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**HAPPY NEW YEAR:
 PLANET EARTH**

Jessie Haas

Are you feeling resolute? The Intergovernmental Panel on Climate Change and the National Climate Assessment have laid out one view of our future on the blue planet, a deeply unattractive one. Now we have a choice: curl up in a fetal position, sucking our thumbs, or resolve to go down another path: the one where we reverse global warming while enriching our soil, our culture, and our health. Also, while having fun and creating beauty, feasting and festivating—because let's aim high, if we're going to aim at all.

These new reports land a few weeks before Resolution season. So, if you're feeling resolute, or just wish you were, if you're inspired by the 15-year-old girl who's been picketing the Swedish parliament every Friday, or the thousands of Australian kids who walked out of school to pressure their government to take action on climate, one thing's certain. Action feels better than despair and has a better chance of getting us what we want.



What to do? Where to start? Luckily there's a list, laid out in Paul Hawken's 2017 book, *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*. His team offers eighty ranked solutions for reducing emissions and sequestering carbon, all current, happening, scalable, and urgent, with an additional 20 promising coming attractions. G.E.T. also published a book review on this in the June 2017 issue.

What's on the list? Reduce food waste (#3). Electric vehicles (#26). Managed grazing (#19). Wind turbines onshore (#2) and offshore (#22). Heat pumps (#42). LED lighting (#33 household, #44 commercial). Solar: Farms, (#8); Rooftop, (#10); Hot Water (#41); Concentrated (#25). Likely, you already participate in several solutions. Going through the list, I found that my husband and I engage with sixteen.

Still, I feel far more enthusiastic and determined knowing that reducing food waste is the third-most powerful solution. With that in mind, I made it my mission to eat everything in my garden that the woodchucks and chipmunks missed. That intersected with solution #4, plant-rich diet, and turned me into a squash fanatic. I now have a bushel (not grown by me, but they traveled only six miles by Prius), and I plan to eat every single one of them before they spoil. At thirty cents a pound on the day Pete's stand closed, this is also a frugal choice. The list is like that. Some solutions cost money, but many save money, and there's a way for everyone to contribute.

Cont'd on p.19

**Sustainable Practices at Local Ski Areas
 - Getting Green Done -**

By Lillian Eden

While ski areas may have a reputation as high energy users, employing more sustainable options make both financial and social sense. That was the message at the inaugural Northeast Weather Summit in a session on efforts to promote sustainability at ski areas. The summit was put on by North American Snowsports Journalists Association (NASJA) and Stratton Mountain with other sponsors at Stratton Mountain, VT, in December.

More ski areas are deploying sustainable technology based on financial concerns or environmental ones, and there is evidence of established successes in ski resorts throughout New England. During the session for "Ski Area Sustainable Practices" sponsored by the National Ski Areas Association (NSAA), there were five presenters who reviewed measures they were taking to reduce their carbon footprint.

Jiminy Peak in Massachusetts switched to sustainable power (wind, solar, cogeneration) both from a monetary and social standpoint. In 2007, the ski area was the

first to generate power from its own wind turbine. It followed with the building of a solar facility, owned and operated by NEX-AMP, on 12 acres of its property.

Killington/Pico Ski Resort Partners, LLC in VT is also making great strides toward sustainability. Killington's 50% decrease in its carbon footprint was enabled in part

by appointing a sustainability officer to oversee its efforts.

Other initiatives include "cow power," using methane from cow excrement. The Cow Power program is a unique form of producing energy from "farm to peak" whereby about a dozen Vermont farms use cow manure at their

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Fan gun undergoing performance testing by Efficiency Vermont during NSAA's 2015 annual Winter Conference at Killington.

2018: A SUSTAINABLE YEAR IN REVIEW

George Harvey

Last year, some impressive developments started to become clear. In some ways the most impressive of these has been the continued decline in the costs of electricity from renewable resources. Two reports on the "levelized" cost of energy (LCOE)

that came out in November both indicate that electricity from renewables is becoming less expensive than the least expensive fossil fuel competition, nearly everywhere on Earth. The LCOE has the cost of subsidies included, so the different sources of energy can be compared directly.

The first of these reports came from Bloomberg New Energy Finance. According



Moonrise over the Cranston Fire. CAL FIRE photo.

to an article at OilPrice.com, it showed that the LCOE of onshore wind and solar power had fallen well below the cost of electricity from any form of fossil fuels in all major world economies except Japan (bit.ly/GET-2018-1).

The second of the reports was Lazard's LCOE Analysis, Version 12.0 (bit.ly/GET-2018-2). Lazard's analysis might be the most referenced publication on the subject. This year it had the exciting news that the unsubsidized cost of electricity from onshore wind and solar had fallen below the marginal cost of coal-burning power plants. This means that for a company that owns a coal-burning plant,

Cont'd on p.3

*We wish you all a
 happy, hopeful
 New Year!*

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Green Energy Times Regional Year in Review

By George Harvey

While individual states have done a lot of work on reducing carbon emissions, one multi-state effort is very much worth mentioning. After a year of assessing the scientific evidence and data, nine of the twelve states in the Transportation and Climate Initiative (TCI), along with the District of Columbia, formed a group to design a regional approach to transportation. The nine states are Connecticut, Delaware, Maryland, Massachusetts, New

Jersey, Pennsylvania, Rhode Island, Vermont, and Virginia. The TCI operates along the same lines as the Regional Greenhouse Gas Initiative but with a special focus on transportation emissions. The next step in the initiative is to take public comment for a year.

MASSACHUSETTS

Massachusetts has seen a lot of work developing new climate and energy initiatives. One effort that is particularly impressive is the continuing development of an off-shore wind farm consisting of three parts. As we go to press, three companies have won rights to develop areas off the Massachusetts coast for development. They are paying a total of just over \$405 million for their areas, which could have a total capacity of just over 4.1 gigawatts (GW). We can compare this to the Walney Extension, the world's largest offshore wind farm, which has a capacity of 700 megawatts (MW).

Onshore, the development of renewable energy in Massachusetts is a bit less clear. While great efforts were made to set rules enabling development of solar power, and some progress appears to have been made, the outcome is complex, to say the least. One bright note is that a new initiative was launched to help farmers put solar systems on agricultural land that will remain in agricultural use, such as for grazing or raising shade-tolerant crops (see article in this issue on page 18 for more information).

NEW HAMPSHIRE

Progress in New Hampshire has been slow. Governor Sununu vetoed important legislation, including one bill that would have raised the maximum array size for net metering from one MW to five and attempts to override the vetoes were only occasionally successful. Some progress was made in individual communities, especially Concord, which is committed to 100% renewable energy. In November, the state elected legislators who favor renewable energy. Now, with both chambers in the hands of Democrats, renewable energy advocates expect that more progress might be made.

NEW YORK

The picture for climate change and renewable energy in New York has been dominated in the last year by Governor Andrew Cuomo and such state agencies as the New York State Energy Research and Development Authority. Fortunately, these have been operating together to make some progress.

New York, like Massachusetts, is looking to install offshore wind farms. The state launched a solicitation for 800 MW, with bids due in February of 2019. The plan is for New York to have 2.4 GW of offshore wind power by 2030.

New York also started moving on energy storage in batteries. The New York Public Service Commission has approved a goal of installing 1.5 GW of batteries by 2025,



Offshore wind farm. Image: Kallerna, Wikimedia Commons.

with the goal for 2030 being double that amount.

In December, Governor Cuomo called for 100% carbon-neutral electricity through the Green New Deal. This may be the most ambitious goal for any eastern state. Some analysts reviewing the call observed that he seemed to want to put the state of New York firmly into the lead on renewable energy, pushing it ahead of California.

VERMONT

Like New Hampshire, Vermont has been going through a period in which the legislature and the governor were not in agreement about renewable energy and climate change. The result has been a slowdown in work on renewable energy and a rise in carbon emissions.

Andrew Perchlik, director of Vermont's Clean Energy Development Fund said the story of the past year has been one in which small utilities have been working to make the changes they need to complete by 2019, under the state's Renewable Energy Standard.

Perchlik emphasized that we really need to address emissions from transportation and heating. Noting that the abundance of oil that we currently have in this country cannot last forever, he said, "We have to be prepared for a shortage." He added, "The better we are prepared, the better off Vermont will be."

Perchlik has been elected to the Vermont Senate, and it may have been from that perspective that he said, "The overall story is about what's next." ♻️



Wind turbines in New York. Image: Sgt. Bender at English Wikipedia.

Researchers Say Solar and Wind Energy Could Be the End of Coal in Texas

Texas is a renowned producer of fossil fuels, such as coal and oil, but researchers at Houston's Rice University claim that increased solar and wind energy adoption could be all Texas needs to quit coal for good. Texas does not even need batteries for such a transformation. *More at <http://bit.ly/EndTexasCoal>.*

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YELLOW VESTS AND GREEN NEW DEALERS



Carl Pope

The fiery street protests challenging French President Emmanuel Macron over his proposed higher taxes on gasoline, and the young climate activists of the

Sunrise Movement who sat in at prospective House Speaker Nancy Pelosi's office might seem like antagonists – one resisting and the other seeking faster and more ambitious movement away from fossil fuels. I'm not so sure about that, though. Some deep currents connect the two movements, currents that raise a fundamental challenge for the climate movement – how to shed the issue's historic framing as a question of austerity and sacrifice.

The Paris protesters' uniform is the brightly colored outer garment that French motorists are required to carry for roadside emergencies – so they are known as les gilets jaunes, or the "yellow vests." Their movement rejects any right-left political label; they identify simply as drivers! The triggering issue was that Macron proposed a (modest) increase in gasoline taxes, to finance France's transition to clean energy and to encourage purchase of more efficient cars. It sounds sensible. But like all sales taxes, this one is regressive by definition and would have hit rural and small-town France disproportionately hard.

Gas is already famously expensive in France, more than \$6/gallon, and most people in rural areas have no realistic alternative to driving. Low-income citizens aren't buying new cars of any sort, let alone the most fuel-efficient models. Macron was already perceived as favoring the Parisian elite, who typically don't drive their own cars to work every day, enjoy access to mass transit and can afford the modest cost increases in their leisure travel.

The protests quickly morphed into something broader and hence harder for Macron to respond to. Eighty percent of the public support the yellow vest movement, which

is raising the fundamental question of whether, as France modernizes and reforms – Macron's platform – it will leave the "other France," the marginal middle class and working poor, behind with lagging incomes, rising taxes and ever-higher cost of living.

Upon his return from the G20 summit in Argentina, Macron was forced to back down on the fuel tax, at least for now. It would have been a small increase – about 12¢/gal. for regular gasoline and 28¢ on diesel fuel. But it's symbolic. As an anti-tax protest coming from the "forgotten" France, the yellow-vest moment has a somewhat similar feel to the "economic anxiety" that drove some blue-collar Americans to support Donald Trump. This entire episode speaks of the cost of "austerity," meaning that when society is perceived as living beyond its means, it is the average person, not the privileged insider, who must scale back.

The protesters sum up their attitude with this slogan: "The government talks about the end of the world. We are worried about the end of the month." The immediate

response to Macron's attempt to address the grievances was that Macron had failed to confront the real issue – salaries and purchasing power.

There lies the potential bridge to the friendly sit-in by young climate campaigners in Nancy Pelosi's office. Carrying signs praising clean energy and calling for a "Green New Deal," they posed a sharp contrast to the yellow-vested protesters in Paris. Members of the new Democratic majority quickly rallied to their demands. While health care was the Democrats' dominant issue in the midterm elections, clean energy and climate were the first post-election progressive de-

mands. Indeed, how to structure the party's climate strategy has become the focus of a generational clash within the newly-elected Democratic House majority. Exactly what this means in policy terms remains to play out.

But all framings of the "Green New Deal" concept, beginning with New York Times columnist Tom Friedman's launch of the idea as a response to the economic slowdown of the Great Recession, conspicuously frame climate action as the 21st-century version of economic stimulus -- investment in innovation. The rest of the package varies. Friedman's version was centrist, with a focus on infrastructure investment, while the 2018 version promoted by Representative-elect Alexandria Ocasio-Cortez and others tilts left of center, with a stronger emphasis on

equity, employment and wage issues. But at its heart, the Green New Deal is first and foremost about the end of the month as well as the end of the world.

Is this just a slogan or will it work in practice? The American evidence is that as a

standalone concept, it may not be enough. Midterm referendum on carbon taxes in Washington State and renewable energy mandates in Arizona, even though framed as pro-growth and pro-jobs, were cut down by a deluge of corporate spending. But in California, the Republican Party bet its future on trying to repeal a gas tax increase put in place by outgoing Governor Jerry Brown – and fell humiliatingly short, losing all of seven of its "at risk" seats in Congress and yielding a super-majority to Democrats in the state legislature.

This was only the latest failure of "carbon populism" to roll back the tide of clean

energy investments in California. But there's a reason for that. California has been careful to ensure that the economic stimulus benefits of green energy preceded the austerity part of the package – so that when, for example, the oil industry tried to roll back the state's long-term carbon cap, voters were already benefiting from a surge of green energy jobs. Then, as revenues began to flow in from the carbon auctions, the state set aside 25% of those revenues for the benefit of low-income communities, a figure raised four years later to 35%.

When the state raised the gas tax in 2017, those revenues were dedicated to repairing and improving the state's existing transportation systems, including roads and highways that are of critical importance to low-income and rural Californians, and whose repair generates blue-collar jobs not just in cities, but in small towns and agricultural areas. Green stimulus has been an experience, not just a slogan, in California.

So "Green New Deal" strategies – not just messages – have proven politically effective at turning back "carbon populism" in California. Equally important, they have enabled California to continually increase both the breadth and the ambition of its climate programs, so that at this moment the world's fifth-largest economy is also moving the fastest towards the deep decarbonization called for by the Paris Climate Agreement.

The climate movement, because of its roots in environmentalism, with its skepticism about "growthmania," has had a hard time consistently embracing and implementing climate solutions as steps towards equity and prosperity. But the fires around the Arc de Triomphe should remind us that if we want entire societies to decarbonize, we have to bring entire societies into the economic future as well.

To learn more about Pope's views on the environment, energy and climate, read *Climate of Hope: How Cities, Businesses, and Citizens Can Save the Planet*, which he has co-authored with former NYC Mayor Mike Bloomberg and which can be purchased online or at a local book store. ♻️



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2018: A SUSTAINABLE YEAR IN REVIEW

Cont'd from p.1

it is now getting less expensive to shut the plant down and buy the electricity from renewable sources than to keep the plant going. I explain this in an article written for CleanTechnica.com (bit.ly/GET-2018-3).

The reports that renewable electricity sources are out-competing fossil fuels reflect conditions that have already appeared in the real world. This means that people who are aware of what is going on, such as the managers of utility companies, had already been seeing the developments and acting on them. And this means other effects have already appeared in the marketplace. These effects include a switch away from plans for future natural gas plants and announcements that coal-burning plants are being closed down.

According to Bloomberg NEF, this year is very close to setting a record for the greatest amount of coal-burning capacity taken offline. What used to be called "Obama's war on coal" has continued, despite President Trump's promises to put coal plants back to work, and his attempts to fulfill those promises. So far in 2018, 16 gigawatts (GW) of coal-burning capacity have been closed down, and 37 GW are expected to be closed down by 2025. That is nearly a quarter of the U.S. coal-burning fleet (bit.ly/GET-2018-4).

News for natural gas, which is credited with coal's demise, is not much better. An



Solar array in Maynard, MA. Electricity from solar is now cheaper than coal. Photo: Swampyank, Wikimedia Commons.

article published by Reuters explained that the gas industry is not growing much faster than 1% per year, and orders for gas turbines are off by well over 50% since 2010 (bit.ly/GET-2018-5). It seems that the managers of utilities have seen the time coming when making money on a gas-fired power plant will not be easy. Perhaps, it will not even be possible.

The problems of the fossil fuels companies are at least partly the result of a near collapse of activity in exploration. According to the International Energy Agency, things are looking pretty dreadful not only for the oil and gas companies, but for anyone dependent on them (bit.ly/GET-2018-6). Because there is little exploration, there will soon be insufficient oil or gas to cover demand.

I want to emphasize the bit that said, "for anyone dependent on them." That means not just the utilities, but everyone else dependent on fossil fuels. These people

include anyone who burns oil, natural gas, or propane to keep warm; anyone who drives a car that burns gasoline or diesel oil; any company that flies airplanes or operates ships. In short, it includes just about all of us, because we live in a society that is addicted to fossil fuels.

The fossil fuels industry has more problems than competition and lack of preparation, however. The Intergovernmental Panel on Climate Change issued a report saying that we have to get busy, right now, addressing the issue of climate change, if we are to keep global warming to 1.5°C (bit.ly/GET-2018-7). It said that goal is achievable, but not if we delay any longer.

Meanwhile, President Trump, touring damage from wildfires in California, said, "I want great climate, and we're going to have that, and we're going to have forests that are very safe" (bit.ly/GET-2018-8). He appeared to blame the wildfires on California's mismanagement of forests, not realizing

that the fires were mostly not in forests, and management of the land that was burned was mostly the responsibility of the federal government, which he heads himself.

Hurricanes were behaving more aggressively this year, also. This was for reasons that we can observe easily, as they are matters of simple measurement. Hurricane Michael, for example, hit the Florida panhandle far more powerfully than it would have if the temperature of the water in the Gulf of Mexico had been normal. But it was not. It was 3°F to 5°F warmer than normal, and since it is the temperature of the water that fuels a hurricane, Michael was stronger than it would have been (bit.ly/GET-2018-9).

Of course, the pressures of the real world have played out in politics. The Democratic Party took control of the House of Representatives in the midterm election. But the greatest changes have been at the state level. For example, California has a unique right to set stricter auto emissions standards than those of the federal government, but other states can adopt California's standards, if they choose. After the midterms, Colorado will be the thirteenth state to do so (bit.ly/GET-2018-10).

One more thing worth noting is that in October, Scotland generated enough electricity from renewable resources, mostly wind power, to cover 98% of its demand (bit.ly/GET-2018-11). ♻️

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David Roberts

Six Year Vehicle Cost of Ownership Comparison

Cost	Typical Gasoline Car	Nissan LEAF	Prius Prime
Purchase Price	\$ (25,000)	\$ (30,000)	\$ (27,300)
Federal EV Tax Credit		\$ 7,500	\$ 4,500
Utility EV Discount Program		\$ 5,000	
Fuel and Energy Costs	\$ (7,920)	\$ (3,672)	\$ (3,312)
Maintenance Costs	\$ (5,825)	\$ (4,716)	\$ (5,033)
Estimated Resale Value after 6 years	\$ 12,000	\$ 8,000	\$ 12,000
Net Cost over 6 years	\$ (26,745)	\$ (17,888)	\$ (19,145)
Average Annual Cost	\$ (4,457)	\$ (2,981)	\$ (3,191)
Annual EV Savings Compared to Gasoline		\$ 1,476	\$ 1,267

The energy costs are based on \$2.75 per gallon of gasoline, \$0.17/kWh of electricity, average efficiency values for new vehicle purchases or the specific model highlighted, and 12,000 vehicle miles traveled annually. Maintenance costs based on 2017 AAA Costs of Driving. Resale value based on current market conditions. Costs do not include insurance, registration or licensing fees which are generally similar across vehicle types.

Driving a plug-in electric vehicle (EV) is getting easier with the arrival of new longer range and more affordable options, including several offerings with all-wheel drive. Plug-in hybrids like the Mitsubishi Outlander PHEV can run 20-plus miles on the battery and then continue running on gasoline for longer trips.

Plugging your ride brings many benefits, including reducing fossil fuel use and associated harmful emissions, fun-to-drive performance with the great torque of electric motors, and significant cost savings potential due to reduced maintenance and fueling costs. This article focuses on the savings EV ownership can bring.

According to the U.S. Department of Energy's eGallon tool, driving an EV is equivalent to about \$1.20 per gallon of gasoline nationally. In Vermont, it is closer to \$1.60 / gallon cost equivalent due to electric rates a bit higher than the national average. This is a great bargain, as gasoline prices are around \$2.75 per gallon in late 2018. Several electric utilities offer off-peak charging rates or other EV charging discounts that bring the cost of driving an EV down even further.

Electric utilities are regulated, so prices are relatively stable over time. This means you don't need to worry about breaking your household budget due to the whims of OPEC, climate-change related flooding of refineries, or other issues that can drive up gasoline prices in your area.

EVs also have fewer maintenance requirements than traditional internal combustion engine vehicles. Regenerative braking systems reduce wear on brake pads and other systems. All-electric vehicles don't have an internal combustion engine, so eliminate the need for oil changes and many other potential maintenance headaches.

Owning any vehicle is an expensive endeavor, but there are many EV options that can significantly reduce costs of ownership. The table below presents a simplified look at several factors that affect the total cost of owning a vehicle for a typical new gasoline car, the all-electric Nissan LEAF with about 150 miles of range, and the Prius Prime plug-in hybrid vehicle with about 25 miles of electric range and the ability to run on gasoline.

The EV options qualify for the federal EV tax credit, and the LEAF is also often eligible for a further \$5,000 price reduction through Nissan "fleet-tail" discounts offered in partnership with electric utilities and others. Even with our relatively low gasoline costs at the end of 2018, EVs can cut your vehicle

energy costs in half or more.


All told, choosing an EV over a gasoline car the next time you are shopping for a new vehicle could save you 30% or more annually. There are excellent calculators available online that offer customized vehicle comparisons based on your specific travel patterns, charging availability and vehicle efficiency. Some calculators can also help estimate costs for leasing an EV. Leasing is a popular option for many EV owners as the leasing company claims the federal tax credit and passes it through in the form of lower monthly payments or down payment costs. Leases typically run about 3 years, so you can be assured there will many more EVs available the next time you are in the market.

Used EVs are not eligible for the federal tax credit, but they can be an even better deal with much lower purchase prices compared to new vehicles. Just do some research and have the vehicle checked out before buying to make sure it will work for your needs.

No wonder EV ownership is soaring in the Northeast!

David Roberts is the Drive Electric Vermont coordinator. He has driven an all-electric Nissan LEAF for the past six years and says, "If you have to drive, drive electric." <http://www.driveelectricvt.com>

References and Notes:

eGallon: <https://www.energy.gov/eere/electricvehicles/saving-fuel-and-vehicle-costs>
U.S. DOE Vehicle Cost Calculator: <https://afdc.energy.gov/calc/> 



Hydrogen May Have a Future on the Rails

Perhaps, finally, hydrogen's moment has arrived. Electricity from renewable sources can be used to split water into oxygen and hydrogen through electrolysis. That "green hydrogen" can then be used in fuel cells to generate electricity. It can also be used to power rail transportation.

<http://bit.ly/HydrogenOnRails>.

AllEarth Rail Commuting Rolling Down the Tracks of Vermont Soon

George Harvey

There was a time when railroads provided most of the passenger transportation in the United States. The Great Depression dealt them a blow, followed quickly by a second blow, as automobiles took their place after the Second World War. With developing financial troubles, railroads had to raise fares, thus reducing total revenues even more. Adding to the troubles was a folk mythology that said railroads were not economically feasible in modern America. But this is not really the end of the story.

In 1949, just as Detroit's road vehicles began to dominate our transportation system, the Budd Company designed and developed the Budd Rail Diesel Car (RDC). Budd had invented a way to weld stainless steel to the structural steel of the RDC without compromising the stainless alloy. The result was a rail car that simply would not rust under normal conditions. Nearly four hundred of these cars were built, and several are still in use today.

With the purchase of twelve, refurbished Budd RDC's by AllEarth Rail, a Vermont holding company, interest is growing by Vermont decision-makers, NGO's and private business to reverse the trends in transportation (Vermont's biggest greenhouse gas sector). For years, Vermont has invested heavily in public transportation, to reduce the cost and environmental impact of transportation. One-person car trips, and corresponding vehicle miles travelled (VMT) and greenhouse gas emissions, challenges the concept of shared mobility over convenience and independence.

The literature indicates that in areas with more public transportation options (i.e., buses and trains), there is a 7:1 benefit in economic transit-oriented development around train stations. This means for every dollar invested in public transportation, there is a \$7 dollar return in economic development (i.e., housing, retail, restaurants and services). The multiplier effect of public transportation is even more dramatic, three times in fuel savings and 5.3 times in reduced greenhouse gas emissions over 1-person car trips.

The RDC passenger cars are self-propelled, equipped with two diesel engines per car. The engine is comparable to that of a tractor trailer and is rather quiet,



AllEarth Rail car. Photo: AllEarth Renewables.

compared to other locomotive engines. It requires a crew of one engineer, though a conductor could be on board too. One RDC can carry up to 96 people, and gets 2.8 miles per gallon (MPG) of diesel fuel comparable to many City buses. The maximum 268 passenger-miles per gallon is even more impressive as buses, like cars cannot avoid congested roadways. Moreover, passenger automobiles, average 24.7 MPG, and usually are 1-person car trips.

Vermont's rail system serves both freight and passengers. Vermont has invested heavily in its rail system with federal Tiger grants and other funds. Transit riders have noted in surveys that they love their commute, relieved of city traffic congestion and parking problems. Trains have relatively low pollution, even being diesel powered as they can hold 96+ people per RDC trip. Sometime in the future, modern trains could run on renewably powered electricity. It is less expensive for passengers to ride a train versus driving alone, not to mention convenience and leaving the driving to others.

David Blittersdorf is well known in Vermont because of his work in energy. As the CEO of AllEarth Renewables, he is actively installing both solar PV trackers and wind turbines. He designed and manufactures the AllEarth solar tracker. What has not been

widely known is that he is a bit of a railroad buff.

He has been considering ways to bring Vermont's railroads back into common use for some time, because he could see that rail transportation has the advantage of lower emissions than passenger cars and is a viable alternative. Most commuters drive solo, getting less than 25 MPG. The 2.8 MPG of a rail car means that fuel is being saved when the train has only nine passengers.

The estimates he saw for the costs for rail transportation provided him with a challenge. One study said the price for restoring passenger service in Vermont could run over \$300 million. He knows that Vermont can do better than that.

Blittersdorf knew about the 1996 refurbished Budd RDC's. He knew that they were built so well they could easily last another 50 years. He also knows its possible to start a new rail organization, providing commuting service, based on the existing track. And in Vermont, almost all of the railroad tracks have been upgraded for Amtrak trains. And so he went to work.

He found the Budd RDC trains he wanted in Dallas, Texas. As RDC production stopped in 1962, all the cars are over 55 years old. They were refurbished in 1996, and served Dallas until 2012 when they were replaced by modern double decker locomotive trains due to popular demand. Blittersdorf made a successful bid to purchase the 12 cars in 2017.

The first of the cars are ready and were displayed in Montpelier in late November. Legislators and decision-makers and the public were invited to climb aboard for the day. People have loved the short rides they got at previous demonstrations in the rail yard in Barre Town. AllEarth Rail is hopeful to encourage short run service in 2019.

My suggestion to commuters driving cars with internal combustion engines is that you calculate all the money you spend on operating your car. According to AAA, in 2017, to own and operate a car is \$8,469, or \$706/month. Keep that figure in mind when you think about the fare to ride a bus, use carshare, or ride an AllEarth Rail community train. The difference is significant, especially of year's of commuting, you might decide there is a railroad in your future. ♻️



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SMART COMMUTING IN NH & VT

Transportation emissions are among the worst offenders that add to the rising CO₂ levels in our atmosphere. In recent months we have learned that our efforts have begun to reduce the detrimental air quality counts (NHDES), but as you may have learned from numerous other reports such as the International Panel on Climate Change (IPCC), <http://climatechange2013.org/>, global warming is still advancing faster than expected.

How do we get our emissions down now? By making new commuting choices!

Lots of choices. Smart Commuting is all about knowing your options and planning ahead. There are many choices to get around in New Hampshire and Vermont. The first place to start in Vermont is "Go Vermont" for statewide choices to travel more efficiently. Whether getting around town, commuting to work or school, or planning a day trip, share the driving or ride with someone else to help save our planet and to save approx. \$2,000 annually. The statewide VT site also lists services for commuters, tourist, and shoppers.

In New Hampshire you'll find a similar site at "NH Rideshare" where you can find car-pools, transit routes and schedules, bike and walk trails and links to statewide transportation information.

When carpooling, remember to use the local Park n Ride lots to meet your connections. Start your trip planning at connectingcommuters.org or nh.gov/dot/programs/rideshare/ for statewide choices.

IN NEW HAMPSHIRE

UPPER VALLEY RIDESHARE (UVRS) - Carpool matching, benefits and support for commuters in/out of Upper Valley. 802-295-1824 x208. uppervalleyrideshare.com.

ADVANCE TRANSIT (AT) - Free weekday bus for Lebanon, Hanover, Enfield, Canaan, NH, and Norwich and Hartford, VT. Dartmouth and DHMC Shuttles. ADA & Travel Training Services. 802-295-1824. advancetransit.com

CARROLL COUNTY TRANSIT - Services and connections to Belknap County. 888-997-2020 tccap.org/nct.htm

CITY EXPRESS - Serves Keene. 603-352-8494 hcsservices.org/services/transportation/cityExpress.php

SCS TRANSPORTATION - Services for Sullivan County.. 603-542-9609. SCSHELPS.ORG

CONCORD AREA TRANSIT (CAT) - Serves Concord 603-225-1989 concordareatransit.org

CONTOOCOOK VALLEY TRANSPORTATION (CVTC) - Monadnock Rideshare for the southwest region 877-428-2882 cvtc-nh.org

COOPERATIVE ALLIANCE FOR REGIONAL TRANSPORTATION (CART) - Serving the Chester, Derry, Hampstead, Londonderry, Salem and Windham, limited service to Plaistow. 603-434-3569 cart-rides.org

DARTMOUTH COACH - Services to Boston, Logan Airport and NYC 800-637-0123 dartmouthcoach.com

MANCHESTER TRANSIT AUTHORITY (MTA) - Manchester, with links to Nashua and Concord. 603-623-8801 mtabus.org/services/local-buses

MID-STATE REGIONAL RIDE RESOURCE DIRECTORY - Services elknapp-Merrimack Counties, excluding Hooksett and the towns of Deering, Hillsborough and Windsor of Hillsborough County. 603.225.3295 x1201. midstatercc.org

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/

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 advance 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, Poulney 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

A Path to a Green Transportation System

Deb Sachs and George Harvey

This is a series of stories, "On the Path to a Green Transportation System"; the intent is to inspire action by everyone to choose more efficient ways to travel and to invest in a shared mobility system.

It's astonishing that Vermonters drive 7+ billion miles annually to jobs, school, errands and leisure. Not surprising, transportation is the single largest CO₂ sector in Vermont (43%). Our auto-dependent lifestyles come at a big price. In fuel alone, Vermonters spent more than a billion dollars in 2017. About 78¢ of every dollar is exported from Vermont. In spite of our collective efforts, greenhouse gas emissions are on the rise. Thus, we examine the path to a greener transportation future?

The Path to a Greener Transportation Future?

I'm heartened by how passionate people are about reversing the trends from community volunteers and energy committees, to business leaders, professional associations, and nongovernmental organizations (NGO's).

Ross MacDonald of Go! Vermont and Dave Roberts of Drive Electric Vermont

recently presented to a room full of enthusiastic energy committee members and volunteers at the 2018 VECAN conference in Fairlee, Vermont. Go! Vermont encourages use of more efficient transportation (i.e., carpooling, vanpooling, walking, biking and telecommuting), and Drive Electric encourages electric vehicles when purchasing a new car. Obviously, the cleanest greenest option is to choose to travel more efficiently.

If we want to move the needle and drive down the vehicle miles we drive each year, we must choose a shared mobility option (walking, biking, bus, carpool and vanpool).

In future stories in *Green Energy Times*, we'll take a deeper look at the broader connection between public transportation, energy conservation and greenhouse gas emissions reductions. First, let's explore efficiency and technology.

The literature indicates that when public transportation is available, people drive less. And shorter commutes occur when transit oriented development (a good mix of land uses), enables people to access convenient and affordable options. This is the key to reducing energy use and corresponding CO₂, making public transportation three to five times more of a carbon benefit compared to one-person car trips. More details on this in a future story.

Combine efficiency and electric vehicles (including electric buses), then Vermont has the opportunity to supply this demand with local renewable power. Rather than purchase gasoline, let's supply clean power instead, and circulate millions of dollars

Vermonters drive 7+ billion miles annually to jobs, school, errands and leisure. Transportation is the single largest CO₂ sector in Vermont (43%).

back into our local economy.

The path to a green transportation system is to invest in modernizing Vermont's shared transportation system. Let's make 2019 the year that we do better than to export 78¢ of every fuel dollar.

We are heartened by the many partners advancing efficiency, fuel switching, tech-

nology and behavior change. Becoming mindful of all travel options is the first step to reversing one-person car trips. While it might feel complicated, daunting, or inconvenient, it's really a lifestyle change.

MacDonald gave an overview of the Go! Vermont program; a statewide clearinghouse of resources, incentives and technical assistance to travel more efficiently. New features include a "Trip Planner" and a newly released carpool matching application (APP) and earns incentive rewards. In addition, Go! Vermont supports hundreds of volunteer drivers offering "demand response" service to those in need.

Go! Vermont's website guides travelers and commuters to various options to save money and reduce pollution. Visit Connectingcommuters.org

for all the options. The new Go! Rewards (carpool) program not only matches drivers and riders going the same way but has a trip calendar to track green trips and earn incentive reward points to discounts and monthly drawings of \$100 gift cards.

Roberts presented the latest at Drive Electric Vermont; a program focused on electric vehicles (EV) technologies. It is coordinated by VEIC, with information on all aspects of ownership and use of EV's. It is a good source of guidance on the environmental and economic reasons to

drive EVs, including incentives and financing. It provides a map showing locations of charging stations.

He made the point early in his talk that we cannot deal with reducing carbon emissions effectively unless we reduce emissions from transportation dramatically. Public transportation is a good solution in urban areas, however many people who live in less built-up areas are unlikely to have access to bus service. Replacing the number of cars to EVs is part of the solution. To meet our emissions reduction goal, we will need at least 45,000 EVs in Vermont by 2025. The latest report is that we have fewer than 3,000, so we have a long way to go.

There is some resistance to buying EVs. One quarter of people polled object to the cost, though prices are declining rapidly, and there are still incentives available. Many people worry about range and charging. Some people feel compelled to have all-wheel drive,



GreenRide Bikes, Burlington, VT. Courtesy CATMA/GoVT.

Transportation Path *Cont'd from p.6*

which is not available on many EVs. He presented several ideas on how to get people into EVs. Vermont is committed to installing charging stations, including fast chargers, which are being installed widely.

Major funding resulted from the Volkswagen (VW) settlement on its diesel emissions lawsuit. Vermont is putting some of its settlement share into building up EV support infrastructure and electric buses.

Roberts also provided tips to people on how to get EVs adopted on the local level. He cited several communities hosting EV demonstration events, giving people the opportunity to see, sit in, and even drive EVs. Vermonters helping Vermonters are encouraged to learn more and talk to their select boards, and other officials about electrification of municipal vehicles.

Electric buses are important to improving air quality in urban areas, in addition to reducing noise. Testing has been done in Vermont, and buses are being adopted. They cost at least 60% more than diesel powered buses, but their reduced fuel costs and maintenance allows for a quick payback on the difference.

Learn more about efficiency and EV resources and the VECAN presentations at:

Go! Vermont is connectingcommuters.org;
Drive Electric Vermont's website is driveelectricvt.com.

An archive of the 2018 VECAN addresses can be found at bit.ly/VECAN-11-archive.

Debra Sachs is the Executive Director of Net Zero Vermont. ♻️



Ethan Allen 5-year old vanpool saved riders \$88K in fuels savings alone, vanpooling in VT is part of the solution. Courtesy GoVT.

DRIVE ELECTRIC NEW HAMPSHIRE END OF THE YEAR RECAP AND PROPOSALS

Randy Bryan, Drive Electric NH



New Hampshire's 2018 National Drive Electric Week events. The biggest ever! Image: Jon Gundersen.

And while we are at year's end, it is a good time to reflect on what we've accomplished and make plans for where we should go. Drive Electric NH (DE-NH) has had a busy year in our roles as expert on and as promoter of electric transportation.

1. Drive Electric NH is a named participant in the NH Senate SB 517 Commission to guide the legislature on the issues and best practices for the mushrooming presence of electric cars, especially the smartest way to use the funds allocated to NH from the Volkswagen Settlement Funds. What expertise there is in NH on electric vehicles meets periodically as the Senate Commission. Many of the organizations on the Senate Commission are also members of Drive Electric NH. The result is a network of organizations and experts that have multiple forums to discuss issues, ideas, and settle on common solutions and goals. While the Commission's work proceeds slowly, it seems to be well guided.

2. A second area of progress is in public education on electric vehicles (EVs). This comes in the form of ride-drive events which have proven to be the most effective way to educate and motivate people to go electric. DE-NH has grown from four public ride-drive events with approximately 400 visitors in 2017 to twelve events and about 1200 visitors in 2018.

3. A third area of progress for NH, independent of DE-NH, is the availability of Volkswagen Settlement funds for investment into cleaner trucks and better charging infrastructure. The NH government's Office of Strategic Initiatives (OSI) is responsible to spend the money wisely, per the fund requirements. NH Division of Environmental Services (DES) and DOT are heavily involved in crafting and implementing the spending plan. Various DE-NH member organizations are involved. This should result in the beginnings of a competent fast-charger network around NH. The presence of this fast-charging network should eliminate the range anxiety issue from NH EV buyers and EV tourists.

4. A fourth area of progress for NH is in the growth of EV sales. For those who recognize EVs on the road, driving has been a lot more rewarding. 2018 will see a doubling of EVs sold in NH vs 2017 (>1500 plug-in EVs vs 788).

Where do we go from here? The simple answer for 2019 is MORE.

The Senate Commission will likely accelerate its work, and I hope the first dollop of Volkswagen funds will be spent wisely.

More EV events should make more people aware of the pleasures of owning an EV. NH's city and town energy committees have shown an interest to organize and stage EV events. Sierra Club's Ready for 100 campaign is gathering more supporting cities and towns and embracing clean transportation.

What needs new initiatives?

- Corporate, municipal and fleet participation needs a push. The Volkswagen money will help for fleet-heavy truck purchases, but the car and light truck areas need their own push. Similarly, workplace charging needs attention. Corporations might encourage and sponsor EV events, too.

- Public education and awareness for EVs. For example, Maine has sponsored a series of upbeat generic EV advertisements on the radio that everybody hears. Public EV charging signage on the streets and highways might make more people aware of the growing EV presence. There are charging stations around NH, but no signage like there is for gas stations.

- EV supply and focus at the dealership and manufacturer level. Very few NH dealerships have adequate supply of EVs to sell or knowledge of how to sell them. MA, VT and ME (zero-emission vehicle mandate states) all have great supply, but not NH. Buying EVs from out of state has become common. The predictions are for the EV sales to nearly double each year for the next few years. We need to get ready.

Want to Help? Contact Drive Electric NH at 603-26-4732 or www.driveelectricnh.org..

Randy Bryan is one of the co-founders of Drive Electric NH. Randy's company, ConVerdant Vehicles, has converted vehicles to plug-in hybrids and sold inverters that turn a Prius into an emergency generator. ♻️

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Reduce Emissions

CITY OF KEENE DELIBERATES 100% RENEWABLE ENERGY GOAL




The city of Keene, New Hampshire: Wikipedia.org.

On November 28th, the Keene Municipal Services, Facilities, and Infrastructure Committee voted 4 to 1 to send the 100% Renewable Energy resolution to city staff to draft revised language. Once rewritten, the resolution will make a return visit to the committee for passage before being sent to the full City Council for a vote. The


goals set are for all electricity to come from renewable sources by 2030 for the entire city and its residents. Then, by 2050, the goal is to have all energy used in the city to come from renewable sources.

This night was special because of the number of Keene residents and nearby townspeople and representatives from

the Monadnock Energy Hub (MEH) in attendance. Steering Committee members Dori Drachman, John Kondos, Ann Shedd, and Peter Wotowiec all stepped up to make their voices heard on this important resolution. Shedd, leader of the Keene Energy & Climate Committee began with an example of a resiliency program from Sterling, MA that Keene could model. Kondos followed with an impassioned plea that we must act now. Drachman stated that surrounding towns such as her hometown of Peterborough look to Keene on such actions. Finally, Wotowiec ended by reading a letter of support from his employer, Bensonwood, for this resolution. Mary Ewell, program coordinator for MEH, did not want the council to forget the power of future generations to problem-solve and apply as-yet unimagined technological advances, considering that the goals are 10 and 30 years in the future. Many more citizens and members of local energy committees spoke during the evening, and the MEH steering committee and program coordinator were proud to have added their voices to such company. MEH plans to attend the next MSFI committee hearing when the revised language resolution is discussed, and the hope is to celebrate the final passage in the near future.



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Making Solar Accessible to Vermonters with Low Incomes

George Harvey

At the VECAN Conference, one workshop topic was "Making Solar Accessible to Low Income Vermonters." It was presented by Jason Edens of the Rural Renewable Energy Alliance (RREAL) and Steve Geller of Southeastern Vermont Community Action (SEVCA).

Edens started the presentation with a discussion of "energy poverty." He explained, "When families have to choose between home energy and other basic needs, families are living in what we typically call energy poverty." He said that roughly 15% of all Americans live in this situation. Many of these people literally have to choose between heating and eating, at a time when the low temperatures make it important to increase caloric intake.

This is a serious problem. People die of cold in Vermont, because they cannot afford heat. People who are most endangered by energy poverty are the least likely to be able to insulate and weatherproof their homes, because they usually do not own them.

There are programs to help with assistance on fuel bills. While such help is important to people depending on it and clearly can be a life-saver, it is a short-term solution that does not address the underlying causes of poverty at all, but simply enables people to cope with its hardships.

That, however, is not the worst part of addressing energy poverty with assistance to buy fuel. Arguably, the worst problem we have in this world is climate change

caused by burning fossil fuels. So giving fuel assistance contributes to climate change and the havoc it is creating.

Edens addressed this problem head on. He asked, "Do we want a carbon-intensive energy assistance program?" He then continued, "The International Monetary Fund and the World Bank have both identified the energy assistance program as yet another fossil fuels subsidy."

That is worth thinking about. Helping low-income households with fuel assistance can be seen as a subsidy for the fossil fuels industry. Edens has a solution, however, which he introduced by asking, "So the question is, do we want [fuel] assistance, or do we want solar assistance?"

The problem of energy poverty can also be seen from another perspective, one of addressing climate change. We cannot address

climate change without addressing fossil fuel dependence among the poorest people among us.

Edens observed, "If we actually want to make a transition to a renewable economy, a clean energy economy, it's absolutely essential that we intentionally create pathways to ensure that our low-income neighbors, friends, and community members also participate in the benefits of clean energy and of solar energy in particular."


This raises the matter of how to deal with energy poverty. "Solar is a hedge against uncertainty," Edens said. It provides not only local control and resilience, but a capacity to serve at least some of the low-income families within an area.

"We are all very committed to making this transition to a clean energy economy," Edens said. "We cannot do so unless we ensure low-

income communities have equal access to the benefits of solar energy and equal opportunity to participate in the clean energy economy."

Edens' presentation at the workshop was immediately followed by a talk by Steve Geller. SEVCA, the organization of which Geller is executive director, has had significant experience with addressing the problems of energy for a number of decades.

Geller's presentation provided details of a project being built under a SEVCA-RREAL partnership, "Community Solar for Community Action." The project is going ahead with a 110-kilowatt array being built at SEVCA's headquarters in Westminster, Vermont. The talk dealt with the vision, opportunities, challenges, and progress of the project, which was designed to fulfill the goals detailed by Edens.

This VECAN workshop can be viewed at bit.ly/VECAN-solar-accessible. 




SEVCA (Southeastern Vermont Community Action) staff and legislative and community representatives gather in Westminster, VT to celebrate the completion of Phase 1 of the Community Solar for Community Action project. Courtesy photo.

Many thanks to our sponsor:




MN-VT Partnership Will Offer Solar to Low-Income Families

A Minnesota nonprofit has a community solar model they think could go national. The Rural Renewable Energy Alliance and Southeastern Vermont Community Action are partnering to get solar power to 50 low-income households in Windham and Windsor counties.

To learn more go to <http://bit.ly/MN-VT-partnership>. 

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Solar Blesses Three Churches in Norwich, VT

George Harvey



Norwich Solar Technology's EZ-PV MetaModule™ system in action at the Norwich Congregational Church. All photos courtesy of Norwich Solar Technologies.

Norwich, Vermont, is not a particularly large town. It has a population of fewer than 3,500 people. That being the case, it came as a bit of a surprise when we discovered that three churches in the town all got solar systems over the short span of just two years. Perhaps each of these systems deserves separate treatment, but we feel it might be good to show what a community can do when its people think along similar lines.

The Norwich Energy Committee runs an annual Solarize Norwich program that helped push the churches to consider solar power. The installations have rather dissimilar histories, the members of the congregations had somewhat different specific goals, and the financing was different from one project to the next. Apart from the fact that they were all in the same community, the most important shared feature was that all three systems were installed by Norwich Solar Technologies (NST).

Troy McBride, the Chief Technology Officer and Co-founder of NST, wanted to be sure to mention the first church in Norwich to have a solar system installed was not

one of the three his company worked with. St. Barnabas Episcopal Church was an early adopter celebrating over 10 years of solar power usage, installed in 2008. The three churches with new systems are the Norwich Congregational Church, St. Francis Catholic Church, and the Unitarian Universalist Church of the Upper Valley (UUCUV) in Norwich.

Norwich Congregational Church

The Norwich Congregational Church has a new, roof-mounted system, consisting of 34 Suniva 325-watt modules, for 11.1 kilowatts (kW). The system includes 34 SolarEdge Optimizers and a SolarEdge inverter. It was commissioned in November of 2016.

Funding for this system was partly covered by a grant from Green Mountain Power. Grant proposals can be daunting, so NST provided the church with help. Over a 25-year service lifetime, the value of net metering for the system is estimated to be \$54,000. The estimated rate of return on the solar investment is 10.4%.

NST used its EZ-PV MetaModule™ system to mount the solar panels. The advantage of this system is partly that the installation can be done quickly and with minimal disruption.

Norwich Congregational Church's website is norwichcongregational.org

The Unitarian Universalist Church

The Unitarian Universalist Church of the Upper Valley in Norwich already had solar credits donated from an offsite solar system when it decided to mount another on the rooftop. One of the factors in the decision was that its new building had beautiful south-facing roofs, and people thought it would be a shame to let it go to waste. The new system is a community solar array, with church members participating in net metering.

This system has 45 solar panels, each of 350 watts, providing a total power of 15.75 kW DC. It includes 45 SolarEdge P400 Optimizers and a SolarEdge HD Wave SE11400H-US inverter. The racking is IronRidge XR-100, using EcoFasten QuikFoot attachments.

The UUCUV system was completed in 2018. Its members blessed the panels near the winter solstice on Sunday, December 23rd. UUCUV's website is uucuv.org.

Congregants of the Unitarian Universalist Church of the Upper Valley bless the rooftop solar array on December 23, 2018. Courtesy photo.



The Unitarian Universalist Church of the Upper Valley has a rooftop array consisting of 45 panels providing a total power of 15.75kW DC.

St. Francis of Assisi Church

The Catholic Church in Norwich also got a solar system in 2018. This turned out largely to be the result of activities of Dominic Scanlan, a high school student who took on the work of pushing for a solar system as part of a confirmation service project.

Scanlan understood that the church was spending \$1,000 per year on electricity, and looked for a way to offset that. He managed to get a donation of \$8,000 from the Jack and Dorothy Byrne Foundation of Hanover, New Hampshire, and he quickly set about finding the remainder of the approximately \$13,000 needed to build the system. In that also, he succeeded.

The St. Francis of Assisi solar system has twelve Solaria 330-watt solar panels, for a capacity of 3.96kW. Like the other systems at the Norwich churches, it uses SolarEdge Optimizers and a SolarEdge inverter. The mounting system is based on IronRidge Flush mounts.

The project at St. Francis of Assisi is expected to save the church \$30,000 over its lifetime.

St. Francis of Assisi's web site is uppervalleyparishes.org/st_francis.html.

All of these systems, built by Norwich Solar Technologies, represent savings and price stability for the churches that own them. Importantly, they point a way for reducing carbon emissions, as well. ♻️



The St. Francis of Assisi rooftop solar array has twelve solar panels, for a capacity of 3.96kW.

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The World's Largest Battery System

George Harvey

The least costly power from combustion of fossil fuels comes from combined-cycle natural gas plants. These plants have produced power so inexpensively that they have been driving coal-burning plants out of business. The situation, however, is changing rapidly. Combined-cycle natural gas plants are themselves in danger of being shut down by renewable energy backed up by batteries of sufficient size to keep up with changing conditions and demand.

A power plant in California provides a good example. It is a combined-cycle plant, of the type that produces the least expensive fossil fuel power. It was first put online in 2005, so it is not old and should have at least another 25 or 30 years of productive life ahead of it. According to Wikipedia, the Metcalf Energy Center (MEC) has a capacity of 605 megawatts (MW), which is roughly the capacity of the old Vermont Yankee nuclear plant. (bit.ly/GET-MEC)

Given that description, we might expect MEC to be a valuable asset. That, however, is not the situation. MEC's owner, Calpine Corporation, wants to close the plant down, because it is losing money.

To understand what is going on, we should consider a combination of two trends. One is the continuously declining cost of electric power from wind and solar power plants. The other is the buildup of renewable power in California, which has been going on for years. The result of this combina-



Tesla battery system in Australia. Images via Hornsdale Power Reserve and Tesla on YouTube.

tion has been that an energy glut has been created in the California market. This glut has come to a point where combined-cycle natural gas plants, including MEC, are having trouble making money.

In 2017, when MEC was about twelve years old, Calpine requested that it be given a license to run on a "reliability-must-run" (RMR) basis, which would give it sufficient extra income for it to keep running when it would otherwise lose money. As the term suggests, RMR is only given to plants that are absolutely necessary for grid reliability. The extra revenue for such operation is charged to ratepayers, and a plant must have approval from the Federal Energy Regulatory Commission for it.

However, the California Public Utilities Commission (CPUC) had its own ideas about MEC. Late last year, it ordered

Pacific Gas and Electric (PG&E) to seek alternative sources of power to save customers money. In the early summer of this year, PG&E requested approval of the plan it had developed from CPUC, and that approval was granted in November.

The plan is stunning. Because power from wind and solar systems is so inexpensive, and battery storage costs have dropped greatly, PG&E decided to replace the MEC plant with batteries. Energy from the combination of renewable energy generation with batteries is expected to cost less than that produced by the combined-cycle natural gas plant. But using batteries to replace a 605 MW natural gas plant, roughly equal in size to the old Vermont Yankee nuclear plant, requires storage capacity that is a multiple of those of the Hornsdale Power Reserve (HPR), the largest battery on Earth.

The capacity of HPR is 100 MW / 127 MWh. That is dwarfed by the second largest of the four batteries to replace MEC, an 182.5 MW / 730 MWh system to be built by Tesla. And the largest of the four, which is to be built and owned by Vistra Energy Systems, is much larger than that, at 300 MW / 1,200 MWh. The four batteries will have combined capacities that total about 580 MW / 2,270 MWh, and they are expected to be fully installed in less than two years.

What this means is that a combination of solar photovoltaics, wind power, and batteries is expected to produce power, both baseload and backup, at costs below those of the least expensive fossil fuels. And this is starting to put the natural gas industry at risk. We have a lot of natural gas power plants coming online right now. They may already be doomed to be stranded assets. ♻️

SOLAR FOR CHURCHES & NONPROFITS IN NH



Dan Weeks of Revision Energy presents at the Solar Saints kickoff meeting to educate churches and nonprofits on installing solar. Courtesy photo.

A kickoff meeting of a program called "Solar Saints" was held Saturday afternoon, December 1st at All Saints Episcopal Church in Wolfeboro, NH. Twenty-six participants attended the meeting representing five churches and four community nonprofits.

Solar Saints is a program sponsored by All Saints Church and the NH Episcopal Diocese to help Episcopal churches in NH and community nonprofits install solar photovoltaic (PV) arrays on their property with the joint benefits of reducing their carbon footprint and directing more of their financial resources towards their mission. They have been working on bringing the program into being for two years.

The two hour meeting included an overview by Solar Saints members of the various financial options available to nonprofits to help them fund a solar array on their property. Solar Saints' vision is to aggregate many nonprofits in a community to "go solar" together and jointly benefit from the economy of scale.

Dan Weeks of Revision Energy presented one financial option called "third party finance" that helps nonprofits take advantage of the 30% federal tax credit and depreciation on their PV array which is otherwise not available to nonprofit organizations. In this option, the third party purchases and owns the array for the first six years while the tax credits are taken. After this initial period, the nonprofit will have the option to purchase the array, typically at 50% less than the initial installation cost. The nonprofit will also receive its electricity from the PV array at below market rates resulting in savings to the nonprofit from the first day of installation.

The two members of All Saints Church leading the Solar Saints program are Douglas Smithwood and Susan Fuller. For more information, please contact Susan Fuller at sfuller5277@yahoo.com. ♻️

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Backing up the Grid – All of It!

George Harvey

It is important to understand that thermal baseload power plants, powered by producing steam, are generally very inflexible and cannot change their output to match demand. Since producing excess power would overload the system and create problems, they are designed only to meet the minimum amount normally needed, the "baseload." They can run flat out all the time, and any demand greater than what they can provide has to come from some other generating type.

At the same time that the old Vermont Yankee (VY) nuclear plant was being built, to provide an output of about 500 megawatts (MW), the Northfield Mountain Station (NMS) pumped storage system, with a maximum capacity of 1080 MW was also under construction just down the river. NMS was to take up power when demand was low and deliver power to cover demand peaks.

There are not many good sites for pumped storage, so usually peak demand has been covered by special generators that are flexible enough to cover peak loads. They provide a service for which they charge quite a lot of money.



Pumped storage systems are used to enable baseload power systems to match grid demand. Now they can be used to enable renewable power systems to do the same job. The Raccoon Mountain Pumped-Storage Plant is shown. Tennessee Valley Authority image.

Clearly, baseload power plants need backup because of their inflexibility. That backup has to be available every day on a massive scale.

Some renewable energy generators can power around the clock. Unlike thermal baseload plants, hydropower and geothermal plants can be ramped up and down rather quickly, but like pumped storage, they cannot be built just anywhere.

While it is true that the sun does not always shine, and the wind does not always blow, solar and wind plants have the advantage that they can be "curtailed" to avoid having too much electricity on the

grid. They also can produce the least expensive power available to us.

Recently, the cost of power from batteries has been reduced to the point that it is practical for them to take up excess power from solar and wind plants, making curtailment unnecessary. Then they can provide it to the grid as needed. In this way, they can replace existing baseload power plants.

The Hornsdale Power Reserve (HPR), in South Australia, has shown its value backing up all grid generators, not just wind and solar power. When coal plants suddenly go offline, the wholesale price of electricity in that country can legally go to

a maximum of over \$10 (U.S.) per kilowatt-hour, a price that gets hit occasionally. With the HPR in business providing for unexpected demand spikes, peak prices have dropped over 90%, the state has paid down a third of the battery's cost in only one year, and the customers have saved a fair amount of money. (See "The World's Largest Battery System" on page 10.)

A set of recent events in Australia show the value of renewable energy and battery backup for providing energy security. In August, a set of storms took transmission lines down connecting grids in four states, Queensland, New South Wales, Victoria, and South Australia. (These states

are huge, by the way. Their total area is about half that of the 48 contiguous states of the U.S.) Power went down in New South Wales and Victoria. South Australia only had momentary flickers because of the Hornsdale Power Reserve, which performed exactly as intended.

Interestingly, Queensland also had only a flicker, despite its lack of a big battery. That was because of widespread use of renewable power. About a third of the homes in that state have rooftop solar power.

What we can see here is that both renewable energy with some battery backup and grid-scale battery systems can provide for unusual demands for electricity that baseload plants cannot. This should probably be no surprise. Baseload power plants were never intended to provide for unusual situations. ♻️

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The Solar Industry in 2018

Progress in spite of all the troubles

We at Green Energy Times often get quite a 'charge' out of news releases from ReVision Energy. It is truly inspiring to learn what they have done recently.

But their most recent news included how the country and New England's solar progressed in 2018 was so exciting to read that we felt a need to include it in G.E.T. and share it with all of our readers. Check out these encouraging statistics.

The Solar Industry in 2018

In the face of tariffs and policy shake-ups across the country, the solar industry was undeterred in 2018. Driven by the best product prices ever (even with tariffs in place), and states that are pushing forward on carbon-neutrality goals despite inaction on the federal level, solar nationally recorded among its strongest years, and FERC data suggests five times as much solar as exists today will come online by 2021.

In 2018, TWICE the ISO-New England grid experienced daytime low peaks as a result of solar (once in April, and again on Thanksgiving day) -- results that demonstrate that the 150,000 solar arrays in New England already have a meaningful positive impact on the energy grid, and show that with greater adoption we can erase our reliance on fossil fuels.

Here are some of the most interesting trends pulled from our data of over 1,000 installations in the calendar year 2018:

- People are tending to install slightly larger solar PV systems (8.2 kW in 2018 vs. 7.8 kW in 2017).
- The increase is largely due to people converting more fuel loads (water heating, space heating, and vehicles) to electric alternatives, and powering those alternatives with solar. Nearly HALF of all solar arrays now come paired with a heat pump (vs. 25% in

2017).

- Solar finance is taking off, with roughly double the number of solar arrays financed in 2018 vs. 2017. The popularity is due to solar financing being a better deal (better interest rates and fees) and demographics (more young homeowners going solar).

- We had a boom in larger-scale solar projects in Maine and New Hampshire, with a record number of projects over 50 kilowatts.

- Battery systems took off! In 2018, around 10% of our residential solar arrays came with battery storage attached, up from roughly 5% in 2017.

2019 Shaping Up to be a Record Solar Year

2019 is shaping up to be a record-busting year for solar, driven by a combination of factors:

150,000 solar arrays in New England already have a meaningful, positive impact on the energy grid and show that, with greater adoption, we can erase our reliance on fossil

- Solar is the cheapest it has ever been. Like the microprocessor industry, solar panels continue to get better and cheaper. Trumps tariffs produced a small bump in the road, but already solar panels cost less than they did pre-tariff.

- The 30% federal tax credit for solar PV drops by 4% at the end of 2019, creating an extra incentive to get your system built in

this calendar year.

- The cost for conventional energy keeps going up and faster than the historical average. CMP in Maine announced a 14% increase, and Eversource announced a 4% increase in Massachusetts.

- The availability of zero-down solar loans such as Revision Energy offers, with the other facts listed above, means that we can anticipate that 2019 is going to be a great year for solar.

Make your 2019 the year where you save money and do something about the climate crisis by going solar! ♻️

Solar in Maine is Looking Good for the New Year

Solar to Go on the Blaine House in 2019



Note that this image is only a mock-up of what solar on the Blaine House might look like. While it has been announced that the Governor's house in Maine will be going solar in 2019, the design remains to be decided. Courtesy image from Revision Energy.

Back in 2015, ReVision Energy made an April Fool's joke about solar panels going up on the Blaine House, the official residence of the Governor of Maine. Well, it's a joke no more! Maine Governor Janet Mills, in her inaugural address, said that solar panels will be installed on the Blaine House, a practical benefit (saving money) and powerful signal that a new era has come in terms of Maine's approach to energy policy.

A rendering we made in 2015 showing how the historic Blaine House might look with solar panels on it. 74 panels would fit, for a roughly 21 kilowatts system, and offset about 50% of the electricity needed for the heat pumps installed there. ♻️

Two Impressive Solar Projects of 2018 by Revision Energy



Below: Pepperell Mills in Biddeford, Maine. It is Maine's largest privately-owned solar array consisting of 1,192 panels over 1.5 acres of rooftop and producing 437,320 kilowatt hours of electricity annually.

Above: Mascoma Meadows, the first manufactured-home cooperative in NH to be powered by solar. This 132kW ground mount will save all of the 50 low-income families around \$300 in electricity costs per year. Installed by Revision Energy. All photos courtesy of Revision Energy.





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Non-Traditional Solar Orientations

George Harvey

Usually, the choice for solar photovoltaic (PV) systems is to have them face due south or mount them on trackers. There are other solutions for solar installations, however, and some are worth knowing about.

A building with a north-south roof ridge axis is not a readily workable place to mount a conventional south-facing rooftop system. In such circumstances, however, it is possible to install some panels facing east and some facing west. Power production is somewhat less than what it might be with a conventional system of the same size, but for some buildings, it may be ideal. PV panels have become inexpensive enough that east-west solar systems can be practical.

A good example of such a system



Integrity Energy, LLC installed the solar system on the east and west-facing roofs to provide 100% of the energy needed for the EyeCare For You office in Bethel, VT. Photo: NR Mallery.

well.

Katrina Wilson, of *Integrated Solar Applications Corp.* of Brattleboro, Vermont, said, "We started installing on the east and west roof as well as the south when we were introduced to SolarEdge Inverters back in 2015." She also gave us some technical details. "The average home in Vermont without conventional electric heat or cold climate heat pumps is sized at 24 modules or 6.96kW with a south-facing array," she

said. She compared this with an orientation of either east or west, saying, "With the same system, with the same factors facing directly east or west is estimated to produce 7,270 kilowatt-hours per year. This is just slightly less than if it were facing south."

Kim Frase of *Frase Electric & Solar* in South Tamworth, New Hampshire, has also had some experience installing east-west solar. He told us, "Depending on the roof pitch and how far west or east it is, it can be a

15-20% reduction from optimal orientation. But with limited shade, it can be as good as a true south installation if the true south installation has 20% shade."

There has also been an increase of west-facing solar arrays, or more commonly arrays facing south-west, in some parts of the country. This happens when the array own-

er can sell electricity from the afternoon sun at a premium. On most days, peak grid demand is in the late afternoon to early evening. It has historically been taken up by power plants that charge very high prices. West-facing arrays can cover high afternoon demand when the sun is shining, and if they are associated with batteries, they can provide power at other times also.

Another non-traditional type of installation uses bi-directional solar panels. Bi-facial solar panels collect light from both surfaces to convert it into electricity.

Panels of this type have been tested at the United States Department of Energy's Regional Test Center (RTC) in Williston, Vermont, one of five such centers in the country. The RTC is doing research on the panels to see how they could best be used. The data it gathers will be useful for making engineering decisions in the future, both for manufacture and use. The bidirectional solar panels they are testing were made by Prism Solar, in Highland, New York, Solar-World USA, in Hillsboro, Oregon, and Tesla, of Palo Alto, California.

While some bi-facial panels can be installed vertically, with one side facing east and the other west, they are especially valuable for applications in northern areas, because they can be mounted in a couple of ways that ordinary panels cannot. They can be set up toward the noon position of the sun, much like other PVs. If that is done, and if their backs are unobstructed so as to receive light coming from the side facing away from the noonday sun, they can generate electricity from light reflected by snow, so they can produce added power from the less powerful winter sun.

Another mounting system for bi-facial panels is to install them above decks, car-ports and similar locations, where the floor or ground below them is of a color that can reflect a good deal of light. The panels have glass on both sides, allowing light to pass through them, producing a mottled pattern on the ground below. If the ground is reflective enough to send light back up to the panels, they generate light from both sides.

Clair Chang of the *Solar Store of Greenfield, MA* told us her business installs bi-facial panels made by Prism Solar for places that are demanding. "They are not for a roof or a similar situation, but they have a unique niche," she said. The dappled shading they produce is very much appreciated in some places. The light reflected from the white gravel driveway of a carport, for example, can produce significant amounts of power. ♻️



Integrated Solar Applications installed this east-west and south solar array on The Marina restaurant in Brattleboro, VT. Photo: Integrated Solar Applications.

appeared in the October, 2018 edition of *Green Energy Times*, in the article, "Solar is a Family Affair" (bit.ly/solar-family). That article describes a 27-kilowatt (kW) system that was installed by *Integrity Energy, Inc.*, one of numerous systems they have done for *EyeCare for You* in Bethel, Vermont, and on the owners homes, as



Bi-facial panels in an east-west solar array. Wikimedia Commons.

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OUTREACH AND COMMUNITY ENGAGEMENT SUPPORT VERMONT'S RENEWABLE ENERGY PLAN

Grace Olsen

Vermont has an ambitious goal to power the state with 90% renewable energy sources by the year 2050 in all sectors: thermal, electric, and transportation. As the state continues to pursue this goal, job training within the renewable energy sector will need to develop, there will need to be a baseline educational system established within the school systems, and the Vermont public must understand this goal



Grace Olsen at the REV Conference on October 18, 2018. Courtesy image.

to support the efforts being made to achieve it. By utilizing means of public outreach and job training to create awareness of the goal and to increase Vermont's overall "energy literacy," the Vermont public is more likely to support renewable efforts going forward. While energy literacy can mean a vast knowledge of energy, policy, and industry, the focus of energy literacy for Vermonters should be on personal energy use, allowing them to take control of their usage and efficiency, and to benefit from incentives. The foundational understanding of energy allows Vermont residents to be able to represent their communities in the process of infrastructure development.

There is currently no requirement for primary school students to learn about energy, but school districts and teachers

can choose to implement lesson plans within their curricula. There are numerous online resources for educators of grades kindergarten through high school such as the U.S. Department of Energy Efficiency and Renewable Energy (http://bit.ly/EERE_EnergyLiteracy), the National Education Association (http://bit.ly/NEA_CleanEnergyEducation) and the National Renewable Energy Laboratory (http://bit.ly/NREL_EducationResources).

These sites have lesson plans for each grade level catering to the learning abilities and relatable topics within their respective grades. These sites are also available to anyone who has access to the internet.

Interactive visual representations of individuals' energy usage help consumers see how their actions can affect the local grid. National Grid, a large utility serving customers in Massachusetts, New York, and Rhode Island, provides a comparison of each customer's monthly usage in comparison with their neighbors, as well as comparisons to efficient neighbors, which displays potential cost savings in terms that don't require in-depth understanding of energy literacy (Building Performance Institute Inc.).

There are many examples of growing employment in the clean energy fields in

other countries. Denmark's growing wind development has created a lot of jobs within the country. More than 40% of the energy supply in Denmark comes from wind power. Their goal is to reach 50% by 2020 and 100% free of fossil fuels by 2050. There are 29,000 people employed in the industry by 2014 (Denmark).

Germany's renewable energy department has grown over time and so has its net employment. They have predicted that the gross employment in the renewable energy industry may increase to around 500 to 600 thousand people compared to more than 370 thousand today. In Germany, the renewable energy industry doubled its employment between 2004 and 2009 (Lehr, et al.). The Office of Energy Efficiency and Renewable Energy has a website dedicated to finding job training within the green energy industry in the United States (www.energy.gov/eere/education/find-trainings). They have connections and links to training and education for places all over the country (www.energy.gov/eere/education/teach-and-learn).

Creating jobs and initiating educational systems within the state boils down to integrating the plan with the public, and the communities to engage in harmonious efforts of completing the ambitious

90% by 2050 goal. As Vermont transitions towards this goal, it is projected that more distributed and locally generated grids will become prominent throughout the state. These "microgrids" will be powered by renewables that will have to be constructed in the communities. Communities will benefit from clean energy jobs, and the cleaner energy there is, the more jobs there will be, especially if microgrid designs that require ongoing maintenance and attention are embraced. Through community

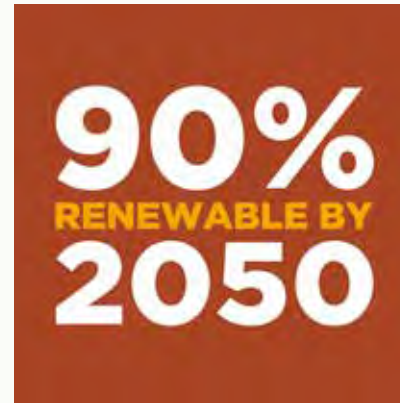
engagement with an energy literate public, Vermonters will be able to implement the most beneficial and appropriate technologies where they live.

Grace Olsen is a sophomore at Green Mountain College where she is pursuing a degree in Renewable Energy and Ecological Design. She is a resident of mid-coast

Maine who has long been involved in community service, especially through trail clean ups and nature conservation.

This article is based on a presentation Grace Olsen delivered at the annual conference of Renewable Energy Vermont in October, 2018. References for further reading will be posted for this article when it appears at www.greenenergytimes.org.

Links and resources available with the posting of this article at the greenenergytimes.org website. See articles for the January 2019 edition where the full edition is also available. ♻️



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Pairing a Solar System with Heat Pumps

George Harvey

Things are changing almost everywhere energy is used. Increasing numbers of people are switching to solar photovoltaics (PV) to power their homes. And increasing numbers are switching to heat pumps to keep their homes warm. It is natural to consider whether it is wise to power the heat pumps with PV systems.

There are a few locations where heat pumps will not work because of geology. Assuming a house is a candidate for heat pumps, however, there is no technical reason not to combine it with solar power, which might be generated at or away from the home site. There are, however, questions about whether it is practical to use heat pumps at homes that are off-grid.

We should bear in mind that a net-metered solar system does not have to provide all the power a home uses. The fact that a grid-tied house has a solar system will not argue against its having a heat pump. In fact, the solar system would not necessarily have to be changed at all, though it might be worth considering upgrading it for the additional electricity load. The simple installation of a heat pump at a home with net



A 6.3kW grid-tied solar electric system paired with two single zone Mitsubishi heat pumps in Bath, Maine. Image: Maine Solar Solutions.

metering would increase the amount of purchased electricity and a decrease in costs of fuel for heating. Normally, the increase is considerably less than the decrease.

While that is fine in theory, it is always best to talk with someone with experience. We asked Sam Zuckerman, the

owner of Main Solar Solutions, what experience he had in combining PVs and heat pumps. He told us the two are increasingly being used together.

Zuckerman said, "We size systems to cover 100% of electric usage. Right now, a good 50% already have heat pumps or get them installed with the solar. The benefit of installing a heat pump and offsetting the electricity with solar power is that you can cover the cost of heating your home."

Most customers who get heat pumps keep their old oil- or gas-fueled systems in place. Once the heat pumps are installed, they rely on heat pumps most of the time to keep costs down. Many install separate smaller heat pumps for hot water as well. The solar power allows customers to leverage their energy bills. Having a heat pump means somewhat more electricity is used, so it makes sense to install a larger

solar system, if possible. But when the combination of solar and heat pumps is compared with other options, the results are so clear that one observer called them a "killer combination."

Zuckerman told us, "It seems to be very compelling for folks who are retired or looking to retire who want to have stable costs. In the past, there wasn't any practical way to do this, for either electricity or heat, but now there is." A lot of people are choosing to invest in solar and heat pumps because when they are used together, they allow the homeowner to control costs in a way that is impossible for people depending on fossil fuels or grid electricity.

We asked whether heat pumps make sense for a home with an off-grid system. Zuckerman told us that he had some experience there also, but it is harder to justify because heat pumps draw a lot of electricity. Not only does the system need a large solar PV capacity, it also needs a lot of battery capacity. One system he installed was for three homes on an island, two of which were summer residences. The large solar and battery system required for the three homes in the summer was enough to supply a heat pump in the winter for the home that was occupied through the year.

Zuckerman would remind anyone considering heat pumps about the importance of insulating and sealing a house. He also said he believes we are moving into an era when houses using net-zero energy are becoming the most cost-effective option. ☻

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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.

- Residential Renewable Energy Tax Credit: <http://bit.ly/energy-gov-R-E-tax-credit>
- Electric Vehicles - Tax credit for qualified plug-in electric drive vehicles including passenger vehicles and light trucks. For vehicles acquired after December 31, 2009, the credit starts at \$2,500 and goes up to \$7,500 based on the battery specs.

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.

Advanced Wood Advanced wood pellet heating systems -- \$6,000 per pellet boiler/furnace. CEDF and EVT each provide a \$3,000 incentive. Details at www.erc-vt.org or call (877) 888-7372.

- Starting July 1st retails sales of "Advanced Wood Boilers" are exempt from Vermont's 6% sales tax. <http://tax.vt.gov/exemptions>,

- **Details at www.RERC-vt.org or call (877)888-7372**
- **Windham County**

- For residential low- and moderate-income residents there is a pellet stove program. Contact the Windham and Windsor Housing Trust for more information: Tara Brown at 802-246-2119
- For wood heating (pellet or chip boilers/furnaces) in municipal buildings, schools, and non-profits contact the Windham Regional Commission: Marion Major at 802-257-4547 ext. 109 or windhamregional.org/energy/www

In Rutland County (and towns in neighboring counties that boarder Rutland Co.) contact Melanie Paskevich mpaskevich@nwwwvt.org at NeighborWorks of Western Vermont, (802) 797-8610.

Pellet Sap Evaporators:

Incentives are available for new, high-efficiency wood pellet- or chip-fired evaporators utilized as primary evaporators completely replacing oil or cord wood-fired units. \$200/sq-ft of evaporator pan. Info at RERC-vt.org

Other Utilities Heating Offers

- Members of Washington Electric Co-op (WEC) can get a \$1,000 rebate on approved pellet boilers/furnaces. This can be added to the CEDF and EVT incentives for a total of \$7,000. Call WEC for details: 802-223-5245.
- Members of the Vermont Electric Co-op can get a \$150 credit on the purchase of an approved pellet stove: www.vec/energy-programs.

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.

Tier III programs

- Additional incentive offers may be available through your local utility provider, contact your utility for more information.

EFFICIENCY VERMONT

Lighting (must be ENERGY STAR®)

- Special pricing on select ENERGY STAR®

LEDs at Vermont retailers.

Home Efficiency Improvements

- Comprehensive air sealing and insulation projects and heating system upgrades - up to \$2,000 in incentives with a participating contractor
- DIY - up to \$100 back for select window, door, air sealing and insulation upgrades

Appliances (must be ENERGY STAR)

- Dehumidifiers \$25 - \$40 rebate
- Clothes Washers - \$40 - \$75 rebate
- Clothes Dryers - \$50 to \$400 rebate
- Refrigerators - \$40 - \$75 rebate

Heating/Cooling/Water Heating

- Central wood pellet boilers and furnaces: \$6,000 rebate (in partnership with CEDF)
- Cord wood and pellet stoves: up to \$1,000 off purchase at participating retailers (in partnership with CEDF)
- Heat pump heating and cooling systems: discounts up to \$400 at participating distributors
- Heat pump water heaters: discounts up to \$500 at participating distributors
- Smart thermostats: up to \$100 back for select ENERGY STAR models.

Heating Wood Stove Change-Out

CEDF Change-Out (customer must have an existing/installed non-EPA certified stove to change-out):

- Pellet stoves: \$1,000 incentive
- Cord wood stoves: \$800 incentive
- A \$100 incentive is also available to replace the catalyst in an existing EPA-certified woodstove.

Efficiency VT offers a \$650 rebate for a new pellet or cord wood stove w/o the need to do a change-out. If the customer does have a EPA certified stove S/he wants to get rid of they can get another \$100 for that.

Residential New Construction

- Enroll to receive a home energy rating, expert technical assistance, and incentives - Efficiency Vermont Certified™ projects receive up to \$3,000 cash back
- Washington Electric Coop and Vermont Gas Systems customers may also receive additional incentives

Other Opportunities To Save

- Advanced Power Strips - special pricing starting at \$6.95*
 - Pool Pumps - up to \$500 back on select ENERGY STAR models
 - Heat Saver Loan - low-interest loans of up to \$35,000 for home weatherization and heating improvements
1. *All rebates/incentives subject to availability, limits, and may change at any time. For complete details and requirements, and participating retailers/contractors, visit efficiencyvermont.com/rebates or call 888-921-5990.

NEW HAMPSHIRE

Renewable Energy Incentives Offered Through the NH Public Utilities Commission

NH PUC: Get up-to-date information at <http://bit.ly/puc-nh-RE-rebates>

Commercial Solar Rebate Program

- waitlist; closed to new applicants

This Program has been modified by Commission Order to consolidate the two eligible project categories:

Category 1 was previously for solar electric and thermal systems rated less than or equal to 100 kW (AC) or thermal equivalent and Category 2 was previously for solar electric systems greater than 100 kW (AC) but less than or equal to 500 kW (AC). Incentives are limited to 25% of the total project cost or \$50,000 if less than the AC

incentive payment otherwise calculated, whichever is less. The Program is available to non-residential structures with a commercial electric meter located in New Hampshire. Incentive levels for PV systems are as follows:

- \$0.40/watt (lower of AC and DC) for new solar electric facilities (Step 1 application received on or after March 19, 2018); and
- Expansions to existing solar systems are not eligible.

Incentive levels for solar thermal systems are as follows:

- \$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; and
- Expansions to existing solar systems are not eligible.

Contact CSolarRebate@puc.nh.gov or at (603) 271-2431.

For C&I solar program details, go to: <http://www.puc.nh.gov/Sustainable%20Energy/RenewableEnergyRebates-CI.html>

PACE

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://cpace-nh.com/index.html> for more information.

Residential Solar and Wind Rebate Program

- Waitlist only until funding available; no new applications being added to waitlist Check for updates at <http://bit.ly/NHResidentialRebate>

Residential Solar Water Heating Rebate Program

- \$1500 - \$1900 per system based on annual system output

Commercial Bulk Fuel-Fed Wood C&I Pellet Central Heating Systems

- waitlist and closed to new applicants.

- 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. Systems must be 2.5 million BTU or less

Residential Wood Pellet Boiler/Furnace

- waitlist and closed to new applicants.

- 40% of installed system up to \$10k
- Must meet thermal efficiency and particulate emissions standards 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 <https://www.nh.gov/osi/energy> for more information.

NH Electric Cooperative Incentives for Electric Vehicles and Electric Car Charging Stations

- NHEC offers a \$1,000 incentive on a Battery Electric Vehicles (BEV), \$600 on a Plug-In Hybrid Electric Vehicles (PHEV), and \$300 on Electric Motorcycles.

NHEC offers incentives for Level 2 Electric Vehicle Charging Stations.

- For Commercial and Municipal Members

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/HPWES for more information and an online Home Heating Index calculator

NH ENERGY STAR Homes

- Incentives for new homes which meet ENERGY STAR guidelines. Incentives include
- HERS rating fees paid by the utility, rebates for ENERGY STAR lighting, appliances – up to \$4,000 based on the HERS score.
- Visit www.NHSaves.com/newhome for more details.

NHSaves Residential ENERGY STAR® certified Products Program

- Mail-in/online rebates are available toward the purchase of the following ENERGY STAR® certified products: Clothes Washers, Clothes Dryers, Room Air Conditioners, Room Air Purifiers, Refrigerators, Dehumidifiers, and Pool Pumps. For current rebate information and forms go to www.NHSaves.com/appliances.

- Refrigerator/freezer recycling is available – unit must be in working condition (10 – 30 cubic feet in size), program includes free pickup and \$30 rebate. For program requirements and scheduling information go to www.NHSaves.com/recycle.

- Instant rebates available on certain ENERGY STAR® certified LED light bulbs purchased through participating NH retailers, and instant or mail-in rebates available on ENERGY STAR® certified light fixtures (varies by retailer, see store associate or rebate form for details). Infor: NHSaves.com/lighting.

- Rebates are available to residential electric customers of the four NHSaves utilities.

NHSAVES Online Store

- Our extensive online store offers discounted pricing for residential electric customers of the four NHSaves utilities on a large variety of LED light bulbs and fixtures, as well as offering additional products to make your home more efficient, such as lighting controls, advanced power strips, thermostats, water saving devices, and various weatherization products. Orders and product fulfillment are handled by our vendor, EFI.

- Visit www.NHSaves.com/lighting-catalog.

PAREI

- To explore the possibility of a solar installation. Plymouth Area Renewable Energy Initiative. www.plymouthenergy.org
- NH Solar Shares: www.nhsolarshares.org
- www.nhsaves.com

Energy Star® Residential Heating, Cooling, & Water Heating Equipment Rebate

- Rebates of up to \$500/ton on Air Source and Geothermal Heat Pumps. Rebates of \$500 - \$600 on Heat Pump Water Heaters. Rebates of \$100 on WiFi Thermostats
- Program details and application at www.NHSaves.com/heating-cooling

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-yr 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-base-ment 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.

Mass. 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 works 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 can be found at <http://www.masssolarloan.com/>.

DEPT OF ENERGY RESOURCES

- 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.
- There is no increase in property tax assessment for residential solar hot water or PV systems for 20 yrs.

MA SREC II Policy

Massachusetts' Solar Renewable Energy Credits Program. SRECs are no longer available. SMART program is available. Details at <http://masmartsolar.com> and <https://www.mass.gov/solar-massachusetts-renewable-target-smart>.

MA STATE INCENTIVE

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

- Incentive updates for air-sourced heat pumps: <https://www.masscec.com/air-source-heat-pumps>
- Wood stove Change-out program: <https://www.masscec.com/commonwealth-woodstove-change-out>

Heating Programs

- The Commonwealth Woodstove Change-Out program, a partnership between MassCEC, the Massachusetts Department of Environmental Protection and the Department of Energy Resources, offers rebates to assist Massachusetts residents in replacing non-EPA-certified wood stoves with cleaner, more efficient EPA-certified wood or pellet stoves.
- Woodstove Program Info: <http://bit.ly/mass-cec-woodstoves>
- Heat Loan info: <http://bit.ly/mass-save-heat-loan>
- Insulation Incentives: <http://bit.ly/mass-saves-home-insulation>

Electric Vehicles

- After January 1, the maximum rebate for EVs in Massachusetts will be reduced to \$1,500 and only fully battery electric or hydrogen fuel cell cars will be eligible. Hybrids will not be given rebates. In addition, the sticker price of the car must be under \$50,000 to qualify for the program. Visit: <https://mor-ev.org/>

NEW YORK

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH NYSERDA

Welcome to the 2017 New York solar incentive and rebate information: 169 programs and incentives at: <http://dsireusa.org> (enter your zipcode) Programs and Services from NYSERDA: <https://www.nyserdanyc.org/All-Programs>.

EV Incentive from National Grid

National Grid, in partnership with BMW, is bringing eligible customers an incentive on a BMW i3 or BMW i3s EV. Form is at <https://www.NG-BMWi3.com>.

- Energy Rebates: <https://NG-energy-rebates>

National Grid: Heat Pumps

Total incentive amount not to exceed \$1,100 for ASHP or \$1,500 for GSHP (installations per project). Installation of

the high efficiency measures must be completed between 4/1/2018-12/31/2018. *Mini-split heat pump units that only provide cooling are not eligible: <http://bit.ly/Heat-pumps>.

Home Energy Waste

Getting a home energy assessment can help you take control of your energy costs, 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: <http://bit.ly/ny-nrg-waste>.

RENEWABLE ENERGY/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.

The Megawatt (MW) Block Dashboard provides real time info on the status of block and current incentive levels by sector and region. Block status is updated as applications are submitted, so check for current status. <http://bit.ly/MW-block>

Residential and Small Business

- <http://bit.ly/ny-sun-Solar-Res-sm-bus>

Commercial and Industrial

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

Commercial Energy Storage

NYSERDA is providing \$350/kWh of energy storage capacity in addition to the current NY-Sun solar incentive. <https://on.ny.gov/2FvS6L1>

Community Solar

- <http://bit.ly/NY-Sun-Community>

Commercial/Industrial PV Installer

- <http://ny-sun.ny.gov/For-Local-Government/Local-Government>

Residential/Small Commercial Solar PV Installer

- <http://ny-sun.ny.gov/Get-Solar/Find-A-Solar-Electric-Installer>

Financing Options

- <http://bit.ly/NY-Sun-Financing>

Clean Power Estimator

- <http://bit.ly/NYSUN-power-estim>

Geothermal

- rebate of \$1500 per ton of installed capacity for residential/small-scale systems, \$1,200 per ton for commercial/large-scale systems up to \$5000

Electric car

- buyers in New York State can now get a rebate of up to \$2,000 on qualifying EV models from participating dealers. See <https://on.ny.gov/2Rd14zL>

- Charge Ready NY: \$4,000/installed Level 2 electric vehicle (EV) charging stations for public, workplace, and multi-unit dwelling stations. <http://bit.ly/ChargeReadyNY>.

Utility sponsored incentives & tips: http://bit.ly/utility-sponsored_incentives

Clean Energy on Farms

- \$19 Million Available to Accelerate the Use of Clean Energy Technologies On Farms. Learn more at: <http://bit.ly/NYSERDA-Farm-Clean-Energy>.

National Grid

- National Grid savings for customers, <http://bit.ly/Thanks-For-Saving-Energy>

UP-TO-DATE INCENTIVE INFO CAN BE FOUND AT: WWW.DSIREUSA.ORG

Holiday Hill Community Wind RUSSELL, MASSACHUSETTS



David Blittersdorf, CEO of AllEarth Renewables, based in Williston, Vermont, announced the groundbreaking for the Holiday Hill Community Wind Project in Russell, Massachusetts. The two turbine,

5 MW project has broad local support and will be generating power for the surrounding Massachusetts communities by the summer of 2019. The project is being developed with resources that were originally intended to build the Kidder Hill Community Wind Project in Lowell, VT. On February 28, 2018 Kidder Hill Community Wind announced that it was stopping project planning activities, citing a hostile environment for wind energy in Vermont.

"The communities of Chicopee, Russell and Westfield should be commended for taking charge of their energy future," said Blittersdorf. "While we are thrilled that we have broken ground on this important project, the sentiment is bittersweet for me. The turbines being used for this project were originally intended to be used here in my home state of Vermont. Sadly, Vermont continues to make the unfortunate decision to rely on our neighbors for energy solutions, and, as a result, we are forced to focus our efforts on developing renewables in other states where the political climate is more amicable toward renewable energy projects."

Lifelong Vermonter, Blittersdorf, is a passionate renewable energy advocate, and Holiday Hill Community Wind is part of his vision for combatting our

CO2 emissions crisis. In the past seven years, Blittersdorf has led three separate partnerships in building two 2.2 MW community scale solar farms in South Burlington, as well as Georgia Mountain Community Wind, a 10 MW wind farm whose power is purchased by the Vermont utility Burlington Electric Department.

Russell Municipal Light Department (RMLD) was founded in 1920 by citizens who had the foresight to believe locally owned and controlled electric service would benefit the Town of Russell. "Russell continues to be an innovative, progressive organization dedicated to providing quality service, low rates and bringing affordable, environmentally friendly renewable energy to the community," said Alan Robinson, General Manager of RMLD. "We are pleased that we are able to partner with David Blittersdorf to move this project forward and provide clean and renewable energy to our customers."

Blittersdorf is also a project partner for Dairy Air Wind, a single turbine project proposed in a cornfield on a 450-acre dairy farm in Holland, VT. Dairy Air Wind was awarded a state Standard Offer contract to sell electricity in Vermont but has been stalled in permitting for almost two years. As detailed in a recent article in the Energy News Network (<http://bit.ly/DairyAirFarmWind>), Dairy Air Wind is the last remaining wind project under development in Vermont.

AllEarth Renewables' website is www.allearthrenewables.com. ♻️



Vermont's Georgia Mountain Wind System. Image: wamc.org

RENEWABLE ENERGY PROGRAM FOR MASSACHUSETTS FARMERS

George Harvey



Farms in the Pioneer Valley. Wikipedia.

On April 11, 2016, Massachusetts Governor Charlie Baker signed the Solar Massachusetts Renewable Target (SMART) into law. It will provide incentives for 1,600 megawatts (MW) of solar photovoltaic installations under a rather complicated scheme. It was much awaited and finally went into effect on November 26, 2018.

One of the complexities of the SMART program is that incentives are awarded for systems in blocks of 400MW. The individual projects within the blocks can range up to five MW. Incentives range from 15.6 cents to 39.1 cents per kilowatt-hour (kWh). The incentives are reduced from one block to the next, as they fill up and vary according to the utility in the area. Clearly, anyone developing a solar system has to plan carefully.

Recognizing the importance of local agriculture and the special needs of farmers, there is a special incentive for them. In addition to the basic incentive, farmers can get a bonus of 6 cents per kWh for electricity from a solar system that is mounted in such a way that agriculture can still be practiced below the panels.

Farming beneath solar panels is not new. A very nice picture of sheep grazing in a solar system appeared in the article, "Upper Valley Aquatic Center is Swimming in Solar," which appeared in Green Energy Times in October of 2017 (bit.ly/GET-aquatic-center). We have been told that

some traditional strains of grazing grass grow just as well in the partial shade of solar panels as they do in full sun, so there is nothing lost to a farmer using such grains.

Other crops can also be grown below the panels. Bees, which can be kept below the panels, provide an income to the farmer who keeps them, but they are valuable pollinators for farms and gardens for miles around. Various types of fowl, herbs, and shade-tolerant vegetables are other potential crops. In Germany, hay has been grown successfully under panels mounted high enough for ordinary farm equipment to operate below them. Other crops we have seen range from fish, under floating systems, to mushrooms. Just about every farm has someplace where solar panels can be mounted.

There are other state programs that can benefit Massachusetts farmers. One has special incentives for energy efficiency. Standard awards going to \$30,000 are there to help with projects. We have been told that in special cases, such as for net-zero buildings, awards can go as high as \$75,000.

Another initiative for Massachusetts farmers is the Organics-to-Energy program of the Massachusetts Clean Energy Center. This has a special focus on using waste from farms and sewage treatment plants

Cont'd on p.19

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Parking Lot Solar - a great solution for our region

George Harvey

Sometimes a solution to one problem produces opportunities to solve others. Parking lots and garages provide a case in point.

One problem, we know, is that we have to switch away from fossil fuels to stop climate change. A part of the problem of how to do that is where to site renewable energy resources. Some great types of sites have already been tried and tested. Among the most promising of these is old landfills, which really cannot be used for much else, but we need more sites than those provide.

A different problem is that we need to achieve energy security to provide for communities during extended grid-power outages. Hurricanes Irene and Sandy gave the people of New York and New England their lessons, but they were only minor inconveniences compared to what would happen in a worst case. The Federal Energy Regulatory Commission has warned us that our electric grids are so vulnerable to terrorist attacks that a well-coordinated and executed operation could bring major grids in this country down for eighteen months. The National Aeronautics and Space Administration (NASA) warned that a severe coronal ejection could bring grids down for 42 months. Whether we are talking about an ice storm shutting off the power for a few days, or something worse, we should be better prepared than we now are. Community micro-grids, even if they only provide power to a food store and the fire department, are a good step in the right direction.

Recently, Green Lantern, a solar developer based in Waterbury, Vermont, approached the Town of Brattleboro with the idea of putting a solar array on the roof of a town-owned parking garage in between Flat Street and Elliot Street, a downtown area.

The photovoltaic (PV) array would go on the top level of the garage and could be accompanied by a battery system that would provide power during outages, producing a small micro-grid.

The solar photovoltaic panels would not occupy any areas where cars could park, so the facility would not cause any

reduction in the town's parking income. While the lease Green Lantern is suggesting would be modest, at \$1,200 per year, it would be a cost-free addition to the town's budget.

The fact that the micro-grid would be at a parking garage would make it possible to charge electric vehicles there, even during a grid outage. It could also be used in an emergency to provide power for Dottie's, a thrift food store associated with the Brattleboro Food Coop. It could also be a place where people could charge cell phones, computers, emergency radios, and other equipment.

Of course, Green Lantern hopes to make some profit out of the PV system it is proposing. The solar array would be net-metered. More profit could come from arbitrage, buying power when there is little demand for it and the price is low, and selling it when the demand and price are high. An interesting aspect of this system is that the effect on the market is to increase price stability, and this tends to stabilize, and possibly reduce, the price of power for all customers.

There are other benefits of putting solar PVs at parking lots. One is that solar panels can be installed so as to shade cars, keeping them cool.

Green Lantern is in early development stages for the system for the parking garage. The engineering has begun, but it is far from complete. We really do not even know much about the capacity of the array. We cannot be sure that if the array is installed a battery system would come with it, though there are good arguments to do so. What we do have is an engineering development underway before us that will be interesting to follow, and all the more so because, if it is successful, it could be duplicated elsewhere. Green Lantern's idea to put PVs on the roof of a parking garage is hardly original, but that as part of a downtown micro-grid could be an innovative solution worthy of note.



Vermont's largest parking lot solar canopy, a 156kW system, at the ECHO, Leahy Center for Lake Champlain. This is just part of what promises to be impressive work we will report on soon. Image courtesy of Encore Renewable Energy.

G.E.T. will have more about parking areas and solar power. Another PV system that has been installed at a parking area is on our list of upcoming stories. It is part of a large set of projects being done at the ECHO, Leahy Center for Lake Champlain, that we will cover together when they are completed. Since the ECHO Center had the first LEED certified building in Vermont, its energy upgrades are sure to be interesting. ♻️

MORE STATES & PROVINCES ADOPT CARBON PRICING

Steven Nadel

Across North America, efforts to put a price on greenhouse gas emissions are growing, creating a market-based incentive to reduce emissions and energy use. Currently 14 US states and Canadian provinces plus one US city have done so, with seven additional states and provinces in active pursuit, according to the American Council for an Energy-Efficient Economy's (ACEEE) new white paper.

We at ACEEE profile these *Cont'd on p.34*



starting in 2019 for high-income countries, 2024 or 2028 for poorer countries. Then-secretary of state, John Kerry, called it "the biggest thing we can do (on climate) in one giant swoop."

The trouble is (and you might have guessed this), the United States has not yet ratified it, although, according to the (refrigerant) association, very much supports it.

Having informed myself, I plan to call my representatives in Washington and hope you will too. Mention the Kigali Amendment and ask what's being done to get it ratified. Meanwhile, as usual, California has come out with refrigerant-management legislation. Other states could adopt those standards, as many of us already do on auto emissions. So, a call to your state representative would also be appropriate or a petition.

What piece can you take on? It should be fun, or beautiful, or otherwise make your life better. It should also involve joining with others. Paul Hawken writes, "...placing too high an emphasis on the

individual can lead to people feeling so personally responsible that they become overwhelmed by the enormity of the task at hand....(But)What individuals can do is become a movement. As (Bill) McKibben writes: 'Movements are what take five or ten percent of people and make them decisive—because in a world where apathy rules, five or ten percent is an enormous number'... The United States was founded on the premise that there are truths that are self-evident, and one of the unmentioned truths is that we only have one home. If we are to remain here, we must together take great care. To do that means we must become a "we," a movement that is unstoppable and fearless. Movements are dreams with feet and hands, hearts and voices.'

Jessie Haas has written 40 books, mainly for children, and has lived in an off-grid cabin in Westminister West, VT since 1984, www.jessiehaas.com.

Links available with the posting of this article on the GET website. ♻️

RENEWABLES FOR MA FARMERS

Cont'd from p.18

to fuel anaerobic digesters (AD), reactors that generate gas similar to natural gas for fuel. In some cases, heat from the reactors can be captured for use in neighboring buildings.

Using AD as a potential source of power is important for a number of reasons. The waste has to be treated for the sake of public safety. The electricity generated can cover the cost of treating the waste, and a side product is compost. Because of its importance, the Organics-to-Energy program offers technical assistance and various types of help for funding. One recent grant from the program put \$500,000 into an AD that is expected to generate 7,000 MWh per year.

You can learn about the SMART program at bit.ly/MA-smart. Search the page for "agriculture" for relevant information. Another good site to visit is Massachusetts Farm Energy Program, at massfarmenergy.com. The state's Anaerobic Digestion & Organics Diversion can be found at bit.ly/MA-AD. ♻️

HAPPY NEW YEAR: PLANET EARTH

Cont'd from p.1

So, look the list over and pick one or a few solutions to add to your daily life. For instance, I'm going to look for a feed laced with a tiny amount of seaweed for my parents' elderly cows, to reduce their methane emissions. You might be planning to put in air conditioning after last year's hot summer. Look into a heat pump (#42) instead.

You could also take a solution you already practice, learn more about it, and do better at it. I plan to be smarter at managing my animals' grazing next summer. I also resolve to be the person who buys the ugly fruits and veggies. Like shelter dogs, they can be very sweet, and if nobody buys them, they become food waste.

In that same spirit, I'm also taking on refrigerant management. The Drawdown folks seem almost apologetic about making it their number one solution. Who's going to care about such an unsexy topic? But that's what the math shows, and progress has already been made. An amendment to the Montreal Protocol, called the Kigali Amendment, will phase out the use of hydrofluorocarbons (HFCs) for rich countries,

UNDERSTANDING COP24 - FROM THE CONTEXT TO THE AFTERMATH

THE CONTEXT OF COP24

George Harvey



António Guterres, Secretary General of the United Nations. Photo: Kuhlmann / MSC.

Climate change denial is well-funded and pervasive. The Wikipedia article "Climate change denial" says, "Climate change denial has been associated with the fossil fuels lobby, the Koch brothers, industry advocates and conservative think tanks, often in the United States. More than 90% of papers skeptical on climate change originate from right-wing think tanks. The total annual income of these climate change counter-movement-organizations is roughly \$900 million" (bit.ly/cc-denial). The article has a large number of references, and I will point out that conservatives are as free to edit its contents as liberals are, though changes by either without adequate source citations may be removed.



Demonstration at a coal mining tower in Chorzów, Poland. Photo: Akcja Demokracja.

What some people do not realize is that despite the denialist rhetoric, there really is no question among scientists that we are experiencing unprecedented and dangerous changes in our weather patterns. Furthermore, there is no realistic doubt that human beings are causing the problem. In 2015, MSNBC ran an article, "How Climate Change Deniers Got It Right – but Very Wrong," which reported that James L. Powell, a member of the National Science Board under Presidents Ronald Reagan and George H.W. Bush, did a survey of scientists who published in scientific journals on weather or climate science. Of the nearly 70,000 scientists he surveyed, only four were ready to challenge the idea of climate change (<http://bit.ly/deniers-got-it-wrong>).

The data is not yet official, but 2018 was almost certainly one of the five hottest years in history. The other four were 2014, 2015, 2016, and 2017. Of the ten hottest years, one was 1998, three were in the 2000s, and six were in the 2010s. The data came from NOAA, but the page conveying it has been removed from the internet (see <http://bit.ly/warmest-years>).

The fossil fuels industry is willing to

finance denial, and some people are willing to earn money in that service, but the simple truth is that denialist funding activity does not change our climate. And even if the weather and climate data from NOAA is blocked by the Trump administration, the damage can be readily observable in our environment.

Things are getting worse. Weather-related insurance claims increased from 1978 through 2016 by a factor of 47. The wildfires in California, costing billions in damage, were worsened by climate change, according to scientific analysis. In 2017, some areas of Texas that were flooded by Hurricane Harvey were not even in 500-year flood zones. 2017 was the first year in history that more than one hurricane of category 4 or higher hit the United States – there were three of them. The hurricane season in 2018 was a little better, but Michael was the third most powerful storm ever to make landfall.

Some events of 2018 were frightening in their implications. One of these came before the public in August, when ice north of Greenland broke up for the first time in history (<http://bit.ly/arctic-ice-breaks-up>).

The damage that has been done so far, including many billions of dollars in economic loss, have come about because of the chaos created by climatic change of only 1°C. Denial, however, continues, and the Trump administration, which announced gloatingly last year that it would withdraw from the Paris Climate Agreement of 2015, now brags on about rolling back climate protections.

On October 8, 2018, the Intergovernmental Panel on Climate Change issued the Special Report on Global Warming of 1.5°C. It was frightening. Written by ninety-one scientists from forty countries, with over 6,000 scientific citations, it warned that we had only twelve years to stop global warming at 1.5°C, and that we could only achieve that goal through strenuous exertion (bit.ly/global-warming-report).

While a 1.0°C increase has already brought damage in the billions of dollars, we can be assured that 1.5°C will be far worse. The Paris Climate Agreement tried to keep warming to no more than 2.0°C. But according to the special report, the trajectory we are on will take us to 3.0°C, a super-destructive number.

The special report says that a reduction in carbon emissions needed to limit warming to 1.5°C are 45% from 2010 levels by 2030 and 100% by 2050. Avoiding doing that will keep money flowing into the fossil fuels industry, but we must do it to avoid heavy losses for most people alive today. It is probable that we will only achieve that goal by implementing technology to draw down carbon from the atmosphere that is as yet undeveloped.

In November 2018, the World Meteorological Organization reported that atmospheric carbon dioxide levels had reached 405 parts per million. This is a level not seen in the last three million years, and there is no question that it has happened because of human activity.

Going into COP24, things looked grim. ♻️

COP24 – THE CONFERENCE

The Conference of the Parties to the United Nations Framework Convention on Climate Change (COP24) was scheduled for December 2, 2018 to December 14, 2018. The purpose of the conference was to create a set of rules for determining that countries were adhering to the Paris Climate Accord of 2015. It was held in Katowice, Poland, in the middle of an old coal-mining area. It opened on schedule, though delegates had to be held over to finish business for an extra day.

The meeting featured speeches by a number of important people and at least one most of us had never heard of but who seems to have become important. Sir David Attenborough, the well-known naturalist, called climate change the greatest threat to humanity in thousands of years. He said that we could see our civilization collapse, with many of the species in nature becoming extinct, unless we act on the matter effectively. His short but pointed speech can be found at bit.ly/attenborough-cop24.

Greta Thunberg, a 15-year-old Swedish climate activist also gave a widely reported speech. Her message is that the threat of climate change is existential. Among the points she made that are worth remembering is, "I've learned you are never too small to make a difference." Not all that big herself, she has nevertheless moved people all over the world (bit.ly/thunberg-cop24).

Antonio Guterres, Secretary-General of the United Nations, said, "We are running out of time." He added, "To waste this opportunity ... would be suicidal" (bit.ly/guterres-cop24).

The sense of urgency for effective ways to deal with climate change pervaded nearly the entire conference. Nevertheless, there were a few places where it was not regarded as quite so urgent.

From the beginning of the event, delegates from the United States obstructed progress. Joining Russia, Saudi Arabia, and Kuwait, the U.S. refused to endorse a statement welcoming the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5°C. Instead, it wanted the conference simply to note the report officially. The difference between the words has profound implications. Welcoming the report implies understanding and a degree of

agreement. Noting the report implies that the country doing so can ignore it. Under the official guidelines of the conference, the issue was dropped (bit.ly/nations-balk).

That, however, was just a start. Unfortunately a few other nations were non-supportive of climate action. Poland, the host country, set up displays of coal. Bins of coal were built into the floor of one area, with glass tops people could walk on. Bins of coal held in metal mesh-work frames decorated a hallway. There were displays of jewelry made from coal (bit.ly/coal-on-display).

The Trump Administration hosted a sideshow, "U.S. Innovative Technologies Spur Economic Dynamism." The U.S. Department of Energy's Principal Deputy Assistant Secretary for International Affairs, Preston Wells Griffith, was at the event along with other U.S. officials and one from Australia, whose nameplate bore an American flag (bit.ly/australian-at-sideshow). The event drew derision and boos from protesters, but it made the point that the U.S. views the threat of climate change as less important than the financial returns of its own fossil fuels industry. The U.S. delegates told the audience that the U.S. would mine more coal and build more coal-burning power plants (bit.ly/US-COP24-sideshow).

Surprisingly, given the obstructive attitude of what was once the undisputed leader of the free world, the conference went on. Though it was not nearly as productive as it might have been, agenda items were pushed forward and agreements were made.

A last-minute hitch on one of the agenda items threatened to bring the whole conference to a halt, just before it ended. The meeting was extended for one more day, as delegates worked on a disagreement. Brazil wanted wording that reflected its position on accounting for carbon trapped in rain forests, but other nations' representatives objected that the system Brazil advocated would allow for double counting of its assets. In the end, an agreement came, and the conference ended with many delegates somewhat unhappy with the results but, nevertheless, delighted that a compromise could be reached at all. ♻️

Cont'd on p.21 >>



Demonstration in Paris. Photo: VVVCFFrance.

<< Cont'd from p20

The Aftermath of COP24



Demonstration in Luxembourg. Photo: GilPe.

The Conference of the Parties to the United Nations (U.N.) Framework Convention on Climate Change (COP24) was brought to a close a day late, with what many people would call a watered-down agreement. The news about it has continued, however.

The Guardian ran an analysis of COP24 in the article, "What Was Agreed at COP24 in Poland and Why Did It Take So Long?" Simply stated, the article tells us that we are not at all where we should be for us to continue living in reasonable comfortable surroundings into the future (bit.ly/guardian-COP24-analysis).

We are woefully behind schedule, and some countries are acting to hold us back. As we have already mentioned, the U.S. joined Russia, Kuwait, and Saudi Arabia in refusing to endorse wording saying the Intergovernmental Panel on Climate Change (IPCC) special report was "welcomed." Australia disappointed most other countries by being silent, and Brazil signaled a lack of support by withdrawing an offer to host upcoming meetings.

The British Broadcasting Corporation (BBC) was also critical, stressing the meeting's failures. According to the BBC, the IPCC special report was the "final call to halt climate catastrophe." A BBC article focused on the fact that there could not even be compromise on the wording about that report (bit.ly/COP24-falures).

The news from COP24, however, is not just analysis and thoughts. Some of what came out of it has been in the form of real action. The Bulletin of the Atomic Scientists ran an interesting article, "EU, Canada, New Zealand, and Developing Countries Vow to Keep Up the Fight," reporting pledges that many countries are making to increase their commitments to fight climate change (bit.ly/countries-on-course).

It is really interesting to see in that article that the U.N. is considering China as a potential leader. This is largely because the U.S. has announced its intention to withdraw from the Paris Climate Accord and is making it clear that it is interested in helping the fossil fuels industry continue pushing carbon-intense fuels. The article says, "The U.N. believes China could play a stronger role in the absence of leadership from the U.S. Sources said Guterres would make a telephone call to Xi to ask for his help in nudging talks forward."

The Trump administration and those who support it seem unwilling to understand something that any real

conservative knows: you cannot lead by disengaging from those who would follow. When the U.S. signaled its intention to withdraw from climate action, it created a power vacuum that has three countries, China, India, and the European Union, vying for leadership. And it abdicated its position of world leadership.

The reaction is not limited to the international scene, however. There is a reaction from the business world that is growing and profound. An article in CleanTechnica begins by saying, "A total of 415 global investors with \$32 trillion in assets under management have this week called on leaders at the United Nation's COP24 global climate change conference currently underway in Katowice, Poland, to address the climate change 'ambition gap' by strengthening their Nationally Determined Contributions to meet the goals of the Paris Agreement" (bit.ly/COP24-investors).

The intent of the fossil fuels industry is to continue to make money. As we deal with climate change, however, we are eliminating the market for its carbon-based fuel products. That is why it promotes coal at a conference seeking to address climate change. And the Trump administration, which seems to owe a lot to the fossil fuels companies, has committed itself to benefiting them.

The chaos created by climate change is already taking a toll on a number of industries. Agriculture is certainly one of them. Financial companies are also affected, because property values are threatened and insurance claims are increasing at alarming rates. Energy and transportation infrastructure is threatened by storms and wildfires. The list goes on and on. Even coal-burning power plants are threatened; plants in parts of the world have already had to shut down because droughts left them with no water for their cooling systems.

We are beginning to see other movements come up to deal with climate change, as well. According to an article in Quartz, 1.7 million citizens of France have signed a petition in favor of suing the French government because of the inaction they see it engaging in over climate change (bit.ly/French-want-to-sue).

Many Americans are unhappy about our government's lack of leadership on climate change and its obstructionism. One article representing this appeared at CNN in November. Its title describes its sentiment, "Trump's Failure to Fight Climate Change is a Crime Against Humanity." The shameful performance from his administration at COP24 underscores this idea (bit.ly/Trumps-crime).



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How and When to Talk to a Child about Climate Change

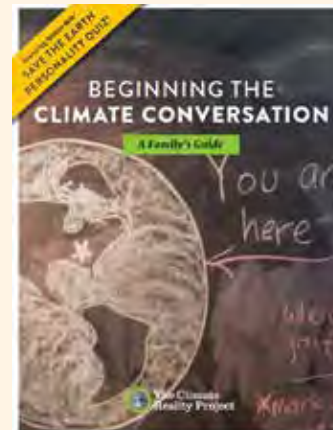
The Climate Reality Project

Even as an adult, climate change is a lot to wrap your head around. And talking about the issue with kids? That can feel impossible.

But kids today will face the challenges of a warming world head-on. They have a right to understand the realities of the climate crisis and what it means for them. As parents, guardians, and caregivers, we have a responsibility to provide that knowledge as best we can.

That's why, for Universal Children's Day, the folks at The Climate Reality Project released a free new e-book that offers some background and tips on where to start: *Beginning the Climate Conversation: A Family's Guide*.

Beginning the Climate Conversation: A Family's Guide will help you talk to your



kids about the climate crisis by:

Providing tips on when and how to start the conversation.

Suggesting what information to share with children of different ages and interests.

Giving you an interactive quiz (from NatGeo Kids!) to help engage your little ones.

Offering suggestions for moving the conversation from the dangers of climate change to things

they can do to help make a difference.

Download the free guide at <http://bit.ly/Free-Kids-Climate-guide> to get science-supported tools, tips and tricks on how to talk about climate change with your children — it's never too early or too late to start! You can also contact info@climatereality.com.



Demonstration in Berlin translates to "Sun instead of Coal." Photo: Leonard Lenz

While it is heartbreaking to see the United States reduced to the level of a rogue nation, as the only nation not in the Paris Climate Accord, it is more heart-

breaking to consider the path our government would take to push the world down. We wish we had better news. ♻️

Heating with Wood: Past to Present

George Harvey and N.R. Mallory



Great Kitchen, Rochlitz Castle. Photo: Norbert Kaiser, bit.ly/Wikimedia-Rochlitz-kitchen

We hope no one minds if we ramble down memory lane. The history of heating can be instructive.

One of the holiday season's many customs is to sing about a Yule log. The songs refer to a way of life many may not be aware of, before chimneys existed. In those days, a fire in a home was on a raised hearth or in a fire pit, in the middle of the main room. It was used for heat, as well as cooking.

That was the reason why the great hall of an old castle had such a high ceiling. The smoke was vented in a hole above the fire in the roof or as high as possible on a wall. The great hall was where everyone slept during the winter, because it was the only place that had any heat. Of course, with the wind blowing through the open vents, it was often not very warm.

The great hall also had a problem some people still have today, though this is a medieval problem that has been dealt with. The indoor air was polluted because of all the smoke.

Chimneys seem to have been invented a bit less than a thousand years ago. It seems odd to think that the ancient Romans, consummate engineers, did not develop them, but such is apparently the case. With the invention of the chimney, people could have fireplaces. By the time of King Henry VIII, wealthy people often had fireplaces in their bedrooms. The vented fires were a little safer

with somewhat improved indoor air. Sadly, they were also less efficient and more used, leading to both outdoor pollution and loss of forests.

Wood stoves were the next improvement. They were far more efficient for delivering heat to the home, and air quality in homes improved even more. The old wood-burning systems were still not perfect, however. The old cannon or box stove could release smoke, and that smoke is a form of pollution. Their replacement, the now-outdated so-called air-tight stoves, are arguably worse polluters, partly because they starve the fire for oxygen, and that produces carbon monox-

ide, a pollutant you cannot smell. Also, air-tight stoves can produce a lot of creosote, which can clog a chimney and fuel a chimney fire, not to mention asthma and other health issues. Fortunately, we have new, modern wood stove technology that does not have these problems.

It was common during the 19th century for farmhouses in New England to operate sustainably, using forest

products from their own wood lots. But with a growing population, and the increased availability of fossil fuels, many chose to use first coal, and then oil and gas for heating, which appeared to make lives easier. You might say there actually were some benefits from the switch to fossil fuels. They have the advantage over old wood-burning technology, which is that they can produce fewer particulates, both in the home and in the environment. The biggest problems are that fossil fuels are unsustainable and are destroying our climate.

Fortunately, now we have better alternatives. The modern wood stoves built today are engineered to reduce emissions considerably. A wood-burning system that is well designed and maintained can actually be much cleaner than many heating systems using fossil fuels. Clearly cleaner than coal or oil, in terms of pollutants, modern wood stoves do not add to atmospheric carbon the way all fossil fuels do, including gas. A well-managed woodlot is a carbon sink and can actually be part of the solution. The low amounts of carbon dioxide that are still released come indirectly from the atmosphere, so the net addition to the atmosphere can be very low. (Note: can be.)

Today's wood stoves produce low emissions and release low particulates via different technologies. One is to have a catalytic converter in the stove. This causes more

complete combustion of the fuel, making the exhaust gases much cleaner, with far lower particulates.

However since the catalyst needs to be replaced after a period of time, at rather high cost, some modern stoves have a non-catalytic design that does not need it. Modern stoves with non-catalytic designs produce relatively particulate-free exhaust by having a secondary burn after a hot initial burn via chambers built into the design with lower emissions. The higher initial burn temperatures must be maintained to keep the system relatively clean, but the stove does this automatically in normal practice.

Pellet stoves operate at very high tem-

peratures so their fuel burns completely and cleanly in a pyrolyzing chamber or firebox. Most of these stoves have fuel fed by an auger, and their air flow is regulated automatically, so they can operate with minimal human supervision.

Another option is central heating fueled by wood or wood pellets. Modern wood and wood pellet boilers and furnaces often use precise combustion controls that measure the temperature and residual oxygen content of exhaust to fine tune air or fuel mixes. Special combustion chambers with advanced computer modeling are designed to provide precise air and fuel mixes and high temperatures for clean combustion. Boilers and furnaces are not made with decoration and fire viewing as major design considerations, and they achieve excellent efficiency and produce very few emissions. Chipped wood and wood pellets enable automation that makes modern boilers excellent renewable heating sources for everything from passive houses to large industrial or municipal buildings.

With forestry practices that provide wood fuel sustainably, modern wood stoves can be about as environmentally sound as combustion heating can get, using the newest technology. (See "Advanced Wood Heating," in the December, 2017 edition of G.E.T. (bit.ly/GET-advanced-wood). There are a lot of old (pre-EPA regulation stoves sold prior to



Froling S3 Turbo wood boiler, courtesy of Tarm Biomass.

1990) wood-burning stoves in use in the Northeast, and environmentally conscious people might want to upgrade them. Fortunately, states sometimes run incentive and change-out programs to make this affordable.

New Hampshire has a Residential Bulk-Fed Wood-Pellet Central Boilers and Furnace Rebate Program (<http://bit.ly/wood-in-nh>).

New York has a Residential Pellet Stove Program (<http://bit.ly/pellet-ny>).

Massachusetts has a wood stove change-out program that runs through 2019 (<http://bit.ly/mass-changeout>).

Various incentives in Vermont, including for heating with wood, are found online (<http://bit.ly/vt-incentives>). ♻️

Grant Opportunity for Community-scale Modern Wood Heating

The U.S. Department of Agriculture has announced its 2019 Wood Innovations Grant Program. This year grant funds can be used for design engineering as well as construction of community-scale (e.g. schools, municipal buildings, public works facilities, hospitals) modern wood-fired heating plants. Grants of up to \$250,000 are available, and require matching funding. A total of \$8 million is available for the national competitive grant opportunity. **Application deadline is January 23, 2019.** More information can be found at <http://bit.ly/Community-Wood-Heat>. In the past, several wood chip boiler installations in New Hampshire have successfully competed for funds through this program.

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Thermoelectric Wood Stoves, Solar Power, and the 2018 Wood Stove Design Challenge

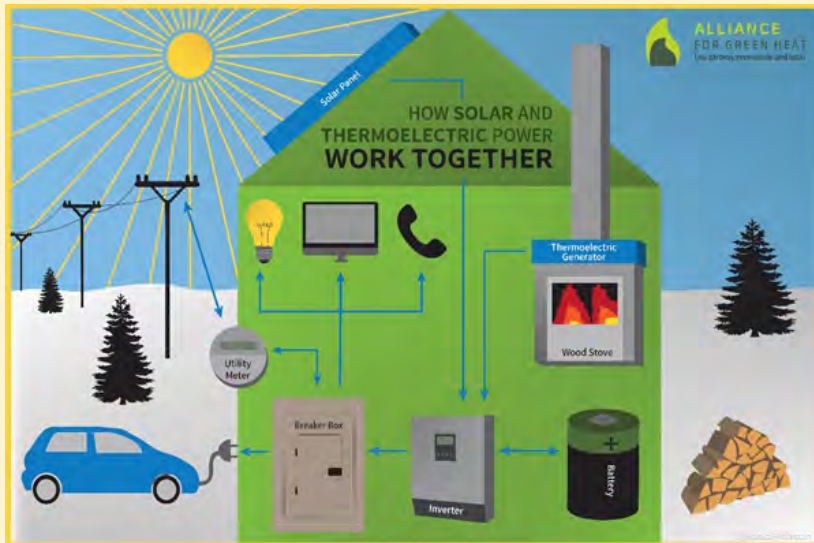
George Harvey

The thermoelectric effect, discovered almost two hundred years ago, is one of those mysteries that science is full of. It produces an electric current out of differences in temperature. For a long time, its tiny currents have been used to give temperature readings. With the introduction of semiconductors, new uses for it have been developed, and soon, it may become important for the lives of ordinary people who happen to heat their homes with wood, especially if they get electricity from solar panels.

We get much more sunshine in the summer than during the winter. The difference is greater the farther from the equator one lives. In the Green Energy Times region, we can expect to get about two or three times as much energy from solar panels during the summer as during the winter. During the winter, we have our wood stoves going, and if we could use the thermoelectric effect to good advantage we could get electricity from our wood burning appliances.

It happens that a number of organizations have been conducting research into exactly that. And now, we can report that they have made enough progress that people can actually use thermoelectric wood stoves in home settings.

Last November, tests were conducted



Solar, battery, and wood stove, working together. Image: Alliance for Green Heat

on thermoelectric wood stoves in a large tent on the National Mall in Washington, D.C. Funding was provided by the U.S. Department of Energy's Bioenergy Energy Technology Office, which has a goal of having homes get 50% of their wintertime electricity from wood heating systems. The 2018 Wood Stove Design Challenge demonstrated that we are getting close to achieving that goal.

The Alliance for Green Heat published a web article about the tests and their results, "Thermoelectric Wood Stoves, Solar Power, and the 2018 Wood Stove Design Challenge," by Ken Adler, Program Director for Thermoelectrics (bit.ly/wood-stove-

challenge). The article gives some details on the stoves and how well they did. Five different wood stoves were compared.

First prize went to E-Stove by Wittus and HE Energy (bit.ly/e-stove-winner). The E-stove had an average output of 161 watts over the three-hour test. That might not sound like much, but in winter temperatures when the stove will be on almost all the time, it can be significant, approaching four kilowatt-hours per day. The E-stove also heats water that can be used to heat other rooms in the house. The hope is that this stove will be

available commercially this year. It outputs 110-volt AC power. ♻️

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Looking Back – Looking Ahead

Dr. Alan K. Betts



This is the time to look back on 2018 and reflect on what we have seen, and what we have learned. At the same time, the climate endgame is getting closer, so we must face reality. As greenhouse gases reduce the cooling of the earth to space, more and more heat is stored in the oceans, and warming oceans make tropical storms, hurricanes and typhoons more powerful and dangerous.

In 2017, hurricanes Harvey, Irma and Maria struck Texas, Florida, the Caribbean and Puerto Rico. Harvey stayed over the Houston region for four days and dumped over three feet of rain, giving catastrophic flooding, because very little rain can soak into the ground in an urban area. In 2018, tropical storms Lane and Olivia brought very heavy rain to Hawaii. Then hurricane Florence stalled for three days in mid-September on the North Carolina coast giving severe flooding from both the storm surge and twenty-five inches of rain. On October 10th, hurricane Michael intensified very rapidly just before it made landfall on the Florida panhandle as a category four storm, creating immense damage that stretched inland into Georgia. Rebuilding costs will be massive. In the western Pacific this year, there were six category

five typhoons. The most powerful storm of the year, super-Typhoon Yutu, devastated the U.S. territory of the Northern Marianas Islands in late October, but little news reached the mainland.

For readers in the Northeast, these tropical storms are far away. Closer to home, it has been a year of different extremes. As the Arctic warms faster than the tropical regions, mid-latitude weather patterns are generally slowing down with larger amplitude waves in the jet-stream. This gives alternating extremes around the globe. In April, there was record cold in north-central U.S., which stretched up into Canada. This was followed by the six months, May to October, which set high temperature records in the east with record precipitation from Virginia to Pennsylvania. High temperatures and drought in the western U.S. led to severe fires in November in California that set new records for loss of life and property – beating the staggering losses in 2017.

The most recent IPCC report is very blunt and very thorough, saying we have just twelve years to drastically reduce fossil fuel emissions, or the damage to life on Earth will be increasingly severe as decades pass. Over Thanksgiving, the U.S. Global Change Research Program released the 2018 National Climate Assessment: a lengthy synthesis by three hundred scientists. This forecasts a century of increasing devastation from climate change to the U.S. economy, agriculture, infrastructure;

coastal city flooding from a four-foot rise in relative sea level, and a cascade of deadly events from hurricanes to forest fires to drought. The chapter for the Northeast will be useful to readers (<https://nca2018.globalchange.gov/chapter/18/>).



Rising sea levels. Image: the conversation.com

In earlier days, government reports like this would be a wake-up call, since we can see what is happening both here and around the globe. But today, the U.S. federal government is simply ignoring reality and denying climate change is happening. The president recently blamed California's tragic fires on forest management ("they should rake the forest floor"). Asked about the National Climate Assessment, he said he didn't "believe" the scientists that wrote it. His falsehoods (<https://www.factcheck.org/person/donald-trump/>) are presumably to protect the interests of his fossil fuel sponsors. Yet in a parallel universe, his application to raise the sea-wall to protect

his Irish golf course from rising sea level cites the dangers of climate change.

Back in 2012, North Carolina legislators passed an astonishing bill that barred policymakers and developers from using up-to-date climate science to plan for rising

sea levels on the state's coast. This was because updated flood zones would restrict development and reduce property values. The climate system paid no attention. The storm surge and twenty-five inches of rain from hurricane

Florence simply drowned the stupidity of the North Carolina legislators, causing immense damage.

Readers need no reminder that living in fantasies is rarely good for business, so keep seeking the best technical guidance. As the oceans warm and the melting Arctic tundra releases methane, the Earth system is moving towards instability, which makes planning for the future a challenge. We must speak up in our local communities and invest in local resilience for the long-term.

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

Climate Change in a Nutshell: The Gathering Storm

Dr. James Hansen, 18 December 2018



Young people today confront an imminent gathering storm. They have at their command considerable determination, a dog-eared copy of

our beleaguered Constitution, and rigorously developed science. The Court must decide if that is enough.

That is the final paragraph of my (thick) Expert Report written more than a year ago for *Juliana v. United States*. We are fortunate to have such a brilliant and dedicated group of attorneys who have assembled a score of experts and are working to ensure that young people receive their day in court.

In the meantime, there are reasons why it may be useful to summarize the climate science story.

Albert Einstein once said that a theory or explanation should be as simple as possible, but not simpler. And it depends on who the audience is. My target is the level of a Chief Justice or a fossil fuel industry CEO.

This is a draft, because I want to be sure that there are no inconsistencies in my testimonies against the government, against the fossil fuel industry, and in support of brave people who have taken risks in fighting for young people.

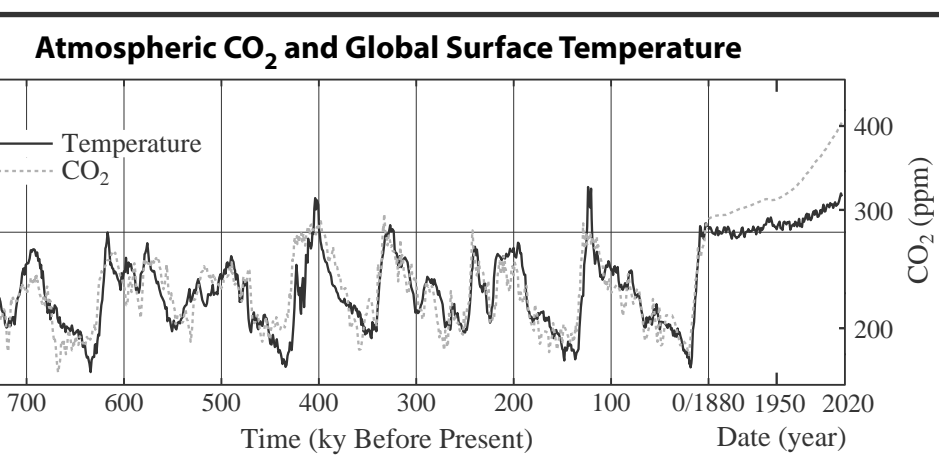
This 18 December version is only a slight

revision to the 06 December 'Nutshell', as it was needed for a specific court case. I will revise it further, so suggestions are still welcome. However, bear in mind that this is aimed at the highly-educated open-minded Chief Justice and fossil fuel industry CEOs. I begin with an 'Outline of Opinions,' but the aim here is not an 'elevator speech' or a summary for relatives and neighbors.

The overwhelming (well-deserved) criticism of the 06 December 'Nutshell' was of the 2-page cover memo in which I seemed to let prior governments, and specifically George H.W. Bush and Barack Obama, off the hook. In fact, they deserve censure for failure to protect the rights and future of young people.

Regarding the end-game strategy, for how we can move off our fossil fuel addiction, we need legal pressure on both governments and the fossil fuel industry. 'Nutshell' is written for use in lawsuits against governments and the fossil fuel industry. However, my long-term aim is not to punish the fossil fuel industry, but rather to bring it to understand the situation and become part of the solution.

CEOs do not get to their positions without being smart people. The example I used, E.E. David, Jr., is illustrative. David brilliantly summarized the nature of the climate system, its delayed response and amplifying feedbacks, and the fact that this implied the need for "anticipation." The anticipation that the fossil fuel industry chose was not to develop carbon-free en-



Note how closely the temperatures follow carbon dioxide levels in the atmosphere.

ergy, but rather to develop unconventional fossil fuels! They anticipated finite reserves of conventional fossil fuels. Via enormous investments, the fossil fuel industry successfully developed 'fracking'. This choice forced E.E. David to become a climate 'denier', which he remained throughout the rest of his life.

Why do I think some CEOs today may be different? David's talk was almost four decades ago! His own scientists were telling him there were many uncertainties about climate change. The situation is different now. First, human-made climate change has emerged far enough from weather 'noise' that even the public notices it. Second, the science has become clearer and exposes an urgency for action that is not convenient for political operatives but is understandable to the well-informed. This conclusion must be made clear to policymakers and judges, and, as useful as a good elevator summary is, two minute summaries are not sufficient for that purpose.

The United States government has possessed extensive knowledge about the threat posed by fossil-fuel driven climate change for several decades, as delineated in my Expert Report for the *Juliana v. United States* case. Yet, as described in the 'Nutshell' summary, the United States government allows, permits and subsidizes fossil fuel reserves, so that the fossil fuels are processed, transported and burned with little or no control on emissions. The government allows the atmosphere to be treated as a free dumping ground for waste CO₂. The government does this even while knowing the consequences thereof.

In 'Nutshell', I note that the deference to the fossil fuel industry, violating rights of young people, is not a problem that can be solved at the ballot box. Both political parties in the U.S. receive large sums of money from the fossil fuel industry and have a sycophantic relationship with the industry, albeit differing in degree.

The Obama Admin-

Cont'd on p.25

EIA PUBLICIZES DROP IN U.S. CO2 EMISSIONS — BUT IS THIS RIGHT?

George Harvey

A recent article from the Sun Day Campaign (SDC), which was posted at the Green Energy Times website (bit.ly/SUN-DAY-CO2-rise), asked some serious questions about data coming from the U.S. Department of Energy's Energy Information Administration (EIA). Specifically, it looked at possible contradictions, not in terms of numbers per se, but in terms of the impressions the EIA gave readers.

In September, an EIA press release said U.S. energy-related carbon dioxide emissions had decreased by almost 1% in 2017. About a month later, in October, another EIA press release told us that CO2 emissions had dropped 28% since 2005.

Also in October, however, the "Monthly Energy Review" made it clear that carbon emissions were very much on the rise in the first seven months of this year. The SDC article observed that the increase in natural gas was up 12% in the first seven months of 2018, compared with the first seven months of 2017. It also said that overall, U.S. carbon emissions from energy were up 2.90% so far in 2018, compared to the same months last year. The observation was that these figures "paint a very different picture and suggest reasonable cause for alarm."

Making sense of this takes a little study. We could start with the note that the figures showing declines in overall U.S. emissions relate to periods ending in 2017. But within the data for this year are other details worth considering.

Having looked at the data with some care to details, we agree that there is some cause for alarm. Nevertheless, we should be careful to portray things in a broader context. We also have eight months of data for comparison now, and the latest data are slightly different from what the SDC had.

The current level of consumption of

natural gas is at an all-time high in the U.S. It is true that it is up 12% from 2017, but the first eight months of 2017 showed a remarkable decline of 4.55% from levels in the first eight months of 2016. Overall, the level of emissions associated with burning gas was up in the first eight months of 2018 by only a little less than 7% from the first eight months of 2016, two years ago. This is not good, and is in fact a bit alarming, but it is still only 3.5% per year, and not as bad as the increase of 12% in a single year would appear to indicate.

Other factors should be taken into account in addition to natural gas. One is that the use of coal is still declining, despite efforts by the current federal administration to revive it. Comparing the first eight months of 2016 and 2017, as natural gas emissions dropped, we see a drop in emissions of 0.56% for coal. Now, with natural gas emissions rising, what we see for coal is that emissions dropped by over 5% from 2017 to 2018, for the first eight months of each year.

Another factor in overall emissions is that we are burning more petroleum, largely for vehicles and heating. Where it had risen a little more than 0.5% from 2016 to 2017, the increase is over 2% from 2017 to 2018.

The overall picture is not good. For the first eight months in 2018, compared to those of 2017, it is actually slightly worse than the SDC article indicated. The extra month of data past what the SDC mentioned shows that the overall rise in U.S. CO2 emissions at 3.0%.

With relaxing attitudes on emissions, relaxed rules, and relaxed enforcement, the levels of emissions are certainly on the rise. Clearly, the situation is not as desperate as it might have appeared to be at first glance, but we need to do better if we are to keep the climate from being chaotically destructive. ♻️

Climate Change in a Nutshell

Cont'd from p.24

istration, e.g., in 2011 opened up hundreds of millions of tons of coal on public lands to new lease sales. Moreover, the sales were at prices far below market value, continuing a practice of federal subsidy of coal titans amounting, through those sales alone, to tens of billions of dollars.

The Trump Administration's astounding recent efforts to accelerate fossil fuel use are pressing the world rapidly toward the climate precipice. The Administration blatantly misrepresents the facts about climate change and specifically the U.S. contribution to climate change. We must expose the facts rigorously, so that the courts can protect the rights and future of young people.

The 06 December 'Nutshell' draft was also criticized for failing to mention the potential of advanced nuclear technology to contribute to phase down of carbon emissions power. The reasons for this omission were: (1) discussion of the full range of promising carbon-free energy sources is not essential here, because a court cannot tell a government how to reduce fossil fuel emissions—it can only demand that there be a plan that stops violation of young people's rights, (2) discussion of the varieties of nuclear power, including advanced nuclear technology, would make this document even much longer.

To see the 'Nutshell' online, visit <http://bit.ly/climate-nutshell>.

That is the background, about why I believe that we must make the climate story as clear as possible to an industry CEO as well as a Chief Justice. Surely, there will be lawsuits against the fossil fuel industry as well as against governments. I am not so much interested in 'reparations,' the idea of extracting money from the industry for its past sins, as in getting the industry's cooperation on moving as rapidly as practical toward clean carbon-free energy of the future. However, at this juncture, the threat of lawsuits is probably necessary to get them there.

Despite the recent turn toward increased global authoritarianism and denial of scientific facts, we have also recently witnessed the heart-warming sight of marching Australian children, defying their Prime Minister's instruction to stay in school. It may not be long until there is another chance at a day of reckoning. This time it must be clearer what young people and other life on our planet need to assure their future. We must be sure that thoughtful people at high government and industry levels have a good understanding of the climate change situation.

James Hansen, former director of the NASA Goddard Institute for Space Studies, is director of the Climate Science, Awareness and Solutions program at the Columbia University Earth Institute. ♻️

Global Warming Acceleration

James Hansen, 19 October, 2018

Climate models indicate that an El Nino, probably a weak one, will begin this (Northern Hemisphere) winter and observations show that warming in the tropical Pacific has begun. Current global temperature (12-month running-mean) has thus reached its minimum and will begin to rise during the next few months. The global temperature minima associated with La Ninas are more uniform in depth than El Nino maxima. This provides an excellent opportunity to check whether the global warming rate is accelerating.

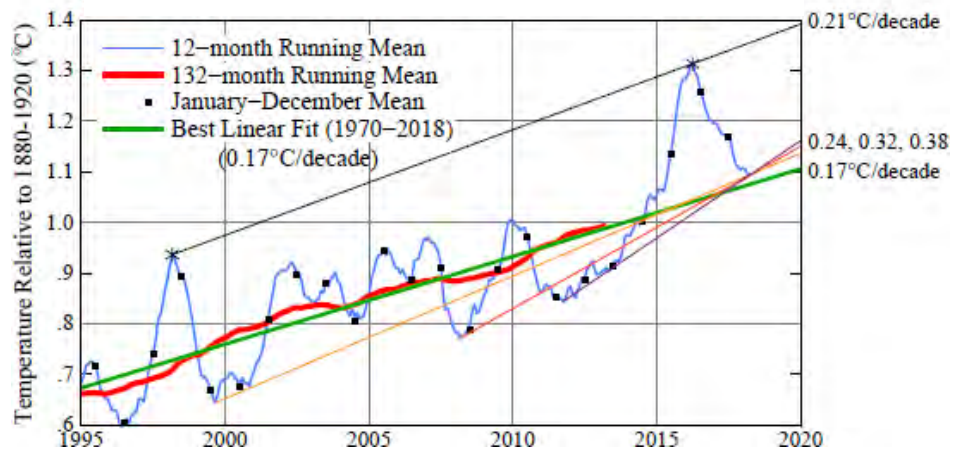
Global temperature appears to increase almost linearly over the past fifty years (green line on graph); the 1970-to-present rate of change is 0.17°C per decade. Investment strategist, Jeremy Grantham, pointed out that the rate of warming inferred by connecting the peak temperatures of the last two El Nino maxima (0.21°C per decade, see graph) exceeds this longer term rate, and he

infers that global warming is accelerating. La Nina minima probably provide a better estimate, and they provide a more recent rate. As the figure shows, the most recent two La Ninas imply a warming rate of 0.38°C per decade, at least double the longer term rate! Acceleration is predicted by climate models for continued high fossil fuel emissions as a result of amplifying climate feedbacks and is a cause for concern. We expect global temperature to rise in the next few months and confirm that the global warming rate has accelerated.

Read more at <http://www.columbia.edu/~jeh1/>.

James Hansen, former director of the NASA Goddard Institute for Space Studies, is director of the Climate Science, Awareness and Solutions program at the Columbia University Earth Institute. ♻️

Connecting El Nino Maximum and La Nina Minimum Temperatures



Global warming acceleration becomes evident by connecting global temperatures at La Nina minima.

ACEEE Partners with Bloomberg's American Cities Climate Challenge

Kate Tanabe, ACEEE Research Assistant, Local Policy

Michael R. Bloomberg recently announced Charlotte as the nineteenth winning city of Bloomberg's American Cities Climate Challenge, of which ACEEE is an official partner.

"With Washington asleep at the wheel, cities like Charlotte are leading the way in the fight against climate change," said Bloomberg, the UN Secretary-General's Special Envoy for Climate Action. His foundation's \$70 million program, launched in June, will help 20 winning cities accelerate their ambitious climate efforts.

Over the next two years, the Climate Challenge will provide these cities with significant resources, including technical assistance and staff capacity, to help them reduce carbon emissions by saving energy and using clean energy sources. The selected cities will target energy savings in the buildings and transportation sectors, the sectors most responsible for energy use and carbon emissions. ACEEE will partner



Image: Charlotte, NC skyline. Image: Flickr

with the Climate Challenge by expanding our efforts to monitor and evaluate city actions. Our independent City Clean Energy Scorecard (formerly City Energy Efficiency Scorecard), the premier tool for assessing local energy ef-

iciency policies and programs, will now include a focus on renewable energy and increased emphasis on policy performance and social equity outcomes. The 2019 City Scorecard will expand from scoring 51 of the largest US cities to 75, with the goal of assessing 100 in future editions...

To read more, visit: http://bit.ly/ACEEE_AmericanCitiesClimateChallenge.

About ACEEE: The American Council for an Energy-Efficient Economy acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. For information about ACEEE and its programs, publications, and conferences, visit aceee.org. ♻️





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Photography by: Martin Paul



A Net-Zero Home in Hanover, NH

Karl Kemnitzer



The Kaiser Gish house in Hanover, NH is retrofitted to achieve net-zero status. It includes three all-weather air-source heat pumps and an 8-kW rooftop solar array. Photos by Karl Kemnitzer.

With the recent release of reports from three main climate organizations (UN IPCC, U.S. National Climate Assessment, and World Meteorological Organization) saying that we need to drastically reduce our greenhouse gas emissions, increasing the energy efficiency of our homes has never been more important. In our region, buildings are second in energy consumption and emissions only to transportation.

Many homeowners in the Upper Valley have weatherized their homes, which often yields a 10% to 30% savings on fuel bills. Other homeowners set the goal even higher. Robin Kaiser and Peter Gish have a long history of caring for their community, and when they decided to move back to Hanover, they wanted to live in a net-zero-energy house. After working with UPC Wind Partners during the 1990's, Peter co-founded First Wind in 2001 and has worked on wind and solar renewable energy projects in North America, Europe, Africa, and Asia.

However, both Robin and Peter have strong family ties to Dartmouth, and when it came time to choose a location to settle, they decided to renovate their family home here. Robin's parents, Bob and Evelyn Kaiser, were integrally involved with the Dartmouth community for nearly fifty years, and their home was often a gathering place for students and alumni. Robin and Peter would like to continue this tradition, because they feel the pressing issue of climate change is only solvable with community action and giving people a chance to meet in a net-zero home will help them envision what is possible.

From the beginning of the project, Robin and Peter prioritized efficiency. After analyzing their old house, they realized that it would be very difficult to achieve net zero

with the existing structure and decided to replace the walls and roof with a pre-fabricated panel construction shell with preinstalled foil-faced foam insulation (rated at R36 for the walls and R55 for the ceiling) from Yankee Barn Homes. A blower door was used by contractor G. R. Porter and Sons during installation of the panels to find and seal any leaks in the seams, because air infiltration is often a significant heat loss in a building. The shell was designed to fit onto the old foundation to save the embodied energy in the concrete. Both operational energy and embodied energy were considered during the design, and parts of the old building (such as the foundation and exterior cedar trim) were reused. Around 80% of the building is locally sourced or fabricated in New Hampshire or Vermont. The Marvin Integrity windows were selected over triple-glazed units because of their predicted ability to seal better than other choices many years from now, saving on air infiltration losses instead of adding to embodied energy from repair or replacement.

With a shell this tight, no fossil fuel furnace is necessary. The heating system, installed and designed by ARC Mechanical Contractors, includes three Mitsubishi Electric MXZ all-weather air-source heat pumps connected to a ducted heating system that pulls in fresh air through a Broan HE series Heat Recovery Ventilator. While this system can supply both heating and cooling, the house was designed to use natural convection for cooling to minimize the use of AC. Domestic hot water is supplied by a Rheem Prestige Professional series heat pump water that has a room temperature sensor and will switch to standard resistance heating elements if the room temperature becomes too cold. Waste water heat recovery was considered, however based on frequency of use, it was decided to

not be effective enough to include. All of the lighting is LED, with most of the fixtures using standard Edison base bulbs for easy replacement, and only a few custom fixtures using a flat LED element. Appliances are selected EPA Energy Star rated commonly available appliances.

An 8kW solar array is installed on the garage roof by Apparent brings the building's energy use to net zero. Each of the panels has an Apparent Smart Grid Utility Interactive microinverter on it. This system not only maximizes each panel's output to compensate for shading effects and tracks each panel's output to help diagnose problems, but it is California Rule 21-compliant and offers grid support such as voltage ride through, surge withstanding, anti-islanding capabilities, and voltage-ampere reactive correction. This is more functionality than Liberty Utilities is capable of handling at this moment, however the Apparent master controller also offers load tracking using a built-in learning algorithm and can calculate the best times for heating water and charging or discharging an electric vehicle (EV) or battery storage. The battery storage will be either a modular system from Apparent that is built with BYD lithium cells or a Sonnen battery system. Robin and Peter currently drive a standard internal combustion engine car and a hybrid but have plans to move to electric vehicles as part of this overall project. They are installing bidirectional level 2 chargers that allow the car batteries to become part of the household energy storage system and have prewired the main roof for additional solar panels for the cars.



The heating system, installed and designed by ARC Mechanical Contractors, includes three Mitsubishi Electric MXZ all-weather air-source heat pumps.

It's now possible to build a net-zero home using readily available materials, or as project architect Andrew Garthwaite of Haynes and Garthwaite Architects said, "Leading edge but not bleeding edge." The Kaiser Gish house is showing us that clean, efficient, and exciting buildings are here.

Karl Kemnitzer serves on the Sierra Club Upper Valley group, and likes building electric cargo bikes. He hasn't had a car for over a year and looks forward to VTrans spending more of their budget on bicycles, pedestrians, and transit, and less on cars. ☘

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Top 10 Tips for a Healthier Indoor Environment – Part 1

Lauren Hildebrand

Look around the space you are in right now and take a pulse on your surroundings. Are the lights too bright? Are you too cold? Too hot? Do you hear constant humming from the HVAC equipment in the background? Are you having difficulty concentrating? Are there plants in your view? Do you even have a view?

For many of us, the term “high performance building,” brings to mind energy efficiency. Less discussed are the performance factors that contribute to human health. So the question we ask is: How do we design for, and maintain, efficient building performance without compromising occupant health and well-being?

Over the past decade, the amount of research being conducted in this area has expanded significantly. Drawing from the LEED, Enterprise Green Communities, and WELL Building Standards, as well as from case studies (specifically Harvard’s T.H. Chan School of Public Health’s Healthy Buildings Program and Stök’s report on workspaces that promote health and wellness), here are Steven Winter Associates’ top five (of ten) tips to effectively address indoor air quality (IAQ):

1) Send in the O2

According to the COGfx study conducted by Harvard, when occupants received double the amount of fresh air, their cognitive function also doubled. Doubling ventilation was particularly effective when combined with energy recovery ventilation (to reduce building operating costs) and low-emitting finishes (further improving cognitive function). Increasing fresh air above code minimums is tied to a corresponding increase in alertness, productivity, emergency response, problem-solving, and reported satisfaction and well-being.

2) Turn on the (Kitchen) Fan

Lawrence Berkeley National Lab research estimated that sixty percent of homes in which residents cook with a gas stove at least once a week can reach unsafe levels of nitrogen dioxide, formaldehyde, and carbon monoxide. To help manage and mitigate these indoor pollutants, design kitchen range hoods to meet ASHRAE 62.1 2013 levels; install fans over the entire stove including all four burners; exhaust directly to the outdoors; and use the fan every time you cook.

3) Take My (Room) Temperature

Thermal comfort is influenced by air temperature, mean radiant temperature, air speed, humidity, personal metabolic activity, and clothing-induced thermal insulation. Low relative humidity (RH) – below 40% – and low temperatures can spread airborne bacteria and infectious



Stök's report breaking down the cost savings associated with healthy work spaces.

disease particles, such as influenza. Indoor environments that are too warm and humid (above 60% RH) showed increased reports of headaches, eye and throat irritation, respiratory symptoms, increased heart rate, negative mood, fatigue and mold growth on surfaces. These not-so-fun side effects can impact performance and learning, as well as cause sleep disturbances. Commission your space to meet ASHRAE 55 – 2017 levels; keep relative humidity between 40% and 60% and maintain optimal seasonal temperatures; conduct regular inspections of roofing, plumbing, ceilings, and HVAC equipment to identify sources of moisture and potential condensation; and immediately address and replace materials where moisture or mildew is present.

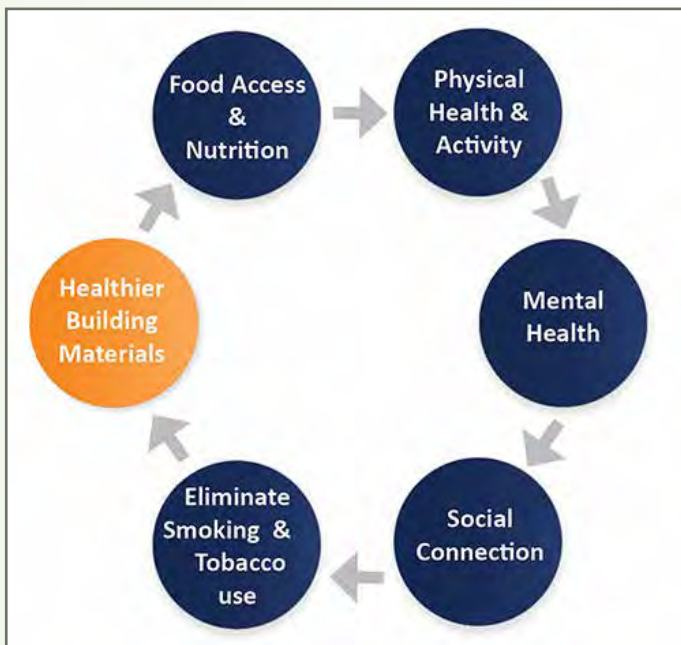
known to cause asthma and respiratory illness, infertility and other reproductive disorders, and certain types of cancers. Read the Health Materials Lab Red List and Green Science Policy Institute’s Six Classes for information to help avoid using building materials that contain known hazardous chemicals.

These are just some key reasons why we need to expand our definition of high-performance buildings to include human health. Stay tuned for part two of our top ten recommendations for a healthier building.

Lauren Hildebrand is the Sustainability Director at Steven Winter Associates. ♻️

Buildings + Beyond
podcast

Available now on iTunes, Google Play, or your favorite podcast platform.
www.swinter.com/podcast
Presented by Steven Winter Associates, Inc.



Healthy building materials as contributors to overall human health. Credit: Home-Free at homefree.healthybuilding.net.

4) Filter Me This

According to the EPA, the air inside your home can be up to five times more polluted than the air outside. Use high-efficiency filters to remove detrimental fine particles in the air. The higher the Minimum Efficiency Reporting Value (MERV) rating on filter, the fewer particles that can pass through. Aim for MERV 13 or higher to capture atmospheric particulate matter (PM) with a diameter of less than 2.5 micrometers (PM2.5). MERV 14 removes 75+% of particles in the 0.3 – 1 micron range.

5) Free to Be...Toxic-Chemical Free

85% of the 82,000 chemicals in use are lacking in available health data. Known chemicals of concern are prevalent in modern building materials, finishes, and cleaning products. Polychlorinated Biphenyls (PCBs), formaldehyde, heavy metals (benzene and mercury, phthalates, microbials), and flame retardants are top offenders. Exposure is

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Carpeting & Indoor Air Quality — WHAT CAN YOU DO?

EarthTalk®, From the Editors of E - The Environmental Magazine



Greener carpet is made from wool, jute or cotton and emits little, if any, VOCs. Credit: Dominika Gregušová, Pexels.

volatile organic compounds (VOCs) into the air.

Meanwhile, carpet backing is typically made from synthetic rubber derived from styrene and butadiene, also respiratory irritants. And that new carpet smell we know so well comes from the off-gassing of 4-PCH, a potent VOC byproduct of the synthetic rubber manufac-

Carpeting is an oft-overlooked culprit when it comes to compromised indoor air quality, but the chemicals used to produce it are typically far from natural. According to the non-profit Environmental Working Group (EWG), most carpeting is made from synthetic fibers derived from non-renewable petroleum-based sources and emits harmful

turing process known to cause respiratory problems, eye irritation and rashes. EWG adds that it can also react with other chemicals to produce formaldehyde, a known human carcinogen.

Likewise, the glues and sealants used to install most wall-to-wall carpeting come chock full of more VOCs and in some cases, toxic petroleum-based solvents. To add

insult to injury, the waterproofing and anti-microbial treatments now common in everyday carpeting have been linked to cancer, birth defects and hormone disruption. Last but not least, carpet padding is typically made from scraps of polyurethane recycled from older furniture and mattresses—and as such likely contains carcinogenic chemical flame retardants now banned in new furniture.

Well that's all well and good, but what choices do we have? Actually, lots. Carpeting labeled with the Carpet & Rug Institute's "Green Label Plus" or UL Environment's "Greenguard" emit low amounts of VOCs and as such are safer for you and your family. Wool is the most common eco-friendly choice, but jute and cotton varieties are coming on strong. Stay away from stain fighting, waterproofing or anti-microbial treatments. For carpet padding, go with felt rather than synthetic rubber. And make sure to use low-emitting, non-solvent adhesives and fasteners during installation.

No matter what kind of carpeting you end up with, make sure to vacuum it regularly—the American Lung Association recommends at least 3x/week with a HEPA filter-equipped vacuum—to remove dust, allergens and pollutants that you (or your pets) might track in. "Carpets are ... the perfect environment to harbor dust mites, mold and mildew, which are all common allergens," reports EWG.

One way to avoid all of these issues entirely is to forego carpeting altogether and go with tile, wood, cork or natural linoleum flooring with low-VOC sealant. They don't off-gas VOCs or harbor allergens and pollutants, and they're easy to clean while lasting decades longer than carpeting anyway. Throw down a few wool area rugs (easily cleaned outside) and you'll be good—and green—to go.

Now what to do with the old carpeting is another question entirely. Carpeting is difficult to recycle as it's made from multiple components with different chemical makeups, so your local curbside recycling hauler is unlikely to take it away for you. The non-profit Carpet America Recovery Effort (CARE) is working to develop the infrastructure needed to recycle carpet efficiently across the U.S. In the meantime, you can search on Earth911 for a carpet recycler near you.

Contacts: EWG, www.ewg.org; Green Label Plus, carpet-rug.org/testing/green-label-plus; Greenguard, greenguard.org; CARE, carpetrecovery.org; Earth911, search.earth911.com.

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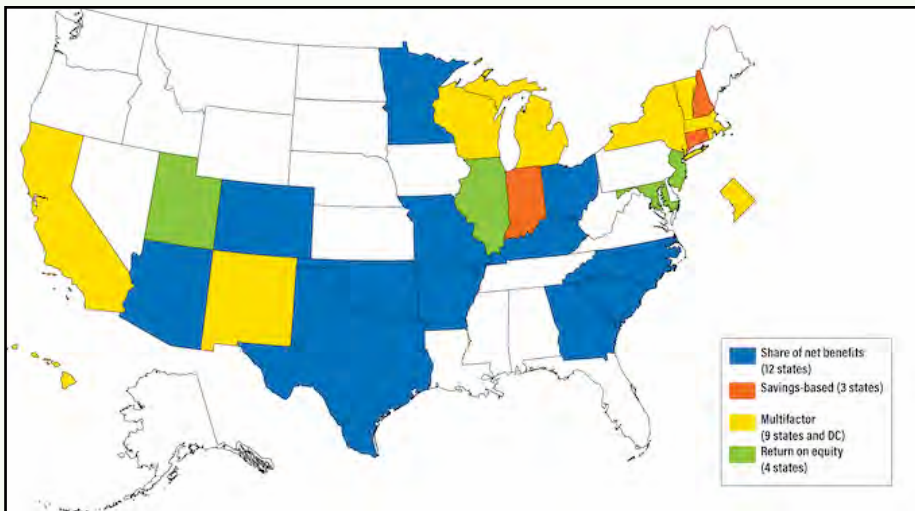
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Can Utilities Incorporate Energy Efficiency into Their Core Business?

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Grace Relf, The American Council for an Energy-Efficient Economy (ACEEE)

Utility Performance Incentive Landscape



The national landscape for state energy efficiency performance incentives by mechanism type. Source: ACEEE state policy database based on 2017 data with additional updates.

As the energy utility business model changes, more states are offering utilities incentives to increase energy efficiency by making it as appealing as traditional investments. ACEEE explores performance incentives for utilities in twenty-nine states, focusing on nine innovative states in particular.

New Jersey is one example. In September, the state's largest utility, Public Service Gas and Electric (PSE&G), proposed a six-year energy efficiency portfolio that would allow them to earn a return on their investment. The utility's proposed portfolio would increase utility investments in efficiency by 60% in its first year, ramping up to a 700% increase in 2024, compared to 2017 utility investments. It would also more than quadruple the number of programs the utility offers, help New Jersey meet its energy efficiency targets, and save customers an estimated \$5.7 billion. The proposal is now being reviewed by the state utility commission.

Even with such clear benefits, however, many utilities would be unable or unwilling to invest as much in energy efficiency. Why? Without proper policies, efficiency reduces electricity sales and profits. To counteract this, New Jersey and twenty-eight other states have performance incentive mechanisms (PIMs) that allow utilities to earn rewards for their investments in energy efficiency, when they meet certain performance criteria.

PIMs can be structured in different ways. Some allow utilities to earn a share of the net benefits from efficiency investments, and others provide a cash reward for meeting energy savings or other targets (called savings-based and multifactor incentives). Another type of incentive allows utilities to earn a rate of return on their efficiency spending as they would for investments in generation or transmission and distribution infrastructure (and these incentives can also be aligned with performance criteria).

Since ACEEE's last national review of performance incentives in 2015, we've seen a notable upward trend in both multifactor and rate of return incentives. The figure below shows the current landscape of utility energy efficiency PIMs.

Rate of return incentives

Four states have adopted rate of return performance incentives, up from one state in 2015. These mechanisms are growing in popularity, because they allow a rate of return for demand-side investments in a manner similar to traditional infrastructure investments, and this helps to level the playing field for energy efficiency. Rewards are sometimes based purely on spending, but they can also require performance criteria such as certain levels of energy savings.

For utilities that are rapidly ramping up efficiency investments, like PSE&G, rate of return incentives can spread costs out

over a longer time period rather than recover them within the year they are incurred. This smooths out the customer bill impacts of large investments and ensures that customers pay for efficiency measures over the many years of receiving their benefits.

In 2016, Illinois set new efficiency targets for its investor-owned utilities. The legislation included performance-based rate of return incentives for meeting or exceeding the targets as well as penalties for not meeting them. The utilities can earn up to 200 basis points for exceeding their targets, or they can lose up to 200 basis points if they fail to meet them.

Multifactor incentives

Beyond energy savings, states are increasingly working to meet new policy goals. These goals include reducing peak demand (and system costs), reducing greenhouse gas emissions, and creating savings particularly for low-income customers. To do so, states including Massachusetts, Rhode Island, Hawaii, and Michigan are using multifactor PIMs, which reward utilities for meeting multiple policy goals.

Massachusetts recently put forth a new and aggressive energy efficiency plan that includes new PIM components. If approved by regulators, the state's utilities

Cont'd on p.35



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Vital Communities Partners with Eight Towns for Third Round of Weatherize Upper Valley



Weatherize Orford-Piermont-Lyme Team at the kick-off event at the Rivendell School in January 2018. Image: Molly Drummond.

January 8, 2019 - An annual program hosted by nonprofit Vital Communities is helping many homeowners keep out the cold this winter, with more than 200 homes weatherized since 2016. Eight more New Hampshire towns join the effort in 2019 (Canaan, Enfield, Andover, Newbury, New London, Sutton, Warner and Wilmot) with kick-off events scheduled in late January.

Weatherize Upper Valley works by teaming up community volunteers with certified weatherization contractors to make it easier and more affordable to reduce energy costs and improve home comfort through air sealing and insulation upgrades. Residents in participating towns can start the process with a \$100 energy audit (often priced over \$400) available between now and March 15. Participants who commit to an energy efficiency project by May 31st will be entered to win \$500 toward project costs.

Throughout the program, volunteers and Vital Communities staff offer homeowners personal support and encouragement. "Without their help we never would have done this on our own," reflected one 2018 Orford participant. "I hope Vital Communities keeps the program going to help others in the Upper Valley."

Vital Communities is answering that call with 2019 Weatherize campaigns launching this month. Weatherize Canaan and Enfield will host a public kick-off event on Saturday, January 19, at Mascoma Valley Regional High School from 3 p.m. to 5 p.m. A Weatherize Kearsarge kick-off event is planned for Saturday, January 26, at the Kearsarge Community Presbyterian Church in New London from 2 p.m. to 3:30 p.m. Interested residents are encouraged to attend to learn more about home energy efficiency and the Weatherize process, meet their community's certified weatherization contractors, and talk with neighbors who have already completed

home energy efficiency projects.

Communities beyond the Upper Valley are taking note and building on the region's Weatherize success. In 2018, Vital Communities helped Efficiency Vermont incorporate the Weatherize Upper Valley model into its statewide Button Up campaign, generating hundreds of participants throughout Vermont. In 2019, energy committees in New Hampshire's Mt. Washington Valley, Monadnock region, and North Country are working with Vital Communities to launch Weatherize campaigns of their own.

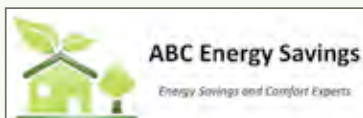
"When we developed the Weatherize model in 2016, we knew we wanted to create something that could be shared beyond the Upper Valley," explained Sarah Brock of Vital Communities, whose idea for Weatherize was inspired by the success of Solarize Upper Valley, which helped more than 300 homeowners go solar in 2014 and 2015. "It means so much to see our work go on to help more people than we could ever have helped on our own."

In the midst of Weatherize and Solarize success, Vital Communities has also become an accidental yet enthusiastic local resource for all questions about home energy. Brock and her staff frequently respond to calls from Upper Valley residents looking for friendly, unbiased energy advice. "Sometimes people just don't know where to begin," explains Brock. "That's something we can help anyone with!"

Vital Communities, a nonprofit organization based in White River Junction, Vt., brings together citizens, organizations, and municipalities to take on issues where an independent voice and regional approach are essential. Working together, we make our region a better place to live, work, and play. Learn more at VitalCommunities.org.

For more information, contact Paige Heverly, Energy and Transportation Project Coordinator for VitalCommunities.org, 802.291.9100 x114. ♻️

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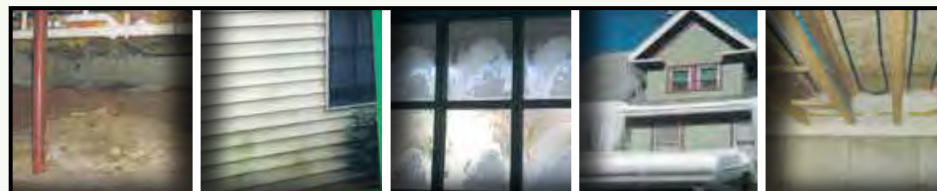
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GRAZING FOR CHANGE AT STONEWALL FARM

Jessie Haas

Julie Davenson, executive director of Stonewall Farm, a non-profit working dairy farm in Keene, NH, was researching regenerative ways to improve Stonewall's overgrazed pastures when she happened upon the book *The Soil Will Save Us*, by Kirsten Ohlsen. There she learned about holistic, planned grazing, the method pioneered by Allan Savory for regenerating soil using large groups of livestock. Savory believes that widespread adoption of his techniques is key to sequestering large amounts of carbon in the soil and reversing climate change.

At around the same time, Stonewall Farm began selling milk to Stonyfield Organic. A specialist there suggested that the farm become a Savory Hub. Hubs are Holistic Management training and demonstration sites. The fit was good. Stonewall Farm's mission is to educate people of all ages about farm ecology and promote economic justice for small farmers.

Stonewall Farm began using holistic planned grazing this year and progress is encouraging. The farm had practiced rotational grazing for many years, but as Davenson notes, rotational grazing is not planned grazing. Planned grazing focuses on recovery periods for paddocks, with the goal of building root and soil health. Rotational grazing simply involves shifting animals from paddock to paddock on a fixed schedule. Over the years, the poorly managed rotational grazing resulted in overgrazed pastures, extensive weed pressure, and poor forage quality.

Using the plan they created, herd managers at Stonewall divided paddocks into smaller units, determined appropriate cow stocking rates, allowed them to graze



Stonewall Farm Hub Launch on September 21, 2018. Image: Karl Thidemann.

a certain period of time based on available forage and stocking rates, then moved them on and did not come back until regrowth was at the right stage. Sometimes that meant keeping the cows on a dry lot and feeding them hay for a few days.

Despite a difficult growing season, overgrazing damage is starting to correct itself. Plant diversity has increased, without fertilizing or reseeding, and without cost, other than a few reels of electric fence. The pastures produced twice as much forage on the same amount of land, and the nutritional quality also improved. Analysis of the soil to measure carbon sequestration has not yet been done, but increased fertility goes hand in hand with increased soil carbon.

Stonewall Farm held its first conference as a Hub on September 21, 2018. Close to 250 people attended, including farmers, researchers, professors, policymakers and business leaders. Presenters included Britt Lundgren from Stonyfield Organic, Rebecca Hamilton from W.S. Badger Co., Ridge Shinn of Big Picture Beef, Seth Itzkhan and Karl Thideman, co-founders of the Vermont-based organization Soil4Climate, and Allen Savory himself. The conference focused on the benefits of regenerative agriculture and on expanding markets for farmers using regenerative practices. Attention to farm profits and farmers' quality of life is an important aspect of the healthy soils movement,

especially for Allen Savory. His method is called 'holistic,' and he is very clear that the whole must include the farmer.

Stonewall will begin offering training and consulting services for New England farmers in 2019, starting with an Introduction to Holistic Management workshop in February. As a Hub, Stonewall will offer training and consultation for farmers who want to learn holistic land management and planned grazing—including everything from creating a grazing plan to financial management. In the future, they plan to offer Ecological Outcome Verification services to livestock producers wishing to be certified through the Land to Market program. Another project of Savory International, Land to Market is the world's first regenerative sourced supply chain, connecting manufacturers, retailers, and consumers to food and fiber grown in a way that regenerates soil. This allows consumers to vote with their dollars. By creating demand, consumers can encourage farmers to adopt regenerative practices, which benefit the climate, the land, and the farmer's bottom line.

Stonewall Farm is already educating others about holistic planned grazing through local schools. Students from Keene High School's Advanced Placement environmental science class conducted ecological land monitoring in pastures this fall.

People can get involved by enrolling in workshops, joining the citizen scientist group to assist with ecological monitoring, or donating to the Farmer Scholarship Fund to help train more New England farmers and homesteaders.

Stonewall Farm was founded when the last private owner, Norman Chase, retired without heirs. The Kidder family preserved



Cows grazing in the paddock at Stonewall Farm in Keene, NH. Courtesy photo.

his farm and incorporated it as a non-profit educational organization. While events such as weddings form an important part of Stonewall's cash flow, farming remains central. Stonewall offers programs for kids of all ages on gardening, wildlife ecology, and farming. The dairy sells milk to Stonyfield Organic. Thanks to holistic planned grazing, the dairy is on track to become sustainable. Production is up, the herd is growing, milk quality remains exceptionally high, and the pastures are improving rapidly, without added expense.

Davenson says, "Given all the recent news about climate change, this work is critically important and we don't have any time to waste . . . (w)e have an opportunity to teach both farmers and landowners how to manage their fields and pastures in a manner that increases the health of their ecosystems, builds soil health while sequestering carbon, and increases farm viability."

Jessie Haas has written 40 books, mainly for children, and has lived in an off-grid cabin in Westminster West, VT since 1984, www.jessiehaas.com.

Links available with the posting of this article on the GET website. 

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The Outside Story: Southern Pine Beetles March North

Joe Rankin

As if the emerald ash borer's incursion into northern New England wasn't enough, now there's another potentially devastating forest pest marching this way: the southern pine beetle.

Dendroctonus frontalis – the first name means "tree murderer;" we should note – is only a fraction of an inch long. But during outbreaks, they reproduce by the millions and can kill trees in a matter of weeks.

"They're one of the most aggressive tree-killing insects in the world," said Matthew Ayres, a biology professor at Dartmouth College who has studied the species for 25 years.

A relative of the mountain pine beetle, which periodically ravage the lodgepole- and ponderosa-pine forests of the intermountain West, the southern pine beetle is native to the vast pine forests in the southeastern United States.

But now, thanks to a warming climate, the beetle is moving north. It's established itself in New Jersey, Rhode Island, Connecticut, and probably Massachu-

setts, according to Ayres. In New York, it's on Long Island and has been trapped near Albany.

"There's no doubt that northern forests in New Hampshire and Vermont are going to be challenged in the next few years – sooner rather than later – by southern pine beetles," said Ayres.

Writing in the journal *Nature Climate Change* earlier this year, a team of researchers predicted "a plausible new threat" from the beetle "to vast areas of pine forest in eastern North America by 2050 and into subarctic Canada after 2080 under continued climate change."

"It is a very big deal" for the northeastern US," said Kevin Dodds, a forest entomologist with the U.S. Forest Service and one of the authors of the article. "It's definitely a considerable forest pest."

Cold winters have traditionally limited southern pine beetle's range. One night at zero degrees Fahrenheit and most beetles are killed, said Ayres. At five degrees below zero, they're pretty much all dead. The problem: "In the last 50 years [in our region],

the coldest night of winter has warmed by 7-8°," said Ayres. In the next 50 years, it could rise

Cont'd on p.33

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George Harvey

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For years, various organizations have engaged in ways to sustain or restore the forests. One interesting solution is a sustainability application called PrintReleaf, provided by Conway Office Solutions. PrintReleaf is an easily adopted, yet sophisticated, means for many companies that care about the environment to reduce their forest footprints to zero. By using it, the people engaged in a printing business, book publisher, university, church, factory, or advertiser can know that for every job they do that requires paper, trees are being planted

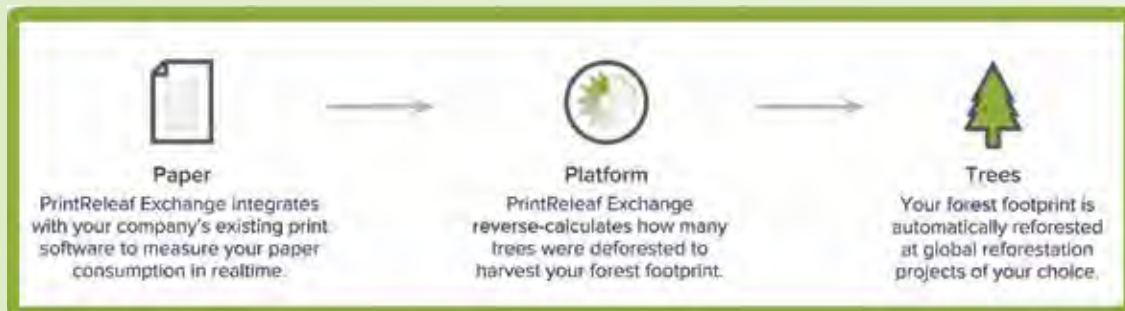


Diagram showing the workflow of the PrintReleaf application. Courtesy photo.

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whole process is certified by SGS International, a leading forestry auditor.

Many environmental issues are sometimes best addressed at the local level. The saying, "Think globally, act locally," is well known. But the matter of climate change affects all people and all parts of the world in some way. While it might be preferred to replace trees with new ones in the same forest, there are beneficial effects of replacing them farther from home. Doing so provides work and environmental well-being in the places where forests are sustainably maintained. PrintReleaf is working in such places as Brazil, India, and Madagascar, in addition to North America and others.

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Southern Pine Beetles

Cont'd from p. 32

another 10 degrees.

Adult female beetles are the ones who seek out new host trees. When they find a vulnerable pine, they burrow into the bark and release pheromones that alert other beetles, which swarm to the tree. Scientists call this a "mass attack." The tree tries to fight back with resin, but the sheer number of invaders overwhelms its defenses. Beetles carve tunnels into the inner bark and lay eggs. After hatching, the larvae tunnel out and fly off to another tree. They can fly up to two miles and can produce multiple generations in a year.

During periodic outbreaks, the beetle's numbers swell. They spread rapidly and kill pines in vast numbers. They then typically crash. In the south, outbreaks occur roughly on a 6-10 year cycle, though patterns can vary widely.

"The southern pine beetle has been recorded attacking and killing every species of pine with which they come into contact, and that's more than a dozen," said Ayres. It favors the "hard" pines like loblolly pine and shortleaf pine. It will kill pitch pines, and the pitch-pine barrens along the Atlantic coast from New Jersey to Maine are very vulnerable. It's likely to go after jack pine and red pine, too.

The big unanswered question is how it will treat white pines.

Ayres said the beetle has killed white pines in Alabama, Kentucky, and New Jersey. "We know they're susceptible. What we don't know well is how well the beetles reproduce in white pines."



Kyle Lombard, the forest health program coordinator for the New Hampshire Division of Forests and Lands, said his office is monitoring the bug's progress. But "We are not overly concerned it will be a real threat to our New Hampshire forests. We just don't have a lot of the preferred host, and the winter temps in New England would severely knock it back or completely control it."

In their mass attacks, southern pine beetles tend to favor forests where the trees grow close together. In New England, white pine

doesn't usually grow in pure stands, but as single trees throughout the woods. That may discourage the beetle.

Unlike with emerald ash borer, where there's virtually nothing humans can do but wring their hands, the thinning of uninfected pine stands can help control the southern pine beetle.

"The best management strategy to discourage southern pine beetle outbreaks is to maintain healthy pine stands, and that is another advantage New Hampshire has - we are not averse to managing forests," said Lombard.

"We can manage it, and we should," said Ayres. "But we should also take this as a harbinger of other changes and challenges that could be facing northern woodlands. This won't be the last."

Joe Rankin lives in Maine. The illustration for this column was drawn by Adelaide Tyrol. The Outside Story is assigned and edited by Northern Woodlands magazine: northernwoodlands.org, and sponsored by the Wellborn Ecology Fund of New Hampshire Charitable Foundation: wellborn@nhcf.org.

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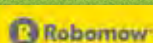


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RESOURCES

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

Carbon Tax: carbontax.org

Clean Power Estimator: www.consumerenergycenter.org/renewables/estimator

CO2.Earth: See emissions harms, scientific advice, and pathways to follow. www.co2.earth

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.encyvt.com

Energy Efficiency & R/E Clearinghouse (EREC): eetd.lbl.gov/newsletter/CBS_NL/nl6/Sources.html

Energy Efficiency & Renewable Energy Clearinghouse (EREC): eetd.lbl.gov

Energy Guide: Unbiased advice about today's energy choices. Find ways to save, lower your bills & help the earth's environment - www.energyguide.com

Energy Star Federal Tax Credits: www.energystar.gov/tax_credits

Federal Energy Regulatory Commission (FERC): www.ferc.gov

Federal Energy Regulatory Commission (FERC): www.ferc.gov

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

New Hampshire Sustainable Energy Assoc. NHSEA Focused on N.E. US, for consumers & industry- RE & clean building info, events. www.nhsea.org

New York Solar Energy Industries Association/NYSEIA www.nyseia.org

New York Solar Energy Society (NYSES): www.nyses.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 Jobs: Listed by city, state, and district, SolarStates.org

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

Weatherization, Energy Star & Refrigerator Guide: www.waptac.org

www.susdesign.com Online info for solar benefit with house design: overhangs, sun angle & path...

MORE STATES & PROVINCES ADOPT CARBON PRICING

Cont'd from p. 19

state and provincial efforts and explore lessons learned from them. Their progress is important, because federal steps to address climate change are unlikely even though the recent Fourth National Climate Assessment warns of dire effects on the climate. While some carbon pricing efforts cover just the power sector, others also cover transportation, buildings, and industry.

Two major approaches are now in use—a carbon tax (sometimes called a fee or levy) and a cap-and-trade system, both of which can improve energy efficiency. A carbon tax charges a fee for every unit of carbon dioxide that is emitted. While its cost is known, its effect on emissions is less certain. Carbon taxes are now in place in the provinces of Alberta and British Columbia, and the city of Boulder, Colorado. Massachusetts, Washington State, Newfoundland, Prince Edward Island, and the Canadian Northwest Territories are all seriously considering carbon taxes. Most of these cover multiple economic sectors.

To read more, visit <http://bit.ly/ACEEE-CarbonPricing-Jan2019>

To download the whitepaper, visit <http://bit.ly/ACEEE-WhitePaper-CarbonPricing-Jan2019>.

Steven Nadel is the Executive Director of ACEEE

About ACEEE: The American Council for an Energy-Efficient Economy acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. For information about ACEEE and its programs, publications, and conferences, visit aceee.org.



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Ingredient of the Month

The Making of a Philosopher Brain

Larry Plesent

"Today you are You, that is truer than true. There is no one alive who is You-er than You." — Dr. Seuss (aka Theodore Geisel)

Real philosopher brains are rarer than hen's teeth these days, and I for one do not consider this to be a healthy state of affairs. There is little available in the educational system or mass culture at large that nurtures and cultivates an open-mind seeking of truth without barrier or predisposition. As a society, we pay so little attention to philosophy that we are in immediate danger of collectively turning into mindless consumers of culture and goods buffeted by the winds of fleeting style and fancy.

Yet if you think about it, all ACTION stems from THOUGHT. Thought stems from PERCEPTION. And perception stems from one's PHILOSOPHICAL PERSPECTIVE; the context through which we process experience.

I am of the opinion that the inherent shallowness of mass culture, including mass politics, is a direct result of the scarcity of philosopher brains. And a scarcity of philosophizing can lead to a dangerous condition known as "Stinkin' Thinkin'," often fatal if left untreated. (Hats off to Zig Zigar for popularizing the term stinkin' thinkin').

And all this scares me because if we are ever going to turn this wagon around, if we are ever going to actually create a peaceful, sustainable, creative, equitable worldwide culture of mutual respect for all living things, our planet and each other; I will bet you that clear thinking will be required to pull it off.

Fortunately a little exposure of the brain at key moments of neural development is sometimes all it takes to turn a young mind from IDLE to ON. And for help with that, we are fortunate to have Theodore Seuss Geisel,

*Think left think right
and think low and think high.
Oh, the things you can
think up if only you try!*
— Dr. Seuss

aka Dr. Seuss to help us along. Who else talks directly to young people with far out statements? Ones such as:

*From there to here, from here to there,
funny things are everywhere!*

And:
*Think left and think right and think
low and think high. Oh, the things you
can think up if only you try!*

He inspired us into seeing one's life as a great adventure:

*You're off to Great Places!
Today is your day!
Your mountain is waiting,
So... get on your way!*

And pressed home that truth about the equality of all people:

*A person's a person, no matter
how small.*

And he taught us to accept ourselves, warts and all, with a statement like:

Why fit in when you were born to stand out?

I would go so far as to say that his influence on the free thinking seventies and the many cultural changes it engendered can only be contemplated. Good job Ted. Thanks for that.

So what's the big deal about philosopher brains and why bother wasting valuable bandwidth thinking about it? For one possible answer to this I bring you GB Shaw, playwright and philosopher brain and one of the few to go ahead and write about it:

... I had better be a ploughman than a philosopher; for the ploughman lives as long as the philosopher, eats more, sleeps better, and rejoices in the wife of his bosom with less misgiving. This is because the

philosopher is in the grip of the Life Force. This Life Force says to him "I have done a thousand wonderful things unconsciously by merely willing to live and following the line of least resistance: now I want to know myself and my destination, and choose my path; so I have made a special brain — a philosopher's brain — to grasp this

for me as the husbandman's hand grasps the plough for me. And this" says the Life Force to the philosopher "must thou strive to do for me until thou diest, when I will make another brain and another philosopher to carry on the work." (From *Man and Superman*, 1903)

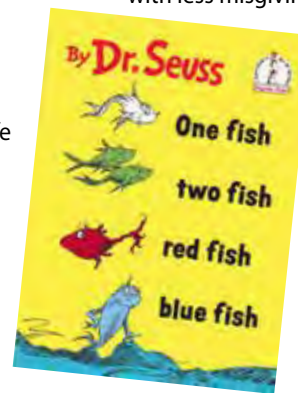
Heady stuff. No wonder the job has so few takers.

Dr. Seuss said it a bit more succinctly:
*You have brains in your head. You have feet
in your shoes. You can steer yourself any direc-
tion you choose. You're on your own. And you
know what you know. And YOU are the one
who'll decide where to go...*

And finally:
*Unless someone like you cares a whole aw-
ful lot, Nothing is going to get better. It's not.*

Thanks for listening folks. Keep thinking!?

Larry Plesent is a writer, philosopher and soap maker living and working in the Green Mountains of Vermont. Learn more at www.vermontsoap.com www.reactivebody.org and www.cancereraser.org. ♻️



Vermont Attorney General Continues to Challenge Federal Exemptions of Mercury Products

Vermont Attorney General T.J. Donovan announced that the State of Vermont recently filed its brief to the Second Circuit Court of Appeals, continuing its challenge of a decision by the United States Environmental Protection Agency (EPA) to exempt several large categories of mercury products from "inventory reporting." Inventory reporting is the practice of an entity reporting to the EPA a complete inventory of all mercury and mercury-containing products in its possession and put in commerce. Mercury exposures at high levels can harm the brain, heart, kidneys, lungs and immune systems of people of all ages, and mercury in the bloodstream of developing babies and young children may harm their nervous systems and ability to think and learn.

Earlier this year, the EPA issued its final rule (the so-called "mercury rule") on the reporting requirements for mercury products under federal law. The law requires a complete and accurate inventory of mercury supply, use, and trade in the United States. The EPA's mercury rule will exempt any product that contains a mercury-added product as a component of the larger product. Examples of products containing a mercury-added product include a mercury battery in a watch or toy, or a mercury switch or relay in a lamp or pump. Many of these products are imported and are not manufactured in the U.S. Under the mercury rule, manufacturers of these mercury-added products will not have to report important information on the uses and quantity of mercury contained inside.

"Eliminating reporting requirements for some of the largest uses of mercury places Vermonters at risk," said Attorney General Donovan. "Vermonters deserve to know what is inside the products we use. Our state can proudly say it has been a leader in mercury regulation for decades. Now, Vermont will continue to lead and will continue to fight against the step

backwards proposed by the EPA and the new mercury rule."

The Vermont Agency of Natural Resources' (ANR) Secretary Julie Moore said, "The Agency of Natural Resources strongly supports the efforts of the Vermont Attorney General's Office in their challenge of EPA's mercury rule. Mercury is one of the most toxic pollutants, and we should not be weakening the mercury reporting requirements. Without fully understanding how and where mercury is being used, ANR's core work of protecting Vermonters and Vermont's environment is unnecessarily made much more difficult."

The Vermont Attorney General's Office has been working closely with the Vermont Agency of Natural Resources and the Vermont Department of Environmental Conservation's Mercury Education and Reduction Campaign throughout this litigation.

In its brief, Vermont argues that the mercury rule's exemptions could impede Vermont from enforcing laws enacted to prevent mercury contamination. For example, Vermont and a handful of other states have outright bans for certain products with mercury-added components. These laws help eliminate non-essential uses of mercury in consumer, household, and commercial products, and reduce mercury releases to the environment through production, use, and disposal of such products. Under the EPA's mercury rule, some mercury-added products might now be allowed to enter Vermont unreported, unlabeled, and undetected, potentially frustrating Vermont's ability to enforce its own laws.

The EPA will now have the opportunity to reply to Vermont's brief. The EPA's reply brief is expected to be filed in the Second Circuit Court of Appeals on or before March 7, 2019.

For more information on mercury and Vermont's mercury-added product manufacturer requirements, including labeling,



Top: Compact fluorescent light bulbs save lots of energy, but they are manufactured with small amounts of mercury; center: Mercury battery, Russian manufactured in 1989; bottom: Mercury in dish. All Images from Wikipedia.



please visit the Vermont Department of Environmental Conservation's Mercury Education and Reduction Campaign website: <https://anrweb.vt.gov/DEC/mercury/merc.htm>.

Utilities & Energy Efficiency

Cont'd from p.30

will be able to earn rewards for achieving energy savings, pursuing demand benefits, and providing incentives to customers who rent, rather than own, their homes or apartments. These new incentives encourage program administrators to address multiple policy goals and to accomplish long-term climate goals.

Incentives in power system transformation

Other states, utilities, and regulators are also innovating to achieve their policy objectives. The rise of utility proceedings on utilities optimizing distributed energy resources, including energy efficiency, offers an opportunity to expand utility business model reform options that can support efficiency investment. The right incentives, including PIMs, can lead to increased procurement of non-traditional resources to address emerging system needs.

Read the full topic brief to learn more about PIMs and other innovative performance incentives that are driving deep energy savings and helping to achieve multiple policy outcomes.

To download the topic brief, visit <http://bit.ly/Energy-efficiency-Utilities>.

All links available online at <http://bit.ly/ACEEE-utilities-energy>.

The American Council for an Energy-Efficient Economy acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors.

Grace Relf is a Senior Research Analyst, Energy Policy ACEEE. ♻️

ELMORE ROOTS' PERMACULTURE KNOW-HOW Bringing Light Into the World

David Fried

When we plant a seed, we are leaning into the future. Now that it's winter, there are not a lot of seeds being planted. There is not a lot of green. The light that has that soft light green-yellow glow as it comes through leaves is not to

be seen. This is why a lot of people and birds head south. They are looking for more light and more life.

This is around the time of year when we start planting seeds indoors in our home. We know that fig trees will grow new leaves when the days start getting longer, and we plant some narcissus bulbs to see life begin again. But what I look forward to is planting seeds that will grow into winter greens that we can eat. I am looking for that nourishment, that plant light, that rare ability of a life form to transform sunlight into energy!

I need this energy for my being. So I take two plastic trays. One with no holes goes on the bottom of another same-sized tray that has drainage slits. I have saved indoors some fluffy, garden earth mixed with a little peat and compost, and I spread it out in the tray. I water it and wait for a day or two,



Sprouted sunflower seeds. Image from David Fried.

in great anticipation. I take out the sunflower black oil seeds and broadcast them on top of the earth in this tray, so they are almost touching each other. I water again and often cover them lightly with a piece of plastic, but not all the way. These seeds need to

breathe to sprout.

A few days or a week later, in the dark or almost anywhere, I see a little poke-up of green light. Then another and another. There is a whole field of sunflower sprouts in my tray! First I dance around the room singing. Then, I water them again, so they are slightly moist but not wet. In a few more days they are taller and have their first leaves. I show my friends my "field of dreams," and then I take a scissor and cut a few off and taste them. Ah, sunflower lettuce! They are packed with vitamins and nutrients, as they have been in a sunny window since a few days after sprouting and have been changing sunlight into leaves and nutrients.



Now I start another tray. This time I broadcast buckwheat seed throughout the tray. These will have a softer, milder flavor and are great in soups and in a salad. The sunflower greens are spicier and crispier and an excellent topping in a sandwich. A couple of weeks later, after all the greens have been clipped and eaten, the whole mat of roots can be added to the garden bed or compost pile to become the springboard for other seeds to grow when it finally is spring again.

David Fried runs Elmore Roots Fruit Tree and Berry Nursery in northern Vermont. ♻️



Snail and seed painting by Gabriel Tempesta

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Silvopasture Can Mitigate Climate Change

Will U.S. Farmers Take it Seriously?



Cattle grazing in a silvopasture forest in Georgia. Image: USDA National Agroforestry Center.

Trees absorb and sequester large amounts of carbon over time. The sequestering process is rendered even more powerful when they are used together with grazing and planted on "marginal" land that is not great for growing crops, such as woodland edges. <http://bit.ly/SilvopastureMitigateClimateChange>. ♻️

Saffron and Solar Farms: A Win-Win for the Environment and Agriculture

Margaret Skinner, Bruce L. Parker and Arash Ghalehgalabbehbahani



Saffron crocuses blooming in a raised bed within a Peck Solar array in New Haven, VT. Image: A. Ghalehgalabbehbahani, UVM.

Ghalehgalabbehbahani, who demonstrated that saffron could be profitably grown in Vermont, have teamed up with Peck Solar to test the potential of growing saffron in their Vermont solar fields. Saffron is a fall-blooming crocus, and

corms planted in September are now flowering. In the first year after planting, corms produce only a few flowers, but in future years they bloom abundantly. A Vermont grower who planted 2,500 corms in 2017 has harvested over 5,000 flowers this year, which produced over 30 grams of saffron. She sold her crop for \$25 per gram for use by a New York City chef who valued the high quality and Vermont-grown brand. Peck Solar, a South Burlington, VT based company, is working with farmers around Vermont to help them capitalize on the value of their land through construction of solar arrays. Saffron could add even more value to farmers from the solar fields. This is just the first year, and the cooperators expect an even more abundant harvest next year. The best is yet to come! More information on UVM's saffron research is at: <https://www.uvm.edu/~saffron/> or

contact Margaret Skinner at 802-656-5440 or mkskinner@uvm.edu.

Margaret Skinner, Bruce L. Parker and Arash Ghalehgalabbehbahani are University of Vermont researchers. ♻️

Saffron Cookies

Saffron is an ancient culinary spice, derived from the flower of a fall blooming crocus (*crocus sativus*). It ranks as the most expensive spice in the world, often selling for over \$20 per gram. It is commonly grown in western Asia, including Iran, but also in Spain and Italy. It is now being successfully grown in Vermont, as an agricultural benefit where solar is now producing clean electricity to the electric grid.

Saffron has a unique aroma, which imparts food with a special taste. It also gives food a distinctive yellow color. It is widely used in Persian, Indian, European, Arab, and Turkish cuisines. For example, it is commonly used in Milanese risotto of Italy, the paella of Spain, the bouillabaisse of France, and the biryani with various meat accompaniments in South Asia. Candy and liquors also often include saffron.

Saffron can be purchased at most health food stores and various co-ops. You may even find it in your local supermarket.

While there are many ways to use saffron, here is one for cookies that can be eaten with a hot beverage during these winter months.

Saffron Cookies

2 tablespoons milk, slightly warmed
1/4 teaspoon of saffron threads, slightly crushed
2 cups all-purpose flour
1 teaspoon baking soda
1/2 teaspoon salt
1/2 cup butter, softened (1 stick)
3/4 cup granulated sugar
1/4 cup brown sugar, packed
1/2 teaspoon vanilla extract
1 egg, slightly beaten
1 cup white chocolate chips, slivered almonds or chopped cashews (optional)

In a small bowl warm, pour the milk and add the saffron strands, slightly crushing them. Set aside and let steep, the longer the better. This can be done several hours beforehand. The saffron will turn the milk yellow.

Sift or whisk flour, baking soda and salt together; set aside. Beat butter until



Image: www.cakesandmore.in

softened. Slowly add sugars and beat well until mixture slightly increases in volume.

In a small bowl, mix together the saffron mixture, egg and vanilla. Add egg mixture to butter mixture and beat, scraping down bowl as needed.

Add flour mixture to butter mixture gradually, stirring until flour is incorporated. Stir in chips or nuts if desired. Chill until firm (30-45 minutes up to overnight) or place in the freezer for 15 minutes.

Preheat oven to 350 degrees F.

Use two teaspoons to drop cookie dough on a baking sheet covered with parchment paper and bake 12-14 minutes. Let rest on baking sheet for a few minutes then transfer to wire racks to cool.

Recipe adapted from www.food.com; created by Jen T. ♻️

Monadnock Food Co-op's 3rd Annual Farm Fund: Supporting Sustainable Local Food Production

Applications due February 1, 2019

The Monadnock Food Co-op Farm Fund program, a partnership with the Cheshire County (NH) Conservation District, is now accepting applications from local farmers. Currently, in its third year, the fund has supported seven farms in our region.

This year, the Farm Fund will award up to \$18,000 to help farms in Cheshire County and abutting New Hampshire towns develop or expand their production for wholesale markets, including selling to the Monadnock Food Co-op and Food Connects. Funds can be used to support a range of projects including the purchase of equipment and infrastructure, packaging and labeling design needs, and technical assistance.

The Request for Proposals and application are available at <https://monadnock-food.coop/farmfund>. Applications are due February 1, 2019.

"The Farm Fund empowers local farmers to grow their businesses to help them become more financially sustainable," said Michael Faber, Monadnock Food Co-op General Manager. "It also helps the co-op broaden its offerings of locally grown,

raised, and made foods — that means more local food for you, your family, and our community."

Tax-deductible donations to this fund can be made to the Cheshire County Conservation District at <https://monadnock-food.coop/farmfund/#donate>. Additional fundraising activities will occur at the Monadnock Food Co-op, including a Round Up Donation Drive in early 2019.

The Monadnock Food Co-op Farm Fund's mission is to support local farmers in increasing sustainable food production and wholesale sales to contribute to a thriving local farm economy. This grant supports several of the co-op's goals, including building a healthy, sustainable food system, supporting local farmers and producers, and contributing to a strong, sustainable and improving local economy.

For more information on eligibility and to apply for a grant, visit <https://monadnockfood.coop/farmfund> or call Amanda Littleton at the Conservation District at 603-756-2988 ext. 116.



Sustainability Example

Monadnock Food Co-op Adds Compostable Bag Option in Produce Department

The Monadnock Food Co-op of Keene, NH replaced its plastic produce bags with a more sustainable option made from Mater-Bi, a biodegradable and compostable bioplastic. Instead of offering bags made from petroleum products, the co-op now offers produce bags made from starch, cellulose, and vegetable oils.

Customers can compost these bags at the co-op (in the co-op cafe compost bin) or sign up for commercial composting pick-up from Elm City Compost Initiative (<https://www.elmcitycompost.com/>). Elm City Compost Initiative also plans to add a compost collection service for community members through the Monadnock Food Co-op later in 2019.

"We reduce waste by offering reusable bowls, plates and utensils for in-house dining and promoting alternatives to disposal bag use through our re-use box initiative and community bag tree," said Michael Faber, Monadnock Food Co-op General Manager. "Switching our produce bags to a compostable option is another important step for our triple bottom line business."

The Monadnock Food Co-op is a community-owned food store located at 34 Cypress Street in Keene, NH. www.monadnockfood.coop

DIY Re-usable Bags from Feed Bags

Jessie Haas

Tote bags are great. When you remember to bring them to the grocery store you feel so virtuous—and in Brattleboro, you'd better remember, because single-use plastic bags are now illegal.

But totes are also expensive, and cotton ones aren't such a good deal for the environment. Counterintuitively, they have a big carbon footprint compared to plastic grocery bags. You need to use your cotton tote 327 times to achieve the same per-use carbon ratio. And cotton is uniquely depleting to soil; that's what propelled slavery west in the 1830s-50s. Cotton had driven soil fertility into the ground, so to speak, all over the South; many lands have still not recovered.

There's a solution, though. If you feed birds, pets, or livestock, you end up with a big pile of colorful, heavy-duty woven-plastic bags just begging to be repurposed. You can keep them out of the landfill and avoid ever needing a plastic bag or cotton tote again.

There are two ways to go with constructing them, sewing machine or duct tape. Sewing is probably better environmentally. The only new material needed is a little thread. Basically, you cut the top and bottom off the bag, create a square bottom so the bag will stand up, fold over and stitch the top edge and make handles out of the pieces you've cut off. There are good instructions online. Go to <https://www.instructables.com/id/Feed-Bag-Tote-Bag/>.

Sewed totes are great, but not everyone has a sewing machine. Luckily, there's duct tape. You cut as for a sewn bag but create your square bottom us-



A homemade tote bag made by the author. Courtesy photo.

ing duct tape 'seams'. Colored duct tape forms the trim at the top of the bag, and strips of duct tape form the wide strap handles. For complete instructions and a video, go to <https://www.youtube.com/watch?v=JepJM6F2uc>.

Because of the broad, colorful trim, the duct tape bags are especially handsome. (One tip: use black for any part that's not going to be seen, like the bottom, or for bags where that is the handsomest choice. Black tape is a lot less expensive than colors and comes in bigger rolls.) A bag can be made in about half an hour, barring any taping accidents.

Feed bag totes, whether sewn or taped, are durable and able to carry a lot of weight. They are excellent for groceries, library books, gathering vegetables and herbs from the garden—anything you'd use a bag or basket for. They're also lightweight and waterproof.

Cont'd on p.38

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DIY Re-usable Bags from Feed Bags

Cont'd from p.37

You can use any size. It's possible to get two totes out of a single large bird seed bag, especially if you decide that it's okay to leave the original, sewn bottom on the bag. Cover it with a couple of strips of duct tape, just for looks. The bag won't stand up when you set it down, but not every tote has to do that, and it's worth it sometimes if the decoration is in the right place. Cat food bags make nice smaller totes, as do five pound bird seed bags.

Once you start making totes, you may change your feed-buying habits. Some



Before and after pictures of a DIY Re-usable bag made from feed bags. Image: Zaaberry.blogspot.com



feed bags are gorgeous, others not so much. Unfortunately, livestock feeds sweetened with molasses stick to the inside of the bags, so you won't want to use those to make a grocery tote.

However, there are good uses even for

sweet feed bags. For a tote to carry flakes of hay, open a grain bag along the bottom and up one side. You'll end up with a broad flat piece of material. Add duct-tape handles to each long edge, and you're done. For logs, open one long edge and close the open, top end of the bag by sewing or with duct tape. Add handles to the long edges. Now you have a log tote, one from which the firewood won't spill out the ends. It won't look like you bought it at L.L. Bean, but it will bring in a nice load of wood without getting it all over you or the floor.

Some of us are old enough to remember getting grain in sacks made of natural fiber. We would empty the grain into a bin at home and take the sack back to the mill when we needed more. That was more environmentally sound, but in this age of dozens of brands and mixes of feed, it's probably not something we're going back to anytime soon. Hemp has been legalized in the new farm bill, and in time, that may start showing up as grain bags, but in the meantime, we can get all the value possible out of those pretty bags we buy. Give your gifts for all occasions wrapped in a lovely new shopping tote—you may find the recipient is most thrilled about the wrapper.

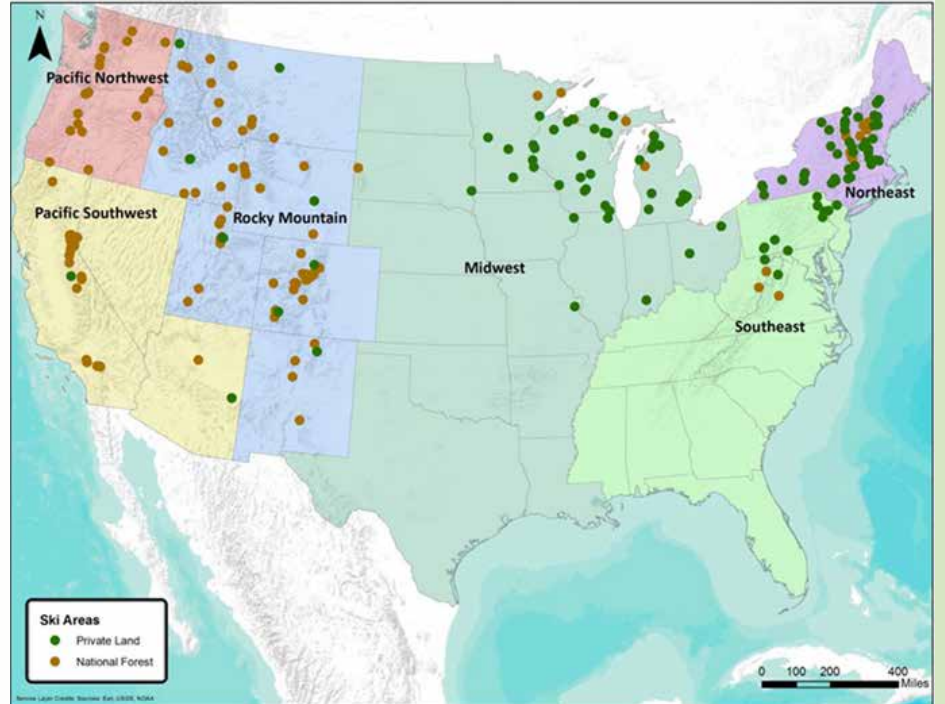
Jessie Haas has written 40 books, mainly for

children, and has lived in an off-grid cabin in Westminster West, VT since 1984, www.jessiehaas.com. ♻️

The Climate Crisis' Effects on the Future of Skiing

With the onset of a warming climate, how likely is it that ski resorts and skiing itself might soon become things of the past?

EarthTalk®, from the Editors of E - The Environmental Magazine



This map from a 2017 study shows projected climate change impacts on natural snow accumulations and potential snowmaking conditions across the U.S., with pink colors representing losses of 80%+ of the ski season and bluer colors representing less severe losses. Credit: "Projected climate change impacts on skiing and snowmobiling"

Last winter's low-snow year and unseasonably warm temperatures across much of the American West meant a bad year for business for ski resorts, and also left many of us wondering whether skiing would even be possible in the warmer world we're getting as we continue to pump out greenhouse gases.

"Our recent modeling suggests that under a high emissions scenario, skiing could be very limited to non-existent in parts of the country by the end of this century, particularly in lower elevations—such as the northeast, Midwest and lower mountains around the West," said Cameron Wobus, lead author on a 2017 study projecting climate change impacts on skiing across the U.S. "Things look better mid-century, so this dire future for skiing isn't imminent—and things also look much better under a more aggressive greenhouse gas mitigation scenario, so this future also isn't inevitable."

According to Wobus' research, ski resorts in the Pacific Northwest have the most to fear, with predicted losses of 80% or more of the ski season. Ski resorts in the Northeast also won't fare well as the climate warms. The relatively good news is that the ski resorts in the intermountain west should face "less severe losses" due to their higher elevations.

The ski resorts themselves are doing what they can to try to reduce and offset their own emissions. To wit, Vail Resorts will power its 15 U.S.-based ski resorts with 100% wind energy beginning in 2020 and is well on its way to achieving its ambitious 2030 goal of "zero net emissions, zero waste to landfill and zero operating impact on forests and habitat." Nearby, Aspen Skiing Company is big on solar, donates six figures annually to local non-profits working on climate mitigation and related issues, and lately has focused on firing up its customer base to encourage climate-friendly voting in Congress. Meanwhile, the list of ski resorts now deriving all of their power from on-site

renewables (e.g., Berkshire East, Jiminy Peak, Squaw Valley, Wolf Peak, Arapahoe Basin, Breckenridge) is growing every year.

Coordinating and facilitating much of this activity is the National Ski Areas Association (NSAA), a trade group representing over 300 U.S.-based ski area owners and operators. NSAA's Sustainable Slopes initiative, launched in 2000, provides an overarching framework for ski areas on sustainability and enhanced environmental performance. Its Environmental Charter serves as a blueprint and inspiration for ski resorts looking to green their operations.

Another influential player is Protect Our Winters (POW), a non-profit organization founded in 2007 by professional snowboarder Jeremy Jones to mobilize the outdoor sports community against climate change. Its "Hot Planet/Cool Athletes" program, in which a professional skier or snowboarder leads an all-school assembly through a 45-minute multimedia presentation detailing the science behind climate change, how it's affecting snow levels and what we can each do to become part of the solution, has been an especially effective way to get young people fired up about solving the climate crisis. The program has reached some 60,000 students since its inception in 2011.

Contacts "Projected climate change impacts on skiing and snowmobiling: A case study of the United States," bit.ly/Projected-Climate-Impacts; Protect Our Winters, protectourwinters.org; NSAA Sustainable Slopes, bit.ly/NASA-Sustainable-Slopes.

EarthTalk® is produced by Roddy Scheer and Doug Moss for the 501(c)3 nonprofit EarthTalk. They are the editors of E - The Environmental Magazine. Read more at earthtalk.org or send questions to question@earthtalk.org. ♻️

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Local Ski Areas Get Green Done

Cont'd from p. 1

farms in an anaerobic digester system to generate electricity to sell to Green Mountain Power. Killington purchases 1,125,000kWh annually of this energy to power the K-1 Gondola and the Peak Lodge.

Killington has installed 47 chargers for electric cars, and it also uses 200,000kW annually from a solar farm grid. Waste water at the area is recycled, so no potable water is being squandered in toilets, saving up to 35,000 gallons of water during the peak season. Transportation, another significant contributor to carbon emission, is being addressed at Killington by funding the local bus routes supporting a regional ridership of 800,000 one-way trips annually, with almost half of all trips for those going to the resort.

Killington uses Freeaire, a system which draws in winter air to keep walk-in coolers cold when the outside temperature drops below 40°F. Energy is also being conserved in accommodations, where hotel thermostats are linked to card usage, so the hotel is not heating the room when no one is there. The ski area also raises honey bees and sells honey and related products.

New York state's ORDA (Olympic Regional Development Authority includes Whiteface, Gore, and Belleayre), has deployed more energy efficient snow



Local cows from Hagar Dairy Farm participating in the Cow Power program at Killington Resort. Image: Chandler Burgess.

guns, making more snow over a faster period using less energy than ever before. Gore Mountain will be "turning sunlight into snow," where 85% of the mountain will be powered by solar with two 25-year contracts that are estimated to offset 113,919 tons of carbon over the course of the contracts.

ORDA is also part of I AM PRO SNOW, the Climate Reality project, which commits ski areas to 100% renewable energy in the future. I AM PRO SNOW is a worldwide project aiming to help organizations, cities, communities and individuals to become sustainable.

Sugarbush Resort in VT has experienced a 30% reduction in energy use since 2014 and is one of more than 40 ski areas nationwide involved in the NSAA Climate Challenge, a voluntary program that aims to help ski resorts reduce greenhouse gas emissions (GHG) and reap other benefits in

their operations, such as reducing costs for energy use, according to NSAA.

Sugarbush installed 15 electric vehicle charging stations, built a solar panel array that supplies power to the local grid, and upgraded its snowmaking system to reduce its energy use by 24%. The resort participated in Green Up Day, a statewide initiative to clean up trash, with the help of volunteers collecting 65 bags of trash and 33 bags of recycling. The waste management in the dining halls provides separate bins for compost, trash, liquid, and recycling.

Like Killington, Sugarbush helps fund the local bus route, which runs from December to March, and there are transportation initiatives for staff including three employee van pools and carpool cafes, which facilitates staff carpooling. Sugarbush has put NO IDLING signs in the parking lots and forbids staff to idle their vehicles.

Replacing old snow guns with high efficiency models are changes that make a huge difference in cost and energy use for any ski resort, John McMurry of Efficiency Vermont noted, and Vermont ski areas have been leaders in the country.

Efficiency Vermont thoroughly tested snow making equipment to determine ideal conditions for each type of high efficiency gun and encourage ski areas to replace snow guns that cost around \$10/hr. to operate with guns that cost about 10¢/hr. to operate.

Whether for monetary gain or environmental concern, northeast ski areas are clearly leading the charge to put sustainable practices to good use and make exemplary models for other businesses to follow.

Lillian Eden is a laboratory research assistant at Tufts Sackler School of Graduate Biomedical Sciences in the Neuroscience Department and hopes to attend graduate school in science journalism. ♻️

Climate change makes snow-making imperative. Photo: Killington Resort.



Shipment of high-efficiency Snow Logic snow guns awaiting installation at a Vermont ski area. Photos courtesy Efficiency Vermont.



Killington Resort

Sustainable XC Ski Areas in New England

Roger Lohr

Some New England cross country ski resorts are quickly becoming very sustainable. According to industry expert, Roger Lohr of XCSkiResorts.com, "There are about forty Nordic ski areas that employ snowmaking today and for more of the Nordic areas to invest, there is often the need for favorable financial and labor circumstances." Below are a few examples of Nordic ski areas in New England that employ snowmaking and use sustainable practices.

The Great Glen Trails Outdoor Center in Gorham, NH upgraded an old micro-hydro system, supplying 80% of electric needs. They've also converted more vans that tour up to the top of Mt. Washington to run on propane gas and installed an electric vehicle charging station, too. The new Glen House (lodging facility on the property) is highly energy-efficient and nearly carbon neutral. A state-of-the-art geothermal system provides heating and cooling for the hotel.

Sleepy Hollow Inn Ski & Bike Center in Huntington, VT has now eight separate solar installations after adding new 4kW and 6kW systems for a total of 60kW, which is enough to provide 100% of electric needs at Sleepy Hollow including the efficient snowmaking operations for its two kilometer trail. The Sleepy Hollow property also powers their three family homes. A solar hot water system heats 50% of the hot water at the inn and the lights on the ski trail have been converted to LED lights.

Craftsbury Outdoor Center in Craftsbury, VT is net metering with 32kW on solar tracker panels in the field and more panels on the roof, supplying the Activity Center with about 70kW. Between the two, that provides 63% of operation's electricity and there is also solar thermal to provide summertime domestic hot water, which is supplemented with heat pumps.

The Craftsbury Activity Center is heavily insulated, uses a heat pump, and has composting toilets. They also cogenerate heat from the snowmaking generator and make snow in one location that is moved around to the trails as needed. ♻️

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