exports and strengthen the technology sector in ways that will pay economic dividends for decades to come. A study by CAP and the University of Massachusetts found that comprehensive renewable energy/energy-efficiency and climate change legislation, combined with the American Recovery and Reinvestment Act of 2009, would lead to $150 billion in renewable energy and efficiency investments and create 1.7 million net jobs in the United States.

The United States retains a global advantage in science and technology education and research, innovation capacity and private financial markets. But only a truly comprehensive approach will help the United States create a vibrant, sustainable future characterized by lower emissions, greater energy security and millions of new middle-class jobs. **ST**

Teacher Training: a Road to the Future

Clay Sterling, education director at the Midwest Renewable Energy Association, explains the details of a ground-mount array.

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Wisconsin program shows schoolteachers can move communities toward sustainable energy.

Text and photos by **SARA WINDJUE**

Sara Windjue (swindjue@uwsp.edu) is energy education specialist at the Wisconsin K–12 Energy Education Program (KEEP).

When a student learns about renewable energy in the classroom and then uses that knowledge to benefit the community and the environment, you know the lesson had an impact. The teacher has succeeded in instilling a sense of wonder and responsibility. One example of successful renewable energy education can be found at Memorial High School in Eau Claire, Wis., where Myron Buchholz, a social studies teacher, incorporates energy issues into his World Studies classes. Buchholz took four energy education courses through the Wisconsin K–12 Energy Education Program (KEEP). He wrote to us recently to say, "It appears that some of the seeds have taken root." One of his former students, now a junior, has organized a student group to raise money for the installation of a photovoltaic (PV) array on the school's roof.

Providing students with a comprehensive energy education, one that inspires action, is critical to our economic and environmental future. Teachers are key to ensuring today's students are prepared for tomorrow's energy decisions. Organizations around the country provide teachers with the knowledge and skills they need to increase students' energy literacy. KEEP, housed within the Wisconsin Center for Environmental Education at the University of Wisconsin-Stevens Point (UWSP), is one of these.

Created to promote energy education in Wisconsin, KEEP receives its primary funding through Focus on Energy, Wisconsin's energy-efficiency and renewable energy initiative. KEEP offers professional development, student involvement, educational resources, networking opportunities and more for Wisconsin's public and private K–12 schools.

Professional Development

KEEP improves energy literacy in Wisconsin's K–12 schools through teacher education. It has found great success in providing education opportunities at community events and training programs. One of these events is the Midwest Renewable Energy Association's (MREA) annual Energy Fair, the largest event of its kind worldwide with annual attendance of more than 20,000.

MREA, a chapter of the American Solar Energy Society (ASES), provides space at the Energy Fair specifically for educators. The Educator Workshops and Resources Tents, staffed by KEEP, provide a home base where educators network, learn and share ideas. In the Educator Workshops Tent, teachers participate in interactive sessions led by skilled energy professionals and educators. These qualified, enthusiastic speakers involve teachers in discussions and experiences that help integrate renewable energy concepts into curricula and prepare students for careers in the energy field. The Educator Resources Tent showcases hands-on materials including solar demonstration kits, DVDs, solar ovens and games. Teachers enter their names into a drawing for educational resources such as posters, videos and books.

Through UWSP Continuing Education, teachers earn graduate credit while attending the Energy Fair. KEEP coordinates the course and partners with electrical utilities and Focus on Energy to provide scholarships that offset tuition costs. More than 300 teachers of subjects ranging from mathematics to art to technology education, from kindergarten to grade 12, have taken advantage of this opportunity. Teachers report that the Energy Fair is one of their most valuable professional development experiences:

"I was very excited about attending the [Energy] Fair. I would like to bring my science/tech ed. club students next year. I have been doing

Phillip Johnsrud, technical education teacher in the Iola-Scandinavia School District, demonstrates an in-classroom photovoltaic kit.

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POWERING YOUR FUTURE

K–12 educators network in the Workshop Tent at the 2009 Midwest Renewable Energy Association's Energy Fair.

some PV and wind in my classroom, but this just reinforces how desperately we need to conserve and think about how valuable our resources are to us now and in the future."

"This is a great opportunity for districts to expand on a curriculum that will guide the future leaders."

"By far, this was one of the best classes I have taken. I have been talking to a lot of people about the great time and all the cool technologies that were [at the Energy Fair]."

One teacher can have a big impact on students.

At the Energy Fair, teachers attend a few mandatory sessions. The rest of the required credit hours are spent attending workshops and visiting relevant exhibitors. Teachers are encouraged to make contacts with professionals who may be able to assist them in future classroom projects; many teachers have invited these professionals into their classrooms as guest speakers or have taken field trips to homes and businesses.

When teachers return home, they are required to complete a final assignment incorporating Energy Fair material into classroom teachings. Many teachers fulfill this requirement with grant proposals to obtain funding for solar demonstration kits, DVDs, field trips and even solar energy technology for their schools.

Teachers Take it Home

School districts across Wisconsin have taken advantage of KEEP's professional development programs. After participating in three KEEP courses, Lauren Ebbecke of the Wausau School District, who attends the Energy Fair yearly, raised enough money through grants and donations to get a wind turbine installed at her school. She is now working to develop a K–12 curriculum for wind energy education that will enable students, teachers and other personnel to understand the new technology powering their campus. Under the plan, students will monitor bird mortality and weather patterns, calculate electricity production, study the history of wind energy, prepare wind maps, and design and assemble smaller-scale turbines. Hundreds of students will achieve understanding of renewable energy at Wausau East High School, through the enthusiasm and vision of just one teacher.

One teacher can have a big impact on students, and fortunately, KEEP staff sees an increasing trend in the number of teachers who revisit the Energy Fair after attending KEEP's graduate courses:

"I have told numerous people that I have no idea why I waited 20 years to get to this [Energy] Fair. It more than surpassed my expectations and I intend to make it an annual event for my personal growth."

"Overall, [the Energy Fair] was a great experience that met and surpassed my expectations. I plan to return next year and bring friends."

"Thank you for the opportunity to expand my horizons at the Energy Fair. You can be sure that I will be looking forward to attending in the future!"

The Energy Fair course assignment encourages integration of renewable energy concepts into curriculum. Phillip Johnsrud, a technology education teacher from the Iola-Scandinavia School District, arranged for a blower-door demonstration at his school. Tom Mellon, a teacher at Kettle Moraine Lutheran in Jackson, attended the Energy Fair in 2007 and was able to get 11 PV trackers installed at his school, generating about 60,000 kilowatt-hours annually. Mellon has also been a key player in the installation of an engineered wetland wastewater-treatment plant at the school. The system uses four PV panels to charge batteries driving a direct-current submersible pump. The wetland has a windmill to aerate subsurface bacteria. These project ideas grew out of the Energy Fair.

The main goal of teacher education at the Energy Fair is to increase renewable energy content in curriculum. A secondary outcome is that teachers incorporate energy-efficiency and renewable energy practices into their lives, sharing renewable energy knowledge and experiences with the whole community. After attending the Energy Fair, many teachers have reported the installation of PV and other renewable energy systems at their homes.

Teacher Development in Community Events

With any renewable energy training and educational project, it is worthwhile to remember that teachers are people, too! They are homeowners and community members who happen to share their knowledge with the next generation's community members every day.

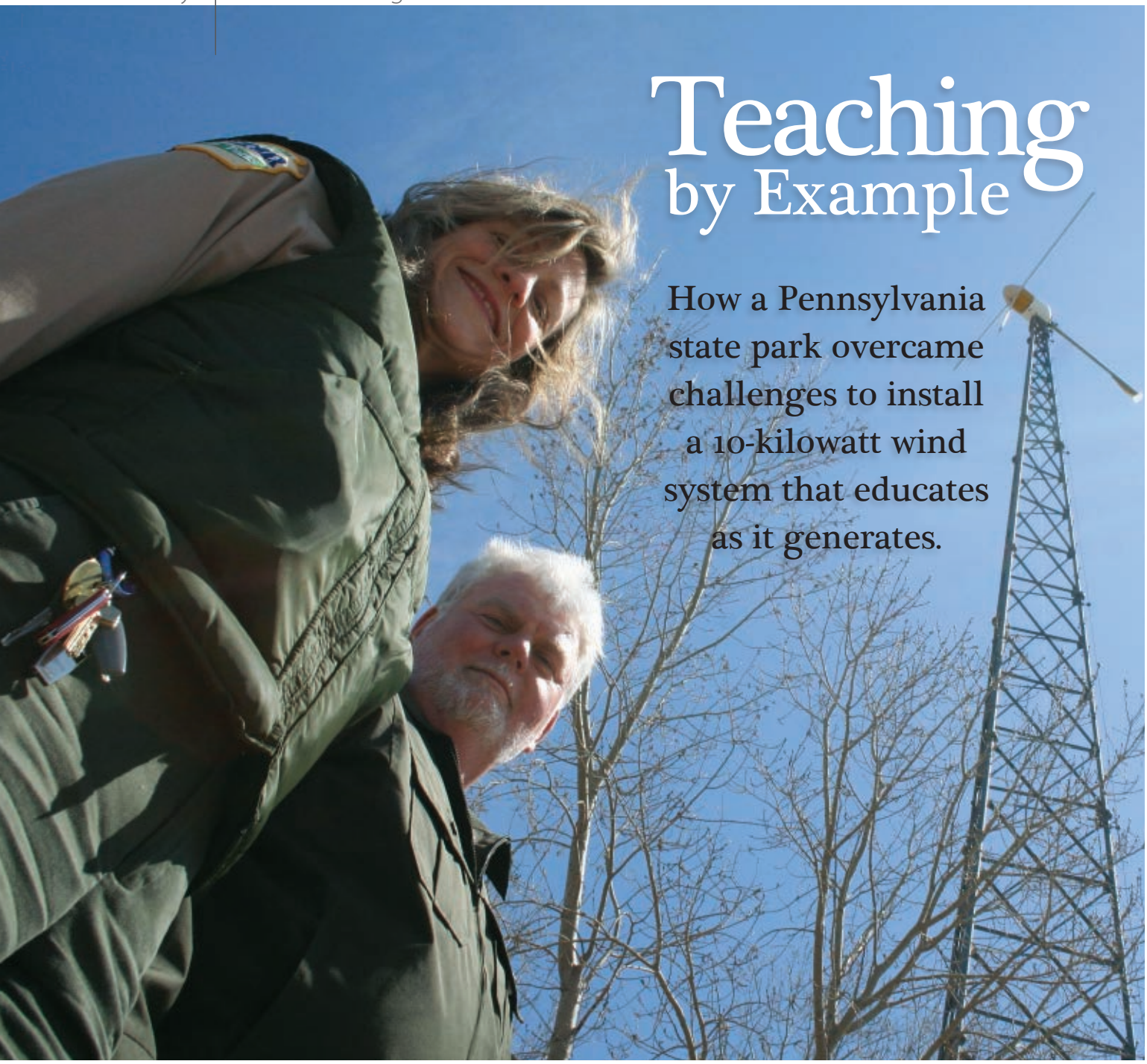
An established community event, such as a fair, is a good way to disseminate energy education materials, resources and professional development. These venues already attract a wide array of individuals, many of whom are educators, looking for information and opportunities that will benefit their teaching. Teachers also appreciate having a place to go to fulfill their teaching needs, which includes networking with other educators.

When promoting your community event, consider sending flyers and e-mail bulletins to school districts and teacher professional development organizations. In addition to bringing teachers to your event, you can go to theirs. Presenting at teacher conferences is a great way to help teachers enhance their curricula with renewable energy. When teachers are at your event, you are educating students through their participation. Teachers constantly seek ways to make learning more interesting for students. Your renewable energy experience can be just the thing they need!

To learn more about KEEP and energy education for teachers at the Energy Fair, visit KEEP's web site at uwsp.edu/keep and click on Professional Development, then The Energy Fair. To learn more about the Energy Fair, visit the Midwest Renewable Energy Association's web site at the-mrea.org/energy_fair.php. This year's fair takes place June 18-20. ST

Teaching by Example

How a Pennsylvania state park overcame challenges to install a 10-kilowatt wind system that educates as it generates.



School groups often visit Presque Isle State Park's wind turbine, according to Environmental Education Supervisor Ann Desarra and Superintendent Harry Leslie, above.

By **MICK SAGRILLO** and **LISA DIFRANCISCO** Photos by Lisa DiFrancisco, North Coast Energy Systems

Mick Sagrillo, Sagrillo Power & Light, is a small-wind consultant and educator. Contact him at msagrillo@wizunwired.net. Lisa DiFrancisco, North Coast Energy Systems, is a small-wind site assessor, installer and educator. Contact her at nces@verizon.net.

Pennsylvania's Presque Isle State Park (PISP), located just minutes from downtown Erie, is a tourist attraction specializing in environmental education for all ages. With more than 4 million visitors a year, the 3,200-acre park, which sits on a 7-mile sandspit peninsula on Lake Erie, is not only a recreational facility, but also a highly visible forum for teaching by example.

Since 2004, PISP has been home to a 10-kilowatt (kW) wind turbine, which powers an interpretive center in the park. The turbine also serves as a teaching tool for park-goers, school groups, bird and bat enthusiasts and even wind installers. A powerful demonstration of the viability of renewable energy, the project encountered a few initial setbacks that taught their own lessons along the way.

PISP Superintendent Harry Leslie firmly believes that installing a wind turbine is the right thing for a natural resources agency to do. One of Leslie's dreams for the park is a 50-kW wind system.

How to Demonstrate a **Wind System** at a Public Facility

Hire a qualified wind-site assessor to evaluate your site, wind resource and energy-generation potential. This information can later be used for educational purposes: How were the tower height and location determined? How were the wind speed and energy production estimates calculated? Were there any zoning, permitting or utility-interconnection challenges? What are the correlations between wind speed, tower height and production?

There's no such thing as a "maintenance-free" wind generator. All turbines need annual inspections and eventual maintenance and repairs. Question your site assessor and/or installer about the real cost of installing and maintaining a high-quality wind turbine. Then budget accordingly and realistically.

Don't cheap out. What you are after is a well-sited wind system that will operate for decades. Such systems are not inexpensive. But then neither is a poorly sited bargain turbine that only runs for a few years.

Don't expect a free wind system. If the owner has "no skin in the game," the first time the system needs attention or repairs, the fixes are not likely to be authorized. If this happens, ask yourself what you are really teaching future generations of consumers and voters.

Overcoming a Turbulent Start

Presque Isle's first wind system was a 4- kW wind turbine installed in September 1982. The turbine was ill-sited, installed on a tower too short for the location and plagued with problems from the start. Within four months, the turbine developed a growling noise. Other mechanical issues continued for the next three years, resulting in significant time and cost for trouble-shooting and repair.

In 1986, the turbine was moved from its original location on Lake Erie's Beach 6 to Barracks Beach, near the Stull Interpretive Center, in hopes that the more favorable site condition would improve production and functionality. Unfortunately, problems continued. By 1995, technicians had recoated the blades, rebuilt the generator, overhauled the control box and repaired or replaced other components, including the anemometers. The turbine continued to function erratically and required excessive attention. The final attempt to repair the turbine was made in 2000. When that failed, the system remained non-functional until it was finally dismantled in 2004, abandoned as a lost cause.

In 2003, a local installer of small-wind systems, realizing the negative perceptions a non-functioning turbine might be creating, met with park managers to discuss options for replacing the wind turbine. Undaunted by the previous wind system experience, park officials agreed that if the funding could be raised, the turbine should be replaced. With that, Lisa and Joe DiFrancisco of North Coast Energy Systems (ncenergy systems.com), under the auspices of the Presque Isle Partnership, applied for and received an

Above, the Stull Interpretative Center in Presque Isle State Park is powered by the 10-kilowatt wind turbine on nearby Barracks Beach. Below, Julie Maries reads the informational kiosk about the wind turbine at Pennsylvania's Presque Isle State Park. The turbine generates energy for the park and serves as an educational tool.

Energy Harvest Grant from the Pennsylvania Department of Environmental Protection (DEP) for installation of a new wind turbine. In addition to replacing the non-functioning wind turbine, the project had several other goals:

- to negate pollution caused by other energy sources,
- to reduce the demand on the local utility grid,
- to promote education and awareness of renewable energy and
- to demonstrate the ability of man and nature to function together.

The Presque Isle Partnership has a track record of successfully delivering on its stated goals, and the proposed project met with an enormous amount of community support and pledged participation. As a result, the Pennsylvania DEP awarded the Presque Isle Partnership a grant of $42,106.

The turbine selected for the project was a Bergey Windpower Co. Excel (bergey.com),

Performance Highlights: The Presque Isle State Park Wind System

While the 10-kW Bergey Excel turbine was projected to generate between 15,000 and 17,000 kilowatt-hours (kWh) annually, actual production has ranged from 11,620 to 15,090 kWh per year. In the first three months of 2010, the system has already generated 4,063 kWh. Other than routine inspections, the turbine has had only six weeks of downtime in the 66.5 months since it was commissioned.

Commissioned: Sept. 15, 2005

Electricity Generated

Lifetime: 74,722 kWh
Annual Average: 13,484 kWh per year

Pollution Offset

Lifetime:
Coal: 37.4 tons (33.9 metric tons)
CO_2 = 173,773 lb (78,822 kg)
NOx = 448 lb (203 kg)
SO_2 = 1,479 lb (671 kg)
Annual:
Coal: 3.75 tons (3.4 metric tons)/yr
CO_2 = 31,595 lb (14,331 kg)/yr
NOx = 82 lb (37 kg)/yr
SO_2 = 269 lb (122 kg)/yr

Project Costs and Funding

Expenses

• Bergey 10-kW Excel turbine, with Grid-Tec inverter	$22,900
• 120-foot freestanding SSV tower	$13,200
• Wiring, energy meter and safety equipment	$1,490
• Inspection and application fees	$1,950
• Labor, materials and equipment rental	$17,494
• Administrative oversight and travel	$2,349
Total	**$59,383**

Funding

• Energy Harvest Grant	$42,106
• Donations *(North Coast Energy Systems, local contractors and individuals)*	$17,277
Total	**$59,383**

The wind turbine at Presque Isle State Park sits on Barracks Beach. The highly visible location brings thousands of visitors to learn about the turbine each year.

manufactured in Norman, Okla., and rated at 10 kW of peak power at 32 miles per hour (14.3 meters per second, or m/s). With a life expectancy of at least 25–30 years, this turbine has a reputation for being the most reliable in its size category, an important criterion when demonstrating any technology in a frequently visited location. Mounted on a 120-foot (37-meter) freestanding tower (40 feet, or 12 meters, taller than the previous tower), the Bergey Excel would provide electricity to the Stull Interpretive Center on Barracks Beach.

The initial site survey by North Coast Energy Systems indicated a very good wind resource for the park, averaging 12 miles per hour at 30 feet (5.36 m/s), and extrapolated to 15.5 miles per hour (6.92 m/s) atop the 120-foot tower. System designers estimated the Bergey would generate from 15,000 to 17,000 kilowatt-hours (kWh) per year.

In July 2004, North Coast Energy Systems, park employees, local contractors and volunteers dismantled the old wind turbine and its 80-foot tower. They immediately began working on the foundation for the new 10-kW wind turbine and its 120-foot tower. The grant covered the cost of the major components, such as the wind turbine, tower, inverter, down-tower wiring and concrete; much of the remaining labor and materials were provided in-kind or at cost by local contractors and individuals.

By September, installers had completed the wiring and mounted the inverter, and the local utility had approved the interconnection application. The system was fully interconnected and commissioned on Sept. 15, 2004, immediately generating energy and drawing crowds.

Creating Understanding, Experience

The Bergey Excel is a valuable teaching tool, noted Ann Desarro, the environmental education supervisor for PISP. It's installed on a public beach, so the area around and under the turbine gets heavy usage. School groups visit often, and environmental education lessons take place under the turbine. More than 10,000 students attend formal programs with staff every year, with thousands of others visiting as well. "The wind turbine is a no-brainer for young people, a piece of the puzzle for a sustainable future," Desarro said.

"The wind turbine is a no-brainer for young people [who visit], a piece of the puzzle for a sustainable future."
— Ann Desarro, environmental education supervisor for Presque Isle State Park

An outdoor interpretive panel explains the workings of the system to beach-goers. Public reaction has been overwhelmingly positive, and many visitors are mesmerized by what they characterize as an "awesome piece of equipment."

In addition to being featured in the park's educational programs, the wind turbine is used each year in the Earthforce Youth Summit (earthforce.org). It has also been used as a backdrop for public education, including an event sponsored by the Presque Isle Chapter of the Audubon Society on wind turbines, birds and bats. The event's participants gained a better understanding of small wind and its benefits.

Assessing Avian Effects

The wind turbine is a mere mile from an ecological preserve, so naturally some expressed concerns about bird and bat mortality. Since these issues are typically at the foreground with wind farms and utility-scale turbines, no wind turbine area for birds or bats and keeping a log of findings. Audubon members accepted the invitation, and the co-monitoring ran from 2005 to 2007. The result: After more than two years with no notable findings (only one seagull with no physical injuries to indicate a strike), the Presque Isle Chapter of the Audubon Society made a preliminary determination that small wind turbines, even when placed close to migratory flyways, pose no significant threat to birds or bats. A more formal study confirming these findings would soon follow.

From fall 2006 to spring 2008, an independent study was conducted for the Pennsylvania Department of Conservation and Natural Resources. Scientists, professors and students from nearby Gannon University conducted the study with oversight by the Regional Science Consortium, a nonprofit that coordinates educational and research projects for Lake Erie and the upper Ohio River Basin. The study proved

Volunteers help assemble and install Presque Isle State Park's 10-kilowatt Bergey Excel wind turbine. The project was entirely paid for through a grant and donations of time, materials and money from local wind installers and individuals.

resource offered conclusive information as to whether smaller wind turbines were responsible for killing birds and bats.

Following installation of the new turbine, North Coast Energy Systems invited members of the Presque Isle Chapter of the Audubon Society to participate in some informal co-monitoring. Each week, representatives from both North Coast Energy Systems and the Audubon Society would be responsible for searching the invaluable, recording which species of birds and bats are active in the area. According to the findings, more than 3,000 bird species either inhabit the area or migrate through it. Of those species, 130 are "threatened, endangered, or rare." Only one common grackle was found dead in the area, and the cause of death was undetermined. These findings reinforced the conclusion that small wind turbines are not decimating bird and bat populations, as is sometimes postulated.

> "It symbolizes a better way to generate electricity, sets a positive example and is a wise use of park dollars."
>
> — Harry Leslie, Presque Isle State Park superintendent

Building on Success

Since the 10-kW wind turbine was installed in 2004, electricity generated has been recorded using a simple, utility grade, cumulative kilowatt-hour meter. Periodic meter readings not only track production, but also provide early indication of problems with the system — before they become irreparable, expensive or cause excessive downtime.

Metering data can be used by organizations, grantors, incentive programs and others to verify the projects they fund are performing as expected. Additionally, small-wind professionals can use this production data to improve the accuracy of site assessments. By tracking production over a number of years, they can identify production variances and patterns from year to year, even at the same site. They can also correlate changes in production to changing site conditions, such as tree growth. This information is valuable for everyone from turbine manufacturers to end-users.

Harry Leslie has been the superintendent of PISP since 1989, back to the days of the first wind system. Asked why, given the bleak experience with that turbine, the park took a gamble on another wind system, Leslie said the time was right. He had seen the technology mature over the years, becoming much more reliable.

Leslie firmly believes that installing a wind turbine is the right thing for a natural resources agency to do for public education. "It symbolizes a better way to generate electricity, sets a positive example and is a wise use of park dollars," he said. One of Leslie's dreams for the park is a 50-kW wind system.

In part due to the success of this project, a second Bergey Excel has since been installed at the Tom Ridge Environmental Center at PISP, and there are now turbines at five other state parks in Pennsylvania. ST

High-Efficiency Cars: The Watershed Year

Late this year, major factories will roll out their long-awaited electric and plug-in hybrid cars. Here's what you'll see by December, along with what you can drive right now.

By **SETH MASIA**

CODA AUTOMOTIVE

Coda: Assembled in Los Angeles with American drive-train parts on a body largely built in China, Coda's pure electric-drive sedan is scheduled for initial deliveries in December. The company expects to produce about 14,000 cars before the end of 2011.

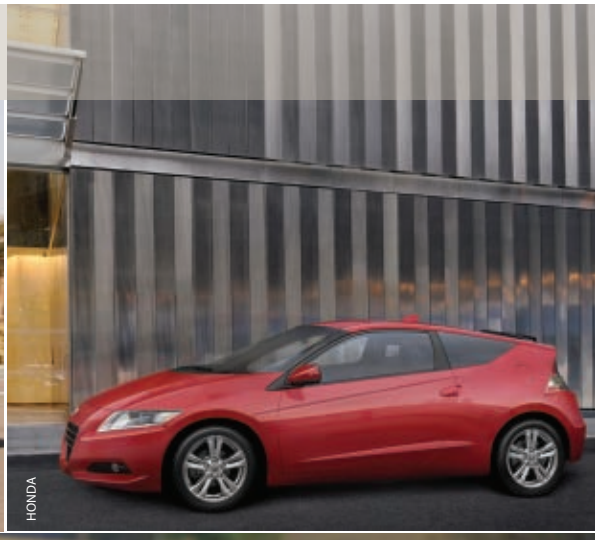
Gasoline prices resumed an upward spiral early this year, rising about 20 percent to $2.85 a gallon as "summer formula" fuels reached the pumps. Prices reached $3.80 a gallon in New York, Los Angeles and Hawaii. Diesel averaged $2.95 across the nation. The Energy Information Agency at the U.S. Department of Energy forecast that, by midsummer 2011, the price of unleaded regular will average $2.96, and diesel will sell for $3.12 (eia.doe.gov/steo).

For recession-battered auto dealers, rising fuel prices are good news. That's because factories are finally gearing up to introduce fuel-efficient cars in serious quantity, and fuel prices drive consumer interest in those cars. The SUV market peaked at about 4 million sales per year in 2004-2005, comprising about 25 percent of all American car and truck sales. But because SUVs carried huge margins, the beasts accounted for about half of the revenue for both dealers and factories. When gas prices nearly doubled in 2008, SUV sales plummeted about 40 percent. While small car sales rose sharply — Toyota and Honda boomed — the credit crash in late 2008 cut North American production from about 16 million cars and light trucks annually to fewer than 9 million. Even if consumers wanted smaller cars, American factories had little to offer in either merchandise or car loans.

Now, with the economy struggling to its feet, the recovery of the auto industry depends on the success of the fuel-efficient cars listed here. By December, for the first time in nearly a century, major factories (Ford, Nissan, Mitsubishi) will offer electric cars in significant quantities in American showrooms. The Chevy Volt will introduce the concept of the series hybrid, a pure electric-drive car with an auxiliary gas-powered charging engine. Nearly three dozen models from 14 marques will offer combined Environmental Protection Agency-rated mileage of 30 miles per gallon (13 kilometers per liter) or better. New EPA standards call for cars and light trucks to do 35 mpg or better by 2020; two dozen cars listed here already meet that standard, at least for highway driving.

The spreadsheet shown on pages 42 and 43, refined and expanded over three years, is our ongoing attempt to summarize the economic and carbon-footprint efficiency of cars you can buy now or in the near future. Note that it includes a few sample used cars. The carbon generated in manufacturing any car usually exceeds the carbon emissions for the first year of driving — and, of course, any new car loses value quickly within the first year. This means, over the short haul, operating an efficient used car puts less carbon into the atmosphere than buying and driving even a more fuel-efficient new

Seth Masia (smasia@solartoday.org) is deputy editor of *SOLAR TODAY*.



Clockwise from top left: Nissan Leaf: A couple of years ago, Project Better Place launched plans to install EV-recharging infrastructure in markets with high gas prices and short commutes: Israel first, then Denmark, Portugal, Hawaii and the San Francisco Bay Area. Nissan/Renault contracted to build the car for these markets, and here it is — a mainstream compact family sedan with a great big battery.

Audi A3 TDI: Sharing a 2-liter turbocharged 140-hp engine with the Volkswagen TDI models, Audi's small front-wheel-drive diesel sedan is even more efficient thanks to a slightly more slippery body style. Is it worth $8,000 more than a Jetta TDI? Drive it to find out.

Honda CR-Z: The coolest car a kid could have in the '80s was the tiny Honda CR-X hatchback, basically a slick little two-seater with a screaming 1.5-liter engine. Driven by an adult, the most frugal version got 41 mpg city/50 mpg highway. Following the success of the Honda Insight hybrid last year, the factory dropped a sporty CR body onto a souped-up Insight drive train to produce what may become the coolest car a kid could have in the '10s.

Chevy Aveo: Built by Daewoo in Korea, the Aveo is GM's entry-level sedan. It's well-made and nimble enough in traffic, and the 10-year cost-to-own is almost unbeatable for a new four-door.

Mitsubishi i-MiEV: Derived from an existing "city car" with a 660-cc engine, the egg-shaped i-MiEV is designed for quick handling in heavy traffic. It's said to offer plenty of headroom so four adults can be comfortable on short trips, and the electric motor produces as much power as the turbocharged engine in the original car. Shown: the delivery van version.

one. Buying a fuel-efficient used car is often the more cost-effective way both to save money and to reduce the household's carbon footprint.

How to read the chart: Cars are arranged on the chart by motor type, and then in order of their estimated cost to buy and operate.

Curb weight reflects the car's general heft, in pounds. It's what the car weighs with a full tank of gas but no passengers or luggage.

MPG is miles per gallon, according to tests conducted by the EPA. The EPA gives mileage for city driving, highway driving and combined; we've shown the city and highway figures. If you do mostly stop-and-go driving — neighborhood errands, deliveries or taxi-cab driving, for instance — the city number is more relevant. To convert MPG to kilometers per liter, multiply by 0.425.

Price is the manufacturer's suggested retail price in U.S. dollars (for new cars) and approximate retail market value for used cars. Prices do *not* include federal or state incentives for low-emission vehicles, so after-tax pricing for electric vehicles (EVs) and some hybrids may be significantly lower than shown here. The federal tax credit for zero-emission vehicles is currently $7,500.

Seats means number of seats, according to the manufacturer. If you carpool or plan to transport whole soccer teams, this is an important number. You might feel better about carbon emissions if you calculate pounds of CO_2 per passenger-mile. We've done it for you, and the column labeled "12,000-mile carbon per seat"

EFFICIENT CARS FOR 2010

Manufacturer	Model	curb weight	mpg city	mpg highway	Price US$ not including credits, subsidies	Seats	Drive	HP comb	Drive type	Fuel	12k mile CO_2 direct lb	12k mile CO_2 per seat direct lb	12k mile E-mode carbon footprint 100% coal
ELECTRIC VEHICLES													
THiNK	City 2011	2,300			30,000	2	FWD	45	EV100	Li			5,138
Mitsubishi	i-MiEV 2011	2,431			30,000	4	RWD	63	EV80	Li	0	0	5,138
Ford	Transit Connect EV	4,000			30,000	6	FWD	134	EV80	Li	0	0	5,138
Nissan	Leaf 2011	3,400			32,780	4	FWD	110	EV100	Li	0	0	5,138
Coda	Coda	3,660			40,000	4	FWD	134	EV100	Li	1	1	5,138
Tesla	Roadster	2,690			110,000	2	RWD	248	EV250	Li	0	0	5,138
Tesla	Roadster	2,690			110,000	2	RWD	248	EV250	Li	0	0	5,138
HYBRID VEHICLES													
BYD	F3DM	3,439	350	40	25,000	5	FWD	135	Phev60	Li-Gas	5,869	1,174	4,110
Honda	Insight 2010	2,723	40	43	19,800	5	FWD	101	Hybrid	Nmh-Gas	5,460	1,092	
Toyota	Prius 2010	3,042	51	48	22,800	5	FWD	134	Hybrid	Nmh-Gas	4,891	978	
Honda	Civic Hybrid 2010	2,875	40	45	23,800	5	FWD	110	Hybrid	Nmh-Gas	5,217	1,043	
Honda	CR-Z 2011	2,800	36	38	23,000	2	FWD	122	Hybrid	Nmh-Gas	6,178	3,089	
Toyota	Prius PHEV 2012	3,150	350	48	32,500	5	FWD	143	Phev13	Li-Gas	4,891	978	4,110
Saturn	Aura Green Line	3,600	22	33	23,000	5	FWD	164	Hybrid	Nmh-Gas	7,114	1,423	
Ford	Fusion Hybrid 2010	3,720	41	36	27,270	5	FWD	156	Hybrid	Nmh-Gas	6,521	1,304	
Hyundai	Elantra Blue	3,500	26	35	25,000	5	FWD	180	Hybrid	Nmh-Gas	6,708	1,342	
Toyota	Camry Hybrid 2009	3,680	33	34	26,150	5	FWD	192	Hybrid	Nmh-Gas	6,905	1,381	
Nissan	Altima Hybrid 2009	3,471	35	33	26,650	5	FWD	198	Hybrid	Nmh-Gas	7,114	1,423	
Chevy	Malibu Hybrid	3,537	26	34	25,555	5	FWD	164	Hybrid	Nmh-Flex	6,905	1,381	
Chevy	Volt 2011	3,300	350	40	40,000	4	FWD	149	Phev40	Li-Flex	5,869	1,467	4,110
Generic	Theoretical PHEV van	5,000	350	40	40,000	9	2/4WD	200	Phev40	Li-Flex	5,869	652	4,110
Toyota	Highlander SUV hybrid	4,641	27	25	33,000	7	2/4WD	200	Hybrid	Nmh-Gas	9,391	1,342	
Generic	Theoretical hybrid van	4,641	20	25	35,000	9	2/4WD	200	Hybrid	Li-Flex	9,391	1,043	
NATURAL GAS VEHICLES													
Honda	Civic CNG	2,910	24	36	24,000	4	FWD	113	IC	CNG	5,333	1,333	
USED CAR EFFICIENCY CLASSICS													
Honda	Insight (1999-2006)	1,856	60	65	5,000	2	FWD	90	Hybrid	Nmh-Gas	3,612	1,806	4,110
Suzuki	Swift 2001 (Geo Metro)	2,800	27	35	2,500	4	FWD	95	IC	Gas	6,708	1,677	
Subaru	Legacy Wagon 1996	2,800	28	31	4,500	5	AWD	130	IC	Gas	7,573	1,515	
Toyota	Prius 2009	2,932	46	46	17,000	5	FWD	144	Hybrid	Nmh-Gas	5,104	1,021	
NEW GAS, DIESEL AND FLEX-FUEL CARS													
M-B	Smart Fortwo	1,808	33	41	11,900	2	FWD	71	IC	Gas	5,726	2,863	
Chevy	Aveo	2,570	27	35	11,965	5	FWD	108	IC	Gas	6,708	1,342	
Toyota	Yaris	2,295	29	36	12,205	4	FWD	106	IC	Gas	6,521	1,630	
Nissan	Versa	2,693	26	34	13,400	5	FWD	122	IC	Gas	6,905	1,381	
Kia	Forte	2,707	27	36	13,695	5	FWD	156	IC	Gas	6,521	1,304	
Honda	Fit	2,489	27	33	14,900	5	FWD	117	IC	Gas	7,114	1,423	
Scion	xD	2,625	27	33	14,900	5	FWD	128	IC	Gas	7,114	1,423	
Mazda	3	2,868	25	33	15,345	5	FWD	144	IC	Gas	7,114	1,423	
Ford	Focus	2,672	24	34	16,290	5	FWD	136	IC	Gas	6,905	1,381	
Mini	Cooper	2,546	28	37	18,500	4	FWD	118	IC	Premium	6,345	1,586	
VW	Golf TDI	2,994	30	41	22,155	5	FWD	140	Tdiesel	D	6,551	1,310	
VW	Jetta TDI	3,230	30	41	22,830	5	FWD	140	Tdiesel	D	6,551	1,310	
Audi	A3 TDI	3,318	30	42	30,775	5	FWD	140	Tdiesel	D	6,395	1,279	
VW	Eos	3,505	21	31	32,390	5	FWD	200	IC	Gas	7,573	1,515	

CLICK Download the complete high-efficiency cars spreadsheet, and tailor it by adding your car or updated fuel prices: **solartoday.org/transportation**

12k mile E-mode carbon footprint 50% coal	12k fuel cost kWh Gasoline Diesel	10yr cost fuel plus purchase per mile	12k CO_2 lb bio fuel	12k fuel cost bio fuel	CO_2 per mile bio lb	CO_2 per mile fossil lb*
2,569		0.28				0.21
2,569		0.28				0.21
2,569		0.28				0.21
2,569		0.30				0.21
2,569		0.36				0.21
2,569		0.94				0.21
2,569		0.94				0.21
2,055	176	0.21	61	166	0.01	0.49
	827	0.17	286	781	0.02	0.45
	693	0.19	240	655	0.02	0.41
	808	0.20	280	762	0.02	0.43
	928	0.19	321	876	0.03	0.51
2,055	172	0.27	60	163	0.00	0.41
	1,248	0.19	432	1,178	0.04	0.59
	891	0.23	309	842	0.03	0.54
	1,125	0.21	390	1,062	0.03	0.56
	1,024	0.22	355	967	0.03	0.58
	1,009	0.22	349	953	0.03	0.59
	1,144	0.21	396	1,080	0.03	0.58
2,055	176	0.33	61	166	0.01	0.49
2,055	176	0.33	61	166	0.01	0.49
	1,320	0.28	457	1,246	0.04	0.78
	1,525	0.29	528	1,440	0.04	0.78
	801	0.20	396	680		0.44
	549	0.04	190	578	0.02	0.30
	1,107	0.02	383	1,045	0.03	0.56
	1,163	0.04	403	1,098	0.03	0.63
	746	0.14	258	704	0.02	0.43
	928	0.10	321	876	0.03	0.48
	1,107	0.10	383	1,045	0.03	0.56
	1,056	0.10	366	997	0.03	0.54
	1,144	0.11	396	1,080	0.03	0.58
	1,090	0.11	377	1,029	0.03	0.54
	1,144	0.12	396	1,080	0.03	0.59
	1,144	0.12	396	1,080	0.03	0.59
	1,183	0.13	410	1,117	0.03	0.59
	1,183	0.14	410	1,117	0.03	0.58
	1,163	0.15	366	997	0.03	0.53
	1,001	0.18	335	1,351	0.03	0.55
	1,001	0.19	335	1,351	0.03	0.55
	987	0.26	330	1,332	0.03	0.53
	1,320	0.27	457	1,246	0.04	0.63

makes the relatively heavy seven-passenger Toyota Highlander SUV look pretty good.

Drive categories include rear-wheel drive (RWD), front-wheel drive (FWD), full-time all-wheel drive (AWD) and on-demand four-wheel drive (4WD). 2/4WD means the standard mode is RWD or FWD but 4WD is an available option.

HP combined is the combined horsepower of the piston engine and any electric drive motor.

Drive type is the technology of the prime mover. IC indicates a normally aspirated (non-turbo) internal combustion engine using gasoline, compressed natural gas or ethanol fuel. Tdiesel is a diesel engine with a turbocharger, able to run on diesel or biodiesel. Hybrid uses an IC engine assisted by an electric motor. PHEV is a plug-in hybrid, able to run an initial distance on battery power alone — for instance, a PHEV40 can run approximately 40 miles before the IC engine needs to charge the batteries. EV is a pure electric vehicle, and EV100 means it has the battery capacity to run approximately 100 miles on a charge.

Fuel types include gas, for cars that run on gasoline. Flex means the car is equipped to use either gasoline or an ethanol blend (but note that all modern gasoline cars can be cheaply modified to run on ethanol). D means diesel, and these cars can also run on biodiesel. CNG is compressed natural gas. Li represents lithium-ion batteries, and NiMH indicates nickel-metal hydride batteries.

12k mile CO_2 direct is the approximate mass of carbon dioxide straight out of the tailpipe in a typical 12,000-mile year of driving, given in pounds.

12k mile E-mode 100% coal applies to EVs and PHEVs. It estimates the pounds of carbon emitted in charging the vehicle for a 12,000-mile year of electric-powered driving if your electric utility uses coal-burning generation exclusively. Note that, if this is the case, your EV may produce a bigger carbon footprint than some modern high-efficiency hybrids.

12k mile E-mode 50% coal estimates the pounds of carbon emitted in charging an EV or PHEV for 12,000 miles of electric-powered driving if your electric utility uses coal-burning generation for half its delivered electric power. There is no column for carbon emissions where electricity is provided from carbon-free sources. In that situation, direct carbon emission is zero.

12k mile fuel cost is the approximate cost of fuel for driving 12,000 miles, assuming that electricity for charging an EV costs 11.64 cents per kilowatt-hour, gasoline is $2.86 per gallon, compressed natural gas is $2.00 per gallon-equivalent (GGA) and diesel runs $2.96 per gallon. These were current prices in April, when the chart was assembled. Prices are expected to rise over time.

10-year cost is the cost per mile to operate the vehicle, combining purchase cost and fuel costs for 12,000 miles per year at today's prices. This figure does not include taxes, rebates, insurance or maintenance costs, which vary locally and over time. Note that maintenance costs should be lower for a pure electric vehicle, which needs no regular oil and filter changes, but that battery replacement may be an expensive item after eight or 10 years.

12k CO_2 lb bio fuel approximates the pounds of CO_2 emitted if a diesel vehicle operates on B100 (pure vegetable oil) or a gas/flex-fuel vehicle operates on E85 ethanol.

12k fuel cost bio fuel approximates the fuel cost to operate a diesel vehicle on B100, at $3.33 per gallon or a flex-fuel vehicle on E85, at $2.25 per gallon (spring 2010 prices).

CO_2 per mile bio approximates the pounds of CO_2 emitted per mile when burning B100 or E85.

CO_2 per mile fossil approximates the pounds of CO_2 emitted per mile when burning petroleum fuel or charging from a coal-burning electricity source. ST

Out-of-the-Box Car Buying

Without the internal combustion engine, most electric vehicles (EVs) are mechanically simple. They don't need engine oil changes or tune-ups. Replacement parts are windshield washer fluid, brake pads, tires and, after eight or 10 years, the battery pack. The real complexity is in the electronics. So why not sell EVs through electronics stores? That's exactly what Best Buy was thinking when the chain began selling electric bikes and scooters last year. In April, the *Wall Street Journal* reported Best Buy may sell the Mitsubishi i-MIEV. That may launch a new distribution pattern for EVs, in which they're sold and serviced like home appliances.

Hybrid Cars: Parallel vs. Series

New variations on a very old idea

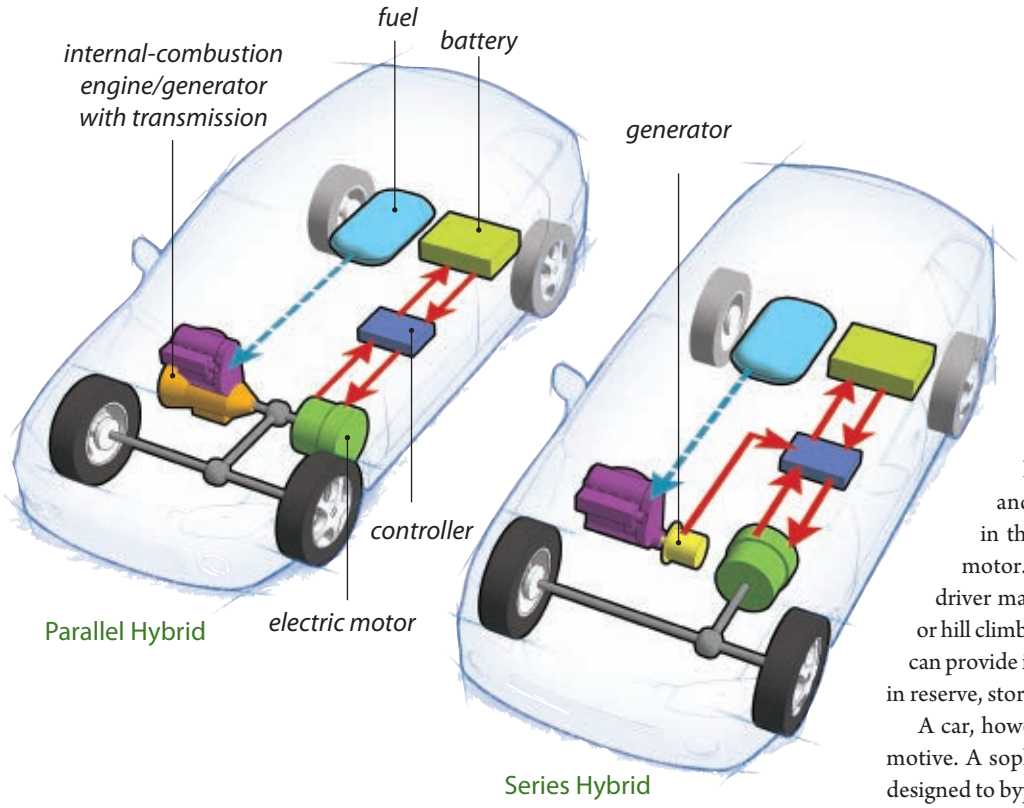


ILLUSTRATION BY KURT STRUVE

By **SETH MASIA**

The hybrid car, powered by both an internal combustion engine (ICE) and a battery-driven electric motor, is not a new concept. The first hybrid was built in 1901 by Ferdinand Porsche, then a young engineer at the Lohner Carriage Works in Vienna, Austria. Porsche's idea was to replace two tons of lead acid batteries in the company's electric cars with a relatively lightweight gasoline engine. The gasoline engine drove a generator to recharge a smaller battery feeding electric motors in the wheel hubs. By 1905, the Belgian engineer Henri Pieper combined the motor and generator into a single unit and invented a single-lever control system that took care of all the drive and recharging functions, including regenerative braking. He got a U.S. patent on his system in 1909. In 1914, Hermann Lemp at General Electric figured out how to scale up the DC power controller to run a diesel-electric locomotive, and since then, hybrid drive has been common for railroad, ship and submarine propulsion.

These are all series hybrids, so called because the ICE drives the generator, which drives the electric motor, which drives the wheels. This arrangement works well in low-speed, high-torque applications because the electric motor produces maximum torque at zero revolutions per minute (rpm). Maximum cranking power is available to get the locomotive or the submarine moving, without the use of a complex, heavy clutch and transmission.

The series drive is less useful in high-speed cruise, because there's an efficiency loss between the generator and motor — and a double efficiency loss if a battery sits in the electric flow between the generator and motor. In automobiles, that's always the case. The driver may need more power, for quick acceleration or hill climbing, than the engine-generator combination can provide instantaneously — so you want some power in reserve, stored in the battery.

A car, however, is light and agile compared to a locomotive. A sophisticated lightweight transmission can be designed to bypass the electric motor at cruising speed and connect the ICE directly to the wheels. The result is a parallel hybrid system, where the ICE and the electric motor work one at a time or in tandem, depending on what's most efficient for the driving situation. Excess power from the ICE is routed through the generator to keep the battery charged and ready to pitch in for bursts of acceleration. This is the system that runs most of today's hybrid and plug-in hybrid cars, including all the hybrids from Toyota, Honda, Ford, Hyundai and BYD.

The exception is the Chevy Volt. In principle it's a simple series hybrid like Pieper's 1905 car — the battery runs the electric motor to drive the wheels through a slick continuously-variable transmission. The ICE never drives the wheels but rides along until needed to recharge the battery. The Volt, to be sure, uses 21st century integrated-circuit controls to make smooth, quiet power throughout the speed range.

Any proper hybrid does better in stop-and-go driving than a pure ICE, because it doesn't idle when stopped and because it recovers energy through regenerative braking. So do you want a series or a parallel hybrid? In theory, the series hybrid should be less complex and more easily adaptable to a wide variety of auxiliary power plants, from diesels to Stirling heat engines. The Volt drive train will thus be the base for dozens of car and truck applications. But parallel hybrids are here right now and here to stay. So we'll see. **ST**

Seth Masia is deputy editor of *SOLAR TODAY*. Contact him at smasia@solartoday.org.

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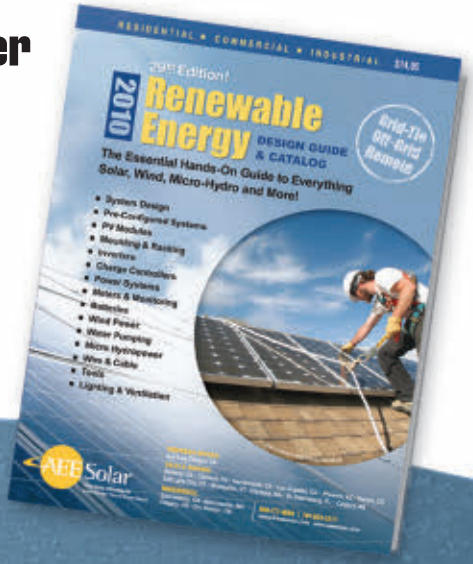

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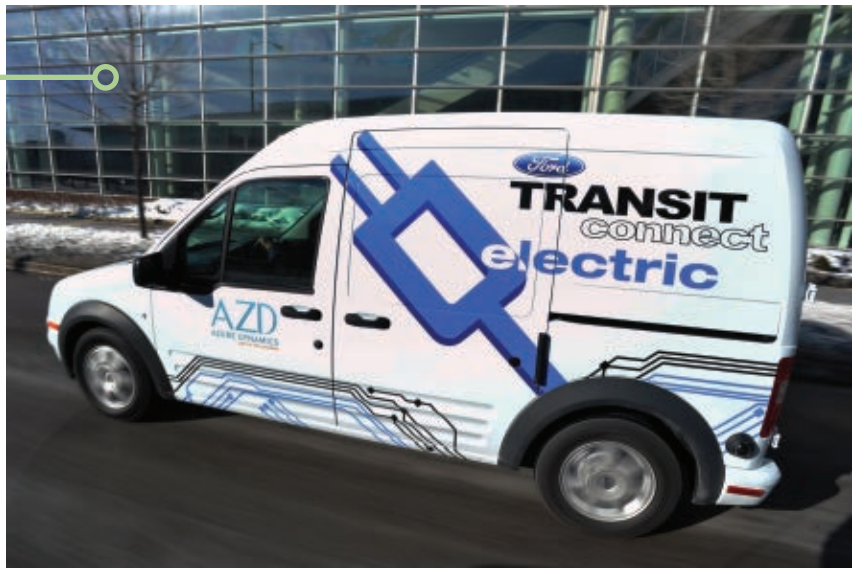
new products | high-efficiency vehicles

A sampling of new cars on exhibit around the country at your local auto dealerships.

Chevy Volt: Already in "preproduction" in Detroit, several thousand Volts will roll into dealer showrooms late this fall. General Motors promises mass availability within a year. The European model, called Ampera, is also in preproduction. Both models run up to 40 miles on plug-in battery power alone, which means, if your daily commute is less than 40 miles, you may burn no gasoline at all Monday to Friday.

Toyota Yaris: The cheapest Toyota, introduced in 2006, comes in three-door, four-door and five-door models, all with a 106-horsepower, 1.5-liter engine offering 29 mpg city, 36 mpg highway.



Ford Transit Connect EV: If the ideal duty cycle for an electric vehicle is stop-and-go driving at relatively low speeds, where the regenerative braking and zero-cost "idling" confer advantages, then Ford figured it would go right to the best target market: the urban fleet delivery van. The company already had a small van selling briskly in Europe and catching on fast in the United States. So in went the electric motor and batteries, and voila! The first electric vehicle you are likely to see in large numbers. This van is also available with windows and extra seats, so a taxi-cab version can't be far behind.

Nissan Micra: A three-cylinder, 74-horsepower gasoline engine drives the smallest Nissan, introduced this summer in most of the world (except North America). Built in six different countries, it may eventually be available with a 50-mpg Mahindra (Indian) diesel engine. Want one? Tell your dealer.

BRÜCKE-OSTEUROPA

BYD ("Build Your Dream") is one of the world's largest manufacturers of lithium-ion batteries for cell phones. Its plug-in hybrid car went on sale to government agencies in China in December 2008, and to consumers there in March of this year. The company promises to sell in the United States during 2011.

Ford Fiesta: Introduced in Europe in March and due in the United States this summer, the 2011 Fiesta aims for 30 mpg city, 40 mpg highway, on a 120- horsepower, 1.6-liter gasoline engine.

New Products *continued on page 50.*

View from the States *from page 24.*

the grant to develop PV and solar heating and cooling curricula for select community colleges across the state. The goal of the five-year program is to provide train-the-trainer workshops in PV installation, led by the Labor Management Cooperation Committee in partnership with the IBEW and the National Electrical Contractors Association, for 320 faculty members. Workshops on solar heating and cooling, led by the California Center for Sustainable Energy (CCSE), will eventually train 220 faculty members. These curricula will include classroom instruction in conjunction with a hands-on lab, to provide students with direct installation experience.

In addition, community colleges have found funding through the American Recovery and Reinvestment Act to build SWH and PV programs. Two examples in the San Diego area are Cuyamaca College and San Diego City College. Some 2,000 solar jobs have been created in California to date, and more than 10,000 additional jobs are likely by 2016. These are non-exportable local jobs.

Grassroots Efforts Paying Off

Nongovernmental entities, such as the CCSE, the Solar Energy Industry Associations of Northern and Southern California and American Solar Energy Society (ASES) chapters in Northern and Southern California, are leading the way in consumer education and advocacy.

Most grassroots organizing is now done via e-mail. Most efforts have seen success: PV has become a household word in California. Some 30 central-station solar power plants now seek licensing in the state, including PV and concentrating PV farms and concentrating solar thermal systems. Green building has become a huge movement, taking the field of building design past energy efficiency into all manner of environmental considerations.

Nonetheless, much of the general public still does not understand solar all that well. They commonly confuse PV with SWH, they do not realize that a typical grid-tied PV system will not provide electricity during a power outage and they do not know that incorporating solar can easily be done in a new house if one starts with the design. Far too few house designers and architects know about passive solar design.

The core issues haven't changed. Electricity prices will continue to rise. Natural gas prices look stable right now but will inevitably rise again. Air pollution continues to plague the state, and the rate of asthma in children has skyrocketed in recent years. Generating electricity via fossil fuel power plants contributes to that condition. We must be the change we want and continue to push clean, renewable solar every way we can. **ST**

new products

New Products from page 48.

THINK

THiNK City: The Norwegian-owned Finnish factory has been selling its two-seat City EV in Europe for a couple of years and promises to introduce the car to New York late this year. Within a year, production should begin in Elkhart, Ind., home of Ener1, the battery manufacturer that now owns a 31 percent stake in THiNK.

ET Silicon PV Modules ET crystalline photovoltaic modules are designed and manufactured to comply with very strict international quality standards. They are backed by a 25-year warranty on power output and a five-year warranty on materials and workmanship. **etsolar.com**

***Kutscher** continued from page 21.*

we not cede the discussion of climate change to the skeptics. For only by successfully communicating the enormity of this problem can we elicit a response of sufficient speed and magnitude to adequately address it.

Carl Sagan often made his fellow astronomers uncomfortable because he simplified science and conveyed it in a passionate way. But he was able to reach the average American and provide an appreciation for astronomy that no journal article ever could. We need more climate scientists with Sagan's vision and enthusiasm. And we also need to enlist non-scientist communications experts to join scientists in getting the message out. In other words, we need to place as high a premium on the art of communication as the skeptics have. If we have learned nothing else from the shift in public opinion, it is that having scientific facts on our side is simply not enough.

Only by successfully communicating the enormity of this problem can we elicit a response of sufficient speed and magnitude to adequately address it.

While it is important to get the climate change message out to wide audiences, we shouldn't underestimate the need to reinforce the message in those who already accept the science. Perhaps the biggest impact of the climate change disinformation campaign isn't that it has fired up political ideologues who will likely never accept the science anyway, but rather that it has drained the enthusiasm from those who should be leading the charge.

People sometimes tell me I'm preaching to the choir. My response is, yes, I often am preaching to the choir. But the fact is the choir just isn't doing enough. If those of us who know better let the attacks and ridicule from the skeptics discourage us from aggressively communicating and tackling this problem, we will bear a major share of the blame for the consequences. **ST**

Back to the Basics: Collector Size

By MICK SAGRILLO

Power is proportional to rotor swept area.

Mick Sagrillo (msagrillo @wizunwired.net) of Sagrillo Power & Light is a small wind consultant and educator.

Several fundamental concepts about small wind turbines are often misunderstood. The first misconception is about the power available in the wind and what diminishes that power: ground drag and turbulence. The second misunderstanding concerns the importance of tower height in maximizing the fuel (that is, the wind) available to the wind turbine. These are wind resource and siting issues, and we've covered these concepts in the last four columns.

However, equally misunderstood is the importance of the size of a wind turbine's *rotor* — that is, the blades and hub that extract the energy in the wind and convert it to electricity for our use.

Rotors Capture Energy

I often get inquiries from people who have come across ads for an inexpensive wind device with a very small rotor that promises to generate incredibly large amounts of electricity relative to its cost. They are intrigued by claims of a breakthrough technology offering the promise of "never-before-seen efficiencies." Consumers are unfamiliar with the nuances of small wind technology, and that unfamiliarity is compounded by a misunderstanding of wind resource and siting. They're understandably confused.

The rotor of a wind turbine is made up of the blades that spin and capture energy in the wind that passes through them. Some rotors are traditional horizontal-axis devices that typically sport two or three blades. Others are vertical-axis systems of various blade configurations. Still others are hybrids of these two orientations. Regardless, it is the rotor that extracts the kinetic energy in the wind and converts it to rotational momentum used to drive an electric generating device.

Small Rotor = Small Output

It is well understood with other renewable technologies that the size of your collector determines the amount of renewable energy that you can collect and convert to some useful purpose. Let's use solar water-heating collectors as an example. One 4-foot by 8-foot solar water collector has an area of 32 square feet (3 square meters). It can collect only the amount of sunlight that falls on it, no more. The collector is limited in the amount of hot water it can process, based on the amount of sunlight it collects.

If we double the area exposed to the sunlight by adding a second solar collector, we double the amount of sunlight that can be collected, resulting in a doubling of the amount of hot water that can be pumped. This is pretty straightforward: The amount of solar energy that can be extracted from the sunlight is proportional to the size of the solar collector used. Simple stuff!

The same holds true for a wind turbine. A small rotor can only extract small amounts of kinetic energy out of the wind and generate small amounts of electricity. The amount of energy that can be extracted at a given wind speed is proportional to the size of the rotor, period. No magic can happen beyond the simple mathematics of the swept area of a wind turbine's rotor.

Increase Swept Area for More Energy

Swept area is defined as the circle delineated by the rotating blades of the rotor. The only way to extract more energy at a given wind speed is to increase the area that the rotor sweeps. Increasing rotor area is quite easily accomplished: Simply increase the length of the blades.

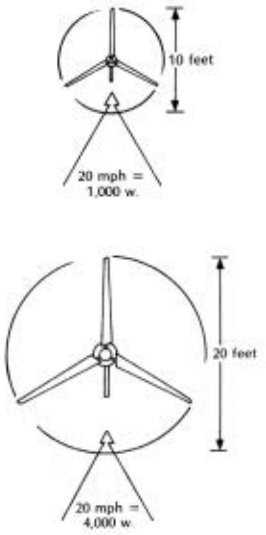
The results of increasing blade length are quite dramatic due to the fact that the area of a circle is proportional to the square of the radius of the circle. In the case of a wind turbine, the radius is the length of one blade. As shown in the diagram at left, doubling the length of the blades results in a four-fold increase in the volume of wind the rotor can capture and convert to rotational momentum used to drive the generator.

The output of a wind turbine depends primarily on the amount of fuel available (the wind resource) and on the size of the collector utilized to harvest that fuel (swept area of the rotor). Unfortunately, one confounding factor often thrown into the mix is the wind turbine's maximum generating capacity or peak electrical output. While the size of the generator is important, it is often very misunderstood from the perspective of determining how much electricity can be generated by the wind system. For any given wind speed, generator size is of no consequence (provided it's large enough to control rotor output) because it is the rotor diameter that determines the amount of energy that can be extracted. In other words, a huge generator bolted to a small rotor can only generate small amounts of electricity.

The following table, adapted from author Paul Gipe, makes a good rule of thumb for estimating the generator capacity of a typical horizontal axis wind system:

Nominal Rotor Diameter in Feet	Nominal Power Rating
4	100 watts
8	800 watts
12	2 kilowatts (kW)
24	10 kW
32	20 kW
50	40 kW
70	100 kW

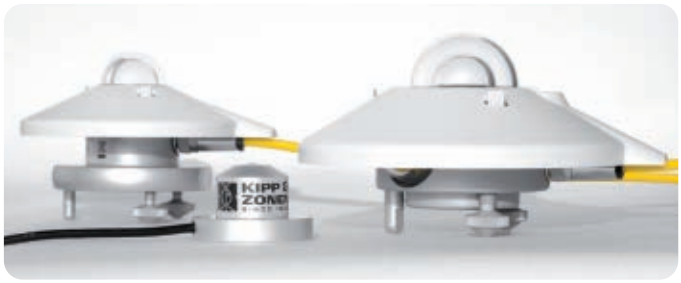
Don't be deluded into thinking you can generate huge amounts of electricity with a small rotor — it simply is not going to happen. To quote Paul Gipe, "Nothing says more about the output of a wind turbine than its rotor." ST



Source: *Wind Power for the Homeowner*, by Donald Marier

Longer blades increase a wind turbine's swept area, which can lead to a dramatic rise in energy output.

Accurately Monitoring the Performance of your Solar Energy System



To maximize the effectiveness of your solar energy system, you need to know how it is performing. A Kipp & Zonen pyranometer accurately measures the solar radiation available to your system in real time. Comparing this with the power generated allows you to calculate the efficiency of the system. A drop in efficiency indicates the need for cleaning, ageing or a fault, allowing you to schedule preventive maintenance and to monitor your return on investment.

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THE BIZ

Increasing Profits with Search Engine Marketing

BY MATT WALKER

WALKER

Search engine marketing (SEM) is a way to promote websites by increasing their visibility across the web and in search engine results pages. Some sources define SEM as the process of buying paid search listings. Search engine optimization (SEO) is a subset of SEM and is different in that the methods are generally cost free, whereas the larger umbrella of SEM incorporates paid advertisements. It can be compared to the difference between hiring a public relations coordinator (SEO) versus an advertising agency (SEM). The former distributes media and information through a variety of free sources, while the latter pays for direct advertisements.

There are two main factors outside of SEO in your SEM campaign: pay-per-click (PPC) advertising and social media marketing.

PPC is a form of paid-for advertising in search engines. Your solar business, in this case, can bid on relevant keywords. For instance, on Google, you might buy the search terms solar energy, solar power, solar electric, photovoltaic, solar installer and so on. Then, when a potential customer searches any of those terms, you get a spot on the sponsored areas in the top or right frames of the search result page. You pay for the advertisement only when someone clicks to go through to your website, hence "pay per click." Perfecting this campaign takes a bit of tweaking in the beginning to figure out which words are increasing profits and which are too competitive or irrelevant to have a positive impact on your site.

Social media are among the most effective ways of advertising without emptying your pockets. Social networking sites, such as Facebook, LinkedIn, Twitter and YouTube, are free to join and offer viral marketing techniques that can be invaluable to your company.

Matt Walker (matt@bestrank.com) is the CEO and co-founder of Best Rank Inc., where he guides sales, product development, marketing, finance and day-to-day business operations. Walker developed Best Rank's SEO methodology based on industry best practices and official search engine guidance. Walker holds an MBA in marketing and management from San Diego State University and a Bachelor of Science from Embry-Riddle Aeronautical University.

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The Future of Hot Water and Solar Thermal

BY GARY KLEIN AND JOSEPH MCCABE, P.E.

ABSTRACT

Solar thermal collectors can be up to three times as efficient as residential photovoltaic modules, and advancements in solar water-heating technology have brought the cost down. Combined with new public policies (such as the California Solar Initiative) and better economic incentives through environmental credits, these higher efficiency solar hot water systems, including utility-grade metering, are enabling new solar hot water business models. These solar hot water business models can be initiated by water companies, gas or electric companies or private entities.

KLEIN

One example of such a business model is the Lakeland Electric project. It installs a high-efficiency solar water-heating system in the customer's house, at no upfront cost to the consumer. The customer gets additional hot water storage, no maintenance costs, a lower carbon footprint and a purchase option, at a cost of $34.95 per month of energy purchase. This reduces the electric power peak for the electric company and the carbon footprint for both parties.

Hot water can be delivered with better energy efficiency through integrated system design, using improved plumbing to tie solar-heated water into the delivery system. The ideal hot water distribution system minimized "time to tap." To do this, it would have the smallest volume of water in the pipe from the source of hot water to the fixture. Sometimes, the source of hot water is the water heater; sometimes it's a trunk

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line. For a given layout of hot water locations, the system will have the shortest buildable trunk line, few or no branches, the shortest buildable twigs and the fewest plumbing restrictions.


MCCABE

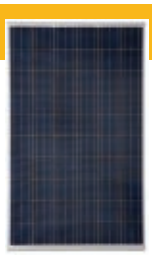
One strategy is to put a circulation loop very close to each hot water outlet. We have found this to be a buildable option, and all circulation systems can save water if the volume from the circulation loop to the hot water outlets is minimized.

The energy-efficient method of operating a circulation loop is to install a small pump that primes the hot water line with hot water after being activated by the user, on demand, shortly before it is needed. It is possible to do this in both retrofit and new construction applications in virtually all types of buildings (single family, multi-family, offices, food service, hotel/motel, etc.). Our paper describes a number of strategies for preheating small quantities of water for immediate delivery, recapture of waste-water heat and other energy-saving design features of a "structured plumbing system."

Gary Klein (gary@aim4sustainability.com) is managing director of Affiliated International Management. Joseph McCabe (energyideas@gmail.com) is an ASES Fellow and owner of Energy Ideas LLC.

This abstract was taken from a full paper by Klein and McCabe. Read the complete version of the paper by visiting solartoday.org/sw. And, if you haven't already, sign up for your free *Solar@Work* subscription to get reports like this delivered straight to your e-mail inbox.

PRODUCTS



Trina Rolls Out Utility-Scale PV Module

Trina Solar has launched its new utility-scale solar module, model TSM-PC14. Trina's most powerful module to date, it is targeted to be available for sale in the European and North American markets in the fourth quarter of 2010.

With expected power output targets ranging from 265 to 290 watts, a positive power tolerance of 0/+3 percent and a 72-cell arrangement, the large high-wattage modules are designed specifically for utility-scale installations and large-scale, ground-mounted systems.

Micro-tec Processing Equipment Now in United States

Micro-tec Solar Cell Processing Systems are now available in the United States. With more than 20 years of experience and a long list of installations in the solar wafer fabrication industry, Micro-tec systems are recognized for their productive and high-quality performance. Screen printers from Micro-tec can produce up to 1,400 wafers per hour with wafer breakage rates of less than 0.2 percent. Fast and secure wafer conveyance is achieved through Micro-tec's quick 2-wafer transport system using pick and place and a carousel print table. Nylon resin materials are utilized for wafer contacting parts to ensure safe conveyance. Mechanical accuracy is +/- 10µm (table stop position) and vision system accuracy is +/- 15µm for a total average accuracy of +/- 25µm.

Saflex, Oerlikon Introduce High-Efficiency Encapsulant

Saflex has introduced a solar encapsulant that helps increase the efficiency of the solar module while reducing material usage. Saflex Radiant White PA27, developed in collaboration with Oerlikon Solar, reflects light back through the module that is not initially absorbed by the active layers.

BUSINESS BRIEFS

Harvard Forecasts Home Remodel Rebound

Home improvement spending will recover this year, according to the Leading Indicator of Remodeling Activity (LIRA) released by the Remodeling Futures Program at the Joint Center for Housing Studies of Harvard University. The LIRA suggests annual spending will accelerate, with nearly 5 percent growth in 2010.

SunPower, Flextronics Partner on California Production

SunPower, the Silicon Valley-based manufacturer of high-efficiency solar cells, solar panels and solar systems, has partnered with Flextronics to begin manufacturing solar panels in Milpitas, Calif., by the end of this year. The partnership is expected to create approximately 100 new jobs this year and produce 75 megawatts of SunPower solar panels annually. The West Coast location will allow SunPower to quickly and cost-effectively supply SunPower panels to solar installations at homes, commercial and public facilities and power plants throughout the western United States.

Santa Clara Expedites Solar Permits

Santa Clara, Calif., residents applying for permits to install rooftop solar panels can now get final approval to start construction and interconnect in a day instead of the weeks or months it can take in neighboring communities. The innovative permitting method means residents can more quickly get their systems operating and receive cash rebates from Silicon Valley Power (SVP), the city's municipal electric utility.

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Grassroots Efforts + National Leadership = Solar Success

By **RICH CAPUTO** and **TEHRI PARKER**

CAPUTO

PARKER

Rich Caputo (richardcaputo@sbcglobal.net), an ASES board member and a leader of the San Diego Renewable Energy Society, is author of the book *Hitting the Wall: A Vision of a Secure Energy Future*.

Tehri Parker (tehri@themrea.org) is executive director of the Midwest Renewable Energy Association and an ASES board member. She holds a Ph.D. in education and teaches at the University of Wisconsin at Stevens Point.

How does a nonprofit organization, based in Boulder, Colo., organize and implement a national movement that will push and pull the country into a new era of sustainable energy? At the American Solar Energy Society (ASES), we believe the most effective way to meet this mission is to merge the efforts of enthusiastic grassroots groups with national leadership and support.

At the grassroots level, ASES has 11,500 members in 50 states. We've formed 62 chapters or subchapters in 40 states. Chapter activities include —

- advocating for regional policies that advance renewables and energy efficiency;
- organizing tours of solar buildings;
- holding energy fairs, conferences and workshops; and
- hosting local meetings of solar advocates.

ASES chapters come in many shapes and sizes, but they share one mission: to provide engaging solar education that is relevant to their state or region.

At the national level, ASES is a progressive nonprofit with a staff of 21 working in beautiful Boulder. The organization is overseen by a board of directors and a board of trustees, both unpaid. The organization publishes the best magazine in the field (*SOLAR TODAY*), organizes the largest renewable energy and energy efficiency education event in the nation (the ASES National Solar Tour, nationalsolartour.org), and produces the longest running and largest technical conference in the renewable energy field (the ASES National Solar Conference, solar2010.org). ASES also produces significant research studies ("Tackling Climate Change in the U.S.," "Estimating the Jobs Impacts of Tackling Climate Change," state job studies for Ohio, New York and Colorado) and policy documents such as "ASES Policy Recommendations for the 111th Congress." We now have a grassroots advocacy arm in Solar Nation.

To merge the efforts of these two levels of ASES, the ASES Board of Directors has developed a chapters relations committee. The mission of the committee is twofold: to help make the chapters more effective at the local level, and to help the chapters more vigorously move forward the national agenda of ASES. The committee's goal is to build on the natural synergies of these groups, thereby significantly increasing the effectiveness of the organization overall.

The chapter relations committee is comprised of seven individuals representing the ASES board of directors, staff and chapters. We, Tehri Parker and Rich Caputo, sit on the committee as its board representatives. Tehri is the executive director of the Midwest Renewable Energy Association, and Rich is the founding chair and a board member of the San Diego Renewable Energy Society. We are joined by three staff members who have key roles in the national organization: Richard Burns, the ASES National Solar Tour manager; Kate Hotchkiss, an ASES program manager; and Irene Law, ASES' chief operating officer. The committee is rounded out with two chapter volunteers: Wyldon Fishman, president and co-founder of the New York Solar Energy Society and Jane Hager of the Potomac Region Solar Energy Association.

The major activities of the committee are to—

- Design and facilitate the annual day-long chapter caucus that takes place at the beginning of the ASES National Solar Conference.
- Host monthly conference calls to keep chapters in touch with current ASES activities and get chapter feedback.
- Develop monthly webinars that are open to all ASES members. Webinars cover a range of "how to" subjects from grant writing to developing hard-hitting advocacy programs.
- Unite the expertise of ASES' nine technical divisions with the chapters through a series of webinars.
- Represent the chapters during ASES Board of Director meetings.

In addition to these activities, the committee is also creating a chapter handbook and a comprehensive package of materials to guide the development of new chapters.

Strengthening ASES advocacy is critical at this time in the history of the planet. Many people appreciate the increasing cost efficacy of renewables and energy efficiency and know that, eventually, our energy system will use these techniques broadly. Others know in their bone marrow that sustainability is key to the long-term survival of our global ecosystem, and they'll support all measures, including renewable energy, to reach sustainability. Both of these groups add up to a lot of people and a lot of support for the eventual movement to renewables and increased energy efficiency.

As great as this is, it is not nearly enough. To avoid the worst impacts of human-driven climate change, we don't have the 80 years it would normally take to reach 50 percent penetration of a new energy system in the United States. We have half that time, and we need to reach 80 percent renewables. It's a challenge that will require effective and consistent public policy support. This can only happen if ASES and allied organizations become much more effective in advocating for a sustainable future.

ASES Honors Award Winners, Fellows

Each year, the American Solar Energy Society (ASES) recognizes individuals for their achievements in solar through its awards program. Outstanding longtime ASES members are also acknowledged and named Fellows of the Society. The following award winners and fellows were presented at the SOLAR 2010, the ASES National Solar Conference, in May.

Abbot Award:
JANE WEISSMAN


WEISSMAN

Weissman accepted the Charles Greeley Abbot Award, which recognizes individuals who have made significant contributions to ASES or solar energy. Weissman has been executive director of the Interstate Renewable Energy Council since 1994. She is vice chair of the North American Board of Certified Energy Practitioners and was named an America Solar Energy Society Fellow in 2004. She also serves on the *SOLAR TODAY* Magazine Advisory Council.

Weissman has provided expert testimony on workforce development and training issues to the Congressional Subcommittee on Energy and Environment. She has also published papers and spoken widely on topics such as renewable energy, photovoltaics, public policy and credentialing.


ANDRAKA

Hottel Award:
CHUCK ANDRAKA

Andraka received the Hoyt Clarke Hottel Award, which honors individuals who have made a significant contribution to the technology in any area of the solar energy field. Andraka works at Sandia National Laboratories' National Solar Thermal Test Facility. He has worked in

getinvolved: locate an ASES chapter in your community

Alabama
Alabama Solar Assoc.
P: 256.658.5189
arch42@gmail.com
al-solar.org
Contact: A. Morton Archibald Jr.

Arizona
Arizona Solar Energy Assoc.
P: 602.952.8192
j2envarch@aol.com
arizonasolarenergy.org
Contact: Daniel Aiello

Arkansas *New Chapter!*
Arkansas Renewable Energy Assoc.
P: 877.575.0379
info@arkansasrenewableenergyassoc.org
arkansasrenewableenergyassoc.org
Contact: Frank Kelly

California
NorCal Solar Energy Assoc.
P: 510.705.8813
solarinfo@norcalsolar.org
norcalsolar.org
Contact: Elisabeth Holmgren

***Redwood Empire Solar Living Assoc.**
P: 707.744.2017
sli@solarliving.org
solarliving.org
Contact: Coral Mills

San Diego Renewable Energy Society
P: 619.778.7263
info@sdres.org
sdres.org
Contact: Bruce Rogow

Colorado
***Colorado Renewable Energy Society**
P: 303.806.5317
info@cres-energy.org
cres-energy.org
Exec. Dir.: Tony Frank

Connecticut
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Solar Energy Assoc. of Connecticut
NESEA Local Chapter
P: 860.233.5684
ramank0@yahoo.com
solarenergyofct.org
Contact: K. Raman

Delaware
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Sustainable Delaware
NESEA Local Chapter
P: 302.645.2657
johnmateyko@verizon.net
Contact: John Mateyko

Florida
Florida Renewable Energy Assoc.
P: 352.241.4733
info@cleanenergyflorida.org
cleanenergyflorida.org
Contact: Craig Williams

Georgia
Georgia Solar Energy Assoc.
info@gasolar.us
gasolar.org
Contact: Todd Patrick

Idaho *New Chapter!*
Idaho Renewable Energy Assoc.
P: 208.639.0656
dustin@idahosolar.org
idahosolar.org
Contact: Dustin W. Baker

Illinois
Illinois Solar Energy Assoc.
P: 312.376.8245
illinoissolar.org
Contact: Mark Burger

***Midwest Renewable Energy Assoc.**
P: 715.592.6595
info@the-mrea.org
the-mrea.org
Contact: Amy Heart

Indiana *New Chapter!*
Indiana Renewable Energy Assoc.
P: 574.536.9483
indianarenew@homeandmobileenergy.com
indianarenew.org
Contact: Leon Bontrager

Iowa
***Midwest Renewable Energy Assoc.**
P: 715.592.6595
info@the-mrea.org
the-mrea.org
Contact: Amy Heart

KEY
* = staffed office
Green = a chapter of the Northeast Sustainable Energy Assoc.

Kansas
Heartland Renewable Energy Society
P: 816.224.5550
cwolfe@craigwolfeeco.org
heartlandrenewable.org
Contact: Craig Wolfe

Kentucky
Kentucky Solar Energy Society
P: 502.227.4562
solar@kysolar.org
kysolar.org
Contact: Andy McDonald

Louisiana
Louisiana Solar Energy Society
P: 225.767.0715
info@lses.org
lses.org
Contact: Jeff Shaw

Maine
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Maine Solar Energy Assoc.
NESEA Local Chapter
P: 207.497.2204
sunwatt@juno.com
mainesolar.org
Contact: Richard Komp

Maryland
Potomac Region Solar Energy Assoc.
info@prsea.org
prsea.org
Contact: Nelson Buck

Massachusetts
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Boston Area Solar Energy Assoc.
NESEA Local Chapter
P: 617.242.2150
hkv@solarwave.com
basea.org
Contact: Henry K. Vandermark

Cape and Islands
Renewable Energy Collaborative
NESEA Local Chapter
P: 774.487.4614
chrisp@weeinfo.com
cirenew.org
Contact: Chris Powicki

Springfield Area Sustainable Energy Assoc.
NESEA Local Chapter
P: 413.734.1456
sasea@gmail.com
nesea.org/sasea
Contact: Mike Kocsmiersky

Michigan
***Great Lakes Renewable Energy Assoc.**
P: 517.646.6269 or 800.434.9788
info@glrea.org
glrea.org
Contact: Samantha Keeney

***Midwest Renewable Energy Assoc.**
P: 715.592.6595
info@the-mrea.org
the-mrea.org
Contact: Amy Heart

Minnesota
Minnesota Renewable Energy Society
P: 612.308.4757
info@mnrenewables.org
mnrenewables.org
Contact: David Boyce

Mississippi
Mississippi Solar Energy Society
sdlewis@megagate.com
Contact: Steve Lewis

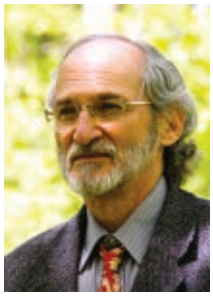
Missouri
Heartland Renewable Energy Society
P: 816.224.5550
cwolfe@craigwolfeeco.org
heartlandrenewable.org
Contact: Craig Wolfe

Nevada
Sunrise Sustainable Resources Group
P: 775.224.1877
philip_moore@charter.net.
sunrisenevada.org
Contact: Philip Moore

Solar NV
P: 702.507.0093
contact@solarnv.org
solarnv.org
Contact: Deidre Radford

New Hampshire
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

concentrating solar power since 1984, specializing in dish-engine research and development. Andraka has worked on Sandia-led projects such as the advanced dish development system and heat pipe receivers, as well as industry-led projects, including Stirling Energy Systems, Infinia and Cummins Power generation.



LEVINE

Passive Solar Pioneer Award: RICHARD LEVINE

Richard Levine is this year's recipient of the Passive Solar Pioneer Award, which recognizes someone whose pioneering work in the passive solar energy field has set the stage for others to follow. Levine is a professor of architecture and director of the Center for Sustainable Cities at the University of Kentucky, where he has been teaching passive solar design concepts since the early 1970s. His early work focused on passive solar development at the scale of the single building; more recently, he has been working on passive solar concepts on a city or regional scale.

WEISS

Women in Solar Award: BETTINA WEISS

Bettina Weiss accepted the Women in Solar Energy Award, which recognizes women who have contributed significantly to the acceptance and advancement of women in solar. Weiss is the senior director, photovoltaics, at the SEMI PV Group.

***New Hampshire Sustainable Energy Assoc.**
NESEA Local Chapter
P: 603.226.4732 (22NHSEA)
madeline@nhsea.org
nhsea.org
Contact: Madeline McElaney

New Jersey
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Central Jersey Sustainable Energy Assoc.
NESEA Local Chapter
P: 732.695.2578
nesea.nj@gmail.com
Contact: Beth Robinson

New Mexico
New Mexico Solar Energy Assoc.
P: 505.246.0400, 888.886.6765
info@nmsea.org
nmsea.org
Contact: Mary McArthur, Ron Herman

New York
New York Solar Energy Society *New Chapter!*
P: 917.974.4606
wyldon1@gmail.com
nyses.org
Contact: Wyldon Fishman

***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

GreenHome NYC
NESEA Local Chapter
P: 917.846.2374
slenard@greenhomenyc.org
greenhomenyc.org
Contact: Steven Lenard

Western New York Sustainable Energy Assoc.
NESEA Local Chapter
P: 716.881.1639
jkbozer@aol.com
Contact: Joan Bozer

North Carolina
North Carolina Sustainable Energy Assoc.
P: 919.832.7601
officemanager@energync.org
energync.org
Exec. Dir.: Ivan Urlaub

Ohio
***Green Energy Ohio**
P: 614.985.6131
geo@greenenergyohio.org
greenenergyohio.org
Exec. Dir.: William A. Spratley

Oregon
***Solar Oregon**
P: 503.231.5662
hadley@solaroregon.org
solaroregon.org
Contact: Hadley Price

Pennsylvania
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Philadelphia Solar Energy Assoc.
NESEA Local Chapter
P: 610.489.1105
kira@sunpowerbuilders.com
Contact: Kira Costanza

Rhode Island
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Rhode Island Solar Energy Assoc.
NESEA Local Chapter
P: 401.855.1170
johntaborjacobson@yahoo.com
Contact: John Jacobson

South Carolina
South Carolina Solar Council
P: 803.737.8030
emyers@energy.sc.gov
Contact: Erika Myers

Tennessee *New Chapter!*
Tenneessee Solar Energy Assoc.
P: 865.974.9218
jim@tnsolarenergy.org or
steve@tnsolarenergy.org
tnsolarenergy.org
Contact: Jim Hackworth or Steven Levy

Texas
***Texas Solar Energy Society**
P: 512.326.3391, 800.465.5049
info@txses.org
txses.org
Exec. Dir.: Natalie Marquis

Utah
Utah Solar Energy Assoc.
P: 801.501.9353
ofarnsworth@aeesolar.com
utsolar.org
Contact: Orrin Farnsworth

Vermont
***Northeast Sustainable Energy Assoc.**
P: 413.774.6051
nesea@nesea.org
nesea.org
Exec. Dir.: Jennifer Marrapese

Building For Social Responsibility
NESEA Local Chapter
jvansteensburg@bsr-vt.org
bsr-vt.org
Exec. Dir.: Jessica Van Steensburg

Virginia
Potomac Region Solar Energy Assoc.
P: 866.477.5369
info@prsea.org
prsea.org
Contact: Nelson Buck

Washington State
Solar Washington Assoc.
P: 206.246.1200
info@solarwashington.org
solarwashington.org
Contact: Peter Barton

Washington, D.C.
Potomac Region Solar Energy Assoc.
P: 866.477.5369
info@prsea.org
prsea.org
Contact: Nelson Buck

Wisconsin
***Midwest Renewable Energy Assoc.**
P: 715.592.6595
info@the-mrea.org
the-mrea.org
Contact: Amy Heart

STUDENT CHAPTERS

Appalachian State University Sustainable Energy Society
P: 828.262.7333
asuses@gmail.com
asuses.net
Contact: Mike Uchal

NCSU Renewable Energy Society
P: 919.515.9782

University of Florida
P: 561.827.3608
ases.uf@gmail.com
ufases.org
Contact: Alex Palomino

University of Mass. Lowell Solar Energy Assoc.
NESEA Local Student Chapter
P: 978.934.2968
john_duffy@uml.edu
energy.caeds.eng.uml.edu
Contact: John J. Duffy

AMERICAN SOLAR ENERGY SOCIETY

DIVISIONS

Divisions Chair:
David L. Comis
dcomis@sentech.org

Clean Energy and Water
Chair: Nathan Mitten
mittenater@gmail.com

Concentrating Solar Power
Board Liaison: Allison Gray
allison_gray@nrel.gov

Renewable Fuels and Sustainable Transportation
Chair: Sam Carroll
samcarroll212@gmail.com

Resource Applications
Chair: A.J. Rossman
aj@drakersolar.com

Small Wind
Chair: Trudy Forsyth
trudy_forsyth@nrel.gov

Solar Buildings
Chair: Vikram Sami
vssami@yahoo.com

Solar Electric
Chair: Joe McCabe
energyideas@gmail.com

Solar Thermal
Chair: Barry Butler
barry@butlersunsolutions.com

Sustainability
Chair: David Panich
dpanich@pnarch.com

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Education
Chair: Nathalie Osborn
education@ases.org

International
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international@ases.org

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Chair: David Hill
policy@ases.org

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Membership
Chair: Paulette Middleton
membership@ases.org

Ethics
ethics@ases.org

She has worked with SEMI since 1996 and spent 10 years working on international standards, eventually serving as director of the SEMI International Standards Program. Since 2008, she has managed the global photovoltaic initiatives and activities of the SEMI PV Group, which serves the photovoltaic supply chain.

Yellot Award Winner: ALEJANDRO PALOMINO

PALOMINO

Alejandro Palomino is this year's recipient of the John and Barbara Yellott Award, which is given to a student concentrating on solar energy in a recognized institution of higher learning. Palomino has been an active member of the University of Florida's ASES student chapter since 2007. He organized last year's Gainesville National Solar Tour and will run it again this fall. Palomino is a member of his school's Solar Decathlon team, which will compete this summer in Madrid. He has also interned with Solar Impact, a Florida solar contractor.

ASES Fellows

KWOK

PEREZ

MCDONALD

ALISON G. KWOK, Ph.D., AIA, LEED AP, is professor of architecture at the University of Oregon. She is also author of the *Green Studio Handbook: Environmental Strategies for Schematic Design*, with Walter Grondzik. Kwok has served in several capacities and as a board member for the Architectural Research Centers Consortium, as past president of the Society of Building Science Educators, is a member of several ASHRAE committees and is a member of the U.S. Green Building Council's Formal Education Committee. She has received the ASES Women in Solar Energy Award and the University of Oregon's Faculty Excellence Award. Kwok has lectured and given workshops in the U.K., China, Korea, Japan and throughout the United States.

RICHARD PEREZ is a research professor at the University at Albany's Atmospheric Sciences Research Center, where he directs applied research and teaches in the fields of solar radiation, solar energy applications and daylighting. He sits on the advisory board of the GW Solar Insititute at George Washington University in Washington, D.C., and has served multiple terms on the ASES Board. He has produced more than 200 journal articles, conference papers and technical reports and holds two U.S. patents on methods of load management using photovoltaics. He has received several international awards including a Certificate for Outstanding Research from the U.S. Department of Energy and the Charles Greeley Abbot Award from ASES.

MARGOT MCDONALD teaches building energy courses, historic preservation and design and is a registered architect in Oregon. She is a doctoral candidate in the geography department at the University of California at Santa Barbara, where she is refining a climate classification system for passive and low energy buildings in California. She is the faculty advisor for the sustainable environments minor, an interdisciplinary degree program that received an AIA/Committee on the Environment eco-literacy award in May 2005. In 2006, she was appointed chair of the U.S. Green Building Council's Formal Education Committee and elected to the ASES Board of Directors, where she now serves as chair. She has also served as as chair and vice-chair of the ASES Solar Buildings Division.

Upcoming ASES Events

2010 ASES National Solar Tour
Oct. 2, Nationwide
rburns@ases.org
nationalsolartour.org

June

5, Sacramento
Geothermal Energy Systems Class
Contact 800.752.0881
extension@ucdavis.edu
extension.ucdavis.edu/gbd

9-11, Munich
Intersolar
intersolar.de

15-16, Stevens Point, Wis.
Small Wind Conference 2010
info@smallwindconference.com
smallwindconference.com

18-20, Custer, Wis.
The MREA Energy Fair
414.431.0758
info@the-mrea.org
the-mrea.org

July

13-15, San Francisco
Intersolar North America
intersolar.us

23-25, John Day, Ore.
SolWest Renewable Energy Fair
Contact Jennifer Barker, 541.575.3633
info@solwest.org
solwest.org

24, Gerald, Mo.
Intro to Small Wind Systems
Contact 303.883.8290
info@evergreeninstitute.org
evergreeninstitute.org

27, Chicago
Smart Buildings: Energy Efficiency in the Built Environment
Contact Joe Trackwell, 415.684.1020, x 7150
joe.trackwell@cleantech.com
cleantech.com

August

3, Odenton, Md.
Solar PV Design and Installation Course
IEC Chesapeake
Contact 301.621.9545
iec-chesapeake.com

ASES Trust Fund

The ASES Trust Fund was established in November 1999 to receive contributions to an endowment for ASES that will provide income for ASES educational programs in perpetuity. To make a donation, visit ases.org/donate.

$300,000 and higher
C.E. Bennett Foundation

$50,000 – $75,000
Otto and Phoebe Hass Fund at The Seattle Foundation $75,000

$25,000 – $50,000
Karl W. and Renate Böer $40,000
Mrs. Lammot du Pont Copeland $25,000

$10,000 – $25,000
Richard Collins $10,000
Molly O. Ross $10,000

advertising index

By **ASES Experts**

Buy Now, or When Solar Gets Cheaper?

What's It Worth on My House?

Osea Nelson

Andy Black

Got energy questions?
Submit them to ASES experts@solartoday.org. Not all questions can be answered personally.

Q My wife and I go back and forth on whether we should install a solar photovoltaic (PV) system now or wait until it gets cheaper. On one hand, you have the lowering cost and increased efficiency of the panels, countered by the shrinking renewable energy credit (REC) offered ($1.55 when we purchased our house, 55 cents as we speak). I'm confident the 30 percent tax credit is here to stay, but will the REC ratchet back up now that our utility is facing a 30 percent renewable energy requirement? What is the prevailing opinion on PV costs going forward? — Tom Patterman, Denver

A Prices for PV modules have dropped almost 50 percent over the past two years and may go lower. On the other hand, in your area, utility rebates dropped 35 percent in 2009 and will step down further. We passed your query on to Osea Nelson, a sales executive at Astralux Power Systems (aessolarenergy.com) in Boulder:

"First, going solar is a fantastic idea, whether it was two years ago or tomorrow, you can't go wrong if you get a high-quality solar installation. Second, the cost/rebate/efficiency dynamic has been a rollercoaster over the last 24 months with the rebate plunging, costs dropping steadily and efficiencies creeping up. Real pricing data on completed sales show that these trends have balanced out: Over the past year, true bottom line price to the consumer has remained reasonably steady. As the price fell, the rebate quickly followed. For the first time since the solar boom hit Colorado, we are actually seeing panel prices stabilize or inch back up, and the rebate has held steady, so the out-of-pocket has risen ever so slightly in recent months.

"As to your point about the REC payment changing in response to the recent 30 percent by 2020 portfolio expansion, it is almost certain that the rebate will not go back up. Xcel [Energy] and other providers have had such a strong response to these programs, many estimates have them well ahead of targets for solar requirements.

"Solar starts paying you back the day you flip the switch and it never stops making you money. The time has to be right for you and your wife, and only you two will know exactly when that is. But rest assured that today is a great day to look at going solar, and nothing that happens tomorrow will change that."

DAN BIHN

Photovoltaic prices are falling, but so are rebates and incentives. Whenever you invest, solar starts paying back the day you connect it.

Q We sold our home last year and my 2.4-kilowatt PV system did not add any value to the appraisal. The appraiser said a standardized value had not yet been established for PV systems. Are any actions underway to help the appraisal community establish values for solar? — Steve Thilker, Denver

A Appraisal policies are usually regulated by states, and the rules are often heavily influenced by local realtors and their multiple listing services. A number of progressive realtors and financial industry folks have begun lobbying to include energy-efficiency upgrades and renewable energy systems into home valuations, on a state-by-state basis. We put the question to Andy Black at OnGrid Solar (ongrid.net). Here's what he said:

"The appraisal value is based on the savings generated in the past year (times 20) or the sum of the expected savings before the warranty is up (usually at the end of 25 years). It has nothing to do with system cost — only on the value being produced. The '20 times' rule comes from the *Appraisal Journal* article on the subject." Readers can learn more on page 14 of "Economics of Solar Electric Systems for Consumers: Payback and other Financial Tests" at: ongrid.net/papers/PaybackOnSolarSERG.pdf. ST

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Web: www.twnesolar.com Tel: +86–28–67050039 Fax: +86–28–67050038 Chengdu, China