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HUGE SOLAR ... just in time for Schools

By George Harvey

Hampshire College's New Solar System

In 2015, Hampshire College in Amherst, Massachusetts, announced it was planning to be the first liberal arts college in the United States to be powered entirely by its own solar photovoltaic (PV) system. Now, it is making good on that promise.

The college is using 19 acres of its campus property to site the 4.7 megawatt system. The project is being built by SolarCity, which will also operate it. Solar Design Associates of Harvard, Massachusetts, provided design work.

Chelvanaya Gabriel, a Hampshire College staff member who served on the planning committee for the project, addressed concerns about putting solar panels on land which had once been agricultural land. She pointed out that the land can be used for agriculture again, when the college decides to re-purpose it in the future.

Readers of Green Energy Times may remember earlier articles on Hampshire College's sustainability efforts. "Coming Soon to a College Near You" appeared in the October issue of 2015, describing the college's Hitchcock Center. In August of 2015, we had an article on the R. W. Kern Center, called "This is How You Do It." Very remarkably, both of these buildings, under construction simultaneously at the same college, were designed to meet the Living Building Challenge (LBC). This represented the only time a single institution had two projects underway declared for the LBC.

Clearly, Hampshire College stands out as a unique environmental leader in more than one way. (Does this allow it to be called very unique? Perhaps Hampshire College will provide not only environmentalists but experts on English usage with new guidance.)

Hampshire College stands out as a great example of an organization that "walks the walk." The solar project is expected to save about 3,000 metric tons of carbon dioxide emissions each year. And by the way, for those who worry about the high cost of renewable energy, it is also expected to save the college about $400,000 each year.

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Groundbreaking for Hampshire College's 4.7 MW solar array is underway. Courtesy photo.

VT State Representative Takes Extra Pride in Local Manufacturing Business

By N.R. Mallery

Sarah Copeland Hanzas, a Democrat, represents Bradford, Fairlee and West Fairlee in the Vermont House of Representatives. She takes special pride in the environmental work done by her constituents, increasing their efficiency and installing renewable power. Now, she is doubly proud of her father's business, Copeland Furniture. It has a long history of being green, and it has just become greener.

Tim and Jenny Copeland started their furniture business in Bradford in 1975. They have built a reputation of being leaders in green living since then. Jenny is a member of the town's Conservation Committee. Tim made his business an example of green manufacturing. He installed efficiency systems and sustainable practices that made sense over the years. His business was a founding member of the Sustainable Furnishings Council. Much of the business' power came from a cogeneration system that also supplied heat for the plant. Wood for their furniture is from locally sourced and sustainably grown forests. The company is moving constantly toward more environmentally friendly finishes. The facility was, in fact, state of the art in nearly every way. Solar power waited, however, for just the right time.

Most people do not consider themselves fortunate to have contaminated land next door, but it turned out to be lucky for the Copelands. The land next to the Copeland Furniture manufacturing plant had become contaminated from dry-cleaning done by a manufacturer of athletic jerseys, who previously owned the adjacent location. Chemicals from that business contaminated the soil on the three-acre site. When land is polluted in such a way, there is not a lot that can be done with it. Nevertheless,

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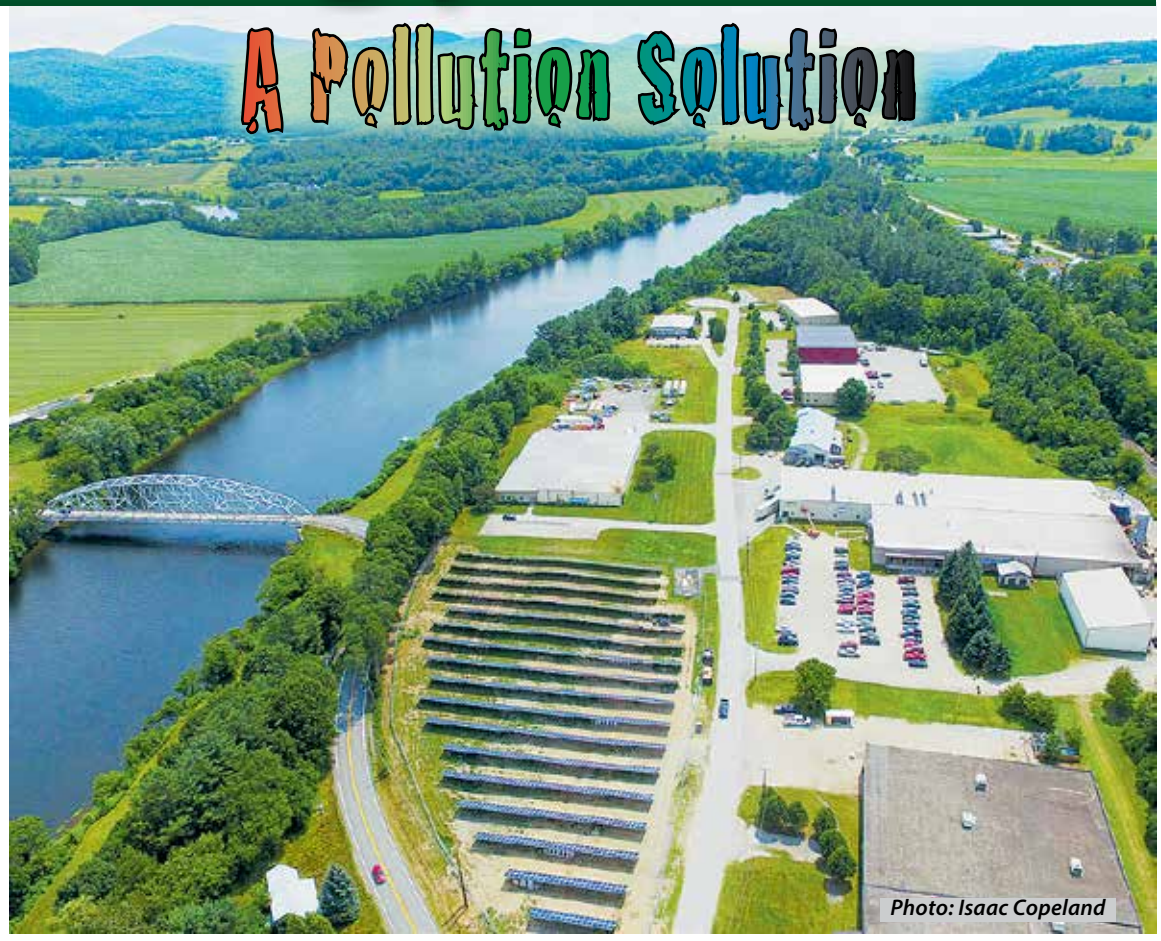

Copeland Furniture' s manufacturing plant excels with their renewable energy example of a 500-kW solar system … Bradford, Vermont

THE SUN IS RISING

The Transition to Renewables Is Unstoppable

By George Harvey

It's always darkest before the dawn. But the bad news is being dispelled in the light of day.

Diablo Canyon and the grid paradigm.

On June 21, 2016, Pacific Gas and Electric (PG&E) announced that it would cease generating power with the nuclear reactors at the Diablo Canyon plant as the license term ends. This was an important announcement for several reasons.

Diablo Canyon has the only two nuclear reactors in California generating power for the grid. They are of environmental concern for a number of reasons, one of which was that they are sited near a number of geological faults. On the other hand, both reactors are rated at over 1,000 megawatts (MW), and they supply 8.6% of the electrical power for the state, an important consideration for any plan to close the plant down.

While anti-nuclear activists cheered the decision to close the plant, many missed a more important issue. The decision to close the plant is not simply one more step toward weening the United States off nuclear power. We should go further than noticing that these reactors are joining seven others whose closing dates have been announced. When we do, we can see that they speak to a complete shift in the electric supply paradigm, the underlying strategy of how energy is produced.

Old thinking would dictate that Diablo Canyon be replaced by a base-load power plant. That, however, is not what was announced. The plant will be replaced by sources often

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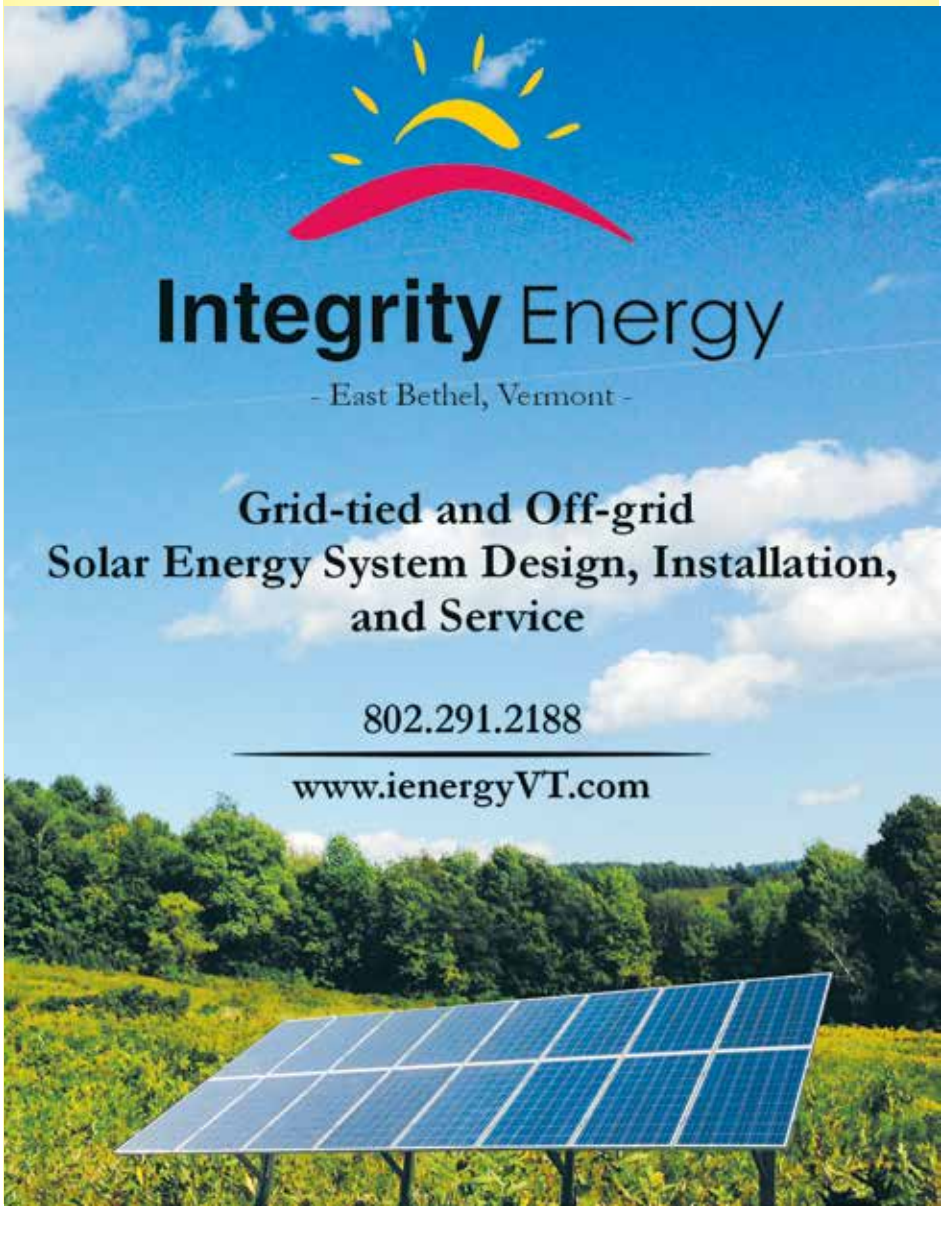
LATE-BREAKING NEWS

1. First, Leading climate scientists have warned that the Earth is perilously close to breaking through a 1.5° C upper limit for global warming, only eight months after the target was set. The decision to try to limit warming to 1.5° C, compared to pre-industrial temperatures, was made at the Paris climate negotiations last December. *Read more at http://bit.ly/reach1pt5degrees.*

2. Energy independence is growing in the U.S. passenger car market, led by Tesla Motors but also by ZEV mandates in 9 states, and EV efforts from auto companies. In July, electric car sales surged 48%, mostly on the back of Tesla, but sales jumped for the Chevy Volt, BMW i3, Ford Fusion Energi, and Chevy Spark EV. *[CleanTechnica: http://bit.ly/2016-ev-sales]*

3. With South Africa in its worst drought in history, a 16-year-old schoolgirl from Johannesburg created a super absorbent polymer out of orange peel and avocado skins. It is capable of storing reserves of water hundreds of times its own weight, forming reservoirs that would allow farmers to maintain their crops at minimal cost. *[http://bit.ly/schoolgirls-polymer]*



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Public Service Board Chooses Utilities Over Customers; Stalls Climate Action and Renewable Energy Progress

One of many pro-solar events held by groups in Vermont last year. Photo courtesy of VPIRG.

Environmental, climate, and sustainable business groups joined together recently to express grave concern over proposed changes to net metering, the program that allows Vermonters to choose renewable energy. The diverse organizations are urging the Public Service Board to reconsider its proposed rule as it undermines the State's commitment to help Vermonters increase their self-reliance and decrease dependence on fossil fuels and out of state energy while doing their part to reduce pollution that causes climate change.

"Vermonters are aggressively taking action to address our climate-change challenges, but monopoly utilities and regulators seem bent on halting progress by taking away our choices, increasing costs, and cutting jobs," said Olivia Campbell Andersen, Renewable Energy Vermont Executive Director. "We hope that regulators will reconsider their plans to derail local job creating renewable energy progress in our State."

Proposed policies including retroactive customer fees, an annual market-disrupting cap, and elimination of support for affordable community solar projects which represent more than 80% of the current net-metering market threatened to crater this important Vermont-grown sector of our clean energy economy, taking jobs and energy savings elsewhere.

"This rule is bad not just for our environment, but for Vermont consumers as well," said Ben Edgerly Walsh, Climate and Energy Program Director for VPIRG. "Make no mistake, this rule would dismantle more than a decade of work done to build towards clean energy in Vermont and pulls what amounts to a bait and switch on thousands of current solar customers at the same time."

"This rule would significantly damage the ability of towns and cities to go solar," said Johanna Miller, Energy Program Director for the Vermont Natural Resources Council. "It's the exact opposite direction we need to be going, making it more difficult for municipalities [that] want to generate clean electricity to do so. The new proposal ignores the comments of hundreds of Vermonters who showed up at public hearings to support municipal solar and community solar options for Vermonters who can't go solar on their own roof or in their own backyard."

"Vermont has a long legacy of working to achieve a clean and energy independent future for our children and grandchildren, so it's extremely disappointing to see a net-metering rule that would make it significantly more difficult for many towns, farmers, businesses, and families to go solar," added Lauren Hierl, Political Director, Vermont Conservation Voters.

Vermonters need and want more clean, local, and reliable energy. In May of 2016, hundreds of Vermonters attended the Public Service Board's two public hearings on the net metering rule revisions and submitted comments supporting community solar and urging the Board to continue a strong net-metering program.

"Vermont needs to move forward and this new rule would be a giant step backward in terms of the state's energy independence," said Daniel Barlow, public policy manager at Vermont Businesses for Social Responsibility. "Home and community solar are growing industries and creating good jobs for Vermonters. We should advance policies that help more Vermonters and Vermont businesses go green, unfortunately this new plan contains little urgency to address the economic and environmental threat of climate change."

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Leaking Oil Pipelines

By George Harvey

Destruction from a gas pipeline explosion in San Bruno, California, 2010. Photo by Brocken Inaglory. CC BY-SA 3.0.

Last September, the Washington D.C. Circuit Court of Appeals ruled that the National Environmental Policy Act did not require federal agencies authorizing a portion of an interstate oil pipeline to conduct a "whole-pipeline" environmental review. This means that portions of the pipeline can be reviewed separately, and this, in turn, means that the Army Corps of Engineers can approve a gigantic pipeline piecemeal, without an overall environmental review.

This practice has gone on for years. An example is the Gulf Coast Pipeline. The project is 485 miles long, running through Oklahoma and Texas. Each water crossing in the pipeline is allowed to be treated as a separate "single and complete project." Each of these projects is too small to warrant a complete environmental review by itself. So the upshot is that the overall project, all 485 miles of it, can be rubber-stamped, with no opportunity for public approval.

We might do well to remind ourselves of the recent history of major pipelines carrying petrochemicals. The number of failures is astounding. There was at least one major incident in every month of 2015. The United States had one fire, explosion, or environmentally damaging leak about every ten days, on average. These are listed in a Wikipedia article, "List of pipeline accidents in the United States in the 21st century."

Please note that this does not include fires or leaks at the wells, in terminals, or during transportation by truck, rail, or ship. The natural gas leak of last winter at Porter Ranch, in California, is not one of the 2015 leaks in the Wikipedia article, because it was a storage facility, and not a pipeline. And it does not include local pipes distributing gas within utility areas. So the 3,200 small leaks found in the natural gas distribution system in Boston by university students were also not included. Further, the fact that upward of 6% of all natural gas coming out of the ground is lost into the atmosphere at the wellhead is also not included.

President Obama signed the Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016 into law in June. Known as the PIPES Act, it authorizes the federal government to move swiftly in the event of a pipeline leak or rupture. But that only addresses problems that have already happened. That, however, is not the best we can do. "An ounce of prevention is worth a pound of cure." Pipelines that do not exist can never leak.

Fortunately, there are a number of organizations fighting this situation. Indigenous tribal groups are suing, because the sovereignty of their land, guaranteed by the federal government, is being ignored: http://bit.ly/tribal-pipeline-lawsuit. The Sierra Club is also continuing to work on the problem of pipelines and fracking: www.sierraclub.org.

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THE INTERNAL COMBUSTION ENGINE -- Is the End in Sight?

By Carl Pope

When Volkswagen engineers were challenged to enable small diesel engines to meet stringent U.S. standards for nitrogen oxide pollution, they tried, and tried – and after failing, cheated.

Now Volkswagen has agreed to one of the largest pollution penalties in history – whose hidden underside is that the engineers are still failing. Of the $15 billion Volkswagen has so far committed, $5 billion is to balance the environmental harm done by the 500,000 cheat-cars – as you might expect. The other $10 billion, $20,000 per vehicle, designated to deal with the cars, not the air, will not, however, fix the vehicles. Even given an effectively unlimited budget, engineers have not yet figured out how to make these cars emit less NOx pollution without creating an equally disastrous increase in CO2 emissions. If such a solution ever emerges, owners of these cars can get their vehicles cleaned up – but that seems unlikely. Meanwhile, owners can drive the cars for another two years, then turn them in to be scrapped. They get paid the value of the car not on the day they turn it in, but on the day when the cheating was revealed. So their incentives are to drive the car until the deadline, and then sell it back for more than its value. During these two years the pollution continues.

Given the complexities of the Clean Air Act, and the threat of litigation by the purchasers of the cars (who are not the real victims, those who breathe the pollution are), this wasteful use of $10 billion may have been forced on regulators. What the settlements make crystal clear, however, is that Volkswagen's engineers, with an unlimited budget, could not produce diesel engines that both met U.S. NOx standards, and also retained the fuel efficiency that makes automakers (and customers) love diesels.

Auto and truck makers have made remarkable progress in cleaning up soot, hydrocarbons, sulfur, and carbon monoxide from internal combustion engines, while making those engines more efficient so that carbon pollution per passenger or ton-mile could be lowered. Nitrogen oxide (NOx) pollutants from gas-powered engines can also be cleaned up. Auto-makers like diesels because they squeeze more energy out of fuel – but they also make it much harder to control NOx emissions. Volkswagen did not cheat to save a few dollars – it cheated because it couldn't make its small diesel cars meet U.S. standards. (Large diesels deal with NOx with a cumbersome, bulky urea injection system, which cannot practically be accommodated in smaller vehicles.)

This engineering limit on diesels is running into a global revolution of attitudes about air pollution. Deaths from air pollution are becoming a larger and larger catastrophe and a bigger and bigger political issue. New studies from the International Energy Agency calculated that 6.5 million people each year die from air pollution; similar studies emerge regularly from the World Health Organization. Governments and business can no longer conceal the death toll, and the public is unwilling to tolerate it. Governments are acting. The Volkswagen settlement is not the only regulatory crackdown on internal combustion engines.

> 2015 was the year in which climate pollution from transportation exceeded emissions from electricity. Oil, not coal, is now the biggest danger.

The Chinese government has drastically modified its entire development strategy to respond to citizen pressure about lethal pollution. The Indian government is scrambling to deal with growing public anger. In Europe, where auto manufacturers have been massively manipulating emission testing results, and urban air quality has been degrading as a result, public outcry has led cities to begin banning significant

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Electric School Buses

Opportunities in the Northeast

By Ryan Gerrity, Drive Electric Vermont

School buses generally come in large fleets, powered almost exclusively by diesel fuel, making them an important potential component of a public strategy to reduce greenhouse gas emissions, improve air quality and improve health. In Vermont alone, there are over 1,800 diesel buses transporting more than 75,000 children every school day. The New Hampshire school bus fleet has 2,900 buses and transports over 175,000 children. These buses release exhaust containing carcinogens, particulates, and pollutants known to cause issues such as facial irritation, respiratory inflammation, higher susceptibility to allergens or even serious health problems such as reduced lung function, asthma attacks, heart disease and lung cancer. Considering these issues, school buses are a great candidate for electrification.

Courtesy photos from Lion Bus.

The Vermont Energy Investment Corporation's Transportation Efficiency group has studied the feasibility of electric transit buses in Vermont and is currently working on an electric school bus demonstration project in four Massachusetts school districts. This article shares some of the opportunities and challenges that need to be addressed for greater adoption of electric school bus technology.

Electric school bus technology is becoming more accessible, creating a growing opportunity for school districts in the Northeast to transition to clean, zero-emission vehicles. Companies like TransPower in California and Lion Bus of Canada are already making electric school bus components and fully functional buses. Through these companies, you can retrofit a used bus with electric drive components, or buy a new, purpose-built electric school bus, making it possible to convert diesel school buses to all-electric today.

Electric vehicle technology still has a higher upfront cost than a diesel vehicle, but there are many opportunities for savings over time which can offset this initial investment. For example, the number of components found in an electric drive system is only a fraction of the amount found in a diesel engine which means no oil changes and dramatically less maintenance needed in general. Electric drive systems can save on average, upwards of $10,000 annually on maintenance.

Lower fuel costs are another benefit of electric school buses. Electricity rates are relatively consistent compared to the pricing of diesel and other conventional fuels and an electric school bus can be powered with electricity equivalent to about $1.25 per gallon of fuel. Costs for charging electric school buses can potentially be further mitigated with time of use rates that encourage charging during off-peak hours.

Buses equipped with bi-directional charging technology also have the potential to offer a vehicle to building (V2B) and vehicle to grid (V2G) service. With this technology, buses could supply schools with electricity to avoid drawing from the grid at peak rates, to save money, or provide relief to the grid when peak rates are present. A utility partnership where buses provide grid reliability services during peak electricity usage times has the potential to generate revenue while the buses are not being used for student transportation. While this application is not yet readily available, it has the potential to add an entirely new functionality, and value to school buses.

Perhaps the greatest opportunity for electric school buses is to provide clean transportation for our children and protect them from exposure to dangerous particulates in diesel fumes. Unlike diesel buses, plug-in electric school buses have no tailpipe emissions. In addition to eliminating the health risks to children riding school buses, we can generally improve air quality in communities and help reduce our greenhouse gas emissions which contribute to climate change.

The main challenge for mass adoption of electric school buses is cost. A new diesel bus typically costs $90,000. The cost of an electric school bus is around $350,000, which includes charging infrastructure purchase, installation and basic software. Public funding is available to help defray the costs of replacing diesel school buses through the Diesel Emissions Reduction Act (DERA) passed in 2005. This program provides funding for replacing outdated diesel vehicles and improving diesel vehicle engines to reduce emissions. As technology improves and more school buses are deployed there will be more opportunities to reduce costs. With this in mind, electric school bus fleets may become more common in the near future.

Drive Electric Vermont

The world's first solar-powered family car

Photo: TU Eindhoven, Bart van Overbeeke.

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NASHUA TRANSIT SYSTEM (NTS) - Buses and trolleys with bike racks. 603-888-0100 **RideBigBlue.com**

NH RIDESHARE – Your Source for Transportation Alternatives. **nh.gov/dot/programs/rideshare/**

WINNIPESAUKEE TRANSIT SYSTEM (WTS) - Services Belmont, Franklin, Tilton, Laconia. 603-528-2496 **bm-cap.org/wts.htm**

IN VERMONT

UPPER VALLEY TRANSPORTATION MANAGEMENT ASSOCIATION (Vital Communities) - Works with UV employers and communities to promote and improve commuting options. 802-291-9100 **vitalcommunities.org/transport/index.htm**

VERMONT PUBLIC TRANSPORTATION PUBLIC TRANSIT - Lists transit, ferries and more at **aot.state.vt.us/PublicTransit/providers.htm**

AMTRAK - Long distance train service. Discounts for AAA members and student advantage card. (800) 872-7245 **amtrak.com**

CHITTENDEN COUNTY TRANSPORTATION AUTHORITY - Burlington bus service with links to Montpelier, Middlebury and commuter route to Milton. **cctaride.org**

CONNECTICUT RIVER TRANSIT - Services in Bellows Falls and Springfield. **crtransit.org**

GO VERMONT - Offers carpool matching and commuter connections in VT 800-685-7433 **connectingcommuters.org**

GREEN MOUNTAIN RAILROAD - Day trips from White River, Champlain Valley, Bellows Falls and Rutland. **rails-vt.com**

GREEN MOUNTAIN TRANSIT AGENCY - Local service in Barre, Montpelier, Grand Isle, Stowe and Lamoille. 802-223-7287 **gmtaride.org**

GREY HOUND/VERMONT TRANSIT - Long distance bus services. 1-800-231-2222 **greyhound.com**/

LAKE CHAMPLAIN FERRIES - Transport between New York and Vermont via Lake Champlain. 802-864-9804 **ferries.com**

MARBLE VALLEY REGIONAL TRANSIT- For Rutland, Killington, rural Manchester, Poultney and Rutland to Bellows Falls. City routes Free on Saturday. 802-773-3244 **thebus.com**/

RURAL COMMUNITY TRANSPORTATION (RCT) - Buses, vans, and volunteer drivers. Routes via The Jay-Lyn, The Highlander (Newport - Derby Line); The US RT2 Commuter (St. J. to Montpelier) and Free routes to rural areas. 802-748-8170 **riderct.org**

STAGE COACH - Commuter buses from Randolph and Fairlee to Dartmouth, Local village buses. 800-427-3553 **stagecoach-rides.org**

SOLAR ROADWAYS

Image: courtesy of Solar Roadways

By George Harvey

Last year, Scott and Julie Brusaw ran an Indiegogo campaign to help fund a creative project called Solar Roadways. The idea was that the roads themselves could be solar photovoltaic (PV) collectors. It turned out that their idea had a wide appeal. The campaign raised over $2.2 million.

The idea of solar roads has been tried in other countries with some success. A section of a bicycle path was set up to generate electricity in the Netherlands. A 230-foot section of the road was converted to include PV modules. In its first six months of use, there were no problems of note, and the path produced enough electricity to power an average home. The project verified the expected output at 70 kilowatt hours per square meter per year. If this seems a bit low, remember that the panels cannot be tilted toward the sun because they form the surface of the road.

Aside from producing electricity, having a road made of solar modules has some safety implications. The modules can have LED lights built into them so they can glow in parts of roads that would otherwise be painted. They can also glow if detectors embedded in them detect pressure, providing a driver with a lighted warning that something is on the road. A solar road might give you the warning you need to avoid hitting a deer in the middle of the night.

The idea of making a road out of glass seems to defy logic, because glass breaks so easily. The thing is, if it is supported evenly so it cannot bend, it turns out to be very strong. It is so strong, in fact, that glass rods have been used to reinforce concrete for military bunkers in places where wartime shortages prevented steel from being used. Nevertheless, solar roads need to be tested under a broad set of conditions to prove they can be safe for vehicle traffic.

Now, testing is starting in the United States. The Missouri Department of Transportation is working with the inventors as part of its "Road to Tomorrow" initiative. The tests will be done on a short length of the historic Route 66. Most of the money for the initiative will come from the Brusaws' original crowd-funding, with smaller amounts from the state and federal governments.

The developers' hope is that everything will be installed for testing before the first snows fall in Missouri. If all turns out as expected, we may see solar roadways being adopted on a wider basis.

THE INTERNAL COMBUSTION ENGINE *Cont'd from p.4*

segments of the European auto fleet. New EU pollution testing systems will make it much more difficult and expensive for auto manufacturers to "game" emission tests, leaving diesel vehicles in particular at risk.

Climate concerns and fuel efficiency standards are also making internal combustion an outmoded technology. The U.S. is moving forward with new fuel efficiency and pollution standards for diesels. Countries like India and China are passing more stringent pollution rules and eliminating fuel subsidies. U.S. auto companies are complaining – falsely – that they cannot meet the current round of fuel economy standards; they are rightly concerned that the next round of post 2021 standards, is likely to exceed the capacity of internal combustion engines to meet. This will force a rapid increase in market share for electric cars.

> The internal combustion engine, powered as it is by thousands of small explosions inside its cylinders, is a 'remarkable kludge'.
> — Elon Musk

As shared fleet transportation companies like Uber and Lyft seize more and more market share, electric vehicles become more and more and more competitive. Vehicles which drive 100,000 miles a year recover the purchase price of an EV from savings on fuel and maintenance six times faster than a car driven only 15,000 miles.

Oil-powered transportation is becoming the most important climate threat. For both the U.S. and Europe, 2015 was the year in which climate pollution from transportation exceeded emissions from electricity. Oil, not coal, is now the biggest danger. That means that advocacy, philanthropic and political efforts that have focused on emissions from coal are going to take a closer look at oil. This closer look will increase the pressure on the internal combustion engine, which stands out as the main technology sustaining demand for oil.

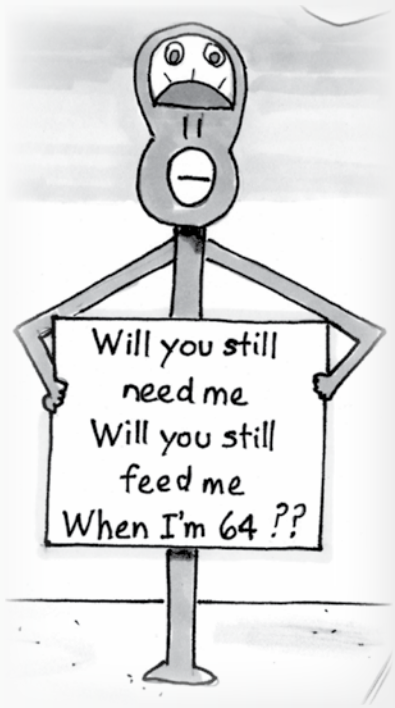
Governments all over the world – California, the Netherlands, Great Britain, Germany among them -- are considering outright bans on the sale of internal combustion engines. (A month ago Norway almost implemented its proposed 2025 ban.) More immediately, Germany, South Korea, Sweden and China are aggressively increasing incentives for EVs. India's car manufacturers have joined with the government to phase out internal combustion passenger vehicles by 2030.

Elon Musk has dubbed the internal combustion engine, powered as it is by thousands of small explosions inside its cylinders, a "remarkable kludge." Automotive engineers have indeed made modern gasoline and diesel engines perform remarkably – but now the limits are being reached.

In 1969 the California State Senate rejected – by *Cont'd on p.7*

THE INTERNAL COMBUSTION ENGINE - IS THE END NEAR?

Cont'd from p. 6



Cartoon courtesy of Leah Wittenberg.
www.leahwittenberg.com

one vote – a bill by then State Senator Anthony Beilenson, to ban the sale of cars powered by internal combustion engines. Beilenson's bill, motivated by a conviction that California's critical air pollution crisis could not be solved by gasoline-powered autos, has stood for almost half a century as an example of environmental over-reach.

Now technology trends, public insistence, industry investment, and government policy are all signaling that Beilenson's dream – an end to the burden of a transportation system powered by gasoline or diesel combustion engines – is coming within grasp.

Carl Pope is a former executive director and chairman of the Sierra Club. He is the principal advisor at Inside Straight Strategies, investigating underlying economics that link sustainability and economic development. He is a Senior Climate Advisor to former NYC Mayor Michael Bloomberg and has served on the boards of numerous environmental organizations. Mr. Pope has also written three books, one of which, Why the Bush Administration Is Recklessly Destroying a Century of Environmental Progress, was called "a splendidly fierce book" by the New York Review of Books.

Carbon Pricing – On the Agenda

By Tom Hughes

source: carbontax.org

In July, NASA announced that the first six months of 2016 was the warmest half-year in history[1]; NOAA released data showing that June was the 14th consecutive hottest month on record[2]; and the Weather Channel reported that temperatures in the Middle East hit an all-time high – 129.2 degrees Fahrenheit[3].

The signs that runaway global warming is upon us have never been clearer. Because of the warmest winter in Vermont history, ski areas opened late and closed early – leaving hundreds of Vermonters out of work. Algae blooms in Lake Champlain this summer closed beaches and endangered drinking water. And ticks have carried Lyme disease north with them – infecting thousands and driving up health care costs.

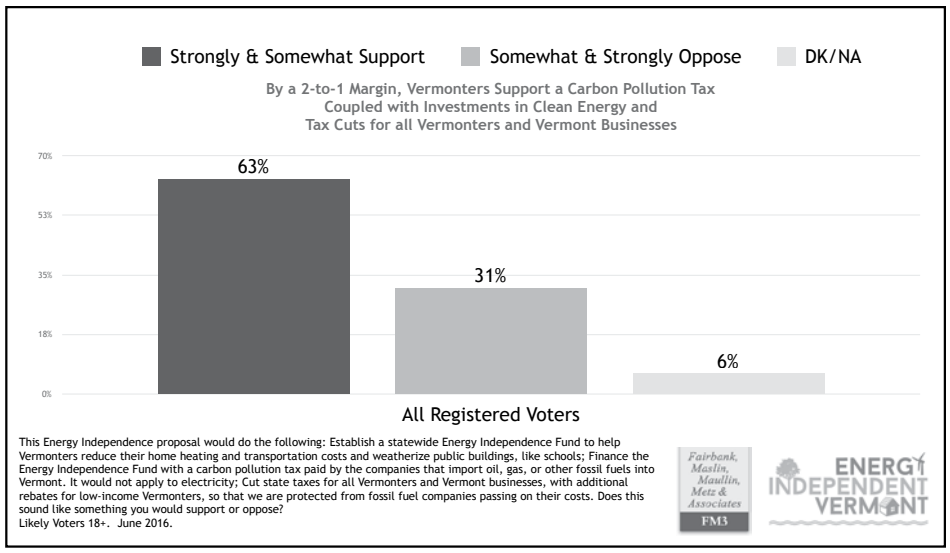
Despite these unmistakable indications of global warming, President Obama's Clean Power Plan is tied up in court; the United States House of Representatives recently voted to oppose sensible solutions to reduce pollution; and the Republican Party nominated Donald Trump for President – a man who has repeatedly claimed that global warming is a "hoax."

With national action to reduce greenhouse gas emissions largely stymied by a dysfunctional Congress and partisan legal challenges, it is essential that individual states act as the "laboratories of democracy" and design their own carbon pollution-reduction programs to address the threat of global warming.

What many politicians in Washington are missing – but many Vermonters understand – is that reducing carbon pollution will create jobs and strengthen the economy.

President Obama has called carbon pricing "the most elegant way to drive innovation and reduce carbon emissions."

Vermonters Want a Price on Carbon Pollution



In a June 2016 poll, nearly two-thirds of Vermonters voiced support for a carbon pollution tax that invests revenues in clean energy and cuts other taxes for individuals and businesses. Courtesy image.

And Republican Henry Paulson says, "A tax on carbon emissions will unleash a wave of innovation to develop technologies, lower the costs of clean energy and create jobs."

Here in Vermont, there is growing support for putting a price on carbon pollution. By a margin of two to one (63% to 31%) Vermonters support the idea of a carbon pollution tax paired with cuts to other taxes and investments in clean energy[4]. More than 20,000 Vermonters have signed a petition calling for the next governor to lower taxes on income, employment and sales and put a gradually rising tax on carbon pollution.

One such proposal has been introduced by Energy Independent Vermont (www.EnergyIndependentVT.org) – a growing coalition of businesses, non-profits, academics, clergy and low-income advocates working to grow Vermont's clean energy economy and ensure that all Vermonters are able to transition away from fossil fuels.

An independent analysis[5] of the Energy Independent Vermont proposal shows it would:

1. Create two thousand new Vermont jobs by spurring the transition to cleaner, local sources of energy and keeping energy dollars local;
2. Strengthen the economy by increasing gross state product by $100 million and real disposable income by $150 million; and
3. Cut carbon dioxide emissions by 30% or more over the course of 25 years as Vermonters switch from heating fuel and gasoline to less-polluting alternatives like solar powered heat pumps and electric vehicles.

Curbing global warming is not a physics problem; it is a political problem. It is a market failure that largely excuses fossil fuel companies from paying the true cost of the pollution their products cause. Correcting that market failure requires political will – and that is what is missing.

But there is hope on the horizon.

In the year ahead, Vermont will swear in a new governor, lieutenant governor, Speaker of the House and Senate President Pro Tempore. There has not been this level of turnover in Vermont leadership since the late 1960s. With new leadership comes the opportunity for a fresh take on a persistent problem: the alleged conflict between bold environmental action and healthy economic development.

Vermonters want clean air, clean water and a healthful climate. We also want jobs and economic opportunity. For years, however, too many politicians have told us we have to choose between a strong economy and a healthy environment. Nothing could be further from the truth.

There is a simple, effective, bipartisan solution to promote both. By re-aligning our tax systems with our values we can create good-paying jobs, reduce pollution and save money.

Tom Hughes is the Energy Independent Vermont campaign director.

1. *http://bit.ly/climate-trends*
2. *http://bit.ly/noaa-record-heat*
3. *http://bit.ly/mideast-weather-records*
4. *http://bit.ly/vt-global-warming-poll*
5. *http://bit.ly/eivt-analysis*

A Pollution Solution

Cont'd from p.1

there was one thing they could do with the land that made perfect sense to them. That was to use it for a solar array.

"We decided about a year ago," Tim Copeland said. "We'd known about solar for years, but the immediate impetus came from Green Mountain Power. GMP was looking at the feasibility of doing 500-kilowatt sites, the largest systems allowed for net metering, and queried their customer base about possible sites. GMP decided not to move forward with their program, but we were intrigued enough to want to do it ourselves. Vermont's net-metering program and the State and Federal tax credits make it financially attractive.

"Financially it made sense in addition to doing someone good on that field that was otherwise useless," Tim Copeland said. Though the contamination issue was costly for the business, the solar system on this site would provide about 75% to 80% of the power needed in the plant. Under net metering, it would get 19¢ per kilowatt hour (kWh) for the electricity, the same amount paid by customers who buy cow power.

Of course, even with incentives and other help from both the federal and state governments, the 500-kilowatt system needed financing, as it would cost $1.4 million. Ledyard National Bank, of Hanover, New Hampshire, was the primary lender. Tim Copeland also wanted a nearby solar installer to do the job. He chose Catamount Solar, of Randolph, Vermont, as the general contractor.

Construction of the solar system was started at the end of June. The array is on schedule, and should be complete and grid-connected on about August 15, just as Green Energy Times is going to press.

"Our interest in sustainability is rooted in the concepts of conservation and stewardship of resources. Waste of resources or spoilage of the environment is never a good thing. As it relates to the solar installation, why wouldn't we use 850,000 kwh/year of "free" energy, effectively reducing the marginal amount of energy that would otherwise need to be produced by burning oil, coal or gas and achieve a reduction of 1,000,000 [pounds] in CO2 emissions."

It might be worth mention that another solar array is just across the street from the one Copeland Furniture is building. This belongs to Farmway, which is now 100% powered by the sun. Neither business was especially influenced by the work of the other, in this matter. Tim Copeland was very much aware of the Farmway array, and appreciated its value, but went on his own thinking. (Cpuld there be something going around?) Copeland gives credit to is the typical environmental ethic of people raised in Vermont. "The ethic of conservation runs deep and long," he has said. "It's not a recent fad. It has nothing to do with politics. It's simply taking care of the land that you live on."

To the right is the 500-kW solar system at the Copeland Furniture Manufacturing plant in Bradford. Inset is one of our VT State Representative, Sarah Copeland Hanzas, who is the daughter of the owner of Copeland Furniture. You will read more about what Sarah is up to in our Oct. Issue of Green Energy Times.

Photo: Isaac Copeland

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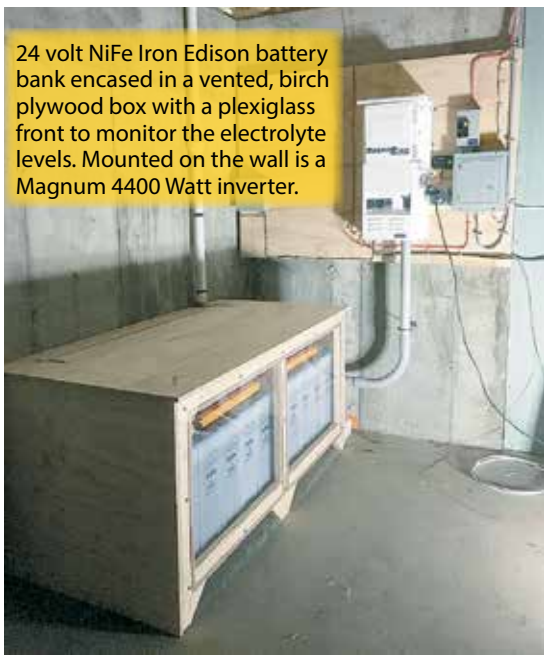
Off-Grid in Vermont and Beyond

By Donna Nicol

Life in Vermont is a unique experience, especially for those who choose to live somewhere off the beaten path. In the past few years, the off-grid solar system and resulting lifestyle has been eclipsed by its more glamorous, but necessary sibling, the net-metered, grid-tied PV system. It's wonderful that so many people are going solar and choosing to make electricity for their homes and their communities. But let's shine a spotlight on the modern off-grid PV system.

First, what is an off-grid PV system? It is a photovoltaic system that is a complete, on-site power plant for your house, cabin, or camp where electric companies haven't installed power lines. Off-grid systems vary widely in size and cost depending on the loads the owner desires or requires to run (in other words, the things that use electricity) and the unique qualities of the site. The major components of a system are the solar array, the inverter, a charge controller, and the battery bank. These individual parts will determine how much power is generated, how much power is available in the conversion to household current, and how much power is held in reserve. And although there is a greater awareness of energy efficiency now, it is most vital when designing an off-grid system. The size of the system (and therefore its cost) is determined by the appliances the homeowner intends to power. Water pumping and refrigeration are necessities, and these appliances and their electrical consumption are considered first when building a system. Next are appliances where use is more driven by choice – if an appliance generates heat (typical examples include a toaster, coffee maker, or dishwasher), it needs careful consideration because these items use a significant amount of power and will increase the size of a system. Off-grid systems are capable of providing every comfort and convenience of a "standard" home. They usually accomplish this by considering high levels of efficiency rather than making extraordinary investments in power production. We design systems that work as efficiently as possible.

OK, you say, so what is the cost? Budget, of course, is perhaps the largest consideration in choosing the size of an off-grid power system. The smallest systems provide DC current only. These systems are great for camps and cabins, providing power for simple living with lighting, DC water pumping, and even entertainment systems. These solar systems range in price from around $3,500 to $5,000. Adding more solar modules increases your charging capacity. Include an inverter, and now you have AC current available such as that in a standard house. Many inverters also include battery chargers that work with a generator to back up the solar array as your source of charging for your battery bank (think dark months, November and December). Battery bank size is determined by the amount of reserve power required but also by the amount of charging capacity available. We do not oversize battery banks relative to the amount of charging available. Mounting for the solar modules is another consideration that has impacts on the cost of the installed system. In short, these larger systems which provide many or all of the conveniences of a standard, grid-tied home range in price from $15,000 to $25,000. Systems can be much larger, thereby capable of producing and storing significantly more power. The sky's the limit and the equation is simple: more watts = more dollars! In short, the off-grid system is tailored to the needs of the homeowner. It's a viable option for producing your own power and living off the beaten path! *[Editor's note: … or even on the beaten path. It is a viable option for nearly anyone.]*



24 volt NiFe Iron Edison battery bank encased in a vented, birch plywood box with a plexiglass front to monitor the electrolyte levels. Mounted on the wall is a Magnum 4400 Watt inverter.

Transporting a palette of American-made SolarWorld SW285 solar panels and racking to an off-grid installation on an island in Lake Champlain. This Korean War-era mechanized transport ship moves goods from shoreline to islands in the lake.

Solartech's owners, Rich and Donna Nicol, have been living and evolving an off-grid lifestyle for nearly twenty years now in Sutton, VT. They design, install, and service off-grid and grid-tie systems. For more information, call 802-467-3500, email info@solartechvt.com, and visit www.solartechvt.com.

This is the first in a new series that will be featured in Green Energy Times about Living with Solar — Off the Grid.

48 volt Rolls-Surrette battery bank encased in a vented, cherry and maple hardwood box custom-built for the battery bank. All photos by Rich Nicol, Solartech

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Pirouette Farm's Community Solar is Not Horsing Around!

The Pirouette Farm's solar panels were installed in six and a half hours. Photo courtesy of Norwich Technologies.

A solar photovoltaic installation in Norwich, Vermont, looks as though it may set a trend. It was put on the roof of a barn at the Pirouette Farm, which not only has the solar exposure, but also the size needed to provide for a number of families. Among other advantages, it has the cost advantages of a rooftop system, but also the economy of scale of a community array.

Norwich Technologies (NT) used a proprietary solar design, EZ-PV for the system. EZ-PV was developed by the company's own designers and is the company's unique approach to solar photovoltaic (PV) technology. It provides for pre-assembly of sets of solar panels into MetaModulesTM. The panels are fitted to their racks using jigs, which make the entire operation repeatable and measurable, more precisely than they could ever hope to be in the field. They are tested in advance by using lights and measuring output before they are brought to the installation site. Once there, they are installed very quickly, with a minimum of disruption.

All of this was very important to Robert and Mary Piro, owners of the Pirouette Farm, an equestrian center, where the array was sited. Horses can become very stressed by the noise and inconvenience that can be associated with construction. The reduced level of activity to which the horses would be exposed was a definite benefit.

The pre-wiring in the building was not a bother to the horses. It was quietly done, and they probably did not notice at all. After that, on the day the solar panels arrived, they were already out, in their regular daily activities.

While the horses were going about their regular routine, a crane arrived so the metamodulesTM could be hoisted into place. It was on the back of a truck with wide wheels, which meant that the soil under it was disturbed as little as possible. The crane lifted 32 metamodulesTM, with a total of 180 panels, to the roof of the barn. Workers on the roof put them into their permanent resting places. Then they wired the modules to the system, while the crane packed up and left for home.

> THE ARRAY'S 180 PANELS WERE INSTALLED IN SIX AND ONE HALF HOURS!

Norwich Technologies uses two crane services at their installations, and they regard both very highly. The operators have received special instruction on how to do the specific job at hand and are experienced in the work. Hutch Crane Services of Stowe, Vermont, provided the work at the Pirouette Farm. NT also uses Miller Construction of Windsor, Vermont.

The installation of the assembled 60 kW's of solar panels with the crane was done in six and a half hours. There was practically no visible indication that the crane had ever been there, aside from the work quietly done on the roof. Meanwhile, the horses were still out, going through their regular activities. Our understanding is that not a single horse complained about the stress caused by the installation.

SunEdison (Flextronics) 335-watt panels were used for the system. These high-power monocrystalline panels allow a greater amount of power in the same space as less efficient modules that are more widely available. The panels have only recently come to market for general use, though they have been used for some

Cont'd on p.26

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Affordable Housing Is GOING SOLAR IN BARRE, VT

The Barre Housing Authority (BHA) is pleased to announce that it has received approval from the U.S. Department of Housing and Urban Development (HUD) to enter into a long-term net-metering agreement with Encore Renewable Energy of Burlington, Vermont. Through the agreement, BHA will save more than $700,000 over the next twenty years as a result of this public-private partnership formed to develop and finance two separate 500kW solar arrays on working farms in Orange, Vermont.

"We view this agreement as a classic win-win, as BHA anticipates lowering our electric bill with Green Mountain Power significantly, while also contributing to the social good associated with the further development of Vermont's clean energy economy," stated Chip Castle, BHA Executive Director. "As part of our ongoing operating budget review process, we are constantly looking for ways to do things as efficiently as possible in order to allow us to deliver the greatest amount of high-quality, affordable housing to the communities we serve. We have been working closely with Encore on this exciting opportunity for some time and it now looks like all the hard work and effort will pay off for BHA and, hopefully, pave the way for other Housing Authorities across the country," said Castle.

"We are delighted to be working with BHA on this important community solar project which is the latest of a number of projects that Encore has worked on with leading affordable housing authority partners," said Encore President Chad Farrell. "We are committed to this important area of solar energy development - projects which deliver low cost solar electricity to low- and moderate-income households, as these projects are entirely consistent with our corporate mission and make financial sense for our partners, such as BHA."

"Sustainability is key to preserving our public housing for the future and the Barre Housing Authority is a leader in this effort," said Jim Reed, HUD New England Regional Administrator. "We congratulate the Housing Authority on this innovative partnership that makes both economic and environmental sense."

Senator Patrick Leahy, a leading member of the Senate Appropriations Committee that authorizes funding for HUD programs, said "This new collaboration between the Barre Housing Authority and Encore recognizes that green building is not only vital to lowering our carbon footprint and energy costs. It also is an essential part of building a sustainable, inclusive community. At the federal level, I believe it is our job to recognize and enable these partnerships as a way to preserve our critical housing stock and to save money by cutting utility costs. I am proud to support this project and remain committed to promoting this ground breaking initiative as a way to improve the quality of life for residents of public housing, and to ensure that renewable energy can continue to flourish as an engine of economic growth, job development and opportunity."

The solar arrays are expected to be commissioned and to begin generating net metering solar credits in late 2016.

An Encore ground mount solar array project, similar to the ones to be constructed for BHA. Photo courtesy of Encore Renewable Energy.

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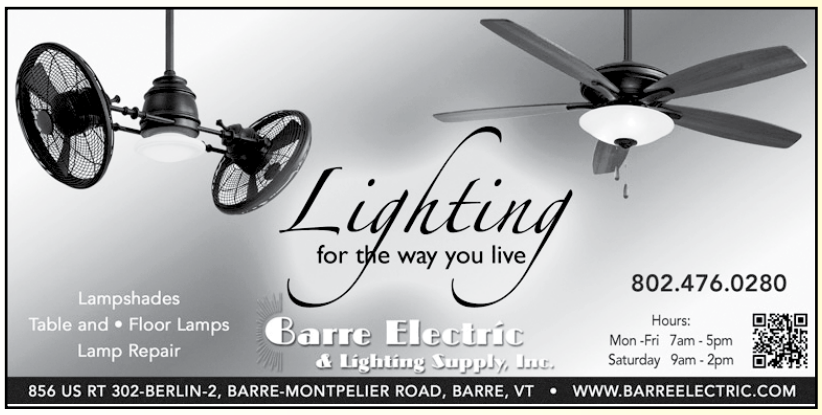

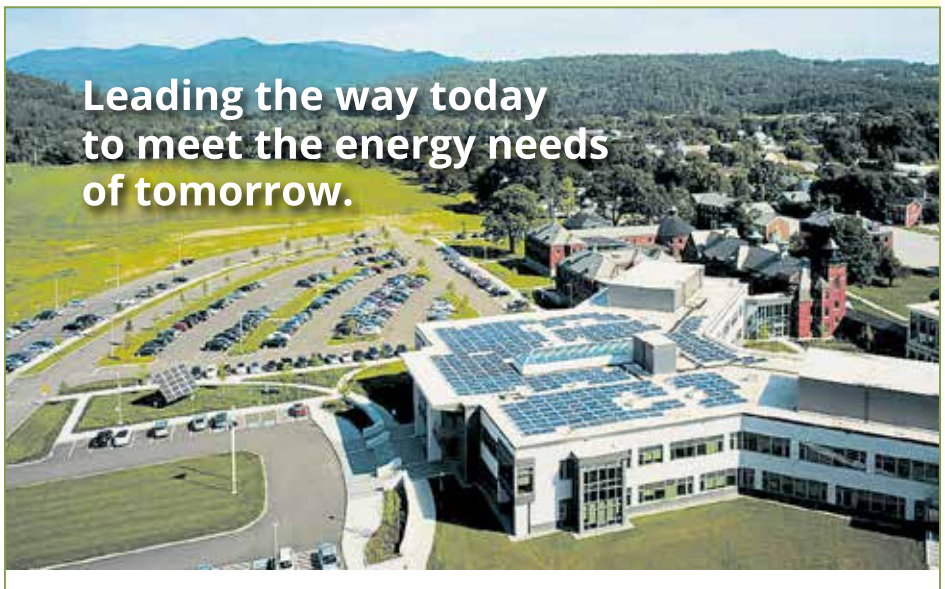

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Meet Your Solar Installer:
Milhouse Enterprises

By George Harvey

Though Milhouse Enterprises, of Belmont, New Hampshire, is now one of the most experienced solar installers in the Northeast, it did not focus on solar installations at the beginning. When it was founded in 1992, Milhouse engaged in energy retrofits and building off-grid, net-zero homes, to be heated by geothermal heat pumps. Today, this would be remarkable, but in those days it was almost unheard of. Chris Milner of Milhouse Enterprises said, "We were green before green was a buzzword."

With the passing of time, the demand for geothermal heating became overwhelming, as people began to understand the benefits, causing this to be the main focus of the business. At the same time, Milner understood that with the dropping price of solar power, it would be possible to use it to drive the heat pumps used to heat and cool homes, and so Milhouse expanded in that direction.

"We assist our self-install customers with paperwork, process, layout and technical support."

Originally, both heat pumps and solar power were outsourced, but in 2003, they brought geothermal in-house, and in 2006, they did the same for solar. The reason for this change was largely because Milner felt that the solar and geothermal installers were not making things as easy for customers as he wanted them to be, a problem he would rectify. The easiest way to make sure the customers have a good experience is to take responsibility for the service.

The economic downturn in 2007 had extensive impact on housing and the building industry. Milner's change of focus made his business better prepared for this than it otherwise might have been, and he was able to shift Milhouse's focus away from construction, in favor of solar power and geothermal heat. When construction activity had not improved by 2010, the company became devoted entirely to alternative energy, closing the construction division. In fact, solar installations take up so much of Milhouse's demand that it is now sometimes necessary to send inquiries about geothermal installations to the competition, because there is simply not enough time to do everything.

Milhouse's background is important for anyone wanting to install solar at home. Because of its experiences with construction, Milhouse has both expertise and equipment for that field. This means that dealing with ground site preparation, concrete, and so on, can be done by the company itself, and there is no need to bring in outside specialists for the purpose. The upshot of this is that a ground installation done by Milhouse can come at the lowest available price, and at a cost very competitive with a rooftop installation. This is a significant advantage, especially for anyone who might have reason to replace a roof in the foreseeable future, a prospect that can either mean replacing the roof early or putting a solar installation off for a few years.

Milner says his company's ability to provide lowest-cost ground mounts is one of a number of distinct advantages. Milhouse uses products made exclusively in the United States for grid-tied systems. It has the longest warranties in the market. It uses "the most advanced and accurate shading analysis equipment that exists," Milner says. "Many of our competitors don't have this because of the high cost."

There is a final advantage that will delight some Green Energy Times readers. Milhouse offers not only grid-tied systems and off-grid and battery-backup systems, but do-it-yourself installation kits. Milner says, "Most firms do not do off-grid, and only one other offers 'self-install,' which they only sell on Ebay. We assist our self-install customers with paperwork, process, layout and technical support."

Milner is dedicated to spreading the word on solar power. Since installing solar systems is not a winter job, he travels a lot in that time of year, teaching architects and engineers about alternative energy. His courses are certified by the American Institute of Architects and state engineering boards, which review courses to make sure they are up-to-date and accurate, so professionals can get credits for their licenses by attending them. The courses, given in many places across the United States, are six to seven hours long.

The Milhouse Enterprises install team in front of the business's 6.84 kW solar array. Photo courtesy of Milhouse Enterprises.

Milner says, "Our goal has always been to be the best at what we do by offering our customers the best experience, quality, customer service, and craftsmanship they can get for a lower price than others can offer, thereby making us the leader in our industry."

The number for Milhouse Enterprises is 603-300-2943. The web site is www.milhouseenterprises.com.

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Durham, NH Nearing 100% Solar

By Green Energy Times Staff

Oyster River Forest 651kW Municipal Solar Array in Durham, NH. Photo from Revision Energy

On Thursday, July 21, the town of Durham, N. H., had a ribbon cutting ceremony to inaugurate its municipal solar array in the adjacent town of Lee. Their solar system, the Oyster River Forest Solar Array, is rated at 651-kilowatts.

The new solar array is the largest project to date for the installer, ReVision Energy, which has offices in Maine, New Hampshire, and Massachusetts. ReVision Energy did the engineering, designed, and installed the system, and will continue to provide any necessary maintenance. It was financed and is owned by IGS Solar, a turn-key commercial and residential solar provider.

The Town of Durham owns the site where the array was erected. At one time it had a gravel pit. It has a water well and an aquifer recharge system, in addition to the solar system. It is not a site that has many other available uses.

The new solar array was designed to generate 100% of Durham's municipal electric load, aside from a waste-water treatment facility. It should produce excess power, and this will be credited to the Oyster River Cooperative School District to cover part of its electricity costs.

Charles Forcey, the chairman of the Durham Energy Committee, said at the ceremony, "The Oyster River Forest Solar Array is an unprecedented collaboration between two municipalities, two pioneering, private solar companies, a cooperative school district and the Public Utilities Commission of New Hampshire. With immense gratitude toward its partners in this utility-scale effort, the Town of Durham celebrates this landmark achieve-

Cont'd on p.14

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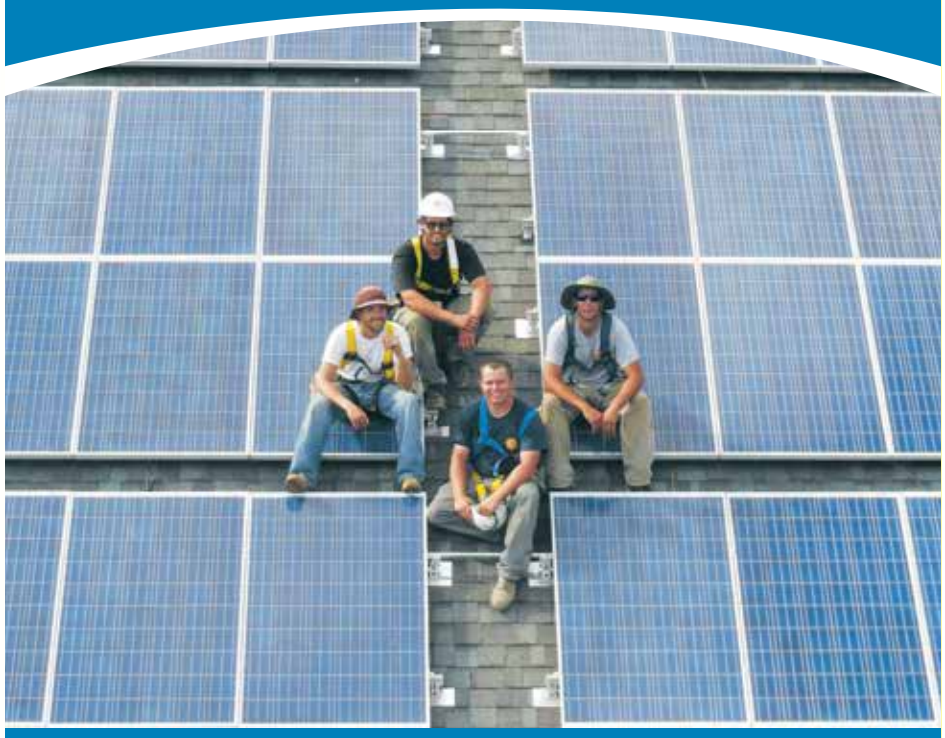

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Liberty, ME 207.589.4171

NH Community Solarizing Program Updates

By Michelle Harrison

Green Energy Times has covered m any of the community solar programs throughout New Hampshire. The progress of the programs is given below. These programs have really been successful!

Solar Up New Hampshire

The Solar Up NH program is being led by the Southern New Hampshire Planning Commission (SNHPC). The SNHPC is working with SmartPower to bring round three of the solarize program to southern New Hampshire.

Seven communities in the SNHPC Region participated in rounds one and two last year and the solarize campaigns held in these communities generated a total of 1.35 MWs of new renewable solar energy through solar installations at 91 homes and three businesses in the region.

Three communities, the towns of Francestown, New Boston and Weare will be participating in round three of Solar Up NH, which began on June 27 and runs for 16 weeks to October 15, 2016. Milhouse Enterprises located in Belmont, NH and Granite State Solar located in Boscawen, NH, were selected installers for the Solar Up NH round three summer campaigns.

The primary goal of Solar Up NH is to lower the cost of solar pv through discount pricing contracts and to double the number of solar PV installations for homeowners and businesses in each participating community.

To learn more and to sign up for more information and a free site visit, go to the Solar Up NH website at: www.solarupnh.com.

Wolfeboro Solarize Campaign

The Wolfeboro Solarize Campaign is being led by the Wolfeboro Energy Committee. The committee's goal was to double the kW of solar that had been previously installed in town, which was approximately 75 kW. To date, the campaign has generated 125kW of new solar in the region.

Frase Electric, of Sandwich, NH, was selected to be the partner installer. In support of this program, Frase Electric has committed to donate five cents to a town project for every watt. This money was used to remove and reinstall a PV array at one of the buildings at the sewer department. This was a way for the whole town to get a small benefit from the installations, not just the residents who installed an array.

For more information, please visit http://www.solarizewolfeboro.org/

Solarize Ammonoosuc

The Solarize Ammonoosuc campaign was spearheaded by the Ammonoosuc Regional Energy Team. The goal of the campaign is to increase the number of local homes and businesses powered by solar PV. It is estimated that the campaign increased the amount of residential solar PV by over 100%.

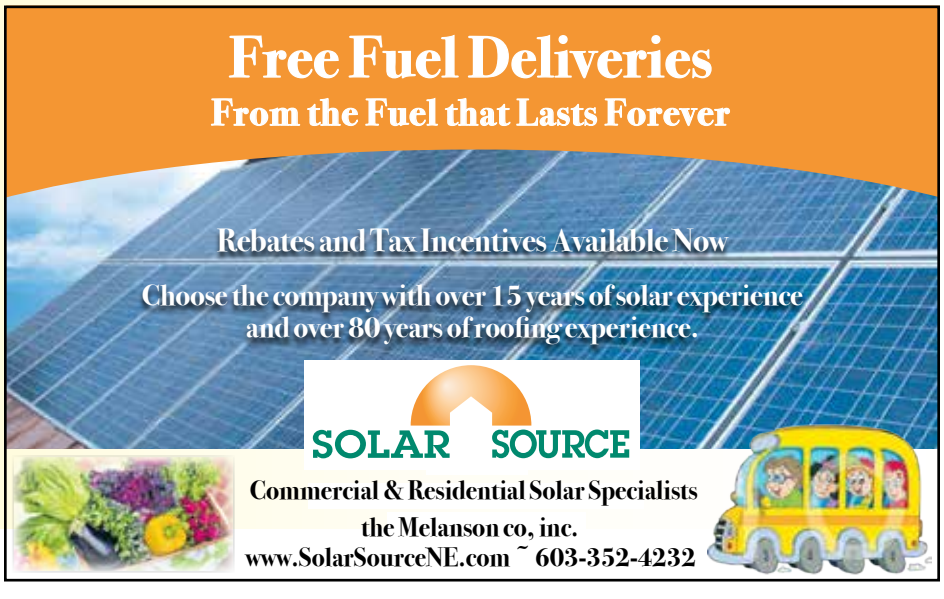
O'Meara Solar is the chosen installer. To date, 14 installs totaling 73.6 kW are completed, and there are several more to do, and more coming in every day. The final numbers will be over 120kW. Other area installers have been putting systems in as well, as the solarize campaign has sparked more installation opportunities. The installations have ranged from Bath, NH to Lancaster, NH, with most in Franconia and Sugar Hill.

For more information, visit http://ammenergy.org/index.php/solarize-ammonoosuc/events-and-news

A 12 kW ground-mount array installed as part of the Wolfeboro campaign. Photo courtesy of Frase Electric.

A 5.13-kW solar PV array using U.S.-made Solarworld modules was added to the home of an Ammonoosuc Regional Energy Team member. This home was previously outfitted with a solar hot water collector. Photo courtesy of O'Meara Solar.

The Upper Valley Solarize Campaigns have also been extremely successful, perhaps setting the stage for the ones that are on-going at this time. We hope this trend continues and would love to hear about what your community is doing. Send us an email at info@greenenergytimes.org or call us directly at 802.439.6675.



Durham, NH Nearing 100% Solar

Cont'd from p.13

ment toward our overarching goal to secure a clean, affordable and secure energy supply for our municipal services."

The array was commissioned in June. It has 2,100 solar modules on fixed ground mounts arranged in fourteen rows. So far, it has produced about 4,000 kilowatt hours (kWh) of electricity each day. That, however, is summer production, when the sun is high and the days are long. Annually, the solar array is expected to generate about 859,300 kWh. This would reduce carbon dioxide emissions that would be produced by burning 1,553 barrels of oil or 75,823 gallons of gas. It is about the amount of electricity used by 115 average New Hampshire homes.

IGS Solar Vice President Patrick Smith said, "We are glad to be a long-standing sustainability partner to the Town of Durham by helping them control their energy costs with solar." The project also qualified for a grant awarded by the New Hampshire Public Utilities Commission.

Electricity provided to the Town of Durham was secured through a power purchase agreement (PPA), which is often the least expensive way for a municipality to buy its power. Under the PPA, the power is provided by IGS Solar, with maintenance provided by ReVision Energy. The Town of Durham will get nearly all of its electrical power from the sun, at no upfront cost.

The solar system for the Town of Durham is is the second largest yet built in the state of New Hampshire. Steve Hinchman, Director of Finance for the PPA division at ReVision Energy, said, "We're honored to help the Town of Durham become one of the first New Hampshire towns to power itself with clean, renewable energy and to reduce fossil fuel use on a large scale."

Oyster River Solar PV Array
Packers Falls Rd., Lee, NH

System Size:
651 kW DC; 504 kW AC
2,100 - Q-Cell 310W Modules

Inverter: 24 SMA 24,000
Racking System by RBI Solar: 14 Rows Driven Pile with Inter-row Spacing of 17'4".

Array: Tilted at 35°; Azimuth 180°; Perimeter: 1,365'; Area: 110,035 s.f.

Annual Generation:
859.3 MWH; kWh/kWp: 1,320

Commissioning Date: 6/15/2016

System Owner:
IGS Energy: IGSenergy.com

System Design/Construction:
Revision Energy: ReVisionEnergy.com

Solar Energy Offtaker:
Town of Durham: ci.durham.nh.us

A Do-It Yourself Ground Mount Solar Installation

By Michelle Harrison

Top left: Owner-installed, twenty-eight panel ground mount array in Londonderry, New Hampshire. Inset: Bruce Harrison working with an employee of Milhouse Enterprises. Below: the kids enjoying the shade under the array during the recent heat wave. All photos courtesy of the Harrison Family.

Are you looking to go solar but want a better payback period? Are you good with hand tools? Are you willing to invest some sweat equity into your project? If you answered yes to these questions, you should consider a solar ground-mount self-installation and save a few thousand dollars.

The first step is to find a solar installer who is willing to sell you a do-it-yourself installation kit. The installer will help with the selection and purchase of the hardware and help locate a good spot for the array. The location must have no more than 20% shading to ensure you are eligible for the government rebates. New Hampshire requires a shading analysis as part of the rebate application. Your solar installer will be able to provide this.

The next item to research is the property assessment laws of your state or local government, as applicable. Some cities and towns treat renewable energy projects as an increase of your property value. Some treat it as a tax-neutral event. Some states have relevant state laws. Do not be afraid to challenge your local government to request a policy change, citing examples of the many towns out there that process renewable projects as a tax-neutral event. You can find this information on your state's website. You will be happy you took the effort to do so.

Once you get your hardware quote, research the cost of panels and inverters. Installers may tend to favor certain products. These may or may not be to your liking depending on factors that are important to you such as product efficiency, place of manufacture, delivery charges, etc. Solar installers most likely can offer better product pricing due to quantity discount purchases, but it cannot hurt to do some research on your own.

One thing that was initially surprising is the size of the footprint needed for the ground-mount. If you have the opportunity to visit a solar array of similar size, do so. This provides a great visual to understand how to locate your array, and if a ground-mount is for you. While considering the design, allocate space if you think you may expand the array at a later time.

Once you have things in motion with the solar contractor, visit your town or city hall and get the required permits. If you plan on tying into the grid, contact your utility company and get your connection agreement approved. The solar contractor will then map out the position for the poles for the rack. This is when the fun begins. Give yourself time to dig holes. If you live in the Granite State, you are guaranteed to find plenty of rocks that will slow your progress. If you don't, try your luck in the lottery!

Setting up the ground-mount poles is next. This is a critical step and takes patience. Your level will be your friend. The proper set-up of the rack is important to achieving the desired array angle and level of your panels to achieve maximum solar exposure.

Installation of the microinverters and panels is next. It is important to get the first, lower row of panels on properly as the other panels sit on top. If the first row is not even, the rest of the array will follow suit. If you need help installing the panels, check out the many community solar- raising groups available to help. The next step is to plug all the inverters to the panels and the inverters to the trunk cable. The number of trunk cables you have depends on the size of your array. The final step is to run the electrical connection from the solar array to the breaker box. Do not try this if you are not qualified to do so; it is best for someone familiar with the electrical codes to do this work. Your solar contractor can help.

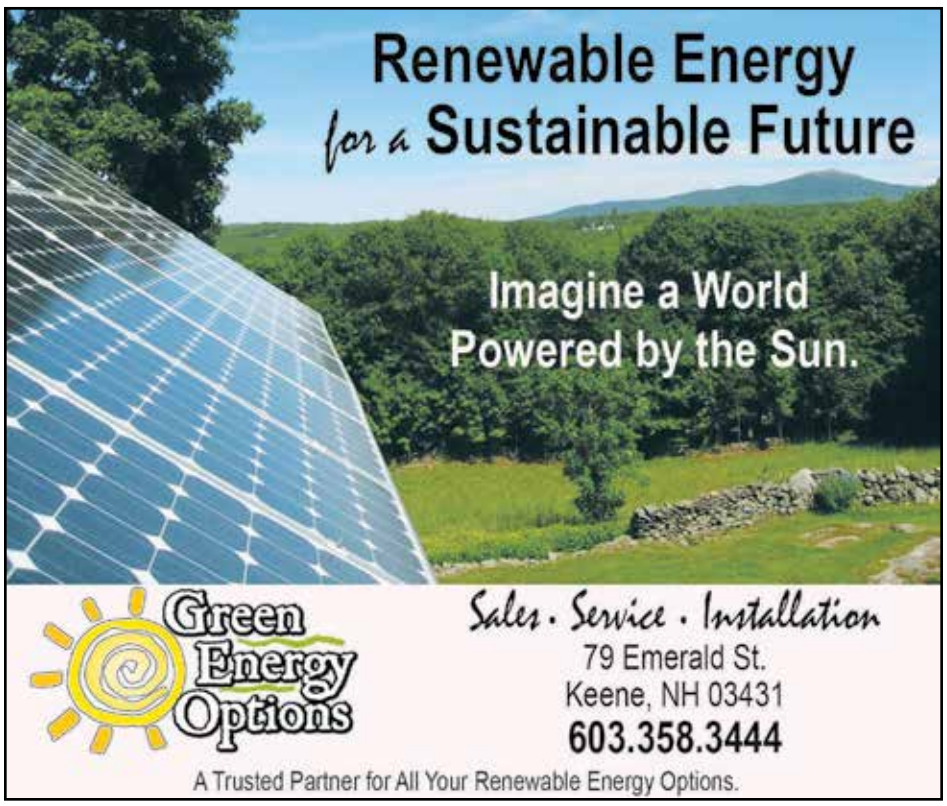
Congratulations, your solar array is now complete! Time now to get the city or town to complete its inspection. If you are tying back to the grid, complete the appropriate paperwork, including a copy of the approved inspection, to your utility company. This will initiate a meter change-out to one that can run backwards. A huge smile will go on your face when you see the utility company drive up to change your meter. Now you can turn on your breakers and run your solar array. You will get lots of satisfaction watching your meter run backwards!

If your location offers Renewable Energy Credits, make sure to sign up for that program. Through the course of the year, you should receive a few hundred dollars back.

We hope these pointers help you in your solar decision and saving some money. Do your homework, but do not delay. Start your solar project while rebates are still attractive.

Michelle and Bruce Harrison installed an 8.4 kW system with SolarWorld solar panels and Enphase microinverters on an Iron Ridge racking system with the assistance of Milhouse Enterprises. It is expected to produce 10.15kWh annually and have a nine-year payback period. It will offset the Harrison family's carbon footprint by an estimated 30 tons of CO2 equivalent per year.

Michelle Harrison has worked with Green Energy Times since 2013 and is currently the Coordinating Director and Marketing Team Leader.



FEDERAL

FEDERAL INVESTMENT TAX CREDIT

The federal investment tax credit (ITC) for most technologies, including solar, wind, heat pumps, and fuel cells, is 30% of expenditures. For commercial geothermal generating systems, microturbines, and combined heat and power the ITC is 10% of expenditures.

USDA RURAL DEVELOPMENT PROGRAM

USDA Rural Development Program - Rural Energy for America (REAP)

Finance the purchase of renewable energy systems, and make energy improvements; energy audits. Funding is awarded on a competitive basis; grant funding cannot exceed 25% of eligible project costs and combined loan guarantees and grants cannot exceed 75% of eligible project costs.

Applicants include Feasibility studies/ regular REAPs: agricultural producers and rural small businesses. Energy audits and renewable energy development assistance: local governments, tribes, land grant colleges, rural electric coops, public power entities. Grant must be used for Construction or improvements, purchase and installation of equipment, energy audits, permit fees, professional service fees, business plans, and/or feasibility studies. Find more at www.rurdev.usda.gov/NH-VTHome.html or call 802-828-6080 in VT or 603-223-6035 in NH

BIOREFINERY ASSISTANCE PROGRAM

USDA Rural Development offers opportunities to producers to develop biofuels through the Biorefinery Assistance Program. The program provides loan guarantees for the development, construction, and retrofitting of commercial-scale biorefineries.

The Biorefinery Assistance Program was established to assist in the development of new and emerging technologies for the development of advanced biofuels and aims to accomplish the following:

• Increase the energy independence of the United States

• Promote resource conservation, public health, and the environment

• Diversify markets for agricultural and forestry products and agricultural waste materials

• Create jobs and enhance economic development in rural America

For more information go to www.rurdev.usda.gov/BCP_Biorefinery

REGIONAL

NEW ENGLAND GRASSROOTS ENVIRONMENTAL FUND

MODEST GRANTS ARE AVAILABLE FOR COMMUNITY-BASED ENVIRONMENTAL WORK IN CT,MA,RI,NH,VT,ME

- Must be volunteer driven or have up to 2 full time paid staff or equiv.
- have an annual budget up to $100,000
- "Seed" grants of $250-$1,000 and "Grow" grants of $1,000-$3,500
- Go to www.grassrootsfund.org/grants/ or call 802-223-4622 for more info.

VERMONT

CLEAN ENERGY DEVELOPMENT FUND

The Small Scale RE Incentive Program, administered by Renewable Energy Resource Center (RERC), provides funds to help defray the costs of new solar thermal and advanced wood pellet heating systems. For more information: www.RERC-vt.org or call (877)888-7372

SOLAR THERMAL INCENTIVES – PER RATED CAPACITY OF SYSTEM

- $0.40 per kWh/year for residential and commercial customers
- $0.80 per kWh/year for Special Category customers

***special customer category limited to municipalities, non-profit housing authorities, public schools., and non-profit hospitals and health care centers. All incentives are subject to availability and may change.*

Pellet Heating

- Advanced wood pellet heating systems -- $2500 per boiler (+$500 if an audit is completed and +$500 if the system includes at least 20 days' worth of pellet storage).
- **Details at www.RERC-vt.org or call (877)888-7372**

VT TAX CREDITS

Vermont offers an investment tax credit for installations of renewable energy equipment on business properties. The credit is equal to 24% of the "Vermont property portion" of the federal business energy tax credit from 2011 to 2016. For solar, small wind, and fuel cells this constitutes a 7.2% state-level credit for systems and for geothermal electric, microturbines, and combined heat and power systems, this constitutes a 2.4% state-level tax credit.

EFFICIENCY VERMONT

Lighting (must be ENERGY STAR®)

Discounted replacement lamp program:

- LED R/BR/PAR $11 to $17 rebate Globe, A, Candle/Decorative $6 rebate
- LED fixtures $15 rebate
- LED task/under cabinet fixtures $8 rebate
- ENERGY STAR LEDs supported by Efficiency Vermont through incentives can be found for as low as $1.95

Home Efficiency Improvements

- improvements: air sealing, insulation and heating system upgrades - up to $2,500 in incentives - using participating* contractors

Appliances (must be ENERGY STAR)

- Dehumidifiers - $25 mail-in rebate
- Clothes Washers - $40 rebate for CEE Tier 1 qualifying models, $75 rebate for CEE Tier 2, 3 or ENERGY STAR Most Efficient
- Refrigerators - $40 rebate for CEE Tier 1, $75 for CEE Tier 2, 3 & ENERGY STAR Most Efficient
- Clothes Dryers - $50 to $400 rebate on select ENERGY STAR electric models

Heating/Cooling

- LP/Oil boilers & furnaces - $500 rebate*
- solar hot water - $950 rebate post installation
- heat pump water heater - $400 rebate or point of purchase discount
- central wood pellet boilers (excluding outside wood systems) - $2,000
- circulator pumps - $50-$600 point of purchase discount
- cold climate heat pump - $400 point of purchase discount

Residential New Construction

- enroll in Residential New Construction Service – up to $2,000 in incentives and free home energy rating and expert technical assistance throughout construction and eligible for ENERGY STAR label
- Washington Electric Coop and Vermont Gas Systems customers may also receive additional incentives (contact EV*)

Other Opportunities To Save

- Advanced Power Strips – coupons at register at participating retailers*
- Pool Pump – up to $600 rebate on qualifying ENERGY STAR models
- Meter Loan – borrow "Watts Up" meter to measure the electric consumption of your appliances

*. *all rebates/incentives subject to availability, limits and may change – for complete incentives and requirements, and for participating retailers/contractors, visit efficiencyvermont.com or call 888-921-5990*

NEW HAMPSHIRE

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH THE NH PUBLIC UTILITIES COMMISSION

Commercial Solar Rebate Program

Category 1:

≤100 kW AC incentive levels for PV systems:

- $0.70/watt (lower of AC and DC) for new solar electric facilities (Step 1 application received prior to September 1, 2016);
- 0.65/watt (lower of AC and DC) for new solar electric facilities (Step 1 application received on or after September 1, 2016); Maximum incentive of 25% of total project cost. Expansions to existing solar systems are not eligible.

≤100 kW AC equivalent incentive levels for solar thermal systems:

- $0.12/rated or modeled kBtu/year for new solar thermal facilities fifteen collectors in size or fewer;
- $0.07/rated or modeled kBtu/year for new solar thermal facilities greater than fifteen collectors in size; Maximum incentive of 25% of total project cost. Expansions to existing solar systems are not eligible. (Does not include federal tax credits)

Category 2:

> 100 kW AC and ≤500 kW AC incentive level for PV systems

- $0.55/Watt AC for new electric facilities, or 25% of total project cost or $175,000, whichever is less. Expansions to existing solar systems are not eligible.

Contact Elizabeth.Nixon@puc.nh.gov or at (603) 271-6018.

PLEASE NOTE: Category 1 C&I Program is accepting applications for a waitlist for the funding. As of May 5, 2016, the budgeted funding for Category 1 of the C&I Program was fully reserved. As funding becomes available, applications will be processed and reviewed in the order of receipt. For Info contact: executivedirector@puc.nh.gov. For C&I solar program details, go to: http://bit.ly/NHPUC-re-Rebates

Residential Solar PV Rebate Program

- Rebates for solar electric/10kW (or thermal equivalent) or less
- New Solar PV = $0.50/Watt DC or 30% of total project cost, whichever is less. Max $2500.
- Expanded Solar PV = $0.50/Watt DC or 30% of total project cost, whichever is less. Max $2500.

Contact jon.osgood@puc.nh.gov

Residential Solar Water Heating Rebate Program

- $1500 - $1900 per system based on annual system output
- Maximum incentive in combination with other incentives received: Rebate in combination with other rebates or grants received from the utility or other programs, including other state, local or federal programs, shall not exceed 40% of the total cost of the system (Does not include federal tax credits).

Commercial Bulk Fuel-Fed Wood Pellet Central Heating Systems

- 40% of the heating appliance(s) and installation cost, up to a maximum of $65,000. An additional 30% up to a maximum $5,000 is available for thermal storage. $5,000 is available to assist in the cost of meters for systems that become REC eligible. Systems must be 2.5 million BTU or less

Wood Pellet Boiler or Furnace

- 40% of installed system up to $10k
- An adder of $100/ton for storage over 3 tons, up to $500 is available.
- Must meet thermal efficiency and particulate emissions standards

Contact barbara.bernstein@puc.nh.gov *www.puc.nh.gov – Sustainable Energy or tel. 603-271-2431 for more information and current program status*

LOCAL INCENTIVES

Some towns provide property tax exemptions for renewables – visit www.bit.ly/NHtownRenewablesTaxBreaks

- These are offered on a town-by-town basis.
- The state also has passed PACE (property-assessed clean energy) enabling legislation which will allow towns to use the PACE mechanism to finance clean energy projects through property taxes.

Visit http://www.nh.gov/oep/programs/energy/pace/index.htm for more information.

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH THE NH ELECTRIC CO-OP

PLEASE Check for UPDATEs With NHEC/ Pre-Approval Is Required

Commercial Solar Thermal (Hot Water)

- Incentives are capped at the lesser of 25% of the system cost or $10,000

Commercial Solar PV

- Incentives are $0.25 per DC watt up to the lesser of 15% of the installed cost or $10,000

Commercial Fossil Fuel Program

- Incentives re 35% of the project cost up to $15,000

Commercial Heat Pump Water Heaters

- Incentives are $500 for 50 gallon heaters and $600 for 80 gallon heaters

Commercial Mini Split Heat Pumps

- Incentives are up to $500 per ton

Residential Heat Pump Water Heaters

- Incentives are $500 for 50 gallon heaters and $600 for 80 gallon heaters

Residential Solar PV

- incentives are $0.25 per DC watt up to $1,375

Residential Solar Hot Water

- incentives are 20% of the project cost up to $750

Residential Heat Pumps

- Incentives are up to $500 per ton

While we at Green Energy Times try to keep things up to date, incentives are always changing. Be sure to check with the appropriate sources for the latest information.

PAREI

To explore the possibility of a solar installation. Plymouth Area Renewable Energy Initiative. www.plymouthenergy.org

- **WWW.NHSAVES.COM**
- **WWW. NHEC.COM**

NH HOME PERFORMANCE WITH ENERGY STAR

Sponsored by all NH electric and natural gas utilities in partnership by the U.S. Dept. of Energy. Fuel-blind eligibility using the Home Heating Index (BTUs of heating fuel / conditioned square feet / heating degree days). Must provide at least 12 months of heating fuel history. Once qualified, eligible homes get a $450 value comprehensive energy audit for $100 (rebated if improvements installed), and 50% instant rebate for eligible weatherization improvements up to a $4,000.
Visit www.nhsaves.com/residential/retrofit.html for more information and an online Home Heating Index calculator

NH ENERGY STAR HOMES

Incentives for builders of new homes who meet ENERGY STAR guidelines. Incentives include HERS rating fee paid by the utility, rebates for ENERGY STAR lighting, appliances and heating systems, and $800 - $4,000 additional incentive depending on the HERS score.

Visit www.nhsaves.com/residential/homes.html for more details.

NH ENERGY STAR APPLIANCES & LIGHTING

Mail-in rebates for ENERGY STAR-rated clothes washers ($30), room air conditioners ($20), room air purifiers ($15) and smart strips ($10).

Visit www.nhsaves.com/residential/es_appliance.html for more information and rebate forms.

Instant rebate coupons ranging from $1 to $7 for ENERGY STAR-rated CFL and LED light bulbs purchased through qualifying NH retailers.

Visit www.nhsaves.com/residential/es_lighting.html for more information.

NHSAVES LIGHTING AND EFFICIENCY CATALOG

Extensive catalog of efficient lighting products, from stylish lamps to hard to find specialty bulbs. Catalog includes other efficiency items such as smart strips, power monitors, and water-conserving devices

Offered at discounted pricing for NH electric utility customers, and fulfilled by EFI.

Visit catalog.nhsaves.com/ for an online version of the catalog.

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OTHER NH ELECTRIC UTILITY PROGRAMS

See also individual utilities for additional programs and variations. NH electric utilities may offer low or no interest on-bill financing for energy efficiency projects.
Visit www.nhsaves.com/resource/ for individual utility contact information.

Business Programs

Includes programs for: small and large business, new equipment and construction, seminars, lighting incentives and catalog, and low and no interest financing programs.
Visit www.nhsaves.com/ for information about NH business incentives for electricity efficiency.

NH Weatherization Assistance Income-Eligible Programs

Home Energy Assistance and NH community action Weatherization Assistance Program. Financial assistance paying fuel bills, and free weatherization improvements for qualified applicants. Funding from U.S. Dept. of Energy, NH utilities.
Visit www.nh.gov/oep/programs weatherization/index.htm for application criteria, FAQs and local program contacts

MASSACHUSETTS

COMMONWEALTH SOLAR HOT WATER (SHW) PROGRAMS

Applicants must be served by National Grid, Unitil (Fitchburg Gas and Electric), Eversource or a participating Municipal Light Plant community.

Homeowners are eligible for a base rebate amount of the lesser of $4,500 or 40% of the installed cost. The system may also be eligible to receive additional funding ("adders") which increase the amount of the rebate. Adders are detailed in the program manual at http://files.masscec.com/get-clean-energy/residential/commonwealth-solar-hot-water/SHW_Program_Manual_Small_Scale.pdf

Visit http://www.masscec.com/programs/commonwealth-solar-hot-water

MASSSAVE HEAT LOAN SHW

Through this loan program, customers may borrow at 0% interest the costs of a Solar Domestic Hot Water and/or Thermal Heating system. Apply through receiving the MassSave Energy Audit. You can borrow up to $25,000 at 0% interest for a 7 year term.
Energy Efficiency
After conducting a free residential Energy Audit, residential customers are eligible for up to $25,000, commercial loan up to $100k at 0% interest heat loan with terms up to 7 years to cover the following energy efficiency improvements: atticwall-basement insulation, high efficiency heating systems, high efficiency domestic hot water systems, solar hot water systems, 7-day digital programmable thermostats, Energy Star replacement windows
Available only to utility customers of W. Mass Electric, National Grid, Berkshire Gas, Nstar, Unitil and Cape Light Compact
Visit www.masssave.com/residential/heating-and-cooling/offers/heat-loan-program. Call 866-527-7283 for a free home energy assessment.

ENERGY EFFICIENCY

After conducting a free residential Energy Audit, residential customers are eligible for up to $25,000, commercial loan up to $100k at 0% interest heat loan with terms up to 7 years to cover the following energy efficiency improvements: atticwall-basement insulation, high efficiency heating systems, high efficiency domestic hot water systems, solar hot water systems, 7-day digital programmable thermostats, Energy Star replacement windows
Available only to utility customers of W. Mass Electric, National Grid, Berkshire Gas, Nstar, Unitil and Cape Light Compact
Visit www.masssave.com/residential/**heating-and-cooling/offers/heat-loan-program Please call 866-527-7283 to schedule a free home energy assessment.**

MASSACHUSETTS SOLAR LOAN PROGRAM

Mass Solar Loan focuses on connecting homeowners who install solar pv systems with low-interest loans to help finance the projects.
The $30 million program, a partnership between the Massachusetts Department of Energy Resources (DOER) and MassCEC, will work with local banks and credit unions to provide financing to homeowners interested in solar electricity. DOER's program design will work with banks and credit unions to expand borrowing options through lower interest rate loans and encourage loans for homeowners with lower income or lower credit scores.
Since 2008, the solar electric industry in Massachusetts has grown into a robust economic sector with over 1,400 businesses and 12,000 workers, with enough solar electricity installed in the Commonwealth to power more than 100,000 homes.
Mass Solar Loan will continue to grow this sector, while allowing more homeowners the ability to achieve the cost savings and environmental benefits of this clean, renewable energy source. **www.masssolarloan.com.**The most updated loan principal buy down rate based on household income ican be found at **www.masssolarloan.com/loan-support-incentives.**

DEPT OF ENERGY RESOURCES

Solar renewable-energy credits (SRECs) associated with system generation belong to the system owner and may be sold via the Department of Energy Resources (DOER) SREC program. Note: appropriate, approved Data Acquisition System monitoring must be utilized for PV systems >10kW in order to qualify to sell SRECs.
MA State Income tax credit for residential solar hot water or PV systems are eligible for a one time 15% off system cost, capped at $1000 max tax credit.
No sales tax on residential solar hot water or PV system.
No sales tax on residential solar hw or pv systems.
There is no increase in property tax assessment for residential hw or pv systems for 20 yrs.

NEW MA SREC POLICY

Massachusetts' new version of its Solar Renewable Energy Credits Program is informally being called SREC II.
SREC II prioritizes sites, however, by using an SREC factor based on the type of installation. The credits provided for energy produced by a system are calculated by multiplying the factor times a full credit value. Full credit is given for residential, parking canopy, emergency power, or community-based systems, or any other system of less than 25 kW. Larger systems get a factor of 0.9, if they are building-mounted or at least 67% of the power produced is used at the site. If a larger system meets neither of these criteria, but is built on a landfill or brownfield site, or if it is less than 650 kW, then it gets a factor of 0.8. Systems that qualify for none of the foregoing get a factor of 0.7.

http://bit.ly/Mass_SREC_II.

MA State Incentives can be found at: www.masscec.com/get-clean-energy

NEW YORK

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH nyserda

Welcome to the 2016 New York solar incentive and rebate information:

https://solarpowerrocks.com/new-york/

New York State Energy Research and Development Authority.

- Business & Industry
- Communities & Governments
- Partners & Investors
- Cleantech & Innovation
- Residents& Homeowners

DISCOVER YOUR HOME'S ENERGY WASTE

Getting a home energy assessment can help you take control of your energy costs. It can identify where your house is using the most energy and which improvements would have the biggest impact on your bottom line. Heating and cooling costs frequently account for 50% of residential energy bills. Identifying your energy waste can lead to big savings.

Visit: nyserda.energysavvy.com to get an energy assessment

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH NY-SUN

http://ny-sun.ny.gov/

NY-Sun is structured around customized Megawatt (MW) Blocks targeted to specific regions of the state. To learn more, see the Megawatt Block Incentive Structure.

Residential and Small Business
http://ny-sun.ny.gov/Get-Solar/Residents-And-Small-Business

Commercial and Industrial
- http://ny-sun.ny.gov/Get-Solar/Commercial-and-Industrial

Community Solar
- http://ny-sun.ny.gov/Get-Solar/Community-Solar

Find a Commercial/Industrial Solar Installer
- http://ny-sun.ny.gov/For-Local-Government/Local-Government

Find a Residential/Small Commercial Solar Installer
- http://ny-sun.ny.gov/Get-Solar/Find-A-Solar-Electric-Installer

Financing Options
- http://ny-sun.ny.gov/Get-Solar/NY-Sun-Financing

Clean Power Estimator
- http://ny-sun.ny.gov/Get-Solar/Clean-Power-Estimator

NY-Sun is structured around customized Megawatt (MW) Blocks targeted to specific regions of the state. To learn more, see the Megawatt Block Incentive Structure.

The Megawatt (MW) Block Dashboard provides real time information on the status of block and current incentive levels by sector and region. Block status is updated as applications are submitted, so click the refresh button to see the current status.

www.powerclerk.com/nysuninitiative/dashboard.aspx

Opportunities Abound to Help Schools Go Solar

By John McReynolds, EarthTalk®

The non-profit Black Rock Solar helped Rainshadow Community Charter High School in Reno, Nevada installed a 31 kilowatt photovoltaic array in 2010.

Putting solar panels on your school is a great idea, not only to provide a free source of electricity, but also as a real-world way to teach students about the need for more renewable energy options and to make the school community part of the solution to our climate woes. School buildings are typically built with large, flat rooftops that are ideal candidates for solar installations.

According to the Foundation for Environmental Education's Solar School Initiative, some 4,000 public and private school systems around the country have already installed solar panels at their own expense or with funds raised through parent-teacher associations, student groups, individual donors and foundations. Analysts estimate that an additional 125,000 schools nationwide are good candidates for going solar and reaping the financial benefits of free energy. Developing renewable alternatives is essential to our transition away from dirty fossil fuel sources.

Grant programs vary from state to state, though some can be very supportive of municipal solar projects. In Massachusetts, for example, cities qualified as "Green Communities" can apply for clean energy grants through a state-run program. California also has a number of solar-friendly programs that schools can capitalize on, including the School Facility Modernization Grants and Self-Generation Incentive program. Several other states offer similar programs.

There are also many federal grant opportunities, primarily from the U.S. Department of Energy (DOE). Their Loan Programs Office works with municipal and commercial applicants to help realize their energy goals. The Office of Energy Efficiency and Renewable Energy shares this mission and recently made an investment of $19 million to improve our nation's buildings, specifically naming hospitals and schools as top priorities.

There are also non-government options that can be utilized to bring solar to your local school district. The American Solar Energy Society (ASES) offers a wide array of resources for achieving successful solar school programs and for navigating issues around choosing a system. Their partnership with The Solar Foundation's BDR Fund has set a goal of 20,000 solar systems installed at K-12 schools by the year 2020.

Another grant opportunity comes from the American Electric Power Foundation's Learning from Light program, which has sponsored over 100 schools' transitions to solar, starting with Bluffsview Elementary in Worthington, Ohio back in 1998. And the Walmart Foundation recently pledged to fund solar conversions at 20 schools in large cities around the country. A list of further programs offered by a number of organizations can be found at solarschools.org.

For more tips, check out the National Renewable Energy Laboratory's report "Solar Schools Assessment and Implementation Project: Financing Options for Solar Installations on K–12 Schools," which explains the myriad ways to finance and own solar installations at schools—including how to choose a location to maximize benefits.

Links: Loan Programs Office: energy.gov/lpo/loan-programs-office; American Solar Energy Society (ASES): www.ases.org/; American Electric Power Foundation: www.aep.com/; National Renewable Energy Laboratory: www.nrel.gov/

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THE BLOCK ISLAND WIND FARM

By George Harvey

The first turbine of the Block Island Wind Farm is installed. Photo: Deepwater Wind.

Construction at the Block Island Wind Farm, off the coast of Rhode Island, is nearing completion. The developer, Deepwater Wind, has not yet given a date for completion, but the foundations are already in place and waiting for masts. The nacelles, turbines, and blades have arrived from Europe. Everything is set for final assembly and the project is expected to be completed during the summer, followed by testing and commissioning in the fall.

The Block Island Wind Farm is not impressively large, by world standards. It has five turbines with a combined capacity of 30 megawatts. It will cover the needs of about 18,000 residents, including those on the island and others on the mainland. In one sense, however, it is an undertaking of huge importance. It will be the first offshore wind farm in the United States.

The wind farm will be of even greater importance to the residents of Block Island itself. Historically, the cost of cables to the mainland were prohibitive, so the island has always depended on locally burned fossil fuels for electric power. That has meant use of diesel generators, whose noise and pollution were not the only thing to complain about. On top of everything else, electric power has cost up to 54¢ per kilowatt hour (kWh).

One major benefit of the wind farm is that since power is being sent both to the mainland and the island, Block Island is now tied to the grid. Since the cost of the submarine cable from the wind farm to the island will have to be paid down, the rate reduction will not be to a low level, but it will go down by 40%.

The costs of offshore wind power have been declining sharply of late. A consortium of businesses recently joined the government of Scotland to fund research aimed at getting it down to $130 per megawatt hour (MWh), or 13¢/kWh, wholesale. Surprisingly, the same week that was announced, the Danish utility DONG signed a contract at just over $80 per MWh. When transmission costs are added to that cost, the price was still less than $100/MWh.

There are more installations under way, though all are in pre-construction stages. Deepwater Wind has made progress getting permits for the 90-MW Deepwater One South Fork, thirty miles east of Montauk, New York. The Lake Erie Energy Development Corporation, or LEED-CO, says it will have completed Ohio's first offshore wind farm, six turbines off the coast of Cleveland, by the end of 2018. With the decline in prices for wind power, we will doubtless see more coming.

Massachusetts is mandating up to 1600 MW in a law passed in early August. Denmark's DONG Energy is already interested in developing an offshore wind farm of up to 1000 megawatts in the waters off the coast of Massachusetts.

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Too Big to Fail - Too Big to Save

By George Harvey


Image: Shutterstock

For those who are interested, two books that describe economic bubbles are *Extraordinary Popular Delusions* and the *Madness of Crowds*, by Charles MacKay (Richard Bentley, London, in 1841, currently in print from various publishers and at Project Gutenberg, gutenberg.org/ebooks/24518), and *The Big Short*, by Michael Lewis (W. W. Norton & Company, New York, March 15, 2010). The Big Short was also produced in a somewhat fictionalized form as a movie.

We do not have to go out and buy a DVD or a book to see a bubble first hand, however. We are living in one. It is called the carbon bubble (en.wikipedia.org/wiki/Carbon_bubble). It is much bigger than the housing bubble that was the subject of The Big Short. The housing bubble only caused household losses in the United States of $19.2 trillion and put 8.8 million people out of work, according to a Treasury Department report (http://bit.ly/treasury-housing-crisis-report).

In case you are wondering, $19.2 trillion is about three times the federal budget or about equal to the national debt. It is also just shy of $60,000 per person in the country. It seems hard to imagine that two people, working at minimum wage, supporting a family of four, could have lost even a tenth of their $240,000 share. But what they lost ranged from retirement fund losses to increased taxes to cover an increase in the national debt. It was all pretty much invisible, except to those who were trying to sell real estate, followed the stock market, or were out of work.

The housing bubble was small, however, compared to the losses we can foresee in the carbon bubble. According to a report from Citigroup, if we are to deal with climate change, the fossil fuels industry will lose $100 trillion in stranded assets over the next thirty-five years. (http://bit.ly/stranded-assets). That is the value of assets they will have to write down. It will be reflected in the value of the shares of their stock. It is five times the housing bubble, though it is stretched over a longer time.

In the housing bubble, some banks were considered too big to fail. The fossil fuel companies are far bigger, however. Unless they change, they are far too big to save.

We might reflect that there is another side of the story, however. Estimates of external costs of fossil fuel, ranging from crop damage to health costs, range from $1.7 trillion to $7 trillion every year, worldwide. That is $250 to $1,000 per person. In dealing with climate change, these external costs will be eliminated, saving everyone a good deal of money. In thirty-five years, this means ordinary folks may save more than the fossil fuels industry loses, if they can avoid entanglement.

Another piece of good news is from the International Renewable Energy Agency, which estimates that increasing the global share of renewable energy to 36% by 2030 would increase the gross world product by about $1.3 trillion. (http://bit.ly/increased-gwp).

I am not a financial advisor, and am not qualified to offer financial advice, but I am entitled to make an observation. If the fossil fuel companies are to fail because they insist on sticking to their ways, it behooves us stay out of the way. They will be too big to save, and their fall will come hard.

FOR SALE: Cape Cod home in West Guilford, VT
with 1kW grid tie solar system and so much more…

This property also includes a cold weather heat pump for hot water, glass attached greenhouse, large garage shop with skylights, and an attached apartment with many passive solar features. House: 3BR 1 Bath, with eat-in kitchen, and living room. Apartment: 2BR 1 Bath, with eat-in kitchen and living room, all on ground floor. Both have wood heating option. 8+ acres, 5 acre field with 1-horse barn. $200,000.

Offered by Brattleboro Area Realty. Call Chris Lewis at 802-380-2088. Chris@realtyvermont.com

Uncertainties For Net Metering in VT

Cont'd from p.3

Issues with the Public Service Board's net metering program revisions that the groups outlined:

1. Towns, schools, universities, and local Vermont businesses can't choose net metered renewable energy to fully power their electricity needs due to the rule's limits.

2. The rule infringes on Vermonters' ability to choose their own energy future, particularly farmers, schools, and small businesses, and folks who don't own property or whose property isn't suitable for renewables, effectively ending community solar in Vermont. Vermont has shown the country how to successfully implement group net-metering and now other states are moving forward as Vermont is moving backwards.

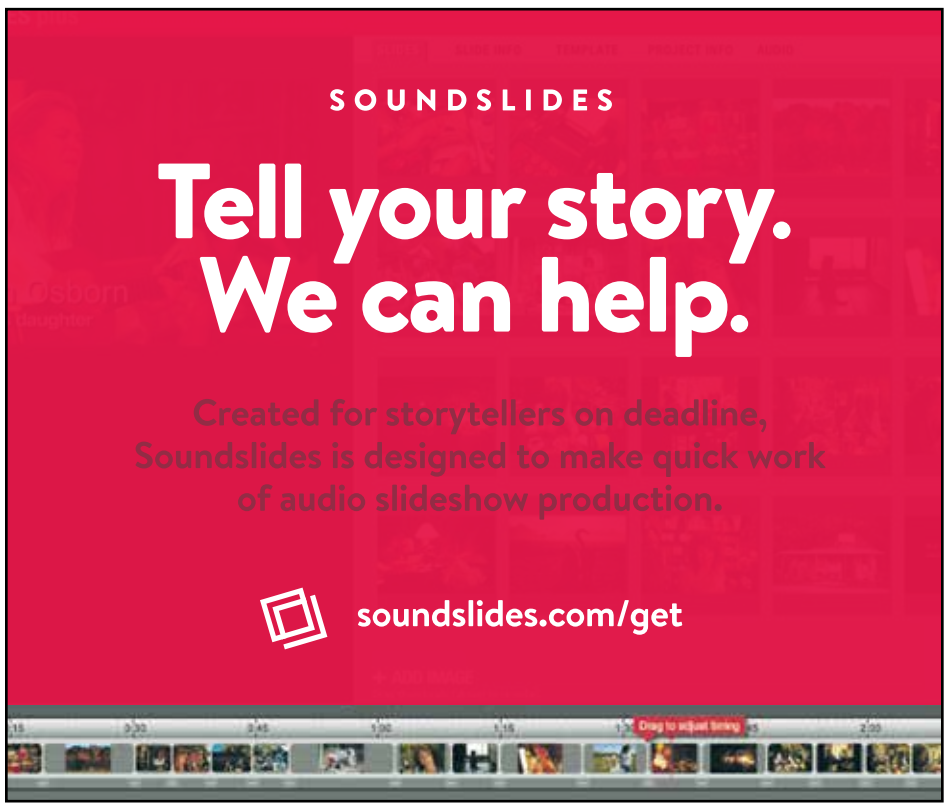
3. The rule completely disregards farmers' calls for continuing their net metering opportunities. The proposed penalizing rates effectively end the ability of Vermont farmers to host systems to keep their farms viable.

4. In some circumstances, Vermonters choosing clean energy would actually be penalized for also making energy efficiency improvements or adopting new technologies under the proposed rule. The rule effectively discourages energy efficiency and innovations to reduce peak demand.

5. Monopoly utilities get to determine customer charges, even for existing solar customers who personally invested early in clean energy and set up financing based on the established cost structure, which unfairly changes the rules of the game mid-way, and will make clean energy more expensive for Vermonters now and in the future.

"It would take close to a century for Vermont to repower our grid with local renewable energy if the arbitrary yearly cap in this rule were implemented," explained Campbell Andersen. "With deadly record heatwaves, wildfires, and flooding already ravaging communities across our country and worldwide due to climate change, we simply have no more time to wait to shift from dirty fossil fuels to renewable energy."

The Public Service Board's Order can be found online at http://bit.ly/proposed-rule.



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The premium venue for buying and selling green, energy-efficient, sustainable and ecological homes, developments and land since 2004.

Sustainability in Tompkins County

By George Harvey

Here is a simple truth. There is no conceivable way we could give all the credit they deserve to the people working for a sustainable future in Tompkins County, New York.

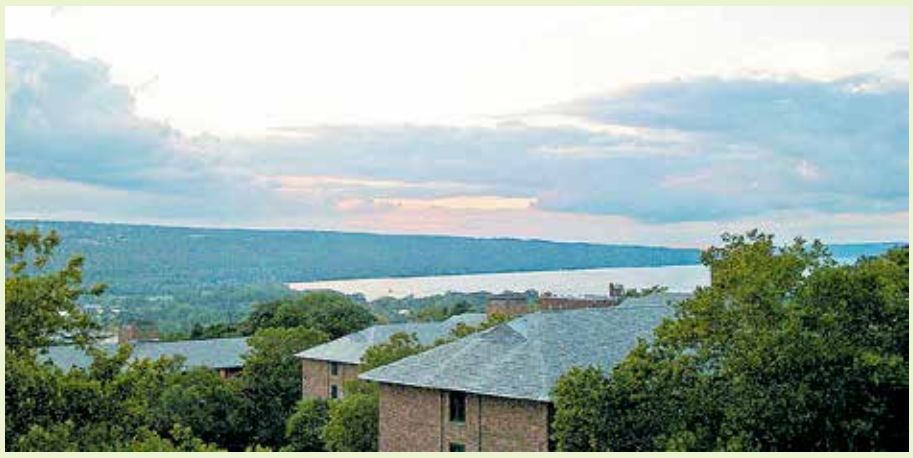
Those who think this is an exaggeration should go to http://bit.ly/tompkins-county-accomplishments and take a look at what has been achieved in 2015 alone. Forty organizations have hundreds of achievements. One might only guess at the numbers of people involved.

Tompkins County may be most widely known for Ithaca, its only city. It is the home of Cornell University, Ithaca College, and Tompkins-Cortland Community College. The high levels of education in the county have been beneficial to its environmental movement.

One really interesting thing about gathering information from people of Tompkins County is the care they take to acknowledge the contributions of others. Among those who shine lights on the achievements of others is Jonathan P. Comstock, a Senior Research Specialist at Cornell University with a doctorate in horticulture. Aside from studying the effects of climate change on agricultural plants, he has been very active in Solarize Tompkins, serving as the board's chairman.

Comstock had a lot to say about Solarize Tompkins, a non-profit organization. It began as a classic "solarize" movement. In time, it changed, but in a way that seems very positive. The program had been so successful that it had achieved double its original goal – but that raised a question. Was further education on solar power really necessary in Tompkins County, or would it be more effective to switch attention to something else?

"After two years of riding the solar rocket, we decided to take on home heating," Comstock explained. In Tompkins County, heating produces about 75% of the carbon emissions associated with homes. So Solarize Tompkins started a new campaign, Heat-Smart Tompkins, to organize energy audits, insulating, air sealing, help with evaluating options, and installation of heat pumps.



Lake Cayuga, in Tompkins County, seen from the Cornel University campus. Wikimedia Commons.

Another person deeply involved with sustainability in Tompkins County is Gay Nicholson. Gay has a doctorate in sustainable agriculture but spent most of her career working on land conservation, environmental ethics, and global warming. In 2004, she co-founded Sustainable Tompkins, which is the oldest sustainability organization in the area. Their programming has helped grow the local movement, and they are often the first to convene community conversations on climate and energy, greening the economy, and sustainable development. Their Finger Lakes Climate Fund collects carbon offset dollars to provide grants for energy efficiency improvements in lower-income households. So far, they have provided over $33,000 in 18 grants to help offset 1736 tons of carbon dioxide emissions.

Nicholson is also a member of the Tompkins County Planning Advisory Board and its Energy Road Map Steering Committee. In 2008, Tompkins County was the first to add an energy element to a county comprehensive plan in support of its goal of reducing fossil carbon emissions 80% by 2050. The Steering Committee then developed an energy roadmap for the county, a project that took several years, with students researching and writing on what mix of solar, microhydro, wind, geothermal, and biomass power, along with efficiency and demand management, would be needed to reach that goal.

Both Comstock and Nicholson referred to the Get Your Green Back Tompkins (GYGB). This campaign is community-initiated and community-supported. It helps people and organizations move toward sustainability for food, transportation, waste, and building energy, reducing carbon emissions, saving money, and creating a socially just economy.

GYGB has been helped by over a thousand volunteers and over a hundred businesses. Karim Beers, the campaign coordinator, said, "GYGB works by encouraging people to take 13 steps for reducing their carbon footprint, save energy, save money, and produce jobs. It encourages key behaviors that are good for the environment, focused on people who do not identify as environmentalists. This is about saving energy and money and connecting with ideas of conservation and being frugal. It is meant to be very inclusive reaching diverse populations."

GYGB started a directory of stores selling second-hand goods and now works with over forty of them in Tompkins County. The director is available online at reusetompkins.com.

The Planning Coordinator for Tompkins County is Katie Borgella. She was the one who suggest the web site given in the second paragraph above.

The county Planning Department started working on energy issues about sixteen years ago, when a 147-kilowatt photovoltaic system was installed on the county library. Now, Borgella says, "Everybody feels a need to do as much as possible, as quickly as possible. Everyone is worried about tipping points, coral bleaching, and the fact that the jet stream has dipped below the equator for the first time."

She conveys a sense of careful urgency, as she talks about protecting the green infrastructure at the upper reaches of watersheds. She says she finds it interesting to see how people are thinking and is heartened by the mind-set, pointing to the Energy Roadmap, which was wrapped up in March, and the fact that it says the county could get 80% of all its needs met locally.

A number of people mentioned Irene Weiser, a member of the town council for Caroline, New York. She has been very active working on banning fracking, pipelines carrying fracked gas, and our societies excessive use of fossil fuels. She started Fossil Fuel Free Tompkins with the hope that the county could be the first in the state to be so. The campaign is working on electric vehicles and charging stations. Weiser was mentioned more than once by other people commenting on her courage and devotion.

And the list goes on.

THE SUN IS RISING

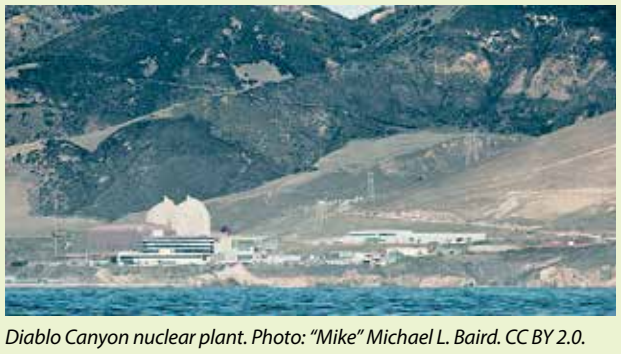
Cont'd from p.1

derided as "intermittent" by aging proponents of a system of electric distribution designed before the beginning of the nuclear era. The power will ultimately come from the sun and the wind with storage to level the load. Centralized base-load power is being replaced by distributed intermittent sources.

As unexpected as this is to some old-timers, it is not a surprise to some people who have looked past the propaganda of renewable energy naysayers. Two German states produce 100% to 130% of the amount of power they use from renewable sources, giving their grid operators a lot of experience with the issue. The official word of one of their grid operators, 50Herz, is that they could get up to 70% of their power from just wind and sun without any need of battery backup.

Indeed, in the United States, we have seen changes underway, not just closing down coal plants, but all other base-load power plants as well. The city of Los Angeles made two interesting, nearly simultaneous announcements in July. One is that it is no longer buying power from the Navajo Generating Station, a large coal-burning plant in Arizona. The other is that they are giving up getting power from a California "peaker" plant, powered by natural gas and replacing it with a 100 megawatt, 400 megawatt-hour battery. A central issue for both decisions is the efficient use of money.

The fixed costs of operating a nuclear power plant that is already operating are reckoned at 5¢/kWh to 7¢/kWh. The price of fuel and variable operating costs are added to this. At the same time, the total cost of wind power, including subsidies, may come in at about 3.5¢/kWh, and the cost of fuel is fixed at zero.



Diablo Canyon nuclear plant. Photo: "Mike" Michael L. Baird. CC BY 2.0.

Replacing the old paradigm, sheep and solar panels are farmed together at one of the largest solar farms in Europe. Photo: Wlkimedia Commons.

A proponent of base-load power might point out that wind power requires backup, but in truth, base-load power does too, on a constant basis. That is why we have expensive peaking plants all over the country. It is why the 1080-MW Northfield Mountain pumped storage station was built at the same time as the Vermont Yankee nuclear plant, with its original rating of 540-MW.

Other signs of the coming of this time, also largely economic, include the fact that the new power plants coming online in this country have been increasingly powered by renewable power. This is not because of the Clean Power Plan; it started before that plan was announced. The coming of this time can be seen in the decline of costs of solar and wind power, which has been ongoing for decades. And at the same time those costs were decreasing, the costs of base-load power plants have only been going up. Though renewable power was once costly, sooner or later, its costs had to fall below those of base-load plants. And that is what is happening.

Critics of the Diablo Canyon shutdown have decried the cost of going to solar and wind with backup, which is estimated at $15 billion. What they need to address is that PG&E calculates that this cost is well below the cost of keeping an aging nuclear plant open.

ExxonMobil, squeezed by the passing of its age

Another thing that surprised many people recently was that ExxonMobil has not only declared itself in favor of a carbon tax but is advocating its position by lobbying other oil giants. Though the initial response of some environmentalists bordered on being giddy, it is well to take a look at the facts.

This is not the first time ExxonMobil has stated a position in favor of a carbon tax. That started in 2009. Stepping up action on the position might be philanthropic but given statements by Rex Tillerson, the company's CEO, we might easily come to the conclusion that support of a carbon tax came about for more pragmatic reasons.

Tillerson proclaimed at this year's stockholder meeting that the company would not have any stranded assets. Given that Citigroup has taken the position that the fossil fuel industry would lose about $100 trillion in stranded assets, an amount about five times

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The Sun Is Rising Cont'd from p.20

the United States' national debt, or about 1.3 times the gross world product, this came as a surprise. ExxonMobil, however, has told its stockholders that it is taking the baselines provided by the Energy Information Administration (which historically has been grossly wrong, 100% of the time) as a predictive tool.

We might also note that ExxonMobil is being brought to court by the attorneys general of a number of states over allegations that they discovered climate change was happening over forty years ago, then systematically tried to persuade people it was not happening while they prepared to be ready to drill in the best spots in the Arctic when the permafrost melted. The combination produces an appearance of ongoing fraud.

"The clean energy train has left the station, folks," said EPA Administrator Gina McCarthy.

ExxonMobil clearly wants to distance itself from misdeeds that may have been committed thirty or forty years ago and wants to point to a more truthful present. It also would doubtless like to be able to take an active part in determining how a carbon tax is formulated. Perhaps, like Entergy, the company will begin to experiment with solar and wind power.

One way or the other, we look forward, without anticipation of any outflow of goodness, to seeing how the oil industry in general reacts to any possible carbon tax.

The age of centralized, fossilized power is rapidly drawing to an end, and that of decentralized, renewable power is emerging. Considering the damage done by fossil fuels to our health, our finances, and our environment, the change is coming none too soon.

Fourth Annual NATIONAL BIOENERGY DAY

October 19, 2016 is designated as National Bioenergy Day. This day is a celebration of bioenergy that highlights its environmental and economic benefits on the local, state and national levels. It's sponsored by the Biomass Power Association, Biomass Magazine, the U.S. Industrial Pellet Association, the Biomass Thermal Energy Council, the Hearth, Patio and Barbecue Association, and Pellet Fuels Institute, Drax and Enviva. The mission is to educate more people - media, elected officials, and communities - about the benefits of bioenergy as a critical renewable energy source along with the many solutions it presents, like using materials with very little to no value that would otherwise be discarded.

National Bioenergy Day began in 2013. Over the last four years, the day has grown to not only represent biomass power but also district heating, residential pellet heating, biofuels, gasification, and other bioenergy applications. Participation has expanded to include organizations outside of bioenergy such as universities and state and local governments. The first year had 25 participants holding events across the country. Last year, there were 60 participants. Crucially, the U.S. Forest Service began supporting the event in 2014 and continues to sponsor Bioenergy Day. They provide funding that helps tell the stories of bioenergy, which can vary dramatically from region to region.

Last year, there were events in Vermont, Maine, New Hampshire, New York, Pennsylvania, Kentucky, Georgia, Louisiana, California, Arizona, Oregon, Washington, Minnesota, Michigan, North Carolina, Iowa, and Mississippi.

So, what exactly is bioenergy? Bioenergy is the use of any organic material, such as forest thinnings, residues, agricultural waste or urban wood waste, to generate heating, cooling or electricity. Many independent power producers generate electricity for the grid using bioenergy. Hospitals, college campuses, school districts and government buildings also use bioenergy for heat and electricity. Thousands of homes and businesses have installed stoves and other appliances powered by wood pellets, reducing their heating costs. Working farms and other businesses with organic waste products recycle their "leftovers" to power or heat their facilities. Bioenergy produces about 2.5% of the nation's total energy and is responsible for sustaining tens of thousands of jobs, many of them in rural communities where they are most needed.

For more information about National Bioenergy Day events being held in your region, visit www.bioenergyday.org. Anyone interested in participating in this day can register on the site or contact Carrie Annand, VP of External Affairs for Biomass Power Association, at carrie@usabiomass.org.

GE's Jenbacher gas engine can run on biogas. Wikimedia Commons

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Geothermal Heat Pumps – *More than a Niche*

By John P. DiEnna, Jr.

Residential geothermal example. Photo courtesy of Bosch Thermotechnology.

Geothermal heat pumps (GHPs) use the Earth's thermal properties, (the energy under our feet) to provide heating and cooling for buildings, along with water heating. It has had more interest by governments, utilities, developers, and users in recent years than in the previous forty. The Environmental Protection Agency says the technology can reduce greenhouse gas emission by up to 40% over conventional HVAC systems. It is a far more effective way to use electricity than even air-source heat pumps. It can also reduce our dependence on fossil fuels, save water, and provide local jobs.

Governments are recognizing that this technology, which combines a renewable thermal asset (the ground loop) and an energy-efficiency product (the heat pump), can support a stronger grid, reduce peak load problems, lower emissions and provide their users more manageable energy bills.

In New York State, Governor Cuomo's Clean Energy Plan recognizes the geothermal ground loops as a renewable thermal asset, making the technology fit very well with New York's Reforming the Energy Vision initiative. GHPs are currently being considered by investor-owned utilities as resources in their distributed service implementation plans. GHPs can provide a "behind the meter," non-wires alternative that can help stave off traditional capital expenditures, such as substation upgrades.

GHP technology has been used to advantage in other states. Western Farmers Electric Cooperative, in Oklahoma and New Mexico, developed a geothermal heat pump program that has seen the peak demand for HVAC in participating homes drop by 38%, or a reduction of 0.55 kilowatts (kW) per ton of installed capacity.

Schools across the country have tapped into the energy they already own to deliver a comfortable learning environment for their students while reducing their energy bills. Don Penn of Image Engineering has installed geothermal heat pumps in over 250 schools in Texas. Alderson Engineering, in Philadelphia, has designed numerous schools in Pennsylvania and New Jersey.

American Water, one of the largest private water companies in the U.S., in strategic partnership with Bosch has developed a state of the art geothermal pilot project in an elementary school built circa 1957, using their water as the medium for the geothermal heat pumps. This system is delivering year-round comfort and has enabled the school to use their facility through the summer. The GHP system has reduced their overall energy use by 30,000 BTUs per square foot.

We now recognize the water saving capability of GHP technology. A study on a 150-room hotel in Florida compared geothermal heat pumps with a water cooled chiller, and the

Cont'd on p. 23

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Geothermal Heat Pumps – *More than a Niche*

Cont'd from p. 22

results were dramatic. The GHP system saved 4,730,400 gallons in one year, reduced maintenance, and eliminated the chemicals needed for the chiller system.

The preliminary results of a recent study by Oak Ridge National Labs, outlining the potential for GHPs, showed that they could save 6.7 quads of primary energy, if they were used in every home and commercial building in the country. This would save 433.3 million tons of CO2 emissions and reduce energy costs in the U.S. by $80.4 billion annually, while reducing peak load and supporting a stronger grid.

The main barrier for increasing use of GHPs, and some think the only barrier, is the high initial cost of systems. The chief reason for that high first cost is in the installation of the item that makes this technology work, the loop field. We now see that resistance to this barrier is changing, as utilities, developers and third party investors see the long term value that loop field ownership has. The loop field can have a life span of over fifty years, making the initial investment a wise purchase.

We also need more trained installers. Although there are over 6,000 in the country we must develop the personnel resources to take fullest advantage of the technology. Widespread adoption of GHP technology could also mean the creation or retention of over five million jobs. The International Ground Source Heat Pump Association has developed the training and certifications needed to support the growth of geothermal heat pumps.

Mr. DiEnna is the Executive Director & Founder of the Geothermal National & International Initiative (GEO-NII). He has over forty years combined experience in the electric utility industry and the renewable energy industry and is a nationally recognized authority on geothermal heat pumps.

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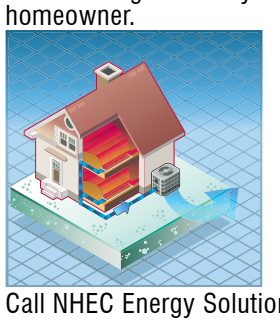

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The Renewable Energy Future Emerges

by Roy Morrison

Elon Musk's outline for a sustainable future is outstanding. Photo: Flickr.

A global renewable energy transformation is underway. The proposed merger between Tesla and Solar City outlines the shape of things to come.

The integration of solar panels with battery storage and electric vehicles is the paradigm for both ecological global economic growth, and reaching the goals of the Paris Climate accord.

An integrated renewable energy company will combine electric vehicles, battery storage, and solar electric panels, all with rapidly expanding market share and plunging prices. Globally, investment in cheap and carbon-free solar energy is rapidly supplanting fossil fuels.

Whether or not Tesla's corporate reorganization proceeds, this is the model for a global renewable energy company with a comprehensive and compatible product line.

Elon Musk of Tesla understands that the combination of increasingly cheaper solar panels with rapidly developing and affordable battery storage makes 100% renewable energy systems achievable globally.

Mega battery and photovoltaic factories, being constructed by Tesla and others like Faraday Future in the United States, India, China, and Ghana, mean that global industrial productive might is being rapidly deployed for a renewable energy transformation.

Benchmark Mineral Intelligence estimates that at least twelve lithium-ion mega-factories will come online by 2020, seven of them in China. Sony is pushing forward with sulfur-lithium battery development. China passed the United States in yearly production of electric vehicles by the start of 2016, producing 250,000 a year, compared to 180,000 for the United States. China is now also a global leader in lithium battery anode production. The French oil giant Total has bought the lithium battery company SAFT for $950 million, as big oil is beginning to see where the sun is shining. Even the Saudis are now planning for major solar development as oil revenues collapse.

The more renewables that are built, the lower the cost, the less pollution, the more good jobs are created. California and its utilities and regulators are a good example of how we are moving rapidly toward a renewable turn. California utilities like PG&E and Southern California Edison have seen the future, and it's renewable. They're making major investments in electric vehicle charging stations at the same time the state, led by Gov. Jerry Brown, mandates the phase-in of more renewable power. The utilities understand that the renewable future means more, not fewer, electric sales.

And it's companies like Tesla, Faraday Future, China's BYD, and Mercedes that aim to provide the vehicles to take advantage of this electricity and charging stations. And the batteries on these electric cars can also plug into the grid and your house to help provide supplemental power.

California's system uses a renewable auction mechanism with competitive bids to help finance renewables, employing market forces to help keep pushing the cost of renewables down.

Wall Street investment in renewable energy is now far greater than in fossil fuels. Peabody Coal was bankrupt on the same day the merger of Solar City and Tesla was proposed, and PG&E announced the planned shutdown of Diablo Canyon, California's last nuclear plant.

The sun is rising. Politicians and regulators need to assist our renewable entrepreneurs, workers and their unions, and communities hungry for clean sustainable jobs. We are witnessing the dawn of global ecological economic growth.

Roy Morrison has been an energy consultant, author, and activist for over thirty years. He has worldwide experience. He drafted the nation's first law on municipal aggregation for retail electric competition. His book, Ecological Democracy, *was first book to discuss an ecological civilization.*

Roy Morrison's latest book, Sustainability Sutra will be published by Select Books in NY in March 2017. He is working on solar farm development with Greater Boston Capital Partners. You can reach him at roy.morrison114@ecocivilization.info.

The author, Roy Morrison. This picture was taken in a tropical rainforest. Photo taken by his wife, Luanne Bakero

Fossil fuel infrastructure targeted in NY State

By Sue Smith-Heavenrich

Assemblywoman Barbara Lifton spoke about a moratorium on fossil fuel infrastructure in Binghamton earlier this month.

Assemblywoman Barbara Lifton (D/WFP-125th District) and 21 other state lawmakers are asking Governor Andrew Cuomo to impose a statewide moratorium on permits for new pipelines, compressor stations, power plants and gas storage facilities. Earlier this month, Lifton penned the sign-on letter to the governor outlining environmental and health concerns.

"We need to stop rolling out new major fossil fuel infrastructure," Lifton told Tompkins Weekly last week. In her letter, Lifton notes that these facilities have caused explosions and fires, and discharge toxic pollutants into the air. In addition to environmental hazards, they perpetuate New York's dependence on highly polluting gas, oil, coal and other fossil fuels that contribute to global climate change, the letter states.

"We have learned over the past 10 years that methane is a huge contributor to climate change," Lifton says. "According to Dr. Robert Howarth at Cornell University, methane is 104 times more potent as a greenhouse gas than carbon dioxide." One-third of all methane emissions in the U.S. derive from natural gas and petroleum systems. Methane is emitted at all stages of natural gas production, from drilling to processing, storage, transmission and distribution.

"If we want to bring down the amount of carbon quickly, and stop contributing to global warming, the best thing we can do is to stop throwing methane into the atmosphere," Lifton says. Rather than waiting for the federal government to make policy, Lifton feels that New York can take the lead in what she calls the "new green revolution".

The first step is to stop creating ways to burn more fossil fuels and focus on decreasing the demand. Cuomo understands this, Lifton says, citing his State of the State "Built to Lead" address. In that speech, Cuomo explains that the least expensive and most effective way to meet New York State's energy goals is to reduce the energy consumption in New York's homes, businesses and institutions. That can be achieved by making these buildings more energy efficient.

That increased energy efficiency means lower utility bills for customers and lower operating costs for businesses. It means putting less carbon into the atmosphere. Lifton's only criticism: why set the bar so low? "Cuomo's plan is aimed at one-sixth of the homes in New York", she says. "Why not 50 percent?"

While Lifton is collecting signatures from lawmakers, Walter Hang, president of Toxics Targeting in Ithaca, encourages citizens and environmental groups to sign on to the same letter hosted at his website (toxicstargeting.com/MarcellusShale). As of July 18, there were nearly 900 signatures. Many of these, Hang explained, are from people who don't want fracked gas in New York.

"There are about a dozen major pipeline proposals, power plant proposals, and compressor station proposals all over the state," Hang says. "They are moving toward approval." One of these is Dominion's $158 million New Market pipeline expansion project that includes a huge new compressor station. The transmission pipeline cuts through Ithaca, Ellis Hollow and Dryden, and would convey gas from Pennsylvania to New England and beyond. He questions the need for infrastructure that will ensure continued fossil-fuel use for the next 50 years.

According to a New York Independent System Operator (NYISO)'s report, "Power Trends 2016," the state has plenty of energy for the next decade. The report predicts that future use will be flat or go down. We don't need additional fossil fuels that contribute to pollution and climate change, Hang says.

One person who doesn't support a moratorium on fossil fuel infrastructure is State Senator Thomas O'Mara (R/C/I-58th District). He is the chairman of the Senate Environmental Conservation Committee and, while he believes New York should continue focusing on short- and long-term strategies to develop more clean energy sources, he contends the moratorium isn't the way to do it.

In an email comment, O'Mara said the moratorium is "an unworkable proposal that would be a job-killer." He feels it would further drive manufacturing and other private-sector economic growth out of the Southern Tier and Finger Lakes regions, and produce skyrocketing energy costs for consumers.

O'Mara characterized the call for a moratorium on fossil fuel infrastructure as unbalanced and unreasonable action

Assemblywoman Barbara Lifton spoke about a moratorium on fossil fuel infrastructure in Binghamton in July, 2016.

that, he said, "would jeopardize local and statewide jobs, workers, employers, consumers and communities from ever being able to survive the economic decline and struggle that's still confronting upstate New York."

Lifton disagrees. Focusing on renewable energy, constructing energy efficient buildings and insulating homes and government buildings means work for New Yorkers. "Tens of thousands of jobs," she estimated. "Good local jobs."

As for costs, Lifton concedes that renewable energy comes with a higher price. But so does continuing reliance on fossil fuels. Noting the enormous costs of climate disasters, she believes we can't afford to keep burning gas and oil. "We're still cleaning up after Sandy," she notes.

Re-printed with permission from the Tompkins Weekly, where it first appeared, on July 24th, 2016. http://bit.ly/Fossil-Fuels-NYS.

Please tell me the weather next month!

By Dr. Alan K. Betts

Climate Prediction: Global Carbon Emissions Could Peak as Early as 2020

Much of the northeast is experiencing drought this summer. It is patchy because a lot of summer rain comes from scattered thunderstorms. Despite periods of drought and heavy rain, our garden here in Vermont is growing well this summer. In part, this is because I have watered the whole vegetable garden twice and a few crops more frequently. There has been one unexpected but delightful change in our local ecosystem, perhaps because of the warm winter, as well as the dry weather. This spring and summer there have been so few mosquitoes that weeding is a delight, and it is a pleasure to eat dinner on the lawn in the evening. It is such a contrast from some recent years, when I wore a net over my head in the vegetable garden.

Last month I visited the European Weather Centre in England, which provides the best ten-day forecasts for the planet. For 30 years, I have worked with scientists there to improve the modeling of the transfer of heat and water from land to atmosphere, since this affects the weather. Computers have improved so much that these forecast models can calculate changes in pressure, temperature, wind and precipitation every hour everywhere on the globe for points that are only 5-10 miles apart for one to two weeks ahead.

So now I am asked, "Weather forecasts have become pretty good for even next week, but what I really want is a forecast for the next two months, so I can make plans for my work, my crops and my vacation." This is a much more difficult modeling challenge. Every day, we measure the state of the atmosphere with surface weather stations, weather balloons and instruments on perhaps a hundred satellites, and all this data goes into models for the global weather, running continuously on some of the largest computers available. One hundred forecasts may be run out for the next two weeks. For the first few days, they are very similar, because they remember the measurements they started from, so we know with some certainty what the weather will be. But as complex jet-streams and storms develop, the hundred forecasts spread apart, and after two weeks we cannot be sure what will happen.

When we run fifty forecasts for the coming season, these too spread out a lot within a month. The earth does have some long term memory, the energy stored in the oceans, and the moisture in the soil that came from last month's rain, the snow cover in winter and ice in the Arctic that keeps temperatures below freezing by reflecting sunlight. These do influence the weather patterns for months. But the global jet stream patterns that strongly influence weather can change every week, so it is harder to predict their pattern a month ahead. However, the seasonal climate of the earth seems more predictable than our models. Scientists are studying whether the links between stratosphere and troposphere play a role.

So, seasonal forecasting still needs improvements in our models. The official three-month outlook for August to October from NOAA is that the northeast will be warmer, but precipitation will be average. The corresponding seasonal forecast from the European Weather Centre is that the northeast will be warmer and drier than average. If this is correct, our drought will continue.

On the energy front, it is clear we need a carbon tax on fossil fuels to nudge the energy system to become more efficient, and accelerate the development of renewable energy resources. In Canada, this helped the economy of British Columbia, and Alberta is now following the same strategy. But on our national front, one political party drifts still further into a fantasy world, where devastating the planet's climate and ecosystems to satisfy its financial sponsors will somehow save America's ego.

Yet despite establishment resistance, the stunning speed of renewable energy development with the rapid fall of the prices of solar panels and lithium batteries is accelerating change. Global carbon emissions could peak as early as 2020, so keep pushing for goals that will bring us a sustainable future.

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a leading climate scientist. Browse alanbetts.com.

August lilies. Photo: Alan Betts.

VERMONT CLIMATE SCIENTIST RECEIVES GLOBAL ENVIRONMENTAL AWARD

Dr. Alan K. Betts Receives the First Bert Bolin Global Environmental Focus Group Award

Alan K. Betts is the first recipient of the Bert Bolin Award/Lecture of the AGU Global Environmental Change Focus Group. He will present this lecture at the 2016 American Geophysical Union Fall Meeting, to be held 12–16 December in San Francisco. The award recognizes an earth scientist for his or her ground breaking research or leadership in global environmental change through cross-disciplinary, interdisciplinary, and trans-disciplinary research in the past 10 years.

CITATION

Alan Betts' research "has been transformative by providing a new understanding of one of the fundamental climate processes – land-atmospheric coupling and how it varies from the diurnal to monthly time-scale, with land cover, and how it may vary under environmental change. His environmental change leadership in Vermont has been exceptional. His writings, public talks and TV interviews dealing with weather, climate, climate change, energy and policy issues have fostered positive debate; as they both clarify the climate issues we all face, while encouraging readers and listeners to explore alternative, hopeful paths for themselves, their families and society," said Prof. Rong Fu, President, Global Environmental Change Focus Group at the University of Texas

RESPONSE

"I am grateful to the AGU Global Environmental Change Focus Group for selecting me as the first recipient of the Bert Bolin Award.

"My work over the past forty years has covered a wide range of topics central to understanding the Earth's climate over land and ocean, and the coupling between the oceans and land-surface, the atmospheric boundary layer, clouds, convection and radiation across scales. Because I have worked as an independent scientist in Vermont for decades, this work would not have been possible without the support of so many across the globe. I would specifically like to thank Martin Miller, Anton Beljaars, Pedro Viterbo and Gianpaulo Balsamo (and the late Tony Hollingsworth) at ECMWF for

Bert Bolin (1925-2007) a world leading climate scientist and science organizer. He is the man who got the world to agree on climate. Photo: simpleclimate.wordpress.com.

thirty years of collaboration using data to evaluate and improve the physics of their analysis-forecast system. My recent work on land-atmosphere-cloud coupling over the Canadian Prairies that this award cites would not have been possible without the foresight of Ray Desjardins at Agriculture-Canada, and the generous support of other Canadian scientists. My understanding of the Amazon owes much to my Brazilian friends and collaborators, Maria and Pedro Silva Dias. Long-term support from NSF and grants from NASA made all this possible.

"My role as a climate advisor in Vermont owes a profound debt to the people of Vermont, who have deep roots in the land. They see what is happening to their climate, and have reached out to me, urgently seeking understanding and answers, as ongoing climate change is transforming the state. So for more than a decade, it has been clear that my research must address these critical questions; and translate all that we know, both locally and globally, into concepts that citizens and professionals can understand and apply to their work and lives." – Alan Betts, Atmospheric Research, Pittsford, VT.

Green Energy Times would like to congratulate Dr. Alan K. Betts for this outstanding achievement. We are grateful for his work and proud that he is a local Vermonter. Betts submits a regular column in each edition of Green Energy Times.

UNBELIEVABLE PHOTO OF THE SOUTHERN CALIFORNIA WILDFIRE

BY JASON MARK | JUL 29 2016

Hieronymous Beach. That's what popped into my mind when I saw Rob Dionne's unnerving photograph, captured last weekend as he stood on the Santa Monica Pier. The sky choked with a cloud of brown smoke, the babel-like crowds in the foreground, the broodiness of the whole scene—all of it recalled the paintings of Hieronymous Bosch, the 16th-century Dutch artist who is best remembered for the dark allegories he created on canvas.

The sun-dampening smoke cloud came from the Sand Fire, a blaze in the Santa Clarita Hills north of Los Angeles that, since it broke out a week ago today, has scorched roughly 38,000 acres, destroyed 18 homes, and forced the evacuation of some 20,000 people. And that's the less dangerous of the two wildfires currently tearing through California right now. In Big Sur, the Soberanes fire is barely contained as firefighters contend with the rugged landscape of the Los Padres National Forest. Earlier this week, a bulldozer operator died in the course of fire-containment operations there.

The smoke cloud from the Sand Fire as seen from the Santa Monica Pier in CA. Photo Courtesy of Rob Dionne.

Fire ecologists are increasingly confident in their predictions that global warming is fueling wildfires in the American West as earlier springs, hotter summers, and drought combine to make fires more frequent and more intense. The "fire season"—an annual apocalypse once limited to the summer months—is now a year-round affair in some parts of the West.

That's worth keeping in mind as you take in this amazing pic. What you're seeing isn't some glimpse of dystopia to come. Rather, the smoke eclipse over Santa Monica is part of the new normal, an all-too-ordinary scene of life on this smoldering planet.

Source: Re-printed from Sierra Magazine. http://bit.ly/CA_Wildfire

Pirouette Farm's Community Solar

MetaModuleTM solar panels being installed. Courtesy photo: Norwich Technologies

Cont'd from p.10 time on systems SunEdison itself installed.

Nine households have their own portions of the system. Almost half of the output goes to the Piros for use in their home and the farm. Others bought into the system in much the same manner that people buy into other community projects. The special Solarize Norwich price was $3.65 per watt, including 25% that goes towards 20 years of operation, maintenance, and insurance. This reflects efficiencies inherent in the EZ-PV system.

The EZ-PV process was developed by Troy McBride and Joel Stettenheim, founders of NT. They are two of four company employees who have doctorates from Dartmouth. The company also benefits from the fact that Dartmouth College is only a short distance away, providing both inspiration and expertise.

Given the level of education and creativity at NT, which led to the EZ-PV system, it should come as no surprise that the company has very active research and development going on. One other project that is in the works is called SunTrap. It is a concentrating solar thermal receiver, using a trough design, developed at Norwich Technologies.

It will be exciting to see what more comes from this Vermont company.

It will be exciting to see what more comes from this Vermont company.

To learn more about Norwich Technologies go to website at www.norwichtech.com, or give them a call. Their phone number is 802-281-3213.

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Passive House for Habitat for Humanity

by Bruce Landry

"Simple, decent and affordable," that is Habitat for Humanity's mantra. This has meant different things to different people. In 2016, it means building to the Passive House Standard.

Chris Miksic of Montpelier Construction, a certified PHIUS PH Builder and Consultant and Bruce E. Landry of 5 Star Energy Tech presented the concept of a Passive House at Habitat's All Affiliate Vermont Conference last fall. Everyone was intrigued by the idea of a cost-effective, low energy use PH home. Our challenge was the affordable part of that statement, tracking the cost on a construction estimate spreadsheet and making the spreadsheet transparent is necessary. The goal is to have a turnkey price of $90 to $95 per square foot.

Habitat for Humanity rendering of south gable. Courtesy of Stonorov Workshop.

The Town of East Montpelier, Vermont Housing Conservation Board (VHCB) and Cross-VT Trail Association (CVTA) partnered in the Benton Conservation Project. CVTA acquired 11 acres through a VHCB grant, and East Montpelier contributed $12, 000 for the project. Habitat for Humanity sold the project an acre of the land for $1.00 if an "affordable house" were built on it, as a condition of the grant.

Tolya and Otto Stonorov of Stonorov Workshop created the design concept of a simple but efficiently designed three bedroom, one bath, 1250 square foot home that looks and feels spacious. Tolya is a professor of architecture at Norwich University in Vermont, and corroborated with Irene Facciolo of Thunder Mill Design, also a professor of architecture at Norwich University. They taught a semester course on design and construction documentation, and the students produced a complete set of construction drawings and documentation for our project. It was a win-win for everyone involved.

Habitat uses volunteer labor wherever possible to keep construction costs down. Part of the eligibility requirement with the family partners is an agreement to contribute at least 500 hours of "sweat equity." They have to volunteer hours to build their home. This house is built on a slab instead of a full foundation, which saved money in excavation, concrete, and insulating costs.

Vermont Mutual Insurance Group generously donated $15,000. VHCB also accepted a grant application for another $15,000. Marc Companion at the VHCB and Chris Miksic helped to contact vendors that provide high performing materials and efficient equipment. They were able to get corporate discounts for the Mitsubishi Heat Pump mini-split. Klearwall PH windows, Zehnder Heat Recovery Ventilation system, GE Air Source Heat Pump water heater, and sheetrock and cellulose from Wallboard Inc. were all discounted. The dollars saved were starting to add up. Locally, Allen Lumber in Barre and VT-ICF in Waterbury provided favorable pricing for the framing, roofing, siding and foundation insulation. All of these organizations and businesses helped to keep the Passive House Habitat Build move forward and within budget.

With the construction budget under control, the focus turned to the operating cost of the home and the comfort attributes. Depending on homeowner behavior, the total energy cost for a small PH can be as little as $60-80 per month for electricity! The Passive House comfort principle designs for all interior surface temperatures (walls, ceiling and concrete floor) to maintain a maximum of 7.2 degrees F difference to interior air temperature year-round.

Insulation levels and air tightness levels are modeled to assure a healthful moisture migration profile. PH buildings will last generations with no health and structural issues. A Passive House Building / High Performance House prevents the accumulation of trapped water vapor in building components. Century-old homes in Vermont are still standing because their walls and attics have been open, uninsulated and able to vapor-dry on a seasonal basis. The same vapor drying principles are applied to super insulated and air-tight PH envelopes today, assuring that PH will perform efficiently and stand to provide shelter for 100 years and longer.

Early in the design process, building assemblies are critiqued with energy modeling and

Cont'd on p.28

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Hi-Efficiency Home by Halfmoon Construction in NYS

Million Dollar 'Net-Zero Reaady' Options Are Affordable

By George Harvey

Andy Ellis is a man with a refreshing attitude. The founder of Halfmoon Construction, in Clifton Park, New York, is a man who clearly loves his work, and his work is making homes efficient. He loves to do it, he loves to teach people about it, and he loves to spread the word. "I live this," he said, "and I can talk about this for hours."

Ellis is even involved during his off hours. He is a member of the Capital Region Builders Association, and is currently the head of the committee working on writing new building codes, which will provide home owners with increased efficiency, lower bills, and decreased carbon emissions. Not only will it save clients money in the present, it will save the environment for their children and grandchildren.

This net-zero ready home was built in Glenville, NY by Halfmoon Construction. Inset shows the kitchen area. Courtesy photos.

Many people, even including some in the building trade, cling to outdated ideas about construction, particularly to the idea that efficient construction costs more than conventional construction. "It is not more costly than stick-built," he said. He asserts that high levels of efficiency are not only within reach of ordinary people with ordinary budgets, they actually save money right up front, if they are done right. This means that a family that can just afford to build a conventional house, can afford to build an identical-looking efficient house and save 90% on their heating bills. "I want people to understand that this is achievable and just takes a different way of thinking."

Ellis does not keep secrets about this, and does not mind sharing what he knows with others. "I need more competitors, so we can bring these homes up to a high standard of efficiency." And so he is about teaching other builders to compete with him. "There is no textbook for this," he has said.

He recently built a really good example home in Glenville, New York. This was an unusual home, because the people who ordered it, while they were very interested in efficiency and renewable energy, were uncompromising on its appearance and functionality. For example, they did not want to orient the building to take special advantage of sunlight, but to take advantage of the view. As it happens, the two goals were compatible. The house is two stories of 3,500 square feet each, and is not designed to be compact or to reduce heat loss through a special shape. It is intended for comfortable living.

Comfort requires efficiency, in terms of heat loss, ventilation, lighting, and so on. The most important things to deal with, to achieve this goal, are insulation and ventilation. The Glenville house has three inches of Logix ICF in the walls on each side of a concrete block, running from the footing to the roof, for a R-24 insulation. The roof has two inches of closed cell insulation, with twelve inches of blown-in cellulose, which comes to R-60. The basement has three inches of Logix Heat Sheet beneath the floor, for R-10. Windows are Anderson 400 series, double pane with argon filling, double hung.

Air-sealing on the Glenville house was nothing short of spectacular. This is an area in which the quality of the builder really can stand out, because it is not entirely a design feature, but requires experience and knowledge. A passive house must meet a standard of 0.6 ACH50 (air changes per hour at 50 pascals). The blower door test at the Glenville house produced the result of 0.1 ACH50. Ellis said of this, "We concentrate on the building envelope, and our building envelopes get national attention." Under the circumstances, that sounds like a modest statement.

Of course, a structure that is so air-tight needs good ventilation. In the Glenville house, the heat recovery ventilation (HRV), from Fantech, is built right into the heating system. The system has some interesting features. For example, when a person takes a shower, the HRV system goes on so the moist air can be ducted out of the house, but this is controlled by a timer, so it does not stay on too long.

Altogether, the Glenville house needs about 20% of the energy for heating or cooling that a conventionally built home would use. It is not a net-zero energy structure. Ellis said it is net-zero ready, however. He calculated that the house needs a 10-kilowatt photovoltaic array to make it net-zero.

"My thing is that I want people to understand; I am about the education. This is how you can achieve it, and it is not difficult to do," Ellis said. "People need to know that these are achievable for the average person, for people with average budgets."

Halfmoon Construction is based in Clifton Park, NY. Their website is: halfmooncon-struction@gmail.com.

Passive House for Habitat for Humanity

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building- science principles. For PHIUS PH certification, third-party verification of the build process is required. Heating and ventilation equipment is sized properly to save on wasted energy. Design energy models and building assemblies go through a pre-certification process of feedback and evaluation. One hundred years is a long time. PH homes will serve and shelter many generations of families into the future. The added extra quality in craftsmanship, planning, design and cost for certification and verification is time and money well spent if you are planning on building an extremely well insulated, air-tight, low energy house that will last generations.

So, yes, a Passive House is simple, decent and affordable housing, that can and should be built.

Bruce E Landry founded 5 Star Energy Tech in 2007, is a certified Efficiency Vermont Energy Star, BPI, Zero Energy Now and a VT Home Energy Profile contractor. 5 Star Energy Tech is based in Barre, VT. Bruce@5StarEnergyTech.com.

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Passive House Goes to the Next Level

By Katrin Klingenberg, PHIUS Executive Director

The Orchards at Orenco in Hillsboro, OR is the largest multifamily passive building in North America. Photo credit: Casey Braunger, Ankrom Moisan Architects

Each year for the past decade Passive House Institute US (PHIUS) welcomes our partners and colleagues to the annual North American Passive House Conference. This September as we gather in Philadelphia, we will reflect on the outstanding accomplishments made since our first conference in Bemidji, Minnesota at the BioHaus in 2006. From building the very first passive house in North America in 2003, to this year reaching the milestone of over 1 million square feet of certified and pre-certified projects across 1,200 units nationwide, we have seen tremendous growth in passive building from coast to coast.

Taking the conversation beyond simple energy consumption and greenhouse gas emissions reductions to put a greater emphasis on human comfort, health, and resilience led to the devolvement of the PHIUS+ 2015 Passive Building Standard released by PHIUS this past year. PHIUS+ 2015 is the first and only passive building standard based upon climate-specific comfort and performance criteria aimed at presenting an affordable solution to achieving the most durable, resilient, energy-efficient building possible for a specific location.

Climate-Specific Solutions

With nearly a decade of experience certifying projects in climates as varied as Louisiana, New England, Illinois, and even Alaska, we recognize that there is no one-size-fits-all solution to achieving comfort, durability, and resiliency. That's why the PHIUS+ 2015 Standard takes a climate-specific approach to performance, providing tailored solutions at the local level that add up to achieve wide-scale adaptability.

Big Gains in Multifamily

The cost-optimized PHIUS+ 2015 Standard has contributed to substantial growth of multifamily passive buildings across North America, particularly in the affordable housing sector, including projects such as Village Centre in Brewer, ME, Beach Green North in New York City,

Cont'd on p.35

New Hampshire Sets Remarkable New Energy Efficiency Goals

On August 2, 2016, an order from New Hampshire's Public Utilities Commissioners approving an agreement for an Energy Efficiency Resource Standard (EERS) is a big step forward in smart energy policy and a victory for our residents and businesses. The approved settlement agreement, endorsed by all parties including the state's utilities, agencies, businesses and advocates, strengthens NH's commitment to lower energy costs and will keep our energy dollars in our state's economy. As stated in the order, "It is routine, as we have long required our utilities to help their customers save money by using less electricity and gas. It is remarkable as it is based on the setting of savings targets, not dollars spent."

Under the EERS, NH will save 3.1% of its 2014 electric sales and 2.5% of gas sales by 2020, with a long-term goal of achieving all cost-effective energy efficiency, that is, all energy efficiency resources that are cheaper than traditional supply resources. In a state where the 2015 average retail price of electricity for residential customers was 18.52 cents, "energy efficiency is NH's cheapest source of energy, costing around 3.76 cents per kilowatt hour," according to consumer advocate Donald Kreis (Concord Monitor 3/29/16).

NH's new EERS also increases funding for low-income customers and will expand the utilities' existing efficiency programs, allowing residential, commercial, and industrial customers to lower their bills by taking advantage of programs for new construction, retrofits for existing structures, advanced lighting, and much more. Not only will program participants benefit from lower energy bills, ratepayers who choose not to participate will also realize savings through the shared generation, transmission and distribution benefits.

The approval of the EERS makes NH more competitive with its neighboring states in the region, most of which have had aggressive energy efficiency goals in place for over a decade. "NH's EERS is solid proof that utilities, advocates, industry, and government recognize the enormous value energy efficiency has for our states' residents, businesses, and economy at large and can work together toward a common goal of lowering electricity bills and keeping our energy dollars within NH borders," says Kate Epsen of the NH Sustainable Energy Association. *Read more at www.nhsea.org.*

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• In the Hot and Mixed zones, the updated ENERGY STAR window specifications required for DOE ZERH are shown below in the chart. Keep in mind that DOE Zero Energy Ready Home allows area-weighted averaging for U-Value and SHGC, as well as an exception for passive solar design exemption.

• For projects in the Cold zone (IECC Climate Zones 5–8 & Marine 4), DOE ZERH has phased in the updated window specifications. For projects permitted after 8/31/2016, the new windows specifications shown in the chart will apply. There are 2 important points about these updated specifications:

1. There are 4 different U-Values called out in the ENERGY STAR window specifications with corresponding SHGC values, as the chart shows. This provides flexibility for project specifications.

2. Area-weighting of U-Value and SHGC for the entire window package is permitted.

If you have any questions about the new window provisions, or any other program requirements, please contact us at zero@newportpartnersllc.com.

Source: Zero Energy Ready Home Newsletter at http://bit.ly/betterwindows.

Window Specs to Apply to DOE Zero Energy Ready Home Projects	Hot Climates IEECC CZ 1-2		Mixed Climates IECC CZ 3-4 (except Marine)		Cold Climates IECC CZ 5-8 & Zone 4 Marine	
	U-Value	SHGC	U-Value	SHGC	U-Value	SHGC
Projects permitted up to 8/31/2016	0.40	0.25	[3] 0.30 [4] 0.30	[3] 0.25 [4] 0.40	0.30 0.31 0.32	Any ≥0.35 ≥0.40
Project permitted after 8/31/2016					0.27 0.28 0.29 0.30	Any ≥0.32 ≥0.37 ≥0.42

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HUGE SOLAR FOR SCHOOLS -- *in MA and NY*

Cont'd from p. 1

The Largest School Solar System in NY

Governor Andrew M. Cuomo has announced completion of New York's largest solar project so far at a public school in Avon, a rural town of about 7,150 people south of Rochester. The project is expected to save $1.6 million in electricity costs for the Avon Central School District, which has 1,000 students in kindergarten through grade 12.

The project is part of the governor's strategy on climate change called Reforming the Energy Vision (REV). The goal is for the state to get 50% of its electricity from renewable sources by 2030. The program's success is already seen in a 600% growth in the solar market, with 105,000 low-income households having permanently cut their energy bills with efficiency, and thousands of jobs created. The REV website, www.ny.gov/REV4NY, has more information

Speaking of REV and the Avon School project, Governor Cuomo said, "New York State is leading the way in developing clean energy alternatives to help communities lower costs and reduce their carbon footprint." He added, "This project is another example of how we are taking action to preserve our environment and create a cleaner and greener New York."

The Avon Central School District's project is a 1.5-megawatt ground-mounted PV array. It will produce enough energy for about 250 average homes each year. Its reductions of greenhouse gas emissions will be 927 metric tons each year, the equivalent of taking about 200 cars off the road.

New York's Lieutenant Governor Kathy Hochul spoke at the ribbon cutting event in Avon. "Under Governor Cuomo's leadership, New York State is making real strides in developing a clean energy system that encourages greater use of renewable energy and energy efficiency," she said.

From top to bottom: Avon Central School District 1.5MW solar array; Avon High School and Avon Middle School. This accompanies a 5.5 kW roof top solar that both schools benefit from. Photos courtesy of NYSERDA.

"In addition to helping this school district reduce energy costs, the solar array will be used to educate students about solar and clean energy."

A NY-Sun initiative provided incentives totaling about $564,000 to support the project. The initiative is intended to advance growth of a sustainable, self-sufficient solar industry in New York. Avon's array is off-site and uses remote net metering to earn the credit to the school district for the energy it supplies the grid. This should give the system about $1.6 million in solar credits over a 25-year period.

The project is being developed through a power purchase agreement with WGL Energy Systems, which will continue to own and manage the solar array. Under the agreement, the school district paid no upfront costs for the solar project and will pay a fixed rate for the energy produced by the solar array. In addition, the Avon Central School District is working with WGL Energy Systems to design a curriculum around the solar project and its educational components.

This is not the school district's first solar project. It has a 5.5-kilowatt system installed on two school rooftops in 2008. When that array was installed, the district also got LED lighting and motion sensors so lights would go off automatically when no one was using them. A capital project also reduced electric use for heating and operating the swimming pool.

New York State Energy Research and Development Authority (NYSERDA) has provided funding for 92 public school districts and private schools in the state. K-Solar, a public-private partnership of the New York Power Authority and NYSERDA have 318 school districts registered for competitive selection of private developers and help with permitting processes and technical and administrative support.

New York State's support for the solar industry has produced impressive growth in the industry. The state currently has over 8,250 solar workers, an increase of more than 3,000 since 2013. It is anticipated that an additional 1,000 jobs are to be added in the industry this year.

Groundbreaking for Hampshire College's 4.7 MW solar array is underway. Photos courtesy of Hampshire College.

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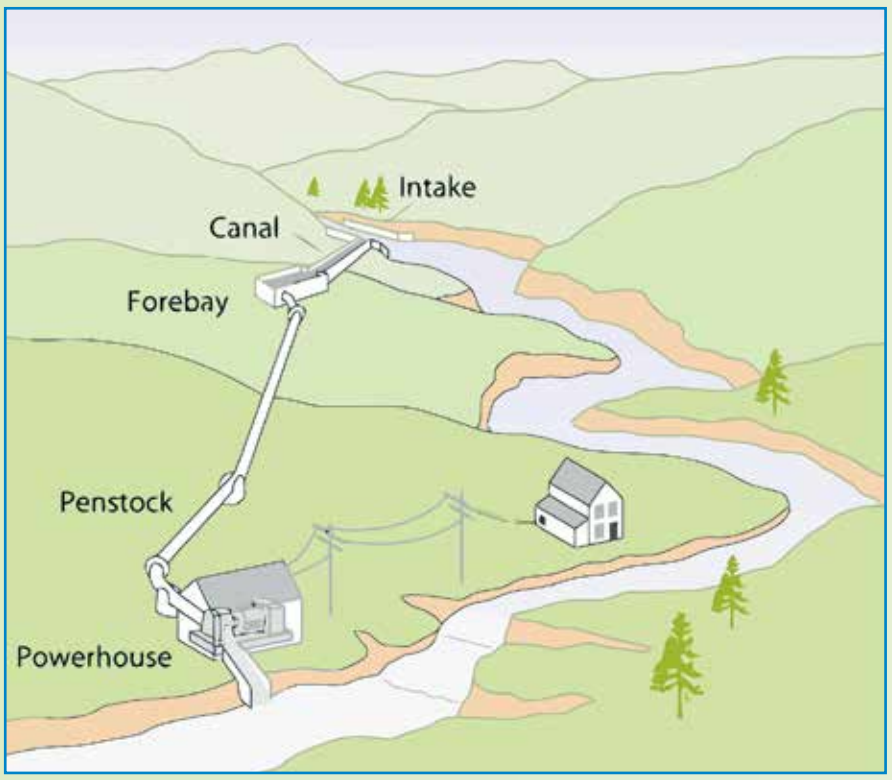
I HAVE A STREAM: CONDUIT-BASED MICRO-HYDRO

by Russell King

The classic picture of hydropower is that of a large concrete dam that spans the breadth of a river, providing water and electricity to thousands, if not millions. Hydroelectric dams are not merely physically big, however; their size manifests in two other ways as well. First, hydroelectric dams have a proportionally large environmental impact. Aside from the aesthetic harm of forever changing a river formally untouched by humans, the river ecology suffers. Whole valleys are flooded to provide reservoirs, destroying the riparian habitat. Water temperature changes, and downstream ecosystems do not receive the debris and sediment they need. Perhaps most importantly, fish cannot travel upstream to spawn, even with fish ladders. Second, large-scale hydropower comes with a correspondingly large set of regulatory and cost hurdles, which places it out of the hands of most. Licensing or exempting a hydroelectric dam through FERC with a capacity exceeding 10 MW can take years and requires technical expertise that is unavailable to the average citizen. NEPA is usually triggered, further extending the licensing period. And then there is the threat of litigation should a party object to what the developer is doing to the river. Simply put, everything about classic hydropower is big: with big dams, big impacts, big costs, and lots of regulation.



In this microhydro system, water is diverted into a penstock. Conduit-based systems use pipes that are already serving other purposes like irrigation or wastewater. Credit: U.S. Department of Energy

Yet there is another way – conduit-based micro-hydro. In 2013, Congress recognized that the licensing process for big hydro did not scale down, disincentivising any smaller projects. The regulation existed for a reason – large hydropower has large impacts. But small-hydro and micro-hydro have small and micro impacts, respectively. So Congress passed the Hydropower Regulatory Efficiency Act (HREA), which created several new programs to make the licensing or exemption process for small-scale hydropower more approachable. Amongst these programs is the qualified conduit hydropower facility program, which completely removes the need for a license or exemption from FERC. Finally, the power of moving water is back in the hands of the average citizen.

So what is a qualified conduit hydropower facility? These facilities must meet a few requirements. First, installed capacity must be less than 5 MW. Frequently, the capacity is less than 200 kW (which is small-hydro); systems as low as 2 kW to 10 kW (which is micro-hydro) make up a significant portion of these facilities. Second, the generator must be part of a conduit, which is any artificial conveyance of water, such as a ditch or a pipe. Third, that conduit must be primarily for agricultural, industrial, or municipal uses. On the ground, these are simple generators attached to already flowing water. They are irrigation conduits in Colorado. They are municipal wastewater pipes in Alaska. They are drinking water channels on farms in Vermont. They are, above all, hydropower for the little guys.

Unlike large hydropower, the environmental impact of these conduit facilities is limited. Firstly, they do not use a natural waterway, so there are no flooded rivers and stranded fish. Secondly, they use water that will be used anyway. Irrigation is the most common, but drinking water and wastewater are used, too. While watering crops, one might as well generate electricity. In the case of wastewater, micro-hydro turns a negative – polluted water headed for treatment – into power for a home or town, a positive. Essentially, the environmental impact is limited to that of the conduit itself, which is usually minimal.

The regulatory hurdles are just as limited, too. If the three requirements are met, the applicant sends in a notice of intent to FERC. Their user-friendly template can be found on their website. After a fifteen-day initial phase and a forty-five day comment period, FERC determines whether the facility qualifies. As the requirements are easy to meet, very few facilities are rejected. Once qualified, FERC no longer plays a role – once the applicant complies with any state laws, they're free to generate hydropower. Gone are the mountains of work, environmental reports, and expert information. What is left is an easy-to-use application, accessible to just about anyone.

Micro-hydro is just that: micro. With it comes a micro environmental impact and a micro regulatory regime. What is not micro, however, is conduit-based hydropower's promise: providing clean, low-impact energy using water for another purpose, all while being in reach of the average citizen. To be sure, residential users may not be able to use it (so it will not replace solar panels), but for New England's farms, towns, and industry, the promise of green power is as far away as the nearest pipe.

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VEEP EXPANDS INTO NH
HANDS-ON SCHOOL PROGRAM

VEEP recently received a grant from the Putnam Foundation to make that opportunity a reality. This first year of funding will begin a relationship with its neighboring state that VEEP hopes will be ongoing. VEEP is actively seeking additional funding to increase this year's offerings and continue to serve New Hampshire schools in future years.

"New Hampshire doesn't have an organization doing energy education programming in schools," says Cara Robechek, VEEP's executive director. "We saw this as an opportunity to help teachers bring this education into their classes.

"We hope to be able to expand our services in New Hampshire during the coming year," says Robechek, "and we'd love if our energy advocates in New Hampshire would let teachers know about our programming."

VEEP offers a free day of in-class workshops for K–12 schools in western New Hampshire, with additional free days available for large schools or schools that serve low-income populations. VEEP's hands-on, interactive workshops on subjects like climate change, renewable energy, efficiency, and weatherization encourage students to think like scientists, solving hands-on engineering problems and reflecting on their observations and experience.

VEEP also plans to offer education and professional development for New Hampshire teachers, including support for all-school projects that reduce energy use and the opportunity to borrow kits of educational equipment to use in the classroom. VEEP can also lead in-depth, custom trainings to help teachers develop hands-on science units and align their lessons with the Next Generation Science Standards.

Students at Cabot School in Vermont tackle a wind engineering challenge in a VEEP Renewables by Design in-class workshop. Photo courtesy of VEEP.

The staff members at VEEP believe that education is the path to societal changes around energy. VEEP programming uses exemplary teaching and learning methods about energy, which empower students with knowledge and paths to action to reduce energy use. This deeper understanding changes the way young people think about energy, helping them to become decision-making adults who can change our society's energy habits and build resilience to weather the changes brought on by climate change.

For more information on VEEP's in-class workshops, curricula, professional development for teachers, and other hands-on energy education programs, visit veep.org. You can also contact Cara Robechek at 802-552-VNRG or e-mail cara@veep.org to schedule a local VEEP educator for your school.

RESOURCES

350-Vermont: General group that coordinates a variety of statewide actions.
To join this group go to: **http://350vermont.org**
American Council for an Energy-Efficient Economy: Consumer guide to home energy savings - **aceee.org/consumer**
American Solar Energy Society (ASES): www.ases.org
Backwoods Solar: Specialty: solar, off-grid - **www.backwoodssolar.com**
Buildings Energy Data Book: buildingsdatabook.eren.doe.gov
Clean Power Estimator: www.consumerenergycenter.org/renewables/estimator
Consumer Guide to Home Energy Savings, Heating, Appliances, Refrigerator Guide, Building Envelope, Driving: http://aceee.org/consumer
Dept. Public Svc. (CEDF): publicservice.VT.gov/energy/ee_cleanenergyfund.html
Dsireusa.com: www.dsireusa.com Renewables & Efficiency. Find state, local, utility, & federal incentives for renewable energy & energy efficiency.
Efficiency VT: This is a must-go-to site for immeasurable amounts of info. **www.efficiencyVT.com**
Energy Efficiency & R/E Clearinghouse (EREC): eetd.lbl.gov/newsletter/CBS_NL/nl6/Sources.html
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Find Solar: www.findsolar.com
Fossil Fuel Freedom: Group working to make Vermont's energy plan 100% free of fossil fuels:
To join this group go to: **groups.google.com/group/fossil-fuel-freedom-**
Greywater Info: www.oasisdesign.net/greywater
Home Energy Saver: Interactive site to help you identify & calculate energy savings opportunities in your home. A lot of great information! - **hes.lbl.gov**
Home Power Magazine: www.homepower.com
IREC/ Interstate Renewable Energy Council: RE educational info. **www.irecusa.org**
NABCEP/ North American Board of Certified Energy Practitioners: This organization that tests & certifies PV system installers. Individuals are Certified, companies are not. **www.nabcep.org**
NESEA/ Northeast Sustainable Energy Assoc.: www.nesea.org
National Association of Energy Service Co. (NAESCO): www.naesco.org
National Renewable Energy Laboratory (NREL): www.nrel.gov
National Solar Institute: www.nationalsolarinstitute.com
NeighborWorks® Alliance of Vermont: Low-cost energy loans - **www.vthomeownership.org**
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New York Solar Energy Industries Association/NYSEIA www.nyseia.org
NFRC independent rating & labeling system for the windows, doors, skylights **www.nfrc.org**/
NH Office of Energy and Planning: www.nh.gov/oep/programs/energy/RenewableEnergyIncentives.htm
Renewable Energy World: www.renewableenergyworld.com
Renewable Energy Vermont: www.revermont.org
SEIA/ Solar Energy Industries Association: The SEIA Tax Manual to answer your solar related tax questions. **www.seia.org**
SmartPower: www.smartpower.org
Solar Components: www.solar-components.com
Solar Living Source Book: realgoods.com/solar-living-sourcebook
Solar Power Rocks: Impressive data and info ,including per state. www.solarpowerrocks.com/
Solar Store of Greenfield, MA Stock & install a wide variety of solar & environmentally friendly technologies. **SolarStoreofGreenfield.com**
Tax Incentives Assistance Project (TIAP): www.energytaxincentives.org
The Energy Grid: www.pvwatts.org
The Office of Energy Efficiency & Renewable Energy (EERE): develops & deploys efficient & clean energy technologies that meet our nation's energy needs - **www.eere.energy.gov**
Track the Stimulus Money: www.recovery.gov/Pages/home.aspx
Vermont Energy and Climate Action Network (VECAN): works to start and support town energy committees as a powerful, people-powered response to realizing a clean energy future. www.vecan.net.
Vermont Tar Sands Action: Group working to stop the XL Pipeline and any other developments stemming from the Alberta Tar Sands. To join this group go to: **groups.google.com/group/vt-tar-sands-action**
VPIRG: understand the clean energy resources available to VT - **www.vpirg.org/cleanenergyguide**
VT Energy Investment Corporation (VEIC): nonprofit organization that issues home energy ratings for new & existing homes. 800-639-6069 - **www.veic.org**
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www.susdesign.com Online info for solar benefit with house design. i.e. window overhangs, sun angle & path…

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GUIDE TO ADVERTISERS

Ingredient of the Month

By Larry Plesent

SLEEPING ON THE JOB. . .

You work hard in your busy day doing what you do. Work, chores, and everything involved in keeping the rain off your head, the wind off your back, and the wolves from your door. And then we drop off to sleep.

And we wake up and do it again.

For years (most of my life actually), I took it for granted that we slept to recover and rest up for our next busy day. Work and rest. Work and rest. For maybe 100 years if we are lucky.

But what if I had it all wrong, and the opposite is actually true?

What if we work all day to set ourselves up to then do the REAL work of living? And what if that real work occurs while we sleep? In other words, do we work all day to sleep? Or do we sleep just to wake up and work?

This is not a trick question. There are unanswered mysteries in the realm of sleep, just as there are unanswered mysteries in the realm of the awake. And it is extremely hard to gather all the data because sleep comes with a built in amnesia mechanism. We awake and have already forgotten most of the lands we traveled when our eyes were shut tight. And so I have to wonder.

Did I dance and play and learn from my friends in the lands of dreams? Do the people I meet by accident in the awake times actually make an appointment to get together while we slept; to learn, share stories and to celebrate being alive? How many times have YOU changed course, turned left instead of right and met someone whose words and actions changed the course or tone of your daily life?

Coincidence? Happenstance? Or appointment?

I do not have all the answers. Like nearly all of us, I have way more questions than answers. But I ask you to practice questioning the current basic western civilization tenets of human existence. We may in fact have been looking at it all wrong.

Time will tell. Maybe we should sleep on it.

This is the Soapman reminding you to take time out to enjoy the warm season and to keep thinking about the molecules!

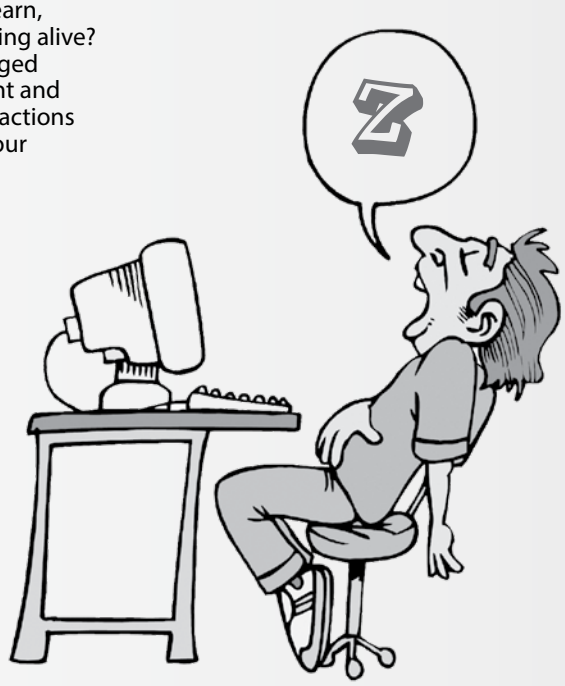


Image: Publicdomainpictures.net

Greener Lawn Mowing Options

By George Harvey

My first job was tending grass in a local cemetery. I used hand clippers to make the grass around the headstones look nice. I was sixteen years old, and for that reason was not allowed near lawn mowers. The cemetery management considered them too dangerous for anyone under eighteen years old to be around.

The problem. The health hazards of gasoline-powered lawnmowers are well known to the operator and to the atmosphere with the amount of emissions that they put out. Operators are exposed to fumes from the combustion of inefficient engines, as well as damage to one's hearing from the levels of noise from the machines.

We could go on at length about the environmental problems of small internal combustion machines, which contribute significant amounts of pollution to the atmosphere. While it has proven difficult to quantify the damage fully, a simple fact provides an understanding of the scale. According to the Environmental Protection Agency, the amount of gasoline and oil spilled just filling these engines is about 17 million gallons per year. This is more than was lost by the *Exxon Valdez*. And according to the government of Massachusetts, "One quart of motor oil can pollute 250,000 gallons of water, and one gallon of gasoline can pollute 750,000 gallons of water!" (http://bit.ly/oil-pollutes-water)

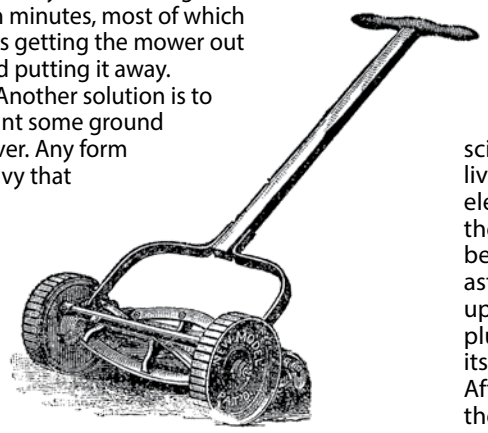
It happens that the 750,000 gallons of water is about what goes over Niagara Falls (both falls combined) in one second, when it is at full flow. The amount of water we can pollute with the gasoline spilled while filling lawnmower engines would keep Niagara Falls at full flow for about 196 days each year.

You can think about this environmental damage in two ways. First, you could see that it is spread out over the entire country, so no one really notices. Alternatively, you could see that it is spread out over the entire country, so the damage is poisoning the environment everywhere. And guess what? The first person poisoned is usually yourself, and the first water or soil you pollute is usually your own.

The Solution. Fortunately we have some good solutions. They range from simple and inexpensive to high-tech. Some are great sources of exercise. Others are so easy, that they don't even need you!

At the simple end, we can easily find pusher-style reel mowers, which have been around almost as long as lawns have. They are inexpensive, with most models costing well below $150, and some are as low as $70. They are a perfect solution for anyone with a small lawn, and in fact, the only person I have ever known who lived in Manhattan and had a lawn used one of these. The lawn was about ten by twenty feet, and mowing was a weekly chore lasting about ten minutes, most of which was getting the mower out and putting it away.

Another solution is to plant some ground cover. Any form of ivy that does not climb is a candidate, as are a number of other plants. Historically, chamomile and thyme have been candidates. A person who really enjoys playing croquet or badminton, or just sitting on a lawn chair on the lawn, can keep a portion of the lawn as grass and mow it with a reel-type lawn mower.



Electric lawn mowers are a blessing I appreciated the first time I tried one. They come in different forms. The least expensive ones are usually plug-in models, and though it takes a little planning to mow a lawn without running over the electric line, it is much easier than some people might imagine. A few of these models cost less than $100.

A popular alternative today is a battery-powered push mower, which can cost upwards of $250. Electric riding lawn mowers have been sold in the past, but they are costly and very hard to find. There is a good commercial one that we recommend, called the Mean Green Mower. They do have one out that has solar panels above the operator and costs $10,910. www.meangreenproducts.com.

Our editor, Nancy Rae Mallery, who is known for being frugal, efficient, environmentally conscious, and very much in favor of simple living, has a clear favorite. It is the robotic electric mower. The lowest cost models of these can occasionally be found at prices below $900. The advantages are rather astonishing. Once the machine is set up, it knows where to mow and when. It plugs itself in at its outlet, and goes about its business with almost no management. After much research, the Robomow, which

Cont'd on p.36

Passive House Goes to the Next Level

Cont'd from p. 29

Village Centre Apartments in Brewer, ME is one of the largest multifamily passive buildings in North America. Photo: Community Housing of Maine (CHOM)

the Orchards at Orenco in Hillsboro, OR, and Second + Delaware in Kansas City, MO. These projects demonstrate to affordable multifamily housing developers and program managers that pursuing passive building standards can have a huge impact on helping them meet their bottom line while providing quality, healthy homes for those in need.

On our recently launched Multifamily Resource Center at multifamily.phius.org we are compiling detailed performance data and metrics for these real-world case studies to inform designers, developers, policymakers, program managers, and investors about the levels of performance that can be achieved with a PHIUS+ certified building.

The Quest for Zero

Buildings designed and built to the PHIUS+ 2015 Standard consume 86% less energy for heating and 46% less energy for cooling (depending on climate zone and building type) when compared to a code-compliant building (International Energy Conservation Code IECC 2009), resulting in an overall site Energy Use Intensity (EUI) of approximately 10-20 kBTU/ft2 year.

Energy efficiency at this scale means that the addition of a small renewable energy system cannot only zero out a building's greenhouse gas emissions and reduce its carbon footprint under normal operation, but occupants can also survive off the grid in the event of natural disaster or other crisis. If all buildings were built to passive building standards, then a small micro-grid would suffice to power an entire community and make it less vulnerable to larger-scale power outages.

Connect with Us

Join us in Philadelphia from September 21-25, 2016 for the 11th Annual North American Passive House Conference (NAPHC2016) as we explore these topics in greater depth. The event features two days of in-depth pre-conference workshops, followed by two days of core conference breakout sessions, and culminates in a daylong tour of passive building projects in the region. Let's work together to bring the benefits of passive buildings – health, comfort, safety, resiliency and efficiency – to the mainstream.

To learn more and register to attend NAPHC2016, visit naphc2016.phius.org.

Katrin Klingenberg is the Executive Director of Passive House Institute US (PHIUS), which she co-founded in 2003. A German-born and -trained architect, she drove the development of the new climate-specific, cost-optimized PHIUS+ 2015 Passive Building Standard and directs the technical and research programs of PHIUS. Learn more at phius.org.

An Old-Fashioned General Store

With a New Sense of Style

By George Harvey

The original Olsen's General Store in Vischer's Ferry, New York holds many memories for the locals. Photo: Flickr, picssr.com.

On September 11, 2013, a suspicious fire severely damaged the Riders Crossing Tack Shop in Vischer Ferry, a hamlet in Clifton Park, New York. Such an event always is difficult for the community where it happens. It is all the more traumatic when the fire is in a building that has fond memories for the people who have lived their lives nearby. The building, built in the mid-nineteenth century, was remembered by many as Olsen's General Store, a place where youngsters could spend idle moments sitting on the porch, watching the world spin. The building housed the general store, and two apartments. After the fire, it needed help.

George and Karan Donohue, close neighbors of the closed tack shop, were worried about what would come of the damaged building. As it happened, they knew another couple, Joanne and Paul Coons, who lived in the area and had a reputation for doing careful renovations of old buildings. With another couple, Tom and Louise McManus, who also were neighbors living close by in a building the Coons had earlier restored, they acquired the building and started the long project of bringing it back to life.

This was not a commercial project, however, with income as its bottom line. For all six of those involved, it was a labor of love. It was not even merely a restoration of a building of some historic importance to those who lived near it. Its intention was to restore the building to be both true to its historic origins and sustainable.

Joanne Coons explained the project, saying, "We're going to maximize what we can within historic preservation standards." For example, the wood in the restoration came from the original building, if possible. Choice of materials was based on the "reduce, reuse, and recycle" philosophy. Wainscotting for the old walls and ceilings was carefully removed and cleaned up to see life again. New pillars and siding were purchased from an Amish saw mill. Original street-facing windows were rebuilt with Indow brand interior storms. Re-used interior doors, hinges and knobs came from the Albany Historic Foundation and Willow Hill Restoration in Fort Plain. Vermont Coatings from Green Conscience Home and Garden in Saratoga, a low VOC product made from milk whey, was used for all wood finishes.

The repurposed building is now energy efficient and called the Vischer Ferry General Store and apartments. Photos above and to the right courtesy of Joanne Coons.

Inside the historic Vischer Ferry General Store that is now fossil fuel free and energy efficient throughout.

Of course, some decisions have to take into account those modern technologies that improve on what was available in the 1850s. Roxul (a brand of mineral-wool insulation) and dense-packed and blown-in insulation cut down on heat loss in a building from a time when insulation was nearly unknown. A new standing-seam metal roof, made from recycled metal, was installed. Countertops were made of soapstone.

Energy Star appliances were used. GE GeoSprings air source heat pump water heaters provide fossil free domestic hot water. Electric vent less heat pump dryers are used and all lighting are LED.

A ground source heat pump, provides for heating and cooling and save both energy and money. The average heating and cooling bill for the 4000 square-foot building is $73 per month. The heat-recovery ventilation system keeps the air fresh and filtered for healthier fossil free living. Hopefully soon the electricity will be provided by offsite community solar. This works nicely to preserve the historic nature of the building.

The driveway is made of rubblestone, which helps recharge groundwater cause less runoff and reduce storm sewer load.

What had been Olsen's General Store in the memories of many residents of Rexford was reopened as the Vischer Ferry General Store and apartments. The name a reflection of its past, but it gives a new sense of purpose to what that name means. It is run by neighbor, Louise McManus. The store sells artisan-produced gifts for home and garden, local specialty baked goods and coffee. It has nice places to sit and enjoy life, where people can enjoy remembering earlier days.

Greener Lawn Mowing Options

Cont'd from p.35

usually costs upwards of $1,250, is clearly her choice. The RS630 has a wider cutting path of 22 inches, compared to cuts of less than ten inches for other brands. It is the strongest robotic mower for small and medium lawn out there. Robomow also has a history going back 20 years. She says, "I haven't mowed my lawn all year, and yet it is always pristine. I love my Robomow and I think this is the overall best choice for those of us who want to have a nice lawn and most of all, an optimal choice in favor of our planet." www.Robomow.com.

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The solar canopy helps to keep the batteries charged on this new riding mower. www.meangreenproducts.com

Robomow RS360 mowing the perimeter. Photo courtesy of Robowmow.com

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Dan 'n Whitt's General Store

Norwich, Vermont

By Green Energy Times Staff

Everyone should experience an old-fashioned New England general store. They can be delightful, and perhaps Dan & Whits in Norwich, Vermont, is about as delightful as they get.

Dan Fraser, the current manager, is the grandson of the original Dan, who started the store with Whit in 1932. Fraser has worked there all his life, ten years as manager. Clearly, this is a store with a history. "We were the predecessor to Wal*Mart," Dan said.

It also has a very special market niche that Wal*Mart cannot fill. A real New England general store, its motto is, "If we don't have it, you don't need it."

The store is heated with wood, just as it was when it opened decades back. But it also has twenty solar panels on the roof, and it hosts a charging station for electric vehicles. It is not free, like Tesla's, but it is there.

Dan & Whits has a lot of local goods, including fresh vegetables, whenever possible. Store policy is to avoid letting things go to waste. You can buy a purse made from recycled auto and boat parts. You can buy new clothing made from good repurposed cloth. Day-old sandwiches have been donated to people hiking the Appalachian Trail, and also to Willing Hands, an Upper Valley food-distribution agency. When there is an oversupply of milk and eggs, some are donated to the Upper Valley Haven, a regional agency that works with homeless people.

Dan & Whits, a remarkable old-fashioned store, can be visited online at www.danandwhitsonline.com.

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Cooking with Solar

...All year long

By N. R. Mallery

At the time of this writing, we are in the midst of a heat wave and drought here in Vermont and in much of the Northeast. I live in a passive solar home that is designed to keep the heat in or out, according to season. Nevertheless, I try to work with whatever weather I get. I got a new solar oven about nine months ago. The present weather has given me more opportunity to use my solar oven, and use it I have.

I can keep my coffee heated or steep some tea at breakfast time. It works great to cook up eggs as long as you are not in a super hurry. I like to use last night's leftover veggies with eggs, add some pesto, and put it all into a small oiled iron skillet or bowl. I simply put it into the solar oven on my deck. I might add some cooked sweet potatoes in another oiled pan to round out the breakfast and then go about morning chores. About 15 minutes before the eggs are done I might add some shredded cheese. When it's done,add some sliced peaches and blueberries for a gourmet breakfast or brunch by mid-morning. If I want something simple, cooking oatmeal is easy. Or if you want something ready-made for breakfast, you can bake your own granola.

Lunchtime is perfect for using the solar oven. I like to heat up a frozen flat bread pizza, possibly over a bed of asparagus that has been coated with olive oil and garlic. Or I might try my specialty of a tortilla shell that has been oiled on both sides; I top it with shredded cheese, pesto, tomato sauce, leftover kale and veggies and put it all in the solar oven until it's done. Fold the tortilla, slice up some fresh fruit, veggies or a salad, and voilà - a lunch fit for queens!

A solar cooked meal: Portobello with sweet potatoes and cauliflower.

Let's talk about dinner, which requires cooking while the sun is shining strongly. Recently I cooked up a marinated portobello mushroom with roasted sweet potatoes and some veggies. It was yummy. I've also cooked up rice and salmon, this summer. To roast garlic, take a fall bulb, snip off the top and place on parchment paper. Drizzle olive oil over the garlic. Wrap the parchment paper and garlic bulb with foil, and toss it into the solar oven alongside your meal.

Last winter I enjoyed cooking winter squash and roasted vegetables, baked potatoes, baked apples or heating up some chili or hot mulled cider to enjoy after an afternoon of cross country skiing.

The solar oven does require thinking ahead, because it generally takes a little bit longer to cook your food. And if it's partly cloudy, it can interfere with the whole process. It's important to keep an eye on the temperature and adjust the oven to face the sun so the food cooks appropriately. With a little experience, you can learn to adjust the heat by changing the angle of the solar oven.

As fun as this all is, I have definitely learned to appreciate the extra value and independence that my solar oven gives me. Not cooking indoors this summer adds a bit to help to keep my home cooler. It's an ideal option to use in the summer, but can be used year-round.

I personally use a Solavore Sport brand solar oven. Other members of my family have other types — one son has a foldable model, one son also has a Solavore oven, and my daughter has a super heavy duty model. I would definitely recommend a solar oven. It's just plain fun and works well without fossil fuels. One downfall is that you need the sun to be shining to use it.

By George Harvey

I got my solar oven last winter also. The first thing I did with it was to cook spaghetti squash. It was February, and the high temperature for the day was about 27º F. The squash took most of the day to cook in the weak sunshine, but it was done before dusk.

I share my stove with a neighbor, who uses it more frequently than I do. Her approach to life is very frugal, and she clearly thought buying a solar stove would be wasteful, because she had made her own from cardboard and reflective foil in the past. She clearly likes the Solavore oven we use, however, as she uses it frequently; I have not seen her old homemade cooker recently.

The solar oven can be used for just about anything that could be cooked in a crockpot. It has the advantage that it uses no electricity. But it also can be used for other heating. It is good for baking certain things, and I have been told this includes some kinds of bread, though I have not tried it yet. It can also be used for pasteurizing things, which is an easy job for a solar oven, because it only requires 145º F for thirty minutes.

You cannot use a solar oven any time you want, because the sun does not always shine. But when the sun shines, it is always worth considering.

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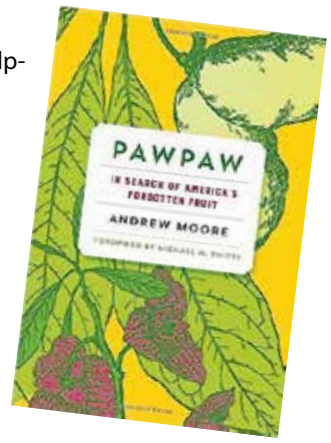
"Pickin' Up Pawpaws, Put 'em in Yur Pocket ..."

PAWPAW - IN SEARCH OF AMERICA'S FORGOTTEN FRUIT

By Andrew Moore, Chelsea Green Publishing, July 2015, 296 pages, $26

Book Review by N. R. Mallery



Pawpaw? What's a pawpaw? Do you remember singing "Pickin' up paw paws, put 'em in your pocket … way down yonder in the pawpaw patch" when you were a child? Did you ever stop to wonder what a pawpaw was? Most of us probably never did, let alone actually eat one. It turns out that the pawpaw is actually a unique fruit that grows wild in twenty-six states and sustained Native Americans, European explorers, presidents and African Americans in the past.

There are many reasons why you may not be familiar with them – in part because they were nearly forgotten until the more recent interest in reviving this mysterious fruit. The pawpaw, Asimina triloba, is the largest of all edible fruits native to the United States. In the forward, Michael W. Twitty describes the fruit as "a tropical tree in a temperate landscape that thrives in the understory on the forest edge or in open fields." He later states, "No fruit has captured the imagination of the forager community in the past twenty years like the pawpaw."

Even so, you may wonder what they look like, taste like, where do they grow and why you do not see them in the market, and do they grow here in the northeast? The best answers are in the book, of course.

Pawpaws fruits. Courtesy photo.

There are various opinions on the taste of this fruit – you either love it or hate it, which may be dependent on the variety and ripeness. The author's quest to find and taste one eventually led him to Ohio where he finally found that first pawpaw by what he described as a sweet, tropical aroma in a grove of the uncommon trees. When he reached to touch the fruit, it fell gently right into his hand. Moore said, "it looked like an expensive import on a grocery shelf, not something you could pick for free." There were three more on the ground, of various sizes and shapes. Squeezing the pulp into his mouth, the author's description was that he "sensed first the texture – like custard, smooth, and delicate – the flavor was truly tropical, with hints of vanilla, caramel, and mango … another one tasted like melon. Both were unlike anything I'd eaten before." He was shocked that he had only recently heard about the pawpaw.

Another reason many have not heard about pawpaws is because they only ripen in September with just a few days to eat them after being picked or when they fall from the tree. This alone makes marketing them difficult.

Moore's first experience led to many more to quench the thirst he had to find the answers of how this wonderful fruit was, it seems, forgotten. Thus, the book covers the history of pawpaws, and the reasons why so many of us only have the memory of pawpaws as words in a children's song. It also covers the importance of its revival, and how many folks and groups are helping to make it happen.

Moore writes that pawpaws are a poster child for American permaculture (permanent agriculture – a sustainable design system modeled on naturally occurring ecosystems). The pawpaw plant is resistant to the ravages of most pests, to start with. The founder of the famous Ohio Pawpaw Festival and owner of Chmiel's Integration Acres believes they are a model of a permaculture system where pawpaws are a large component to make it all work together. Since most animals will not eat them, they can be efficiently integrated with grazing farm animals, including goats and pigs or wildlife such as deer. The farm animals' manure, in turn provide nutrients for the trees and attract pollinators as well. There are many examples of how farmers are working with them that will certainly lead to the time when most will know just what a pawpaw is.

But the taste is not all that makes this fruit unique. Pawpaws are highly nutritious and offer many health benefits that scientists have been studying for decades and have shown that the chemical compounds in Asimina triloba might be the strongest cancer-fighting tool yet discovered, for instance.

I picked up the book out of curiosity, and in my quest for my own evolving permaculture journey with sustainability and am left with a deep desire now to find some pawpaw trees to establish near my home in Vermont. I plan to start this fall which is a great time to plant trees. I hear of some that are growing in Brattleboro, which is 90 miles south of my home. If climate change continues to bring the mild winters like last year, I am hopeful to be pickin' up pawpaws and putting them in my own pockets in the near future.

Image from Pinterest. Recipe at taste.com.au/recipes/25788/pawpaw+parfait. Photo by Rob Palmer

KALE | FOR LATE SEASON HARVESTS

Courtesy of West Coast Seeds

Purple Kale. Photo ourtesy of West Coast Seeds

Late season planting is often a finicky affair. With choices limited, it takes careful consideration in picking the right seeds to keep your harvests arriving weekly even late into the season.

Kale (Family: Brassicacea, Latin Brassica oleracea var. acephala) is that savory, sweet leafy vegetable that is the go-to "superfood" in many celebrity diets. Top athletes also swear by kale as their veggie of choice because it's rich in iron, calcium, and vitamins A, C, and K. It also contains the highest levels of beta-carotene among green vegetables, though collards are not far behind.

All varieties of kale are quite easy to grow. It is cold-tolerant, vigorous, nutritious and easy to harvest and prepare. And the greens get even sweeter after frost. It's great for juicing and blending nutrient packed smoothies and stores well.

Follow along with this handy How to Grow Kale and Collards from Seeds Guide and grow healthful food!

Kale is easy to grow!

Recommended: Lacinato is a summertime favorite. While it is less cold-hardy than many of its cousins, it forms tall, almost architectural rosettes of substantial leaves. Packed with flavor and nutrients, it's a great variety for the beginner kale farmer.

For urban gardeners: Dwarf Green Curled varieties stay smaller and more compact and grows perfectly well in containers or raised beds. It's also cold-hardy, so well suited to winter harvesting.

Season: Cool season (but will generally grow all summer in northern climates)

Exposure: Full sun

Zone: Winter hardy to zone 6.

Timing: Direct sow March to mid-July for summer to winter harvests. Optimal soil temperature: 10-30°C (50-85°F). Seeds should germinate in 7 to 10 days.

Starting: Sow 3-4 seeds 5mm (¼") deep in each spot you want a plant to grow. Thin to the strongest plant. Space 45-60cm (18-24") apart in rows 75 to 90cm (30 to 36") apart.

Growing: Ideal pH: 6.0 to 6.8. Add lime to the bed three weeks prior to sowing. Kale likes well-drained, fertile soil high in organic matter. This plant prefers plentiful, consistent moisture. Drought is tolerable, but quality and flavor of leaves can suffer. Mix ¼ cup of complete organic fertilizer into the soil beneath each transplant, or use one cup beneath every 3m (10 feet) of seed furrow.

Harvest: Kale and collards can both be grown as a cut and come again crop for salad mixes by direct-seeding and cutting when plants are 5 to 8 cm (2 to 3") tall. They will re-grow. Or pick leaves from the bottom up on mature plants as you need them. In spring, the surviving plants start to flower, so eat the delicious flowering steps and buds.

Diseases and pests: Protect from cabbage moths and other insect pests with floating row cover. Prevent disease with a strict 4-year crop rotation, avoiding planting Brassicas in the same spot more than once every four years.

Companion planting: All Brassicas benefit from chamomile, dill, mint, rosemary, and sage. Avoid planting near eggplants, peppers, potatoes, or tomatoes. Plant collards near tomatoes, which repel the flea beetles that so often look for collard leaves to eat.

Fall planting: Here's a list of seeds to start in August for fall and winter harvests. These fast-growing seeds are cold-hardy and will thrive as the nights get cooler in late August and September.

Arugula, beets, carrots, cauliflower (start indoors, transplant first week September for fall harvest), chervil, chives (after the 15th), cilantro, columbine, corn salad (after the 15th), garlic, kale and collards, kohlrabi, lettuce, mescluns, mustards, pac choi, parsley, peas (before the 15th), radishes (after the 15th), scallions, spinach, sweet peas, Swiss chard.

** More on companion planting and other organic gardening questions as well as recipes can be found at www.westcoastseeds.com.*

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ELMORE ROOTS' PERMACULTURE KNOW-HOW

PLANT IN THE FALL

for amazing results!

By David Fried

There are at least three great reasons for fall planting:

1. The earth is moist, and it will be raining or snowing for the next six months, so the new plantings will receive all the moisture they need without having to water them. This is especially good for those without time to water, or who don't live full time at the same place where you are planting

2. Many people think you have to wait for spring to plant, but you lose a few growing seasons. When you plant in fall the tree or shrub much prefers being in the earth than in its pot. It will begin to grow in mid- or late March, way before anyone even considers planting in the north. This means you get fruit and flowers a lot sooner as you are gaining a few seasons of growth, especially that early spring when they really take off.

3. We don't have as much to do as we do in springtime. When we plant now we have something to look forward to in our landscape when the snow melts ....

At Elmore Roots, we have been successfully planting fruit trees, nut trees and berry plants for 36 years in the fall. We save time not having to water them all spring and summer, like we would if we waited until then to plant. When you plant well rooted trees in September, October or November, they will usually grow very well and give you many years of fruit and flowers, except you will not have to wait as long or work as hard to get it!

Paw paws are fun to grow, and you can plant them in the fall, too. About 15 years ago we saw paw paws ripening on some trees in Bristol, Vermont. We dug up some shoots (after asking of course) and planted them around our hill. Some of them have grown, and we have added more. Neal Peterson has searched all over America for the best and tastiest cultivars of paw paw. I wrote to him and asked which ones would be the best for our northern Vermont climate. It turns out the key is to have early ripening ones, like "Pennsylvania Golden" or "Sunflower." These are some of the ones we offer at our nursery.

Paw paws are the most northern species of a fruit that include soursop and cherimoya. The fruits are large and delicious, and the leaves look like tropical rainforest leaves, ornamental in their own right. Ours have not fruited yet, but they do not show any winter dieback, just moose and deer nibbling.

We carry in our nursery store and recommend the new paw paw book, Pawpaw — In Search of America's Forgotten Fruit. It will inform you about the adventure and excitement of growing this lesser known fruit that zebra swallowtails need to survive. I guarantee it will spark a lot of conversation and be a point of interest in your yard. By the way, you need two different varieties for pollination. Why not plant three, in case one does not make it? You double your chances of a big ripe succulent harvest.

David Fried grows paw paws at Elmore Roots Nursery both in full sun and as a south side understory of sugar maples. He often plants more out each year in the fall.

Top left: Paw paws ripening on a tree in Bristol, Vermont. Above: Patrick, planting a fall pear tree at Elmore Roots. All photos courtesy of David Fried.

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