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Double Trouble

George Harvey

Out of perhaps a million headlines, there is one I found the most frightening. And yes, I mean "a million." It is not hyperbole.

Every day, I search the news for articles on energy and climate change, and I put links to the important articles I find up in a post on my blog, geoharvey.com. I have done this every day since June 2, 2012, and as of July 12, 2021, I have posted links to 44,053 articles. I could reasonably argue I may have had to look at over a million headlines to find those articles.

Many of the stories I see make me hopeful. We are making a lot of useful progress. Of course, some of the stories I see are not at all hopeful. In June, I came across one that frightened me the most of any I have seen.

CNN carried the story with the title, "The amount

U.S. Drought Monitor
California



of heat the Earth traps has doubled in just 15 years, study shows (www.bit.ly/double-ability-to-trap). A few other news sources carried the story, but I have not seen many. Clearly, most of the media think other things are more interesting.

This story tells us, based on a report from NASA and NOAA, that the Earth is cooking under an atmosphere that is out of balance, and the imbalance is getting measurably worse very quickly. Over the course of just fifteen years, the atmosphere's ability to trap and retain heat has doubled. One thing that that fact makes clear to me is that achieving net zero by 2050 will not do, if we want to survive tolerably well. In fact, even going to net zero immediately would not do, by itself, to stop climate change. We have to go beyond that.

Cont'd on p.26

JAY LENO AFFIRMS TESLA PLAID

N. R. Mallery

It seems likely that most of us know who Jay Leno is. He was one of the top comedians in the country, and then hosted the Tonight Show, starting in 1992. He hosted shows until he retired, in 2014, in part to focus more his hobby which was collecting and talking about cars. Of course, as a TV personality who is retired but loves cars, he had to have his own show, Jay Leno's Garage.

Leno even shows up in the pages of Green Energy Times from time to time. The article that appeared in January 2021, "The 'Never Charge' EV of the Future," which is about the Aptera electric vehicle, mentioned the fact that he owns an Aptera prototype that is several years old, and takes interest in the design and the company (www.bit.ly/GET-Aptera).

Being famous, Leno was not surprisingly connected to other famous people, and so he was able to try out the new Tesla Model S Plaid. He arranged to do that on a track in Bakersfield, California, with official witnesses present.

Jay Leno Breaks Record in Tesla Model S Plaid



Jay Leno speaking. (U.S. Department of Defense) Inset: Tesla Model S Plaid. (Tesla)

The Tesla Model S Plaid is a new production car. At the time Leno tested it, it was just starting its production run. The car he drove was not fitted in any special way – it was the ordinary production Tesla Model S Plaid, just as it comes off the assembly line.

Perhaps we should pause here for a minute. Leno, who has had a lifelong interest in cars of all sorts, was very aware of the specifications of this car. It has three motors, which together produce 1,020 horsepower and 1,050 pound-feet of torque.

Cont'd on p.7

COMMUNITY SOLAR NEWBURY, VERMONT

New Community Solar Terms Provide Vermont Businesses with Savings

John Kluwin

When you hear the words "solar panels" you probably think of panels on your roof or possibly on the land next to your building. Maybe you've thought, "That seems great, but it's not a fit for me or my property."

There are many factors that limit the ability of small businesses to benefit from a solar installation. Many small businesses lease their building or have future plans to relocate, older buildings may need roof upgrades, site constraints can limit ground installations, and shade from nearby trees or structures may impact production. Then there's the cost. Installing a solar array on-site requires a large capital investment and not all small businesses can finance the cost of building their own



Newbury, Vermont village. (Tom Narwid)

array, benefit from the tax credits, or have an interest in utilizing or monetizing the renewable energy credits produced by the array. While many small businesses have heard community solar is a way to support locally produced renewable energy, there hasn't been a program available to them.

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Sustainability for Your Pets

(See feature on pages 20-21)

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A huge special thank you to all of our contributing writers:

Rob Aldrich, Dr. Alan K. Betts, Kim Bliss, John Bos, Randy Bryan, Efficiency VT, David Fried, Nate Gusakov, Jessie Haas, George Harvey, Debra Heleba, Henry Herndon, Victoria Ines, J. D. Kaplan, John Kluwin, Nancy Rae Mallery, Toby Martin, Doug Moss, Steven Nadel, Larry Plesent, Roddy Scheer, Joshua Singer, Barbara and Greg Whitchurch, Jennifer White.

Ad Design/Layout NR Mallery, PJ Fischer

Printing Concord Monitor, Concord, NH using 100% recycled paper and plant-based, environmentally-safe inks.

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Green Energy Times is produced by 100% solar power, off-grid with a 3.8 KW PV system. We live and know that Energy Independence is indeed possible – with clean, sustainable renewable energy along with reducing your needs. We walk the talk! **Our mission is to create Energy Awareness, Understanding and Independence – Socially Responsible Living.**

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Green Energy Times would like to thank everyone who has submitted articles or helped in any way to make this all a reality. We want to also thank our advertisers & ask that you support them. Say that you saw them in *Green Energy Times*. Now let's all G.E.T. moving ahead towards a clean, renewable future – one where our children & grandchildren will be able to breathe & grow, live & love on this beautiful planet where we live.

Thank you for reading G.E.T. Please send your comments & suggestions to: info@greenenergytimes.org

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***G.E.T.'s Carbon Footprint Disclosure:** *Green Energy Times* is printed locally on recycled paper. The printing process uses eco-friendly inks. There are not any totally green printers in the area that we are aware of, so it would mean trucking them MUCH farther to have G.E.T. published in a totally green manner, thus increasing carbon emissions, as a consequence. G.E.T.'s distribution emissions are also kept to a minimum, as well. With the wonderful help that we g.e.t. within many communities, it keeps our carbon footprint a lower. Hopefully our footprint is offset because we are 100% solar powered! Because all of our employees work from home, our carbon footprint is kept to a minimum. We grow most of our food organically and live as sustainably as possible. We DO walk our talk! **Peace!**



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GREEN ENERGY TIMES IS EXPANDING INTO MAINE!

Green Energy Times (G.E.T.) has been distributed throughout 90% of Vermont, 85% of New Hampshire and regions of New York State for twelve years. We are often approached by readers from other states who would like to have us there. We do wish a big investor would come along to finance to help us reach further. (Be sure to let us know if you have an interest in helping!). G.E.T. is making a difference and should be available across the country and beyond!

In addition to the financial ability to take on such an endeavor, it takes a team in the new regions. Our New York team consists of dedicated volunteers who took the task and ran with it. The NY team is set up by Wyldon Fishman and the New York Solar Energy Society (nyses.org) along with Joanne Coons who teaches at Hudson Valley Community College.

This year a group from Maine approached G.E.T. to volunteer their efforts to get the publication in their region. They ran a pilot distribution trial with the June 2021 edition in designated regions of the

state. As anticipated, copies of G.E.T. flew off the shelves. We had to supply them with more bundles.

The Maine team consists of Cliff Babkirk (cbabkirk502@gmail.com), Toby Martin (mtm.tpsmail@yahoo.com), Frank Mundo (frank.mundo@gmail.com), and John Pincince.

The pilot regions where you will be able to find G.E.T. include Belfast, Camden, Islesboro, Lincolnville, Montville, Northpoint, Rockland, Rockport, Saco, and Sanford.

If you are a reader in Maine, please be sure to share your copy with others, and let us know about stories and businesses that we should feature. The hope is that *Green Energy Times* will become a tool that can help those who seek to achieve energy independence. Most of all, we hope that it serves to help more to reduce their carbon footprint as we face the challenges from a changing climate.

Contact anyone from the Maine team or connect with the original G.E.T. team at info@greenenergytimes.org or 802.439.6675. Welcome Maine!

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See the new all-electric Ford Mustang Mach-E. Take an e-bike for a ride. There will be more than 12 different e-bike models to try. Learn how to build your own e-bike. Talk with EV owners and see their cars.

This event is a large and comprehensive showcase of energy savings ideas, systems and techniques. There will be plenty to see and do and many energy experts will be available to answer all your questions.

Contact Nancy Wightman at nwlaststraw@gmail.com or Evan Oxenham at evan.oxenham@gmail.com for more information.

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COMMUNITY SOLAR SOLUTION

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Historically, the Vermont net metering program has disproportionately benefited towns, hospitals, school districts, public companies and other entities that can provide audited financials or corporate guarantees of payment in exchange for community solar credits. Furthermore, long term contracts up to 25 years have been typical. There just hasn't been a solar solution that fits the needs of many small businesses.

Impact investors interested in promoting the larger community benefits of locally harvested renewable energy have now entered the Vermont solar market to address underserved small businesses with flexible subscription terms, no credit checks and guaranteed savings. The Welch Community Solar Array, financed, owned, and operated by Sea Oak Capital, is the most recent example of this new approach to community solar.

Located in Newbury VT, the Welch Community Solar Array is an 830 kW DC ground mount solar array. Up to 20 small businesses and non-profits are subscribed to the array at any given time with each entity saving hundreds of dollars each month on their Green Mountain Power bill. Among the subscribers are a hotel, restaurant, insurance agency, and a church. These subscribers have locked in savings from the Welch Community Solar Array under a short term, flexible subscription agreement that allows easy transferability if a subscriber moves locations or in the event a business is sold.

Community solar arrays generate electricity that flows directly into the local power grid in turn producing monetary net metering credits. When a small business subscribes to a community solar array, it is subscribing to a portion of the total credits produced

by the array. Each month, Green Mountain Power applies a portion of the total credits directly to the existing electric bill of the small business. This appears as a monetary credit that reduces the amount the small business owes to Green Mountain Power. Green Mountain Power continues to supply the business with electricity and there is no disruption in the service, just a reduced bill amount. After the business receives the credit from Green Mountain Power, it then pays a discounted price for that monetary credit, in turn capturing guaranteed savings. It functions similarly to purchasing a Groupon or a gift card at a discount to the face value. Small businesses can capture up to \$1,000 per month in savings from a community solar subscription.

Community solar arrays avoid the before mentioned pitfalls that small businesses have faced when considering going solar. There is no installation on their property, no added insurance requirements, no maintenance, and no upfront cost. Since Sea Oak Capital owns and operates all of its community solar arrays, subscribers contract directly with the array and not a middleman or aggregator. Therefore, there is no need for a credit check, corporate guarantee or financial review prior to subscribing to a Sea Oak Capital community solar array. Eliminating this requirement has reduced the subscription process to about five minutes through an online portal accessible on Sea Oak Capital's website. In addition, since all of Sea Oak Capital's projects are fully financed and under construction, subscribers can see savings as early as

their next billing cycle.

"Our number one goal is to make the subscription process easy and efficient for small businesses," said Dan Poydenis, CEO of Sea Oak Capital. "We know every small business has their hands full with daily operations. Savings from a community solar array doesn't have to be an added burden."

Sea Oak Capital is an impact investment fund that owns and operates community solar projects in the Northeast with operations across the country. As a fully integrated independent power producer with internal staff responsible for all aspects of asset management, operations, and maintenance of its solar arrays, Sea Oak Capital is dedicated to expanding the renewable energy economy by providing all small businesses with access to community solar savings. While the Welch Community Solar Array is fully

subscribed, Sea Oak Capital is currently building five more community solar arrays in Green Mountain Power's utility territory in Vermont and offering short term subscription agreements to local small businesses. The arrays are located in Hartland, Wallingford, Cavendish, Clarendon, and West Pawlet, but all businesses in Green Mountain Power territory are eligible to join.

To learn more about Sea Oak Capital's community solar program please visit <https://seaoakcapital.com/submit-a-community-solar-application/>

John Kluwin is the Chief Development Officer at Sea Oak Capital and is responsible for all aspects of the company's community solar program in Vermont. When he's not saving money for small businesses, he is hiking, surfing or snowboarding. ♻️



The 83kW Welch Community Solar Array subscribes 20 businesses and non-profits. (Norwich Solar Technologies)

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GMP Begins Electrifying Field Operations Fleet with First All-Electric Bucket Truck

VW Settlement Grant Through State of Vermont Covers Most of the Cost, Major Step Toward Going Fossil-Fuel Free for Field Operations Fleet



carbon emissions in Vermont and we're proud to start the process of converting our line truck fleet to clean electric trucks."

GMP received about a \$915,000 grant through the VW settlement fund managed by the Agency of Natural Resources, and will collect data about the trucks' use, performance, charging, and carbon reduction to help the state learn more about the opportunities electric trucks offer the state in reaching clean energy goals.

"Reducing public exposure to diesel emissions is an ongoing challenge," said Peter Walke, commissioner of the Vermont Department

of Environmental Conservation. "This project reduces both criteria air pollutants and greenhouse gases, moving Vermont closer to meeting our GHG emissions reduction goals, and supporting our electrification goals for the medium- and heavy-duty vehicle sector."

Lion Electric – a leading North American manufacturer of medium- and heavy-duty zero-emission vehicles – will manufacture the trucks to order, with the first truck expected to be delivered to GMP in the first quarter of 2022, and the second one scheduled to arrive next summer.

"As a clean-energy leader, Vermont is a great example of how to integrate sustainable energy and electrified transportation, which is key to creating a successful sustainable society and economy in the future," said Marc Bedard, CEO, and founder of Lion Electric. "With reduced emissions and noise pollution, these trucks will eliminate emissions in the communities where they operate while saving on fleet costs, and we look forward to growing our relationship with GMP in the future."

Because there is no combustion engine, like all EVs, there are savings on maintenance and fuel – reducing maintenance costs by up to 60%, and energy costs by up to 80%. Additionally, the bucket truck

and its auxiliary systems run entirely off the vehicle's battery pack, eliminating emissions and noise pollution. The line truck has a range of 130 miles, and the stake truck can go 200 miles on a charge.

The grant will also help customers through the purchase of two bi-directional fast chargers for the trucks. This provides charging convenience, plus the chargers' two-way energy flow means when the trucks are plugged in and not in use, GMP can tap into the stored energy in their batteries during peak energy use times on the grid. This helps reduce demand and costs when energy is most expensive for customers. The two vehicle-to-grid (V2G) chargers are expected to generate more than \$135,000 in savings for

customers, building on GMP's earlier work with V2G, using stored energy in a Nissan Leaf for peak energy reduction.

To learn more about the work GMP is doing to make it easier than ever to convert to an electric vehicle, go to greenmountainpower.com. ☞



Green Mountain Power (GMP) will replace two heavy-duty fossil-fuel field operations trucks with two all-electric trucks manufactured by Lion Electric in 2022 – a fully outfitted bucket truck for line crews and a Class 6 stake-body truck for electrical maintenance field crews.

The two trucks are expected to offset up to 100 tons of greenhouse gas emissions per year, representing a big advancement in clean electric vehicle technology for heavy-duty work and are a major step toward GMP's goal of electrifying its field operations fleet. GMP is among the first utilities in New England to receive all-electric heavy-duty trucks for its fleet. This move is the latest step GMP has already taken to cut carbon in its fleet, including using clean B20 biodiesel in almost all trucks for many years, and incorporating fully electric cars and plug-in hybrid vehicles into other aspects of its fleet.

"Electrifying our heavy-duty field operations fleet to reduce carbon emissions as we travel the state keeping the lights on and building a more resilient grid is a critical next step in our work to eliminate fossil fuels from our operations," said Mari McClure, president and CEO of Green Mountain Power. "Transportation with fossil-fueled vehicles is the top source of

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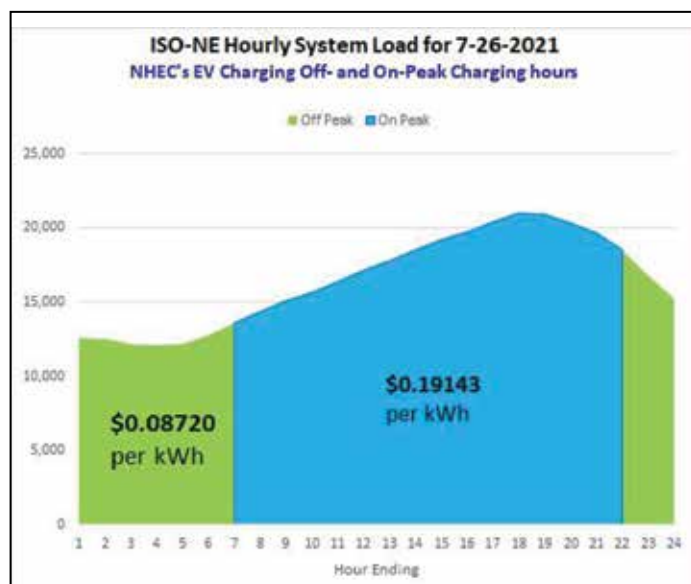
We Dare You to Look Under the Hood of NHEC Electric Rates!

Owning and driving an electric vehicle (EV) has many benefits under the hood.

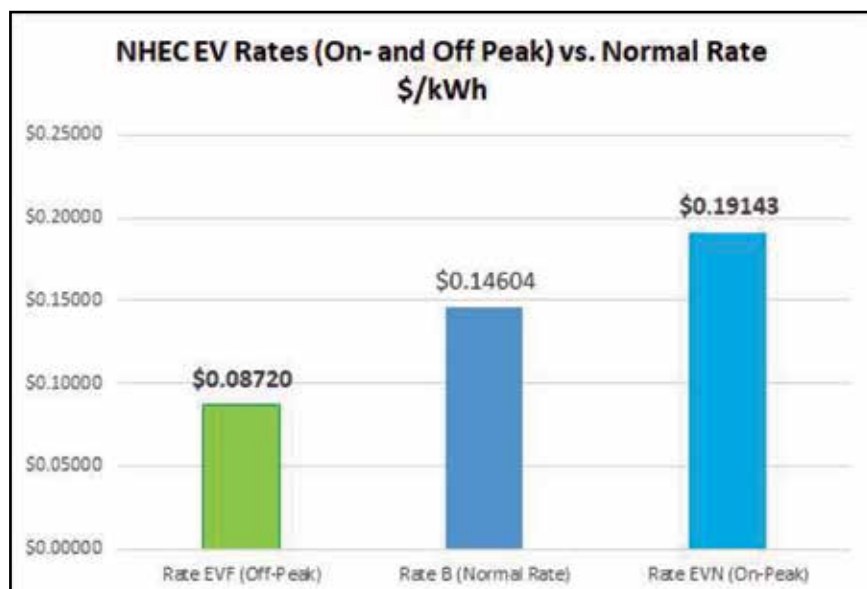
- ✓ **A quiet, more enjoyable driving experience** from not having a combustion engine.
- ✓ **Less expensive to maintain** due to fewer moving parts.
- ✓ **Regenerative braking** that re-charges the battery.
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The New Hampshire Electric Cooperative (NHEC) offers EV drivers another benefit, **lower electricity rates** when charging overnight, 9 PM - 7 AM.



Currently, NHEC's electricity price is \$0.14604 per kWh. NHEC offers its members a lower rate if they charge their EV during off-peak hours. Members simply have to install a time-of-use meter between their electric panel and their Level 2 charger to get this lower off-peak rate of \$0.08720 per kWh. This amounts to a **40% discount off normal rates**, enabling members to charge their vehicles at a lower rate when there is less demand for electricity.



By charging at night, EV owners not only get the lower rate, but they help NHEC and all of its members by keeping this new charging load from coming on during on-peak periods, which would result in increasing NHEC's overall peak load, driving prices up.

NHEC is working together with members on this **special EV Rate** to reduce emissions, save money and reduce peak demand, now that's teamwork and a win for everyone! ♻️

* Note: For NHEC members on this time-of-use rate, there is a \$3.10 monthly service charge. The current EV Off-Peak Rate EVF is \$0.08720 per kWh while the EV On-Peak Rate EVN is \$0.19143 per kWh, both assuming you are on NHEC power and not on a competitive energy supplier. These rates change twice/year and may fluctuate both up and down. But rest assured, the Rate EVF Off-Peak Rate will always be less than NHEC's normal Rate B.

VEHICLE POWER OUT

Randy Bryan

New Hampshire is not immune to power outages. Everyone knows a tale or two about outages and their effect on lives. While generator solutions abound, everyone also knows a tale or two about generators that won't start or require too much maintenance. Our topic here is about solutions using hybrid or plugin vehicles. My business is ConVerdant, now PlugOut Power, and due to that background I have followed 'vehicle power out' technologies for many years, namely Vehicle to Grid (V2G), Vehicle to Home (V2H) and Vehicle to anything (V2X) technologies. Basically, this means using the hybrid or plug-in vehicle (HV battery and inverter) as an energy storage appliance for accepting and supplying power for various uses. This is one of the new side benefits to shifting to electric drive from fuel-combustion drive. Vehicle charging is well known, but vehicle discharging is not so well understood. We'll focus on vehicle discharging here.

There are two types of implementation possible, similar to solar inverters, grid-tied and off-grid. There are a variety of issues germane to this difference; synchronization to and connection with the grid are most important.

A grid-tied inverter allows the vehicle to give off power to the home or property while connected to the grid. This is useful for offsetting power as desired to normal grid power feeds. While useful to control power bills, the technology requires coordination with utilities in ways they



PlugOut inverter with Randy's car. Courtesy photo.

are not used to providing (net metering, but not for solar). Unfortunately, grid-tied solutions are having difficulty catching on due to issues with grid operators, rate systems and billing procedures. But make no mistake, this market is coming.

A vehicle off-grid inverter must give off power to its own island of appliances (home and worksite, not connected to the grid). Off-grid inverters work similarly to generators, making power for local appliances. In fact, the home and appliance connection interfaces are similar to those for generators. To be used in a home and business, the off-grid power source must be isolated from the grid by a 'transfer switch' which will only allow power feeds from the grid or the generator.

A vehicle's 12-volt system (alternators

Cont'd on p.7



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DOE Awards \$60 Million to Accelerate Advancements in Zero-Emissions Vehicles

24 University- and Industry-Led Projects Focus on EV and Battery Technology, New Mobility Systems and Vehicle Lightweighting to Cut Pollution.

The U.S. Department of Energy (DOE) today announced \$60 million for 24 research and development projects aimed at reducing carbon dioxide (CO₂) emissions from passenger cars and light- and heavy-duty trucks. The projects will help decarbonize the transportation sector and enhance the infrastructure needed to support the growing adoption of zero-emission vehicles—crucial to reaching the Biden-Harris Administration's ambitious goal of a net-zero emissions economy by 2050.

"Fossil-fuel powered cars and trucks are a leading cause of air pollution and carbon emissions, and that is why we are focusing on decarbonizing the transportation sector to achieve President Biden's climate goals," said Secretary of Energy Jennifer M. Granholm. "Partnering with industry and leading research universities, DOE's investment in these 24 projects will create technologies and techniques that will cut vehicle greenhouse emissions and boost America's competitiveness in the global clean energy market."

Transportation accounts for approximately 30% of total U.S. energy needs (www.bit.ly/3faZqg8) and generates the largest share of the country's greenhouse gas emissions (www.bit.ly/3BXsP7C). The projects, funded through DOE's Office of Energy Efficiency and Renewable Energy (EERE) Vehicles Technology Office (VTO), address the two largest contributors to



Tesla Model S Zero Emissions. (AdobeStock_419746291)

transportation sector emissions (<https://bit.ly/3j5YFGI>): passenger cars and light-duty trucks account for nearly 60% of emissions and medium- and heavy-duty trucks account for nearly 25%.

The selected projects will:

- **Accelerate innovation in EV batteries and electric drive systems**

- Awardees across 12 projects will focus on developing next generation lithium batteries with improved lifespan, safety, and affordability, improving the performance and durability of electrolytes that carry ions within batteries, and increasing the power density of electric drive systems. These advancements would increase the useful life of EVs and enable more affordable, better performing vehicles. (Total award amount: \$28.1 million.)

- **Ready new mobility systems technology for commercial and consumer use**

- Awardees across six projects will help develop a better understanding of new mobility technologies, particularly on how automated, connected, electric, and shared vehicle technology, like automated electric shuttles and connected vehicle/infrastructure technologies, interact with the

larger transportation system. (Total award amount: \$20.2 million.)

- **Develop lightweight materials to increase passenger and commercial vehicle efficiency**

- Clemson University will develop a lightweight, multi-material passenger vehicle body structure, addressing challenges in joining dissimilar materials. (Total award amount: \$5.8 million.)

- **Reduce exhaust emissions while improving commercial vehicle engine efficiency**

- Two projects will develop simulation tools to accelerate and optimize the development of advanced emissions systems for heavy-duty vehicles. (Total award amount: \$5.1 million.)

- **Improve understanding of energy use and environmental impact of new vehicle technologies**

- Three projects will develop tools to understand charging infrastructure needs for medium- and heavy-duty electric vehicles and analyze environmental, cost, and energy impacts of infrastructure upgrades. (Total award amount: \$1 million.)

The reader may get access a full list of the projects from the energy.gov website (<https://bit.ly/2UWLpMx>). Here are some comments from awardees:

"This nearly \$2 million will be a well deserved boost for WMU's ongoing autonomous vehicle research. Yes, climate change is real and technology developed here at institutions like WMU will certainly chart a path forward for a cleaner tomorrow. Clean energy jobs will help rebuild the American economy and protect our planet," said U.S. Representative Fred Upton (MI-06).

"Michigan has long been the heart of the auto industry and we're working every single day to ensure that statement remains true," said U.S. Representative Debbie Dingell (MI-12). "We must keep the

United States at the forefront of technology and innovation, and with over \$1.6 million to Navitas Advanced Solutions Group in Ann Arbor, we can work towards that goal. This critical funding, from the Department of Energy to advance next generation electric vehicles batteries, will accelerate the increased deployment of electric vehicles and create a pathway to a clean energy future."

"Today's announcement represents the federal government's strong commitment to prioritize the health of our communities and our planet," said U.S. Representative Jimmy Gomez (CA-34). "Thanks to the Biden Administration, the funds announced today by the U.S. Department of Energy will help ensure more electric vehicles on Los Angeles roads and fewer CO₂ emissions in our skies. I'd like to thank President Biden for his continued partnership in our shared efforts to address the climate crisis by strengthening our nation's green economy."

The battery and electrification projects under this funding opportunity support the National Blueprint for Lithium Batteries' goal of maintaining and advancing U.S. battery technology R&D leadership. (www.bit.ly/3fcAxRu)

EERE's mission is to accelerate the research, development, demonstration, and deployment of technologies and solutions to equitably transition America to net-zero greenhouse gas emissions, economy-wide, by no later than 2050. The projects and work supported through EERE aim to ensure the clean energy economy benefits all Americans, creating good paying jobs for the American people—especially workers and communities impacted by the energy transition and those historically underserved by the energy system and overburdened by pollution. Learn more about at energy.gov (www.bit.ly/2VIDbgq). ♻️

Confessions of an Electric Car Driver in Vermont

Larry Plesent

It's been 18 months since I drove my all electric 2020 Chevy Bolt off the lot two icy January's ago. Here at last, a "seasoned" electric car driver punctures the myths and reveals the downsides of affordable electric commuting cars.

I consider the Chevy Bolt to be the best buy of the smaller electric cars available today. Safe, practical and with up to 250 miles of git-go, its only major downside is the ongoing and profound lack of fast chargers when traveling afar. If your range is more than this can guarantee, the Tesla fast chargers are still much more common, so a Tesla might be the best option for you. The Bolt is basically a great front-wheel drive commuting car that even does well on gravel roads as long as you don't mind the damage to the paint job on some of the plastic parts. With good tires, it is very capable in snow up to three or four inches. As with most small cars, if there is more than five inches of snow, I start looking for my four-wheel-drive truck.

You can get by with the little 110v charger that comes with the car. But unless you only use the car 50 miles or less each day, have a real electrician set up a 220-volt charger at home; preferably in your enclosed and heated garage. Now do what you can to persuade your employer to install a few 220-volt chargers at work. It's a terrific employee retention bonus.

My neighbor tells me that he "will never

drive one of those." He discusses further that he is a connoisseur of high-performance vehicles and considers himself a "different type of driver than most."

The truth is that electric vehicles are pocket rockets. How about zero to sixty in 6.4 seconds? Very handy when passing safely and legally between town and even considered on the slow side for today's electric vehicles.

By every measure, including the quietness of the driving experience, acceleration, handling (comfortable up to about 90 mph for this vehicle), four door comfort and reasonable cargo space in the boot; I would rate the Bolt superior to any comparably sized car or gas-powered mini SUV out there.

If European styling and comfort are what you are after, there is a man named Elon with a high-performance Tesla made just for you.

But if you are on a more conservative budget the Bolt might just be right for you. Buy with an eye for deals, discounts,



Larry Plesent and his Chevy Bolt. (Courtesy photo)

offers and credits from your federal and state tax departments, electric power company, and whatever and whomever is promoting a more sustainable future by helping to ease the transition off of internal combustion propulsion systems. If your household income hits a certain sweet spot in Vermont for example, several special rebate and tax credit options are still available. Read *G.E.T.* to stay tuned to the changing landscape of offers.

Consider buying your all-electric car in January if not today. That's when electric

car sales in New England are at their lowest, and there may be a discount to be found then. Get on the dealers mailing list, so you are the first to catch a manufacturer's sale when it comes around.

And you don't have to sell your old reliable four-wheel-drive truck or SUV yet if you don't want to. Take the pressure off your gas vehicle with the all-electric and save old Betsy for Nor'easters and plowing and other such tasks. The two types of transport complement each other nicely.

Maintenance headaches to expect are basically none. They include tires, washer fluid, and wash the car once in a while. I will also add protect the batteries.

Lithium batteries do not like below zero temperatures, and it is your job to keep that in mind during the deep winters of the North Country. At a minimum, keep the car plugged into your 110v charger overnight when 17°F or colder. Try not to leave it outside during below-zero days and nights. Best case scenario for your batteries is the aforementioned heated garage.

I don't mind driving my old beat-up Toyota truck around town. I know that I am driving a bit of history, a museum piece that technology has already rendered obsolete. It gets me wondering when those new electric four-wheel-drive trucks will be available here in the North Country!

Larry Plesent is a writer and soap maker living in the hollows of central Vermont. ♻️

ENERGY DEPT. PROVIDES FUNDING FOR HYDROGEN RESEARCH

Green Energy Times staff

The U.S. Department of Energy announced on July 2 that it is providing a total of \$52.5 million to 31 projects to accelerate development of clean hydrogen technology. The projects are working on solving the technological issues for clean hydrogen production, storage, distribution, and use. The funding is part of the Hydrogen Energy Earthshot initiative intended to reduce the cost of clean hydrogen and make it easier to produce.

Hydrogen can take a major place in the switch away from fossil fuels and help us deal with the climate crisis. It can be used as a combustion fuel, but unlike natural gas or most other such fuels, burning it creates no carbon dioxide.

Most hydrogen manufactured today is made from natural gas. This is a problem because there are emissions associated with the process, so, while burning the hydrogen may be clean, creating it is usually not. By contrast, clean hydrogen, or green hydrogen, is created by hydrolisis of water, a process in which electricity breaks up water molecules to produce hydrogen and oxygen molecules. If the electricity is generated by solar, wind, or another renewable energy source, the entire process can be free of emissions.



Hydrogen fuel cell bus with zero emissions. (AdobeStock_308564950, Oleksandr)

While hydrogen can be used as a combustion fuel, it can also be used in fuel cells to produce electricity directly. In either of these cases, the by-product is water. It also has other uses. It can be used to form ammonia, for example, which in turn has a wide variety of uses. A recent study found that hydrogen could be used as a replacement for natural gas, even with the pipelines filled to 100% with hydrogen, providing that the equipment using it is adjusted for its characteristics. It could fuel a gas range, for example.

The worldwide emergence of hydrogen technology is something that has to be observed carefully to be understood. Many governments, across the world,

and many private companies are investing heavily in hydrogen technologies. Some of the fossil fuel and utility companies are putting large amounts of money into developing clean hydrogen generating systems.

The Biden administration has been setting goals that include a sharp reduction in the use of fossil fuels to avoid the worst of climate change. Clean hydrogen fits into that set of goals rather well.

The technological problems are not trivial, however. On the one hand, some of them are already being addressed. New catalysts have

been developed to make the creation of hydrogen out of water more efficient, for example. And as such things are developed, the cost of hydrogen will almost certainly decline.

On the other hand, hydrogen has some difficult characteristics. It has a tendency to make some metals brittle. It also leaks directly through the sides of steel tanks that might be used to hold it, because

hydrogen molecules are so small that they can fit between atoms in the alloys that hold them. Such leaks are rather slow, so steel can be used to store hydrogen effectively, over the short term of days to a few weeks. Another issue is that hydrogen is not particularly energy dense, by volume, because it has to be stored as a gas for many applications. It might turn out to be useful as a fuel for ships, aboard which it could be stored in liquid form, but not for cars.

The potential value of hydrogen is so high, however, that it should not be ignored. And we are still at a point where we have not investigated the full scope of its potential uses.

Secretary of Energy Jennifer M. Granholm spoke about it recently. "Part of our path to a net-zero carbon future means investing in innovation to make clean energy sources like hydrogen more affordable and widely adopted so we can reach our goal of net-zero carbon emissions by 2050," she said. "These projects will put us one step closer to unlocking the scientific advancements needed to create a strong domestic supply chain and good-paying jobs in the emerging clean hydrogen industry." ☺

VEHICLE POWER OUT – Cont'd from p.5

and 12v battery) are great for providing incidental off-grid power (< 1kW, usually < 400W) for car accessories but are ill suited to providing more power for driving, home or worksite uses. Getting more power off the engine is certainly possible (Power Take-Off on trucks), but quite expensive and inefficient.

Hybrid and plug-in vehicles, on the other hand, are designed and built as incredibly reliable, powerful and efficient DC storage and generators needing only an inverter to provide AC power compatible with the grid and home appliances.

A few car makers are finally offering this technology as bait for their new and coming electric vehicles. My company (ConVerdant, now PlugOut Power) was an early entrant, offering this capability as an aftermarket inverter product on Prius (now almost any Toyota and Lexus hybrid), it is very popular with the knowledgeable few. But a small marketing budget ruled out any major PR. Nissan, Toyota and Honda developed small (1.5kW) inverters as an option for the Japanese market only in the wake of the Fukushima disaster and widespread power outages.

Going forward, I am delighted to see the concept finally catching the public's attention as large manufacturers start offering this capability on electric vehicles with larger PR budgets. Rivian started the trend by advertising their upcoming trucks in a camping scene with electric camping appliances (off-grid). Then Ford publicized their plugin hybrid F150 trucks providing power to homes during the recent Texas freeze. (These were off-grid, actually loaned to a few customers in a corporate PR push.) Now, Ford has gone all-in by publicizing their future Lightning F150 all-electric trucks as off-grid and grid-tied ready. Volkswagen recently announced all their future electric vehicles will be off-grid and grid-tied ready, too. In fact, all the

major vehicle manufacturers have experimented with V2H and V2G technologies, even to the public trial phase, though no capabilities announced.

Still, using the electric vehicle as an off-grid energy appliance is an attractive concept and catching on. Off-grid power itself is useful; home power backup, campers, remote workites, tailgating, and off-grid events like field gatherings. Vehicles plus inverters offering from 3-10kW of AC power out are useful in most situations. The benefits to using the vehicle plus inverter for power instead of a generator are many: quiet, clean power, always starts, no maintenance, fewer and safer recharging requirements, and up to twice the electricity per gallon (hybrid use). When the grid goes down, use your vehicle to power your home. Make power where generators are forbidden like campgrounds, trailer parks, condominium and townhome properties, or anywhere the noise is not appreciated (field music events). Make power where fires are not allowed or practical, like camping in dry forests (now much of the western U.S.) or desert areas where there are no trees. Some use the technology to charge their urban e-scooter rental business or to power food service vehicles or to keep battery-powered landscaping equipment charged.

In my own NH experience, getting the car set up for power out is more convenient and less troublesome than using a generator. Knowing it will work when needed is even better.

Randy Bryan is one of the co-founders of Drive Electric NH. Bryan has been an advocate for electric cars since 2006. His company, PlugOut Power (formerly ConVerdant Vehicles), has converted vehicles to plug-in hybrids and currently develops and sells inverters that turn electrified cars into mobile generators. ☺

JAY LENO AFFIRMS TESLA PLAID

Cont'd from p.1

For those of us who do find that hard to visualize, it means the car is insanely powerful. Leno arranged to test the car with timing officials close by, so he could have some fun.

Jay Leno was out to set a new record for the quarter mile in a production car. The record was held by a Bugatti Chiron Super Sport, a car costing roughly \$2.5 million, which was able to finish a quarter mile in 9.4 seconds. Leno, in the Tesla Model S Plaid costing roughly \$130,000, succeeded in setting a new record of 9.23 seconds for the quarter mile. His speed at the end of the run was 152.16 miles per hour (mph). He got to 60 mph in 1.99 seconds.

Leno made a number of observations about the race. One that stands out -- something that he mentioned with a laugh -- was that he even had the air conditioning on during the run. We do not know exactly what effect that could have had on the record he set. It would be reasonable to assume, but might not actually be the case, that it robbed the car of power and slowed it down very slightly. Considering the needs of an air conditioner and energy available to feed the 1,020 HP motors, it would have been very slightly indeed.

He also spoke about the fact that the car is very quiet. He mentioned that he noticed that there were birds sitting on the "Christmas tree," the set of lights that signal the driver when to start the race. After his run, when he got back to the starting area, he saw that the birds were still sitting there. They were unconcerned about the car that had just taken off so fast. If Leno had been driving that Bugatti, or some other car with an internal combustion engine, the birds would



Tesla Model S Plaid (Tesla photo)

surely have taken off even before the car started to move.

Leno said one thing to remember. He said, "I'm a huge fan of American technology, especially products that are developed here in America that are using locally sourced stuff. And that's why I love this car." We might note that of all American car manufacturers, Tesla is the one that has the most American-made parts.

There is a reason why this is important. Not many people notice slow, uninteresting cars. For this country to switch to electric vehicles, it will be necessary to make cars that people do notice. Elon Musk, the founder of Tesla, knew that right from the start, when he set out to attract the attention of the American public. To do that, he produced cars that are impressively fast and sporty.

You can bet that Jay Leno will not hold this record long. There is probably a long line of race car drivers who are determined to beat it and will probably leave the AC off.

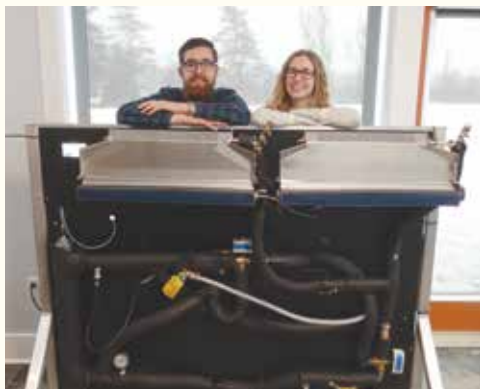
N.R. Mallery is the publisher of Green Energy Times. ☺



Another car Jay Leno has taken an interest in is the Aptera. (Aptera)

DELTA CLIMEVT ENERGY 2021 ENTREPRENEURS TACKLING CLIMATE CHANGE

Entrepreneurs from seven start-ups, focused on reducing energy use and greenhouse gas emissions in residential, commercial and industrial buildings, graduated from the DeltaClimeVT Energy 2021 climate economy business accelerator during a recent virtual awards ceremony. The Energy 2021 winner, selected through a peer-review process, was Neothermal Energy Storage, based in



Neothermal Energy Storage co-founders Louis Desgrosseilliers and Jill Johnson with a very early lab prototype ETS system used to evaluate the various component interactions. (Nova Scotia Community College)

Nova Scotia, Canada. The company, which offers supplemental electric thermal storage (ETS) systems using salt hydrate to electrify residential boilers and furnaces, won a \$25,000 cash prize and a pilot project awarded by Burlington Electric Department (BED). BED also awarded a pilot project to Arc Industries, and Green Mountain Power (GMP) awarded a pilot project to Grid Fruit.

"We are honored that the award came from the peers," said Jill Johnson, Neothermal Energy Storage co-founder, business development, on winning DeltaClimeVT Energy 2021. "Everybody has been so helpful and we are really grateful that we were able to take part in this group this year. I feel like we were all able to really move forward during the past few months."

The DeltaClimeVT business accelerator, managed by Vermont Sustainable Jobs Fund (VSJF), aims to bring innovative technologies, services and business models to Vermont in an effort to reach Vermont's climate and renewable energy goals more quickly while also ensuring the inclusion of low-to-moderate income residents in our energy transition.

"Through our DeltaClimeVT business accelerator, the 13 climate economy entrepreneurs improved their product market fit, fine-tuned their business models, developed a go-to market strategy and fast tracked their way to securing financial investments so they can grow their business opportunities in Vermont and beyond," said Geoff Robertson, Managing Director of DeltaClimeVT at VSJF.

The goal for the Energy 2021 program was to reduce energy use and greenhouse gas emissions in residential and small commercial and industrial buildings, and enable increased adoption and

better integration of distributed energy resources and smart building technologies. In November 2020, VSJF initiated a national recruitment process and in March seven start-up companies from all over the U.S. and Canada were selected to participate in the three-month

intensive learning experience where the entrepreneurs completed an intensive curriculum, developed by ecosVC, which included online workshops, webinars and mentoring sessions. Due to the COVID-19 pandemic, VSJF offered the Energy 2020 cohort virtually and continued to offer this year's program in a completely virtual format.

"It's been a massive pleasure to work with these seven companies," said Joseph Steig, cohort facilitator with ecosVC. "They've all equally engaged, all equally worked hard and really all equally have a tremendous opportunity to make money and make a difference for Vermont and addressing climate change generally through their energy technologies and services."

DeltaClimeVT Energy 2021 Graduating Cohort Companies are as follows.

- **Neothermal Energy Storage** – Offers homeowners the first integrated, supplemental electric thermal storage (ETS) system for boilers and furnaces that reduces fossil fuel use by up to 90%, lowering GHG emissions and monthly energy bills. neothermal.ca (Nova Scotia) - First Place Winner and Awarded BED Pilot Project
- **Arc Industries** – Designs and manufactures vertical axis wind turbines with a new cutting-edge turbine design that addresses the many issues that have traditionally plagued small wind turbines. arcindustries.co (Massachusetts) - Awarded BED Pilot Project
- **Grid Fruit** – Provides software that reduces energy and maintenance costs for food businesses, using previously untapped data through AI software to bring energy efficiency and power grid incentives to refrigeration and HVAC. gridfruit.com (Pennsylvania) - Awarded GMP Pilot Project

- **Andluca Technologies** – Develops UV-solar-powered smart glass for improving the energy efficiency of buildings. Andluca's patented technologies can reduce building energy use by up to 40% while significantly enhancing occupant comfort and productivity. andluca.com (New Jersey)
- **Bloomcradle** – Engages, connects, and mobilizes the public and leaders through accessible and educational storytelling to drive local community and large-scale action for a sustainable future. bloomcradle.com (Vermont)
- **Flick Power** – Helps consumers take advantage of time-based electric rates and reduce carbon emissions from dirtier energy sources that are used during peak energy times. flickpower.com (California)
- **YellowTin** – A cloud-based, data-driven platform that educates and empowers consumers to make informed decisions, so that they can switch to cost-effective, electricity-based solutions at their own pace. yellowtin.com (California)

"We're very thankful to the Vermont Sustainable Jobs Fund for organizing this impressive program and encouraging us to apply because DeltaClimeVT has given us our entry point into the U.S. market," said Louis Desgrosseilliers, Neothermal Energy Storage co-founder and CEO.

Partners and sponsors of DeltaClimeVT Energy 2021 include, Vermont Electric Power Company, Burlington Electric Department, Vermont Public Power Supply Authority, VGS, Green Mountain Power, VSECU, Vermont Electric Coop, Efficiency Vermont, Washington Electric Co-Op and the Flexible Capital Fund.

To learn more about DeltaClimeVT Energy 2021, visit deltaclimevt.com.

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Woodstock, VT's Net Zero Ice Arena is Up and Running!

Barbara Whitchurch



Above: Eastside solar panels consisting of 644 430-watt modules that cover the entire roof; solar panels on the back end consist of 211 400-watt modules, atop a 28-foot awning. (Images: EJay Bishop, Woodstock Union Arena Community Center)

The Union Arena Community Center (www.unionarena.org) in Woodstock, VT might be the first ice arena renovation in North America to reach net zero. The arena is the culmination of a four-phase plan, carefully mapped out back in 2014 by its Executive Director, EJay Bishop and the arena's Board of Directors. Way back then, this author wrote a piece about it (<https://greenenergytimes.org/2017/02/15/ice-skating-with-solar/>) describing the process in some detail. Phase 3 and much of phase 4 has since been completed including the solar array and the reclaimed heat storage.

I spoke with Kevin McCollister of Catamount Solar (www.catamountsolar.com) about the solar installation at the arena. It was designed to be completed in two phases: The first, consisting of 211 400-watt modules, was mounted on the roof and atop a 28-foot awning. The second phase, completed last May, consists of 644 430-watt modules and it covers the entire roof. The number of panels was calculated to "over-generate" in order to offset the use of natural gas and propane, as well as the electrical usage. Was it successful? According to EJay Bishop, "We won't know until the end of the year if our projections are accurate. But so far, we are up and running and on track!"



The heat reclaim storage tanks from the refurbished refrigeration plant produce lots of hot water.



The arena is also reclaiming energy and heat from its refurbished refrigeration plant, which is almost complete. Stored in four large tanks, this heated water from the refrigeration heat exchanger is being used to resurface the ice and for hot showers. According to Bishop, "It's working great, producing lots of hot water, and reducing our propane consumption."

How did the arena pay for this huge undertaking? Bishop says, "Fundraising, incentives, and, most importantly, energy cost savings! Every year, we have reinvested our savings into capital replacement and repairs, while in the past there wasn't any money to invest. Going forward for the life expectancy of this building, we can use our cost savings to pay for future expenses."

Although the project was a team effort, Bishop credits Harold Mayhew with the idea and vision. "Harold, as the new Board president and with support from the entire Union arena board, introduced and initiated his vision in 2014. I can't overstate the importance of having him.

He is a design leader in the ice rink industry; he has the expertise and knowledge, and we couldn't have done it without him."

The Woodstock Union Arena Community Center serves a large area of VT's Upper Valley communities and into New Hampshire. It hosts a myriad of community events in addition to its ice skating programs and competitions: ceremonies, graduations, off-season trade shows, blood drives, etc.

Asked about a takeaway for other ice arenas, Bishop mentioned two points. First, "This project was definitely worth doing. We are a small community with limited resources, and this will provide sustainability for the arena for years to come." Second, Bishop is happy to help other rinks with any information or advice they may need. "Every rink

is different," he says, "but they should all consider the solar aspect. It's good for the rinks, and it's good for the planet."

The Whitchurches power their EVs with solar in Middlesex, Vermont. www.bit.do/gkw-li. ♻️





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SOLAR POWER WORLD'S TOP INSTALLERS PLUS G.E.T.'s LIST

George Harvey

Each year, *Solar Power World* (SPW) publishes its "Top Solar Contractors List," including hundreds of installers in the United States. (www.bit.ly/SPW-Tops) The list is made up of 426 contractors performing a wide range of services across the country. It is broken down into sublists by state, and companies can choose to appear in the list for every state where they work. There are also lists broken down by market and service. The lists are ordered by the amount of solar capacity installed.

Often, companies take pride in their positions on the SPW list and on the various sublists. Some rank among the largest in a particular market or state, a feat that is never trivial. For those, we offer congratulations for their successes. Here are some in our area (the text in the article that appears online will have links):

iSun, in Burlington, Vermont is ranked at number 1 on the Vermont list and number 38 on the SPW national list. The company was created when Peck Electric, of Vermont, acquired iSun and changed its name. *GET* had an article about Peck in the issue of September, 2020, "VT-based 'The Peck Company' is in the News Again."

Revision Energy, is number 1 in both Maine and New Hampshire, 24 in Massachusetts, and 84 nationally. It was last covered in *GET*'s article of April, 2021, "Phillips Exeter's Green Academy Awarded Sixth Leed Certification."

SunCommon is number 4 in Vermont, 29



The 1.38MW Windsor solar project was built in 2020 by Aegis Renewable Energy of Windsor, MA. (Aegis Renewable Energy)

in New York, and 131 in the SPW national list. *GET*'s article of November, 2020, "Going Solar (Plus Storage): A Vermont Homeowner Shares Her Experience," covered some of its work.

Norwich Solar Technologies is number 2 in Vermont, 5 in New Hampshire, and 166 nationally. You can see it in a number of *GET*'s articles, including "Norwich Solar Technologies Named One of Vermont's Best Places to Work."

Aegis Renewables is number 6 in Vermont, 30 in Massachusetts, and 206 nationally. The article "Bristol Community-Owned Solar Expands" in *GET*'s edition of June, 2021 and relates to its work.

Green Mountain Solar is number 7 in Vermont and 280 nationally. *GET*'s article, "Working Together: Fortress Battery and Green Mountain Solar," also appeared in June, 2021.

Granite State Solar is number 4 in New Hampshire and number 294 nationally. *GET*'s

article of November, 2019, "Solarize Kearsarge Nears Completion," covers some of their work.

Same Sun of Vermont is number 8 in Vermont, 9 in New Hampshire, and 347 for the nation.

Solar Store of Greenfield is number 36 in Massachusetts and 411 nationally. One of the great small installers of our area, they have been a valuable source of information and help for us. For example, they are

cited in "Non-Traditional Solar Orientation," in January, 2019.

There are many very fine installers in our readership area who are not on the SPW list. In many cases, they may not have able to spend time on the application because they are local and it is national. We want to include some of the really good ones *Green Energy Times* recommends.

Apex Solar Power is based in Queensbury, New York. It does work on solar and battery installations.

Ayer Electric does many types of electrical work, including solar installations throughout New Hampshire.

Catamount Solar, another Vermont installer, was the subject of the 2018 article, "Catamount Solar."

Eden Renewables is an interesting community solar developer with an office in Troy, New York. It has also been working in the U.K. and Africa.

High Peaks Solar is based in Wyantskill,

New York. It does residential, community, and commercial solar projects, both grid-tied and off-grid.

Integrity Energy, of East Bethel, Vermont, designs and installs both on-grid and off-grid systems. They were the subject of their own article in 2017, "Integrity Energy."

O'Meara Solar is in West Topsham, Vermont. It does work in the Upper Valley region of Vermont and New Hampshire. It has been in several of our articles, including "Off-Grid Solar Installations Increasing During the Pandemic," in November 2020.

Power Guru, based in Bennington, Vermont, was recently rated as the best solar installer by the *Bennington Banner*, the local newspaper. They have been in *GET*'s pages many times, for example in the recent article, "Power Guru Launches Community Solar for Bennington."

Solalect is a highly innovative solar company in Norwich, Vermont, that does installations and its own research. A post from its blog appeared in *GET*'s April 2021 issue as "Spring Equinox at the 45th Parallel: Halfway to the Center of It All."

Solartech has an office in Sutton, Vermont. Their work can be seen in "Off the Grid in Vermont and Beyond," which appeared in 2016.

Southern Vermont Solar, based in Putney, Vermont, is a great installer that has appeared on our pages many times. One article is "A Vermont Homeowner's Experience," in June 2021.

We feel that we probably missed somebody, and we will try to do better next time. Anyone who has a solar installation business in our readership area should feel free to contact us to be certain to be included in the next list that comes out. ☺

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Community and Market-Based Renewable Energy Legislation Prevails

Commendation for Enduring Cross-Party Energy Leadership, Sen. Jeb Bradley and Hon. Clifton Below

Henry Herndon

It has been a dramatic legislative session for those who follow energy policy in New Hampshire. As the dust settles, one particularly consequential energy bill emerges from the scrum and makes its way to the finish-line at Governor Sununu's desk.

The key energy bill of the session, House Bill 315, will catalyze serious gains in New Hampshire-based renewable energy development that directly benefits our cities, towns, counties and communities.

House Bill 315: From Villain to Hero

If House Bill 315 were a living thing, it would be a kind of happy Frankenstein. The bill was born an evil little monster whose effect would have been to kill New Hampshire's Community Power market in its cradle. But as a result of cacophonous public backlash and a series of transformative surgeries (amendments) – including the Senate attaching language quintupling the size of renewable energy projects public entities may develop under net metering – the bill was born again as the hero of New Hampshire energy policy.

House Bill 315 comingles two distinct policies: Community Power and Municipal Net Metering. Let's take them one at a time.

Local Control & Markets Over Regulation: Community Power, the New Hampshire Way

As a result of the substantial public pressure and an encouraging letter from the Governor himself, House Science, Technology & Energy Committee Chairman Michael Vose partnered with Lebanon Assistant Mayor Clifton Below to amend House Bill 315 through a consensus building stakeholder process. The Honorable Clifton Below, longtime guru of NH energy legislation, is currently helping lead the formation of Community Power Coalition of New Hampshire, a public nonprofit supporting cities and towns to launch Community Power programs.



NH State House in Concord. (Wikimedia)

The Vose-Below amendment transformed House Bill 315 from something that would have dismantled Community Power into something that clarified the regulatory process to ensure successful launch of this exciting new market with broad bipartisan stakeholder support.

Community Power is New Hampshire's last best chance to demonstrate that markets are still superior to state mandates and regulation when it comes to modern energy policy. It is a policy that gives municipalities and counties the local control to procure electricity from the competitive market on behalf of their residents and businesses that don't choose a competitive supplier. Community Power lets each city or town to choose for itself whether it wishes to prioritize minimizing short-term rates, developing local renewable energy projects, or expanding innovative retail options for customers to adopt small-scale solar, storage, or other energy technologies.

New Hampshire stands apart in New England when it comes to energy policy. We spend the least on energy efficiency. Our renewable energy goals under the Renewable Portfolio Standard are pathetically low compared to our neighbors. We do far less as a state to incentivize and subsidize clean energy.

The other New England states have embraced top-down regulation and mandates as their main tools to bend markets towards clean energy. With Community Power,

New Hampshire has an opportunity to chart a path that relies instead on expanded market competition and local control as tools to enable the clean energy transformation. Cities and towns that implement Community Power programs become the masters of their own energy destinies, free to develop their own local renewable energy if they so choose.

Doubling Down: Public Renewable Energy via Net Metering Expansion

After the Vose-Below amendment, House Bill 315 received a unanimous bipartisan vote of "Ought to Pass with Amendment" from the House ST&E. It emerged from the House floor a shiny symbol of must-pass energy legislation.

Senators Avard (R), Bradley (R) and Watters (D) saw an opportunity to double down and use the bill to advance another energy issue that NH municipalities have been clamoring for for several years now: net metering expansion.

The Senate amended House Bill 315 to quintuple the allowed size of renewable energy projects that can be developed via net metering by municipalities, counties, schools and other political subdivision of the state from 1 megawatt to 5 megawatts. This policy is likely to result in significant development of renewable energy projects that power public facilities.

Enduring Energy Leadership: Senator Jeb Bradley and the Honorable Clifton Below

While the House initially called a Committee of Conference on the bill, throwing into question its chances of survival, Senate Majority Leader Jeb Bradley, the Honorable Clifton Below and other legislative champions rallied to hammer out yet another compromise, this time on SB 91, that ensured HB 315's safe passage to Governor Sununu's desk. The Governor is expected to sign both bills on August 3. There is some good bipartisan energy legislation in SB 91 as well, but that is another story.

Bradley and Below have an enduring history of cross-party energy leadership. Collaborations between the two statesmen over the past quarter-century include: enactment of RSA 374-F, Electric Utility Restructuring; enactment of and numerous updates to RSA 362-A:9, Net Metering and Group Net Metering; enactment of RSA 125-O, Multiple Pollutant Reduction Program (related to the Regional Greenhouse Gas Initiative and reducing carbon dioxide emissions from the power sector); revisions to RSA 362-F, Renewable Portfolio Standard; and the 2019 update to RSA 53-E, the Community Power Act. Thanks largely to their leadership, alongside leadership in the corner office and that of Rep. Vose on down to the grassroots, New Hampshire will be taking a key step forward on energy policy this session.

Henry Herndon is an energy professional working with leading communities to launch New Hampshire's Community Power market.

NEW HAMPSHIRE CLEAN ENERGY NEWS

Associated Grocers of New England Solar Project

ReVision Energy's Brentwood, New Hampshire, office is installing what will be the largest rooftop solar array in New Hampshire on a 500,000 square foot warehouse. The array will have 3,400 solar panels and a capacity of 1,292 kilowatts (kW) DC. That will provide a peak of 1,000 kW AC.

The warehouse belongs to Associated Grocers of New England, which will benefit from the reductions in use and costs of electricity from the grid. The array is expected to provide 1,454,000 kilowatt hours (kWh) of electricity each year. That amount of electricity generated by fossil fuels would put 1,100 tons of carbon dioxide into the atmosphere each year.

The work on installation is expected to be complete by the end of the summer. The array will provide about 20% of the electricity needed to operate the building. The cost of construction is \$2.4 million, of which a quarter can be recovered from federal incentives.



RMC's Stearns Lodge gets a new metal roof, 21 solar panels were installed and a heat pump. (Revision Energy)

Clean Energy Projects of the Randolph Mountain Club

The Randolph Mountain Club (RMC) is a non-profit organization founded in 1910. Its purpose was to create and maintain trails, camps, and shelters for hikers in the area of Randolph, New Hampshire. In addition to miles of trails, it maintains four shelters on the north slope of Mount Adams. It also keeps Stearns Lodge, a place for the club's employees to live when they are not on the mountain. The four shelters are not connected to the power grid.

In 2020, RMC started fundraising to pro-

vide some of its facilities with solar power. In particular, Stearns Lodge was to be given a heat pump to offset the use of gas for heat. Donations came in from over 110 members. Three organizations, the Tillotson Local Grants Program of the New Hampshire Charitable Foundation, the Thomas W Haas Fund, and the Randolph Foundation, also provided important funding.

Work on the installations began in the spring of this year and should be completed by the end of the summer. Contractors and volunteers worked together on the project. Stearns Lodge needed a new metal roof, and an array of 21 solar panels was installed along with the heat pump.

Also, one of the camps, Gray Knob, already had a small solar array. That array is being replaced. Gray Knob, which is just below the tree line, is normally open year-round, though during the Covid-19 pandemic it has been closed. Because of lack of road access, components are being transported to the site by helicopter.

Fundraising for the RMC solar systems and heat pump is being undertaken in memory of a Randolph resident and RMC member Mike Micucci, who had died in October 2020. He was an active volunteer who

tended trails and volunteered for search-and-rescue operations in the mountains.

Stratford Awarded USDA Rural Development Community Grant

Stratford, New Hampshire, has been awarded a USDA Rural Development Community Grant. Part of the grant will be used to finish installation of LED lights at the town hall and the fire station. The change to LED lights is also supported by Eversource, the local electric utility. Another part of the USDA grant will be used to help install a 20-kW solar array on the town hall roof.

Between them, the solar array and the LED lights are expected to reduce the town's electric consumption by 22,185 kWh per year. Producing that amount of electricity from fossil fuels would produce nearly 35,000 pounds of carbon dioxide emissions. Buying that much electricity would also cost the town about \$38,000 over 25 years.

The town plans to continue its solar project into a second phase, to provide 100% of the electricity it uses. The plan is to construct a ground-mounted, 50-kW solar array at the town's transfer station.

Hanover Community Power Aggregation Moves Forward

George Harvey

Hanover, New Hampshire, started acting on a switch to renewable energy some time ago. Clearly, that happened long before 2017, when its residents voted at town meeting to become the first town in New Hampshire, and the 29th in the country, to commit to 100% renewable energy by 2050.

The commitment to using 100% renewable energy is a great goal, but the details of implementing it require some thought and good hard work. After extensive efforts by the town's Electric Aggregation Committee, Hanover was ready this year to put the Hanover Community Power Electric Aggregation Plan to the town meeting for a vote.

One thing that Hanover needed before passing its plan was amendment of the municipal aggregation statute, RSA 53-E, which allows municipalities and counties to aggregate the purchase of electricity. The amendment allows customers to "opt out" of a municipal aggregation rather than requiring them to opt in, which insures a higher level of customer participation. That amendment was signed into law in the fall of 2019 which meant municipal aggregation was finally viable in NH. Aggregation combines the buying power of customers within the area doing it, and there are a number of ways that is useful.

Community aggregation makes it possible for electric customers to pool their electricity demand and buy at lower rates than if they were each paying at the default retail rate separately. Importantly, it also means that the customers can decide, as a group, what to use as sources of the electricity they use, including both the technologies and the actual generators. The result is that electricity generated from renewable sources, such as solar photovoltaics and wind turbines, can usually be purchased at rates below what the customers had been paying for electricity generated by burning fossil fuels.

The fact that customers can buy their electricity in this way is very important. With community aggregation, it is not just a matter of customers saying what



Hanover town officials at the town meeting held at Dewey Field; town residents vote yes! (Photos are screenshots of the CATV coverage of town meeting)

they want, it is customers contracting for what they want. And under the terms of aggregation contracts, we might say that the sun shines, the wind blows, or we are provided with an alternative just as clean.

These are not the only advantages of community aggregation. Issues of fiscal stability, local resources, local jobs, resilience, and grid modernization are also addressed. Fairness is a central issue of the plan. As a matter of fact, anyone who thinks the plan is unfair or


has any other reason to object to it has the right to opt out and continue to buy electricity from the utility's default generating sources, even fossil fuels, at the standard utility price. Please note, however, that by opting out, the customer would almost certainly be paying more.

After considerable preparation, the issue went before the town meeting on Tuesday, July 13. The scene of this town meeting may have seemed almost surreal because of the demands for safety in the era of Covid-19. Dewey Field was the site of what has been termed a "drive in town meeting." Hanover Town Manager Julia Griffin told us that by the time that the issue came up, she found it hard to see hands going up. Nevertheless, it was clear to her and to others that the vote was a resounding "Yes." In fact, it seemed to be unanimous.

The vote authorizes the Select Board to proceed on power aggregation, which is far too complicated to happen all at once. The hope is that the actual aggregation will be ready to implement by spring of 2022.


One other thing to remember about this is that while Hanover Community Power is very important, bringing it into is just a step in the overall goal of running 100% on renewable energy, Hanover's ultimate goal.

Julia Griffin expressed delight in the result of the vote. It reinforces the leadership role of Hanover and provides a model that other communities can follow to their advantage. ♻️



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The Largest Anaerobic Digester in the Northeast

A Vermont dairy farm, a Vermont utility, a Vermont college, and national energy innovators working together for the environment.

George Harvey

The largest anaerobic digester in the Northeast started operations with a commissioning ceremony on July 21. Among the people attending were representatives from the Goodrich Family Farm, Middlebury College, Vanguard Renewables, Vermont Gas Systems (VGS), and the state of Vermont. We point out to anyone who might say that an anaerobic digester

is not much to cheer about that the state of Vermont was represented by both Vermont Governor Phil Scott and Lieutenant Governor Molly Gray.

We might start by considering the business and educational organizations involved in this story:

The Goodrich Family Farm is a dairy farm in Salisbury, Vermont. It was founded in 1956, with a herd of ten cows. Today, it has expanded to have a herd of 900 cows, in addition to 2,400 of acres of land used to grow corn and hay. The owners of the farm have been working to have the lowest environmental impact possible, including dealing with the manure from all those cows. Left to itself, the manure would emit large amounts of methane into the atmosphere, along with phosphorous compounds that would eventually get to Lake Champlain.

Middlebury College is in Middlebury, Vermont, the next town over from Salisbury. The college is well-known for its efforts to end its use of fossil



The largest anaerobic digester in the Northeast began full-scale production of renewable natural gas (RNG) this month at the Goodrich Farm in Salisbury, VT. (Glenn Russell/VT Digger)

fuels, switching entirely to renewable resources. Historically, the college has been dependent on natural gas for heat. Over the years, it has actively sought a way to replace natural gas, a fossil fuel primarily made up of methane.

Vanguard Renewables is based in Wellesley, Massachusetts. It develops, owns, and operates anaerobic digesters sited on farms. Its anaerobic digesters convert organic waste materials, typically manure and food waste, into bio-methane and fertilizer. It has worked mainly in the Northeast, but it is expanding to work across the country.

VGS owns and operates natural gas infrastructure in Vermont. One of its pipelines was laid out in such a way that it could carry bio-methane from the Goodrich Family Farm to Middlebury College.

Every day, about 100 tons of manure is mixed with 180 tons of unavoidable food waste from Vermont businesses, such as Ben & Jerry's and Cabot/Agri-Mark. This is mixed in a 250,000-gallon pre-treatment

tank. After the material is treated, it is moved into one of the two 925,000-gallon anaerobic digesters at the farm. The digesters are maintained as environments where the particular microflora in the process could be happily doing their jobs.

The products of this work are a gas and a mix of solids and liquids. Both of these need to be treated before they can be used. The gas has to be treated to remove compounds that would negatively affect use in equipment designed for natural gas, after which, the bio-methane is a drop-in replacement for the fossil fuel. The solid and liquid materials need to be treated to remove phosphorus compounds that would pollute the waters leading to Lake Champlain and the lake itself.

We should note that the methane captured in this process would have been emitted anyway. This is a natural process and part of the way nature breaks down such organic materials as manure. However, since methane is a greenhouse gas twenty to eighty times as powerful as carbon dioxide, trapping and burning it reduces the load of greenhouse gases quite a lot.

Also, the phosphorous and other compounds that have been removed from the effluent would otherwise have gone into the soil and water of the area, supporting unwanted biological activity in Lake Champlain, included blooms of algae and cyanobacteria. The fact that these materials have been removed is very beneficial

for aquatic life.

Once the bio-methane is created, it can be injected into the natural gas pipes VGS operates. The pipes move the gas to Middlebury College, which burns it for heat and cooking. The college has contracted to buy 55% of the gas produced by the digester at the Goodrich Family Farm.

Vermont already has a number of biodigesters, all working in a similar manner. All of them operate to the benefit of our environment. Addressing those attending the commissioning, Governor Scott said, "Think about it – we've got a Vermont farm, a Vermont utility, a Vermont college, and national energy innovators all coming together to build a model for our region. And it can be replicated in other parts of the state and country, as well. This is truly transformative work that Vermonters can be proud of."

Lieutenant Governor Molly Gray added, "This includes continuing our efforts to weatherize homes, make solar and community solar available to Vermonters and supporting incentives for Vermonters to purchase electric vehicles." ♻️



The Goodrich Family Farm. (Vanguard Gas Systems)

OFFSHORE WIND IN NEW HAMPSHIRE IS ON TRACK

Joshua Singer

The East Coast is on track to add more than thirty gigawatts of offshore wind (OSW) generation in the next 15 years, with the Biden Administration issuing an executive order that calls on our country to build new, clean American infrastructure to drive a clean energy economy, creating tens of thousands of new jobs along the way. The Bureau of Ocean Management (BOEM) is conducting an environmental review of twelve potential wind projects through 2021 and an additional 16 construction operations plans (COPs) by 2025, which will represent more than 19 GW of clean energy.

The build out imagined is unprecedented. We are poised to do in ten years what it took Europe 30 years to do.

The Biden Administration has announced a new priority wind energy area in the New York Bight, in between Long Island, NY and New Jersey, the construction of which, will support up to 25,000 development and construction jobs. The Department of the Interior (DOI) and Commerce (DOC) are planning to deploy the thirty gigawatts of OSW infrastructure while protecting biodiversity and protecting ocean co-use.



Wind turbines at sunset. (makistock - AdobeStock_132194031)

What makes OSW so exciting is the quantity of power we can derive from the existing potential of our coastal waters, essentially indefinitely. We have the potential to power nearly two times the entire U.S. electric demand, according to the National Renewable Energy Laboratory (NREL). As the old gas, oil, and coal power plants of New England are retired, it is the perfect opportunity to begin a transition to a clean energy source that is locally generated and provides a massive benefit to our communities.

The New Hampshire Offshore Wind Commission is engaging in a Request for

Proposal (RFP) process to learn more about the public perception of OSW, and how it will potentially impact the electrical grid and market in New England. One issue that has come up is the lack of interconnection points to handle such a large load of electricity coming in from the coast. The grid will need further investment to handle the new influx of electricity coming from the sea.

No source of energy comes without some impacts, and OSW is no exception. Developers will need to take great care to not worsen the fate of the critically endangered Northern Atlantic Right Whale, which now is estimated to number fewer than 400 individuals. Fortunately, thanks to the dedicated advocacy of environmental organizations, many considerations are already being made for ocean wildlife and habitat. The construction and operations plan for the only offshore wind farm to have received permission for construction, Vineyard Wind, includes over 46 pages on mitigation and monitoring measures,

including restrictions that limit the pile driving of foundations – the most dangerous process for sea creatures – to times of year when whales tend to be in Canadian waters.

While it is important to monitor the environmental impacts of these projects, we're not exploring new territory. Europe has already installed more than 5,000 OSW turbines and has worked to characterize their impacts on the marine environment, which seems to be largely manageable. The Federal Government's environmental impact statement (EIS) for Vineyard Wind found that the impacts to fish and wildlife were "negligible" to "moderate."

If you, your municipality, or your company are interested in OSW or how you can get involved in the process to make this clean energy infrastructure a reality, reach out to us at Clean Energy NH, or to your local clean energy leader!

Josh is the Program Coordinator at Clean Energy New Hampshire, where he plans, develops, and delivers technical and educational assistance to communities around NH. Josh has a Master's in Environmental Law and Policy from Vermont Law school. ♻️

Tide Power Generators to Drop Near Boston

J. D. Kaplan

The sea-town I live and work in has an impressive history of bold action, at least to me. First, we invented the life-saver, and began floating stranded seamen back to shore when their boats were marooned, or worse. This activity took root as budgets for special equipment and personnel were allocated, and permanent stations were built expressly to counter the losses observed among rocky shorelines and storms. Boston Harbor and its surrounding isles, littered with drumlins and plagued with, say, spotty weather, had proved unusually murderous.

According to Hull Lifesaving Museum, until about 1900, all ships bound for a port in Boston, including a daily trickle of "coasting schooners carrying lumber, coal, plaster, and other industrial goods," had only one navigational option. It was "the only natural channel deep enough to accommodate large vessels." This killer race-route inspired a host of inventions in addition to the 'life ring,' the lifesaver.

Next, we became the first town on the eastern seaboard to sport a commercial wind turbine. It is a Vestas unit that has possibly generated stronger returns advocating renewables than actual electric power output. It can make 600kW, great for its age, and stands at the very tip of a long peninsula that sticks out into Boston Harbor. It has been visible for miles, twenty years running.

Thus, my community became a green power advocate somewhat early on. Now, as the offshore projects step forward and bureaucrats inch frustratingly toward permits and licenses, we wait in earnest for a federal infrastructure funding act to break itself out of grid-lock. The second appearance of a *heat dome* in North America may yet open



Hull Gut

Hull, MA became the first town on the eastern seaboard to sport a commercial wind turbine. The wind turbine is located at the tip of the peninsula next to the Hull High School and sports field. Note the white building where the wood pilings are seen for a possible deployment of the tidal-turbine-system, seen in the graphic below. (Images and graphics courtesy of Changzheng Huang, Aegis engineer)

the eyes of politicians who look through a power lens, say, at the planetary emergency and just see *nothing*. Any temperature reading that can lead to dozens of bodies being rolled out of homes in a first-world country ought to make even reactionary jaws drop. This is a disaster without a single clap of thunder, without wind knocking things around or even a lick of ground shaking.

Such is the reading our newsies reflect to us midsummer, as *GET* goes again to print. Following this season we may look forward to *trillions* in official funds moving in the right direction. It would amount to the biggest response to climate by the U.S. government so far.

Glacial progress will have led to such a crescendo. Meanwhile, a moderate mudslide of seed funds have been awarded to advance the readiness of industry to decarbonize proactively. Small business innovation funding has been operating since a legislative mandate circa 1982, when the Small Business Innovation Research (SBIR) program was established.

The SBIR is detailed at (sbir.gov) and the full history of its funding is searchable. However, *GET* readers might really dig the EERE (<https://bit.ly/2VloDgP>) and their Water Power Tech Office (<https://bit.ly/37mqkxD>). These folks are your family.

Every arm of the executive with a budget big enough is required to set aside a small portion of that budget for this technology seed-funding purpose. Eleven agencies, the SBIR site reports, qualify under this rule and thus spend 3.2% of their hundreds of millions awarding companies like Aegis and Bioenno funding for the projects that we need in order to "stimulate technologic innovation." There was no Sustainable Development Goals list in 1982, but its message and attitude have long-since taken root, and this results in many, many projects designed to put our renewable-energy convictions to the test.

Further, given that we're not alone in this general endeavor—several countries have been spending big for decades to harness the tides and associated flows—the SBIR has opted to support a clever diversity of 21st-century project goals. This will include mapping the seafloor to provide clear answers to our concerns over living habitats near power installa-

tions, for example, and floating wave energy converters (WECs) to support buoys and other sensor-equipped hardware that will actively monitor the ocean's activity. These are pursuits that can help with monitoring climate change long-term, in addition to weather prediction and emergency warning systems. See <https://bit.ly/3lb1Ejq> for details on these and many more. An aside: My favorites are those addressing corrosion, since that is such a problem for marine engineering—or even for homes near the ocean.

In Hull, within eyeshot of an operational U.S. Coast Guard station, engineers from Aegis and Bioenno will drop a turbine system into the water to generate power from the moving tide. Once the unit has operated well enough to show that

it can make juice reliably and without disturbing anything else (lobstermen, for example, or some pesky ecosystem, or whatever), the unit will come out of the water and be replaced by ... well, phase two.

By phase three, I'm told, power output will approach utility scale, at least at its relative size. Tens of kilowatts are possible from units around 6 meters cubed—or even less.

This is but one example of the richness of progress SBIR has made possible. Let us hope that with or without a six trillion-dollar tsunami, we will have our homes and vehicles powered by brilliant, resilient systems such as what we'll be seeing tested in Massachusetts Bay in the last days of summer. It's a system that has been conceived and deployed with all that we've learned from Mother Nature and the weather machine well in place. The systems of yesteryear ... weren't.

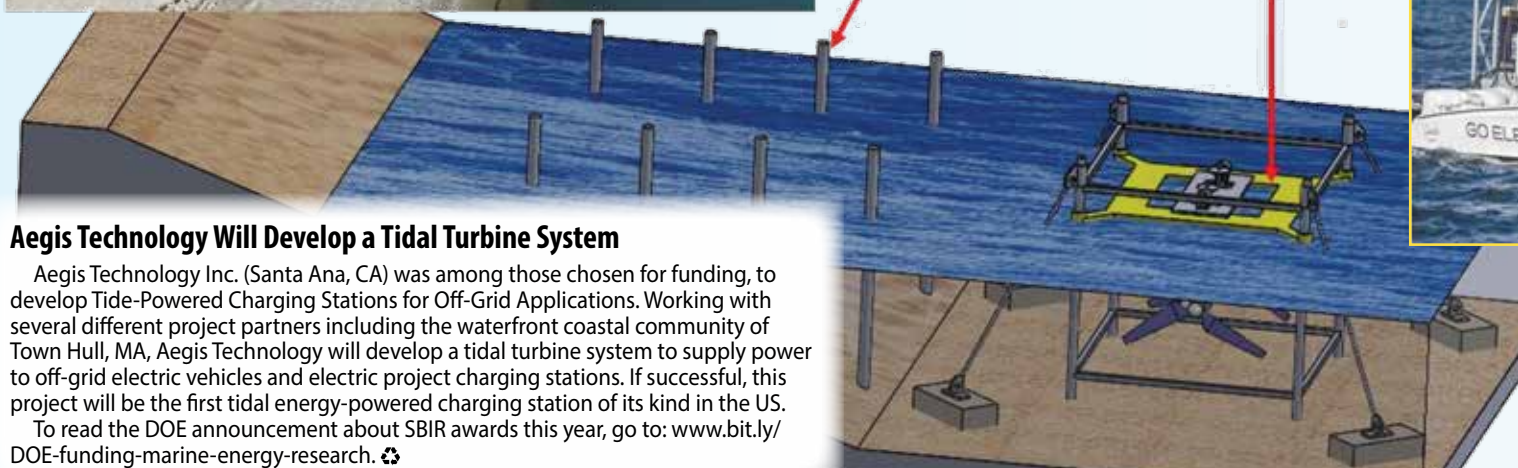
Today we have the Coast Guard. Tomorrow, the tide and swells may feed the grid just as smoothly as a coal plant, sans the noxious bits and particulate matter. It will only breathe with the Earth.

J. D. Kaplan is a certified remote pilot and a former member of the I.T. crowd. He is a reader in the areas of bioelectromagnetics and cryptocurrency. For *G.E.T.* readers, Mr. Kaplan will continue to profile blockchain activity within the energy sector. He lives and works at or above sea level near Boston, MA. ♻️



Wood Pilings

Tidal Energy System



Aegis Technology Will Develop a Tidal Turbine System

Aegis Technology Inc. (Santa Ana, CA) was among those chosen for funding, to develop Tide-Powered Charging Stations for Off-Grid Applications. Working with several different project partners including the waterfront coastal community of Town Hull, MA, Aegis Technology will develop a tidal turbine system to supply power to off-grid electric vehicles and electric project charging stations. If successful, this project will be the first tidal energy-powered charging station of its kind in the US.

To read the DOE announcement about SBIR awards this year, go to: www.bit.ly/DOE-funding-marine-energy-research. ♻️



Charge Stations for E-Boat's and EV's

One possible deployment for the Tidal Energy System is next to the wood pilings near Hull High School (see Hull Gut image).

FEDERAL

FEDERAL INVESTMENT TAX CREDIT

- The federal investment tax credit (ITC) for most technologies, including solar, wind, heat pumps, and fuel cells, is 26% of expenditures through 2022. 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>
- Biomass heating systems Tax Credit: 26% of the purchase and installation costs (with no cap or lifetime limit) for tax years 2021 and 2022; reduces to 22% of purchase and installation costs in 2023 (under Sec. 25D of the U.S. tax code)
- 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 energy independence
- Promote resource conservation, public health, and the environment
- Diversify markets for agricultural, 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 Heating: Advanced wood pellet heating systems -- \$6,000 per pellet boiler/furnace (in partnership with Efficiency Vermont). Commercial spaces over 5,000 sq. ft. may also be eligible for incentives. See www.rerc-vt.org or call (877) 888-7372.

- Retail sales of "Advanced Wood Boilers" are exempt from Vermont's 6% sales tax. <http://tax.vt.gov/exemptions>
- Residential Bulk Pellet Bins. Up to \$3,000 rebate.
- Coal Change-out adder. Up to \$7,000 additional incentive for a pellet heating system if replacing a coal heating system. Businesses can get up to an additional \$27,000 incentive.
- Details at www.rerc-vt.org or call (877) 888-7372.

• More into at fpr.vermont.gov/woodenergy/rebates

• 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

In Rutland & Bennington County (and towns in neighboring counties that boarder Rutland Co.) contact Melanie Paskevich mpaskevich@nwwvt.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 \$1000 rebate on approved pellet boilers and \$500 for pellet furnaces. This can be combined with the CEDF and Efficiency Vermont incentives for a total of \$7000; \$250 for qualifying pellet or wood stove installed by a qualified installer. This can be added to stove offers from CEDF and Efficiency Vermont.

- Members of the Vermont Electric Co-op can get a \$150 credit on the purchase of an approved pellet stove: www.vec/energy-programs.

- Stowe Electric Customers can get a \$150 rebate with the purchase of a pellet stove.

VT TAX CREDITS

- Vermont offers an investment tax credit for installations of renewable energy equipment on business properties and wood and pellet heaters with at least 75% efficiency. 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 6.24% 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

All incentives subject to availability, limits, and may change at any time. For complete details, and participating retailers/contractors, call 888-921-5990 or visit efficiencyvermont.com/rebates.

Lighting

- Special pricing on select ENERGY STAR® LED fixtures at Vermont retailers.
- LEDs for indoor growing: \$100 back for qualifying fixtures

Weatherization

- Comprehensive air sealing and insulation projects with an Efficiency Excellence Network contractor: 50% off eligible project costs, up to \$1,000. Moderate income Vermonters get 50% off up to \$3,000.

- DIY: \$100 back for completing eligible projects, like weatherizing windows and doors, and sealing air leaks in your attic and basement.

Appliances (must be ENERGY STAR)

- Dehumidifiers: \$25 - \$40 rebate
- Clothes Dryers: \$200-\$400 rebate

Heating/Cooling/Water Heating

- Central wood pellet boilers and furnaces: \$6,000 rebate (in partnership with CEDF)
- Advanced pellet or cord wood stove: \$200 discount at participating retailers for replacing an old stove.

Heat Pumps:

- Air-to-Water System: \$1,000/ton rebate
- Ducted Systems: \$1000-\$2000 discount at participating distributors
- Ductless Heating & Cooling System: \$350-\$450 discount at participating distributors
- Ground Source Heat Pumps: up to \$2,100/ton rebate
- Heat pump water heaters: \$300-\$600 discount at participating distributors;
- Moderate-income Vermonters are also eligible for bonus rebates up to \$500 for heat pumps and heat pump water heaters.

- Window air conditioners: \$100 for select ENERGY STAR Most Efficient models.

- Smart thermostats: up to \$100 back for select ENERGY STAR models.

- Electric utility rebates may also be available.

Residential New Construction

- Enroll to receive a home energy rating, expert technical assistance, and incentives – Efficiency Vermont Certified™ projects receive up to \$4,000 cash back
- Washington Electric Coop and Vermont Gas Systems customers may also receive additional incentives

Other Opportunities to Save

- Home Energy Loan – finance up to \$20,000 in energy-related home improvements with interest rates starting at 0%. Restrictions apply.
- Additional incentives may be available through your local electric utility provider. Contact your utility for more information.

Incentives for Pro-environment Agriculture Behaviors

To protect the ecosystem around the Lake Champlain Basin, several programs have been introduced to encourage environmentally-conscious farming in the area by providing monetary incentives. A recent study has looked at two of these programs (<http://bit.ly/EQIP-CREP-study>), the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP). Both programs could benefit from reduced transaction costs and administrative complexity.

* Source: *Vermont Research News - Center for Research on Vermont*, 1.18.21.

Electric Lawn Mowers

- Incentives for commercial and residential battery-electric lawn mowers and some tools are now offered by all of VT's electric utilities, including:
- VEC (www.bit.ly/VT-mowers-VEC);
- WEC (www.bit.ly/VT-mowers-WEC);
- BED (www.bit.ly/VT-mowers-BED);
- VPPSA (www.bit.ly/VT-mowers-VPPSA);
- Stowe Electric Company: (www.bit.ly/VT-mowers-SEC);
- GMP (www.bit.ly/VT-mowers-GMP).

NEW YORK

RENEWABLE ENERGY INCENTIVES OFFERED THROUGH NYSEDA

Welcome to the New York solar incentive and rebate information: 169 programs and incentives at: <http://dsireusa.org> (enter your zipcode) Programs and Services from NYSEDA: For the latest NYSEDA solar, ground source and air source heat pumps, EV residential and commercial incentives..

NYSEDA currently has a \$1,500 per ton incentive on geothermal for residential systems.

Visit NYSEDA's new website. It is user-friendly and a one-stop learn-all site: <https://www.nyserda.ny.gov/ny/PutEnergyToWork/Energy-Program-and-Incentives>.

Extended Federal Tax Credits for Renewable Energy

Good news for renewable energy and climate action!

A budget package has finally been developed that begins to address the climate crisis.

Making local renewable energy more affordable, this bill translates directly into good jobs, less climate pollution and more resilient communities.

Among the most significant measures are extended tax credits for renewable energy.

- SOLAR: The investment tax credit (ITC), which was scheduled to drop from 26% to 22% in 2021, will stay at 26% for two more years.
- ADVANCED WOOD HEAT: For the first time, a 26% investment tax credit applies to the installed cost of home heating and hot water systems that utilize wood pellets, chips and cordwood at efficiencies greater than 75 percent high heat value.
- GEOTHERMAL HEAT PUMPS: The 26% tax credit was also extended for geothermal heat pump projects that begin construction in 2021 and 2022. Overall, the bill includes \$600 million for wind energy, \$1.35B for solar, and \$1.35B for grid-scale energy storage. It also includes a plethora of stimulus measures for small businesses.

NEW HAMPSHIRE

Renewable Energy Incentives Offered Through the NH Public Utilities Commission

NH PUC: Get up-to-date information at <https://www.puc.nh.gov/Sustainable%20Energy/RenewableEnergyRebates.htmls>

Commercial Solar Rebate Program

Effective March 6, 2020, incentives are limited to 25% of the total project cost or \$10,000 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:

- \$0.20/watt (lower of AC and DC) for new solar electric facilities.
- Expansions to existing solar systems are not eligible.
- Incentive levels for solar thermal systems are as follows:
- \$0.12/rated or modeled kBtu/yr for new solar thermal facilities fifteen collectors in size or fewer; \$0.07/rated or modeled kBtu/yr for new solar thermal facilities greater than fifteen collectors in size;
- Expansions to existing solar systems not eligible.

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

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

Residential Solar/Wind Rebate Program

-Currently closed, this program offers rebates to qualifying NH residents who install photovoltaic (PV) or wind turbine electrical generation systems. Rebate levels are \$0.20 per watt of panel rated power up to \$1,000, or 30% of the total facility cost, whichever is less. **Check for updates for ALL Rebates at <http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-SREG.html>**

Residential Solar Water Heating Rebate Program

- Program is currently closed: \$1500 - \$1900 per system based on annual system output

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

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

Residential Wood Pellet Boiler/Furnace

- 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
- Information at www.nh.gov/osi/energy for more information.
- Plug-In Hybrid Electric Vehicles (PHEV), and \$300 on Electric Motorcycles.

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 – Incentives are up to \$2,500 per charging unit. A maximum of two charging units may be installed off-peak hours at a rate that is lower than the basic residential rate.

NHEC's ENERGY STAR Heat Pump incentive structure for 2020 is as follows:

Heating and Cooling - (Must meet or exceed the minimum efficiency requirements - SEER 18/EER 12.5/HSPF 10) \$500 per ton.

Geothermal - (Must meet or exceed the minimum efficiency requirements - EER 16/3 COP) \$500 per ton

Cooling only - (Must meet or exceed the minimum efficiency requirements - SEER 15/EER 12.5/) \$70 per ton

Wi-Fi thermostats - (Must be installed with a heat pump also receiving an incentive) \$100 rebate per T-stat

Weatherization Bonus – (Available for members participating in the Home Performance with ENERGY STAR Program) \$250 per ton

Whole House Bonus – (Available for qualified heat pump applications that offset 80% or more of the total heat load. Two years of fuel use history is required) \$250 per ton

ENERGY STAR Heat Pump Water Heater – (Must meet or exceed 2.3 energy factor) \$750 rebate on 40-80 gallon heat pump water heaters

Loan Buy down – NHEC provides interest subsidies through participating banks and credit unions for the installation of qualified heat pump installations. Must get pre-qualified. Loans up to \$15,000 after rebate.

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 75% instant rebate for eligible weatherization improvements up to a \$8,000.

- 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/nh-rebates.

- 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 select ENERGY STAR® certified LED light bulbs purchased through participating NH retailers (offers vary by retailer, see store associate for details) Visit: www.NHSaves.com/nh-rebates.
- 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, EFL.
- Visit www.NHSaves.com/lighting-catalog.

Plymouth Area Renewable Energy Initiative (PAREI): plymouthenergy.org

- **NH Solar Shares:** nhsolarshares.org

NHSaves: 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 - \$750 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 electric-ity 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 <https://www.nh.gov/weatherization.htm> for application criteria, FAQs and local program contacts.

Community Development Finance Authority (CDFA) Clean Energy Fund Low-Interest Financing for Businesses, Non-Profits & Municipalities:

to support energy efficiency and renewable energy projects.

Small Business Energy Audit Grants

Rural Small Businesses & Agricultural Producers can apply for grants to cover 75% of a comprehensive energy audit cost.

Community Facilities Energy Assessment Grants

Non-Profits and Municipalities can apply to receive a grant covering 75% of the cost for an energy-related study.

Find out more at: nhcdfa.org/energy.

NH Rural Renewables

Solar, wood and energy efficiency technical assistance for NH's rural small businesses

www.lrcc.edu/nhrr

Expert • No-cost • Vendor-neutral

MAINE

EFFICIENCY MAINE

Efficiency Maine is a division of the Maine Governor's Office of Energy, provides information and rebate opportunities online and by phone (efficiencymaine.com, 1-866-376-2463) for Maine homeowners, businesses and municipalities.

Rebates included through Efficiency Maine's programs include a wide variety of approved energy efficient devices and services that cut energy costs and lower greenhouse gas emissions. Standard rebates range from \$50 to \$7,500 or more, available through pre-approved businesses, dealers and contractors. Low income eligibility options are available.

Appliances: Clothes dryers, clothes washers, dehumidifiers, dishwashers, freezers, refrigerators, retail store discounts, room air purifiers.

Weatherization, HVAC, Insulation: Air sealing and energy assessment, circulator pumps, electric vehicles, gas heaters and boilers, geothermal systems, heat pumps, heat pump water heaters, gas heaters and boilers, insulation, pellet boilers

Financing: Energy upgrade loans, up to \$15,000 at 4.99% over 10 years.

Federal Tax Credits: Also available for EV chargers; gas, propane and oil furnaces, boilers and heaters; pellet and wood stoves; solar systems (no cap, 26%),

Learn more at efficiencymaine.com.

Impressive Solar Progress in New York State

George Harvey

One thing about some renewable energy technologies is how astonishingly quickly they can be developed. It is common for a developer to announce the start of a major development that is to be finished in six months, and follow that less than six months later with an announcement that the development was finished ahead of schedule and on budget. And such seems to be the case for entire solar programs that have been underway in New York State.

This year, NYSEDA (the New York State Energy Research and Development Authority) launched its fifth annual solicitation for renewable energy projects, the State's largest land-based procurement to date. In April, New York Governor Andrew M. Cuomo announced that over twenty large infrastructure projects were to be under construction in his state this year. This was expected to produce \$1.5 billion in investment and 2,000 jobs, pushing New

Cont'd on p.18

MAINE LAW ENDS FOSSIL FUEL INVESTMENT IN EMPLOYEE FUND

Toby Martin

When a state's visionary leadership unites and exhibits bipartisan courage to create a noteworthy and groundbreaking law as Maine's L. D. 99 has, it deserves recognition.

On January 11, 2021, Maine State Representative O'Neil of Saco and nine others united and co-sponsored the bill, which directs that:

"The Treasurer of State and the Board of Trustees of the Maine Public Employees Retirement System may not invest the assets of any state pension or annuity fund in any stocks or other securities of any corporation or company within the fossil fuel industry or any subsidiary, affiliate or parent of any corporation or company among the 20 largest publicly traded fossil fuel companies, as established by carbon in the companies' proven oil, gas and coal reserves, to divest any such stocks or other securities whether they are owned directly or held through separate accounts or any commingled funds, (and) divestment must be complete by January 1, 2026," with annual progress reports presented to the joint standing committee charged with oversight, by January 1, 2023, 2024, and 2025.

The state employees' retirement fund currently has investment assets of about \$17 billion. The fossil fuel industry's share stands at roughly \$1.3 billion, 7.6% of the fund's value.

As expected, the bill attracted testimony from climate activists and environmental organizations, as well as supporters of the fossil fuel industry.

A month after Representative O'Neil introduced the bill, on the afternoon of February 10, Francesca Gundrum, Communications Manager for Maine Conservation Voters (MCV), presented



Maine State House in Augusta. (David Grant/Flickr)

testimony before the Committee on Labor and Housing at the State House in Augusta.

Gundrum explained that "MCV works to address environmental degradation and the climate crisis in order to create a healthy and safe future for all of us here in Maine and beyond." And she added that divestment of fossil fuels from Maine's employee retirement fund is essential to meeting the state's climate goals, as well as being the right choice for socially equitable reasons. Divestment is supported by the work of national and international organizations and climate activists motivated by concerns for the protection, health and survival of all species everywhere across the globe.

She also drew from her own divestment experiences where, as a Dartmouth undergraduate, she was inspired by her peers to support climate action, where, she said, "I got my start in the climate

movement with my college's fossil fuel divestment campaign, Divest Dartmouth, (where) we organized the largest climate rally in the history of New Hampshire and brought national attention to using fossil fuel divestment as a unique strategy to combat the climate crisis and align our institutions with their values."

And here she was again on behalf of MCV, in her role as an environmental advocate and pro-

fessional, testifying before this Maine joint decision-making committee, echoing the important work of youth activists worldwide, and arguing for support that could lead to a recommendation for enacting L. D. 99 and divestiture.

The joint committee voted to recommend, and after votes to pass by the House on June 3 and the Senate on June 8, L.D.99 became law with Governor Janet Mills' signature on June 10, the first of its kind in the nation.

State Representative Victoria Doudera, from Camden, represents Maine's seacoast mid-coast towns of Camden, Islesboro and Rockport. Now in her second term, she has served on two joint committees: first on the Energy, Utilities and Technology Committee, and currently on the Environment and Natural Resources Committee.

Doudera reinforces Gundrum's testimony:

"The enactment of L. D. 99 signals an

important shift in how we in the legislature achieve what I see as our duty to protect the earth.

"While climate change should be reason enough to disinvest from holdings in the fossil fuel industry, the actions outlined in L. D. 99, now public law, also make sound business sense. Given that extraction is increasingly costly, and many firms have taken on debt to invest in exploration, most investors believe renewables are better investments than fossil fuels.

"The arguments in favor of L. D. 99 were compelling because they coupled concern for the earth with concern for our pocketbooks. Needless to say, this approach has broad bipartisan appeal. Even climate skeptics can be won over if they feel a shift to environmentally-friendly policies makes financial sense. This idea isn't new, but L. D. 99 (and other policies) demonstrates how successful it can be. Going forward, I believe it will be increasingly important to demonstrate that environmentally-friendly policies all benefit us economically if we are to truly tackle climate change on the scale necessary to really make an impact."

Clearly, the people of Maine are fortunate to have such people as Francesca Gundrum of MCV and Victoria Doudera in the State House acting on behalf of Maine's citizens and the planet.

Toby Martin lives in Islesboro, ME, where he works locally and statewide to strengthen Maine's clean energy sustainability. A founding member of the Islesboro Energy Team and the Islesboro Energy Committee, he also coordinates the Islesboro Energy Conference, and he contributes to Green Energy Times as a writer and member of its new Maine distribution team. ♻️

Solar Progress in NYS

Cont'd from p.17

York State toward its goal of getting 70% of its electricity from renewables by 2030.

The announcement was made at the largest community solar project in the Mid-Hudson region, near the town of Bethel. The project has a capacity of 6.1 megawatts, enough to cover the annual needs of about 1,000 households. It was developed by Delaware River Solar and is owned by Generate Capital.

That was three months ago, and it was a forward-looking announcement. Now, Gov. Cuomo has another announcement looking back at the accomplishments of the last ten years, especially the NY-Sun program. They are not just impressive – they are rather amazing. When the two are viewed together, the whole produces a heartening view of how renewables are developing. And this is particularly true, considering that we are still in the process of recovering from the Covid-19 pandemic.

"Solar energy is a key component in New York's transition to a clean energy economy as we work to reduce harmful emissions across the board and address the dual challenges of fighting climate change and rebuilding stronger post-pandemic," Governor Cuomo said. "The success of NY-Sun demonstrates we are on track to meeting our nation-leading energy goals while stimulating green job growth and eco-

nomie recovery in communities across the state as part of our comprehensive plan to reimagine New York following the pandemic."

Since 2011, the capacity of New York State's solar photovoltaic infrastructure has been brought up to three gigawatts (GW). That is a growth of 2,100% over the span of the ten years. At the same time, the cost of solar systems has dropped by 69%, largely because of the increased efficiency that goes along with developing new technology as it is put into use (largely a result of doing the installations). The work created 12,000 jobs in the state.

According to the governor's announcement, the total of what has been done since 2011 and what is now under development will take the state 95% of the way to its goal of six GW by 2025, which was mandated when the Climate Leadership and Community Protection Act became law, in 2019.



The 6.1-MW array in Bethel, New York. (Courtesy photo)

New York Lieutenant Governor Kathy Hochul was quoted in the new announcement saying, "By reaching the historic milestone of three gigawatts of solar installed in New York, we can now power more than a half million homes with clean energy, while also creating good jobs and attracting further investment in our State's green energy economy."

The announcement especially pointed out community solar projects. The state is leading the nation in community solar installations. In 2020, the state had its most productive year ever for community solar installations, with 549 megawatts of capacity installed. The majority of these

were supported by NY-Sun incentives.

Today, because of the NY-Sun initiative, the state of New York has solar installations on the roof or ground-mounted on the property of 145,000 homes, and they can be found in every one of the state's counties. The incentives provided by the initiative came to \$1 billion, and they produced \$5.3 billion in private investment.

Altogether, the progress New York has made covers the electricity needs for 522,000 homes.

Clearly, the state of New York is making remarkable progress on its goals for renewable energy. It is reducing carbon emissions, reducing pollution (and thereby reducing medical costs), and reducing the costs of electricity.

In this age, when many people worry about the state of the American democracy, we could add one more thing worth note: There is not much in this world that supports democracy more than solar power at home. ♻️

Maine's Promising Clean Energy Future

Toby Martin

Maine's climate change leadership found a new focus in 2019 with the inauguration of Governor Janet Mills, who based her pre-election campaign on strong environmental and climate goals, science, economics, and her conviction that Maine could take a leadership role in reducing U.S. carbon emissions and building a clean energy economy.

The new governor went to work and influenced sustainability policy and decision making at state, regional, national, and international levels.

"Maine Can't Wait" became the Mills motto and call to action, affirming Maine's mission, commitment, urgency, and purpose, echoed in energy policies and initiatives, across public, private and nonprofit sectors, mainland and island communities, educational institutions, and businesses of all types and sizes throughout the state.

She immediately formed the Maine Climate Council, where she assembled teams of Maine experts to frame plans that would meet the needs of Mainers and ensure their future. She selected Hannah Pingree of North Haven, a midcoastal island, to head the Office of Policy Innovation and Future and co-chair the Climate Council, to create Maine's strategic plan for a clean energy economy and offset negative climate impacts. The plan was completed a year later, in December 2020, on schedule.

Efficiency Maine, a state agency, supplements the Maine Climate Council's work by connecting consumers with approved energy contractors and dealers, aided by rebates, loans and other economic incentives for residences, businesses, industries, and municipalities. This serves to implement infrastructure goals, including LED lighting, heat pumps, wood and pellet stoves, heating equipment and systems, electric vehicles, vehicle charging stations, insulation, and weatherization.

State nonprofits influence Maine's energy and environmental sustainability. Maine Conservation Voters, in the capital of Augusta, evaluates Maine's senators and representatives on high environmental voting standards in its annual nonpartisan report, A Climate to Thrive. On Mount Desert Island,



University of Maine's VoltturnUS is a floating concrete structure that supports a wind turbine, designed by University of Maine Advanced Structures and Composites Center and deployed by DeepCwind Consortium in 2013. (Wikipedia)

advocates for grassroots efforts such as community solar energy, vehicle charging stations, and pledge programs that lower carbon footprints, plastic and single use waste, and it offers youth advocacy and internship programs. The Island Institute, in Rockland, offers diverse educational, small business, and energy team programs, grants, and a coveted Island Fellows program for recent college and university graduates, and environmental impact studies for Maine's coastal and island communities. And climate advocacy work is happening through Sierra Club, Nature Conservancy, and 350 Downeast chapters.

Maine island, coastal and mainland communities work on energy, conservation and sustainability at the municipal level and through community action teams and town committees. The Mid-coast has the D94 Group, District 94 residents sharing sustainability ideas and serving on town committees; one of its members is State Representative Victoria Doudera, serving Camden, Islesboro and Rockport, first on the Energy, Utilities and Technology Committee, and now on the Environmental and Natural Resources Committee.

Islesboro, a mid-coast island community with under 600 year-round residents, has been involved in sustainability more than a decade, with organizations devoted to energy, the environment, protection of open spaces, native species and natural habitats, clean air, soil and water, like the Islesboro Energy Team (IET), the Islesboro Energy Committee (IEC), Islesboro Islands Trust (IIT), and Pesticide Safety on Islesboro (PSI). IET is known statewide

for its Islesboro Energy Conference and community action programs. IEC handles municipal energy efficiency in many areas. It has retrofitted street lighting with LEDs, installed solar power to supply electricity for town operations, air-sealed and weatherized the Islesboro town hall which includes offices, a health center, fire and police station, and is continuing with even more plans for the coming year for both the town library and transfer station buildings. More broadly, the IEC is framing a strategic plan that aligns with Maine Climate Council objectives.

Maine's colleges and universities including College of the Atlantic (COA), Bates, Bowdoin, Colby, Unity, and the University of Maine system offer interdisciplinary programs and student action groups that focus on climate change. Among the impressive facilities and offerings in Maine were:

- COA and Colby were ranked among the top college sustainability programs nationally in 2019,
- UMaine's Senator George J. Mitchell Center for Sustainability Solutions has over 40 professors and interns working to meet its public service objectives, and
- UMaine's Aqua Ventus wind turbine initiative is developing offshore wind prototypes, adding to wind turbines on the Fox Islands and at Camden Regional High School already at work.

Maine is making a strong impact on climate change, sustainability and green economic growth efforts across the entire New England region. Its organizations, businesses, nonprofits, grassroots groups and legislative bodies are working to overcome widespread barriers to efficiency, sustainability and environmental justice with leadership, regional responsibility and influence, and Maine is committed to meeting its share of New England's climate change and sustainability needs.

It's clear Maine can't wait and Mainers are aware that the state's wide-ranging sustainability initiatives are already having an impact abating greenhouse gas emission and are also developing a skilled transitional workforce and economy for Maine's future. ☺

Community Leaders in So. Portland, ME Win Big against fossil fuels!



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This summer, residents won with a huge step forward for clean air. Community leaders passed a bill that requires the companies that own oil tanks in Maine to test for tank emissions and monitor air quality!

South Portland neighbors came together to pass this bill when they realized their air was being polluted by dozens of oil tanks. These tanks had been polluting above and beyond the legal limit for years—and they are right near homes, schools, and daycares.

Testing and monitoring for pollution are critical first steps to protecting the air we breathe. This bill will protect communities living next to oil tanks across Maine, including Searsport, Bucksport, Hampden, and Bangor.

And secondly, after six years, the company seeking to bring tar sands through South Portland has given up the fight! The company dismissed its appeal of the federal court judgment that upheld the city's Clear Skies Ordinance, effectively ending their lawsuit against the city.

This victory comes after years and years of community action.

Years ago, neighbors formed the group Protect South Portland to fight the tar sands pipeline. In 2014, they pushed the City Council to pass the Clear Skies Ordinance—which blocked ExxonMobil's plans to load tar sands oil onto tankers in South Portland's harbor. That plan would have included two 70-foot smokestacks spewing toxic chemicals.

These victories show that even fossil fuel giants are no match for neighbors who come together to fight for their community. Congratulations to 'Protect South Portland'. ☺

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SAVING PETS AND THE PLANET

AT COLUMBIA-GREENE HUMANE SOCIETY

Jessie Haas

In 2013, the Columbia Greene Humane Society (CGHS) in Hudson, New York built a highly efficient, solar-powered building.

Prior to building its new state-of-the-art facility, CGHS, an animal protection organization serving over 5,000 animals a year, was making do with older buildings that got the job done, but had become run-down and sadly in need of repair. The no-kill shelter places thousands of animals and hosts thousands of visitors. It's the kind of place that needs to create a welcoming, clean, healthy atmosphere, and that's hard to do in an older, battle-scarred building.

The impetus behind the new 22,000 square foot shelter building came primarily from executive director Ron Perez, who is familiar with efficient technology from his on-demand hot water system at home. The shelter building was designed by Len Angerame Architects of Albany, New York, a company which specializes in senior living architecture; has a beautiful reception area, meet and greet rooms, and all the fixings to keep animals healthy and comfortable as they find their new families. Engineer David Robinson, on the CGHS board, was also part of the design process. The building was constructed by AOW Associates, a general contractor in Albany, New York.

A non-profit, CGHS funded the new building through donations, bequests, and sponsors. They also took out a mortgage, which has already been paid off. Perez says, "From soup to nuts it costs \$15,000 to run the place, which is very impressive for this size building and facility."

According to Nancy Mallory, publisher of Green Energy Times (G.E.T.), who adopted two Newfoundland dogs from the shelter, "...the way they do things there as a non-profit is super impressive. They took care of vet checks, even spaying and neutering both [dogs] at no cost to me (would have been over \$300 for my local vet to do..."

The efficiency features and solar array allow the CGHS facility to be close to net zero. Efficiency designed into the building from the very beginning reduced the need for electricity to a level that the solar system could meet. That starts with blown-in insulation in the roof, and foam on the outside of the building. LED lighting came courtesy of a \$16,000 grant from NYSERDA (New York State Energy Research and Development Authority). The shelter uses Energy Star refrigerators. Both the LEDs and the efficient appliances reduce the need for



Columbia Greene Humane Society in Hudson, New York built a highly efficient, solar-powered building. (Courtesy photo: Ron Perez)

cooling in the summer, as they don't produce excess heat while running.

The dishwashers, made by FAGOR, are the type used in bars and restaurants. They have their own separate reservoir, allowing reuse of the water that is maintained at 180 degrees. That temperature is high enough to kill pathogens, and the machines use a short, intense wash cycle of just 45 seconds. This saves water and energy, and uses very little soap. Hot water is supplied by a propane-fired on-demand hot water heater, which is extremely efficient, and as Ron says, "saves you a ton of money."

The building is heated and cooled with top-of-the-line Carrier heat pumps. Ron said, "...the logic in them is impressive in that it saves energy and money." The heat pumps were installed by Eastern Heating and Cooling of Albany, NY. The heat pumps carry most of the load; when the outside temperature goes down to 18 degrees, a high-efficiency propane backup system automatically kicks in. The energy recovery ventilation system (ERV) normally exchanges the air twelve times an hour. The shelter arranged to have a dial put on so at night the system only exchanges twice

an hour, saving a lot of money. It is turned up in the morning. ERV systems pre-cool and dehumidify air in warmer seasons, and pre-warm and humidify it in colder seasons. They reduce the needed capacity of HVAC equipment, reducing energy use, and help maintain a comfortable relative humidity and good air quality. The ERV system was installed by Sunlight General Capital (SGC), a solar energy equipment

supplier in New York City. SGC says on their website, "We build and finance renewable energy projects for our clients, saving them money compared to their regular utility bill, often at no upfront cost to them. We then operate these projects to maximize savings for our clients, while bringing strong and predictable returns to our investors."

The solar-system which powers all this was installed by Monolith Solar, later bought out by Eastern Heating and Cooling. Monolith offered CGHS a package which cost half a million dollars, but the energy payments still represented a 20% reduction in cost. Ron says, "The solar produces pretty much everything we need," which in a facility serving 5,000 animal clients annually, is a tall order, and a tribute to the thought and care put into efficiency.

The shelter later added a commercial wing more which houses a boarding facility and doggie day care. This was also designed and built (by AOW) with energy efficiency in mind, with Comfortmaker Soft Sound heat pumps (owned by Carrier) and blown-in insulation. The shelter, day care and boarding facility operate with very little waste. Plastic and stainless steel are washed in those efficient dishwashers. Donated food and treat bags represent most of the landfill waste. All cardboard is recycled, and poop is trucked off-site.

Good design, forethought, and efficient technology have helped CGHS save thousands of lives, and saved the organization many thousands of dollars that it has put to good use, rescuing animals in distress and connecting them to new human families. Are they happy they went solar? Perez says, "Oh yeah. Saves you forever. Will always save you money."

Source links available online in the posting of this article at greenenergytimes.org.

Jessie Haas has lived in an off-grid cabin in Westminster, VT, for 37 years. She is the author of over 40 books for children and adults, including *The Hungry Place*. ♻️



Sheba (later re-named SheSheena) and Bear (later re-named KoBear) where they came to live in their furever home. Their new home in Bradford, Vermont is also 100% solar-powered and highly efficient. (All images: N.R. Mallory)



Sheba and KoBear happily adjusted to their furever home in Bradford, Vermont. (Color intentionally left uncorrected.)

IT'S A SOLAR DAY IN THE NEIGHBORHOOD OF OXBOW VETERINARY CLINIC

Jessie Haas

The Oxbow Veterinary Clinic in Bradford, VT recently installed a solar system at its clinic, after years of discussion with *Green Energy Times* (G.E.T.) publisher Nancy Mallery. Mallery is a client and has been giving Dr. Christopher Spooner copies of G.E.T. for the office, always with a copy left just for him. Spooner also gets a good look at a neighboring



The 8.5kW solar array sits atop the new addition's roof at Oxbow Veterinary Clinic located in Bradford, Vermont.



100% solar-powered business, North Country Organics, every day on his way to and from work. Another neighbor is ARC Mechanical, which specializes in air-source heat pumps. So the local peer pressure is considerable and going solar is something Dr. Spooner has been interested in for a long time.

Mallery entrusts the care for her Newfoundland dogs to this local veterinary clinic. During a visit this spring, she was met with a surprise. "I was unaware of the new solar system until I stopped there this past spring. As I was about to leave, Chris came running out saying, 'I knew I would see you at some point. I have been waiting for you to come by. Come, follow me, I have something to show you.' He took me to the side yard and pointed my attention to look up. Lo and behold I saw the roof full of solar!"

Oxbow Veterinary Clinic is located in an old train station and has retained the historical look of the building while making many energy-efficiency im-



Christopher G. Spooner, DVM (left) and his wife, Aimee Spooner, DVM lovingly practice their great pet care.



provements. Finally, this past winter, the time was right, and Oxbow installed a full roof of solar. The 8.5kW system was installed by O'Meara Solar of West Topsham, VT. The array is comprised of twenty-seven 315W all-black Hanwha QCELL modules and a SolarEdge Inverter and optimizers. Electrical work was performed by the Eastman Electric crew from Pike, NH. The array has produced 3,661kWh in 2020. It was installed in July 2020. The array offsets increased power usage due to the addition of two new exam rooms and an

enlarged waiting room constructed in 2019. The fluctuations in size and equipment make the electricity usage a bit difficult to track, but certainly the new solar panels are making a strong contribution.

The location for the array was chosen based on the best solar location. Darren O'Meara, the installer, said, "The low sloped roof is the most southerly and will produce more than any other available surface. Grid-tied arrays produce most of their power outside of the winter months. For grid-tied arrays, most of the time we are optimizing for maximum yearly production."

How and why did Oxbow Veterinary Clinic go solar with all of the efficiency improvements? Here is how Chris Spooner described it, "When we first purchased the clinic, the windows were old single-pane windows with storm windows, and there were large spaces for heat to escape between the foundation and the rim joists. The building was cold and drafty.

The focus was to improve energy-efficiency, so we began with replacing the windows with double-pane Anderson energy-efficient ones. And work was done to seal the places around the foundation that were open.

Then we had an energy audit done to see what the recommendations

Cont'd on p.34



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RADIANT FLOORS PROVIDE INDOOR AIR QUALITY BENEFITS

Radiant floors bring energy-efficient, low-maintenance comfort to homes while promoting a cleaner indoor environment.

Kim Bliss

When the global pandemic forced lockdowns across the country and many employees were mandated to work from home, it brought a new focus on the need for sustainability and indoor environmental quality (IEQ) in structures. This trend is bringing energy-efficient solutions, such as radiant floor heating, along with renewable energy sources, such as geothermal and solar, to the forefront.

While hydronic radiant heating has been around for hundreds of years and has been the main form of heating homes throughout Europe for decades, the United States has lagged behind in adopting this technology, with only about four percent of homes using hydronic radiant heat.

In addition to its extreme thermal comfort that keeps warmth close to the body, hydronic radiant heating is also an exceptionally energy efficient means to distribute heat in a building and helps promote a cleaner indoor environment with better air quality.

Cleaner Indoor Air

In a hydronic radiant heating system, warm water flows through flexible plastic tubing embedded in a concrete slab or placed on top of, within, or underneath the subfloor. The warmth from the flowing water through the tubing radiates up from the floor to bring comfort to people in a space.

Because hydronic radiant heating systems use pumps to move water instead of fans or blowers to push air, the system does not circulate air and

anything air could carry – viruses, allergens, or odors – throughout the indoor space.

In addition to the air-quality benefits, hydronic radiant floor heating systems do not require ductwork, so it provides greater architectural freedom for building design, including expansive ceilings with open spaces.

Quieter Home Environments

Traditional forced-air HVAC systems and the ductwork associated with them are noisy. Most people are familiar with the loud sounds of forced-air equipment turning on and running to accommodate interior climate comfort. There is also the sound of the ductwork expanding and contracting as the hot air blows through the system and then cold air enters when the system is off.

Hydronic radiant floor heating is quiet. The water running through the tubing in the floors silently distributes warmth throughout a space without any noise. The mechanical-room parts, such as a boiler, pumps, manifolds, and actuators, also work quietly.

Best of all, radiant systems are practically maintenance-free. With the excep-



Underfloor heating system of water pipes with collector on the new building floor. (ronstik/Adobe Stock photos)

tion of boiler maintenance, the rest of the system does not require any annual work. Traditional HVAC systems, on the other hand, need regular replacement of air filters and equipment tune-ups that can add up over time.

Sustainability Advantages of Radiant Heating

Water has the capacity to transport heat 3,500 times greater than air. That means a hydronic radiant heating system that uses water to heat a space rather than air will be much more energy efficient. This is especially important because heating and electricity generation accounts for nearly 25% of all greenhouse gas emissions.

Radiant is also more energy efficient

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because the heat stays near the floor where people are located. In a traditional forced-air HVAC system, the hot air blows into a room and quickly rises to the ceiling.

Additionally, people are more comfortable with a radiant floor heating system at a lower thermostat setting, such as 68°F, than with a forced-air system at a higher thermostat setting such as 72°F. These four degrees can make a big difference in energy use over time.

Another benefit of radiant heating systems is the fact that they are installed in zones. This means occupants have a separate thermostat for each radiant-heated space. Not only does this provide custom comfort control when people are in a space, but it also makes the system even more energy efficient because people can keep the heat low in spaces that are not in use.

Best of all, hydronic radiant floor heating systems can become energy-sustainable when paired with sustainable heat sources, such as geothermal and solar. These types of systems can potentially provide a structure with free heat, which is the best form of sustainable comfort.

Hydronic's Superior Home Comfort

We mentioned comfort above, but there is more. Hydronic radiant floor heating systems are the most comfortable form of heat

Cont'd on p.24

See Why New York Homeowners are Making the Switch to Geothermal

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Air-source Heat Pump Installation Guide in Homes

Robb Aldrich

Electrification is all the rage. Modern air-source heat pumps (ASHPs) are fantastic technologies, and they can provide reliable, efficient, clean, affordable, and sustainable heating and cooling when done well and in the right application. I worry that these caveats are too

often glossed over. I've also seen really bad heat pump installations, and I think it's easier to screw up a heat pump than a boiler or furnace.

Below is an overview of the process I suggest for good ASHP installations. The focus here is on homes, mainly in colder climates. I use the generic second person, so "you" can refer to different people in different steps.

Be clear about your goals.

Why are you considering a heat pump? For cooling? To save money (now or later)? To get rid of on-site fuels? For health and safety? Practicality? Comfort? To reduce CO2 emissions? Do you want to heat and cool the whole house or just one space? Any or all of these can be viable. How you approach a project, design systems, and select equipment really depends on goals. For example, if you're primarily interested in cooling, that may change how you consider heat pump performance



Three air-source heat pumps at a home. (All images courtesy of SWA)

in cold weather. What follows generally focuses on systems that provide most (or all) heating and cooling to most (or all) of a home.

Consider the envelope.

For many reasons, ASHPs are more effective in homes with lower loads. Really think about practical envelope improvements before you install a heat pump.

Calculate design heating and cooling loads accurately.

Let me emphasize accurately. ACCA Manual J is the industry standard, but in my experience, Manual J design loads are quite a bit higher than reality. I have my own spreadsheet based on ASHRAE Fundamentals, but very few folks are going to do that. Regardless of the tool you use:

Calculate loads for every room or space.

- Use appropriate 1% and 99% design temperatures.
- Don't add many internal gains.
- Don't fudge parameters to make loads look bigger.

Do your best to assess real insulation conditions (and/or improve envelope, step #2). Use a blower door to evaluate infiltration.

Determine configuration and distribution strategy.

Use 1:1 ASHPs when possible; avoid multi-zone heat pumps. Are you looking for a ductless solution for one or two spaces? Does a ducted system make sense for an entire floor? Or one central

heat pump? Multiple heat pumps? Consider how you might use existing ducts or add new ducts when necessary.

Select right-sized, climate-appropriate equipment.

ACCA Manual S focuses on this step, but it's for all types of heating/cooling equipment. Observant readers may see there are two #4 steps. That's because you may have to

go back and forth between steps A and B. My simplified take on this:

- Don't oversize heat pumps for the heating load.
- If you must oversize, go back to step 4a. Don't oversize.
- Don't be afraid of intelligent use of backup heat.
- Don't oversize for cooling, especially in a warm or mixed humid climate.
- If you must oversize for cooling, either reconsider your selections or look at alternative humidity control strategies.

There's kind of an art to selecting the best systems. It's an art based on hard numbers, but outside-the-box thinking can be very helpful.

Proper ducts and distribution.

Proper use of ACCA Manual D results in great duct design and distribution. ASHRAE duct sizing methods are also very good. Pay attention to details and big pressure drops (e.g., high MERV filters, which I often recommend). Also pay attention to available static from air han-

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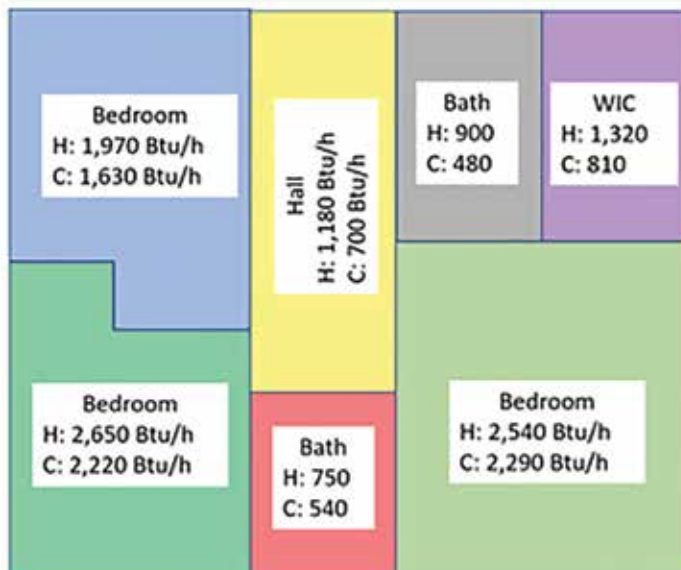
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dlers (you might have to go back to the steps #4a and b). Make ducts air-tight, use smooth fittings and transitions, and don't run ducts in unconditioned spaces.

Select proper controls. Wall mounted thermostats are recommended over hand-held remote controls. If other/backup heating is used

Cont'd on p.24



Example heating and cooling design loads (BTU/h) for one floor of an efficient home.



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RADIANT FLOOR BENEFITS

Cont'd from p.22

available. The reason radiant heat is so comfortable is because it most closely aligns with the ideal heating curve for the human body.

In fact, people in a radiant-heated space will actually feel warmer and more comfortable at a lower thermostat setting than people in a forced-air space at a higher thermostat setting. This is because forced-air HVAC systems are the most divergent from the ideal heating curve for the human body.

And, as stated previously, when forced-air heat enters a room, it quickly heads to the ceiling, so people can't keep an even heat near their bodies. Radiant heating, however, provides a consistent, even comfort that stays near the floor at all times.

Installing Radiant Floors

There are many different methods for installing a radiant heating system. For commercial applications, the tie-down method to wire rebar or the staple-down method to foam-board insulation is a typical installation for embedding the tubing in concrete slabs.

For residential applications with floors that have joists below, there are aluminum heat-transfer plates that fasten to the underside of the floor. The radiant tubing simply snaps into the plates and

the aluminum is an excellent heat-transfer medium to warm the floors above.

For the tops of subfloors, there are several different methods, including stapling to the wood subfloor, or fastening wood panels supplied with grooves for the tubing and an aluminum sheet on the underside to help transfer heat.

There are also knobbed mats that adhere to concrete floors. These knobbed mats make it easy to simply "walk" the tubing into the mats for a quick, easy method that doesn't require a lot of bending down.

Many radiant tubing manufacturers offer online or in-person training to learn more about the design and installation of these systems. It is very important to understand how to create a proper design of a radiant heating system before doing an installation.

For more information about radiant floor heating systems, research the various radiant tubing manufacturers across the United States or visit radiantprofessionalsalliance.org, heatinghelp.com or healthyheating.com.

Kim Bliss is the content development manager at Uponor.

This article has been repurposed with the approval of Green Builder Media, North America's leading media company focused on green building and sustainable living. For more information, visit www.greenbuilder-media.com.

Air-Source Heat Pump Guide – Cont'd from p.23

aside from the ASHP, consider automatic controls that will prioritize the ASHP and switch to backup heat only when necessary. This is not always straightforward, and you may need to do some research into specific products or control systems.

Good installation.

This is a big, important category – too big to summarize now. Good installation is critical for efficient, reliable, and comfortable ASHP operation. I covered this in some previous posts (<https://bit.ly/SWA-ASHP-ColdClimates>). Also see some of Jon Harrod's excellent posts on Green Building Advisor (<https://bit.ly/GBA-ReduceLeaks-HeatPumps>).

Proper operation and maintenance.

People using the heat pump need to know how to operate it, how to use controls, how to operate other heating

systems (if present), when and how to change or clean filters, when professional service is needed, etc.

Essentially, I think heat pumps need to be designed thoughtfully and installed conscientiously to perform well. I've seen way too much oversizing, one-size-fits all "designs," slap-dash installations, and very disappointed homeowners. I've also seen very accurate load calculations, great equipment selection, and meticulous installation lead to results that exceed everyone's expectations. This latter scenario is what I recommend.

Source links available with the posting of this article at greenenergytimes.org.

Reprinted with permission from Steven Winter Associates blog on June 7, 2021.

Robb Aldrich is a Principal Mechanical Engineer at Steven Winter Associates, Inc.

Colby-Sawyer College Reaches Milestone in its Sustainability Journey

Colby-Sawyer reduces emissions by 70%.

Jennifer White



Colby-Sawyer's Ivey Science Hall with a roof covered with solar pv, Feb. 18, 2013. (All images courtesy of author)

In 2020, Colby-Sawyer reached an exciting and important milestone along its sustainability journey. The college reduced its annual carbon footprint by 70% compared to its initial 2008 baseline, which is a reduction of more than 5,400 MTCO₂e (metric tons of carbon dioxide equivalent). According to the Environmental Protection Agency (EPA), this amount is the same as the annual CO₂ emissions from 650 homes' energy usage or the greenhouse gas emissions of 1,174 passenger vehicles driven over a year.

Because of the college's long-standing focus on experiential learning, the origin and continued evolution of sustainability at Colby-Sawyer has been student centered. Achieving this latest goal required significant collaboration and leadership

vestment in offsets. A few highlights are mentioned below but details regarding these many initiatives can be found in the Blueprint and on the college's website at colby-sawyer.edu/sustainability.

Since 2010, the college has run on green energy through the purchase of Renewable Energy Certificates (RECs) for 100% of its electricity consumption. In 2012, a campus-wide energy efficiency project, including upgrades to lighting, building envelopes and HVAC systems, resulted in \$163,000 of annual cost-avoided savings. The addition of a fifth rooftop solar array on the new Davidow Center for Art + Design in 2017 brought the total number of photovoltaic panels on campus to 745, which together generate roughly 380,000 kilowatt-hours of electricity annually.

At Colby-Sawyer, we encourage our students to make a difference and discover their potential to build a better world. And, as an educational institution, it is our responsibility to model the values that we hope our students and community will embody. Campus stakeholders continue to explore ways to journey further down the path toward carbon neutrality, enhance the resilience of both the

college and the region and contribute to a more sustainable future.

Jennifer White is the Director of Sustainability & Innovation and Assistant Professor in the School of Arts & Sciences at Colby-Sawyer College.



The college's wind turbine is seen behind Sue's Sugar House with the Curtis L. Ivey Science Center (left) and the Susan Colgate Cleveland Library/Learning Center (right) in the background. (Henrique Plantikow, Colby-Sawyer College's photographer)

from many students, faculty, staff and community partners. The process began in earnest in 2007 when students recommended that Colby-Sawyer become a charter signatory of the American College and University Presidents' Climate Commitment, in which the college pledged to be 100% carbon-neutral by 2050.

Student research helped build the foundation for both the original 2010 GreenROUTES Climate Action Plan, as well as its 2019 addendum, the Blueprint for Resilience and Innovation (<https://bit.ly/ColbySawyer-SustainabilityBlueprint>). Like many organizations, the college followed a carbon reduction hierarchy to systematically address conservation of resources, increases in efficiencies, installation of renewable energy systems and in-



Established in 2020 on a parcel of land located beside the President's House, the Main Street Garden was created in an effort to help combat food insecurity within the greater New London, NH community.

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Subtract: The Untapped Science of Less

by Leidy Klotz

Publisher: Flatiron Books, 304 pages, \$28.99

Book review by Victoria Ines

The title of the book *Subtract* happens to be a fairly accurate summary of its contents. Through seemingly unrelated experiments, personal stories, and professional experiences, author Leidy Klotz makes a solid case proving that subtracting could be an effective answer to many societal issues. Whether it is removing an unnecessary freeway in California, refusing to fund the apartheid system in South Africa, or extracting CO2 from the atmosphere, society has the potential to be drastically improved, simply by subtracting.

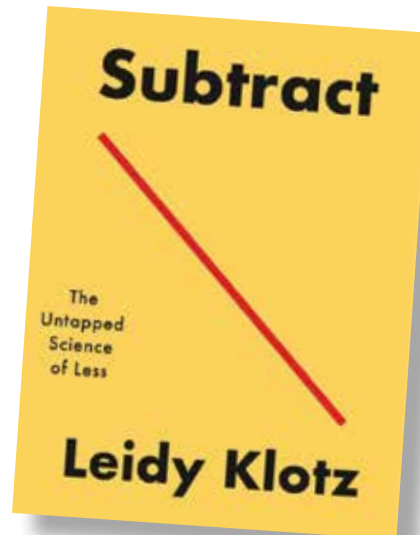
I often quip that it isn't "quality over quantity" that is rewarded, but "quantity over quality." As a rising senior in high school, I have had 12 years to experience teachers' natural bias toward more. Less is seen as the product of laziness, so more must be better. It is very rare for a teacher to request a maximum of (blank) words. Instead, students are almost always asked for a minimum word count. Even when teachers don't set a word or page limit, I often find myself adding more than is needed, thinking that the extraneous words will make my paper better. But this phenomenon isn't unique to teachers or students. Klotz bases his entire book on the idea that we all subconsciously prefer to add.

To demonstrate people's collective inclination toward adding rather than subtracting, we might consider

a simple example. In an experiment inspired by his three-year-old son, Klotz requested that participants complete a Lego bridge. To successfully build it, they must decide whether to add or subtract a single brick, without specific instructions. Even when told that the use of each extra brick would cost money, a majority of the participants still added.

However, when prompted with the phrase "you may add or subtract," more people chose to subtract. This phenomenon indicated that most people did not even consider the possibility of subtracting, but when prompted, decided that it was a good idea.

Klotz acknowledged that the issue is not necessarily that people add. Instead, it is that people do not even consider the act of subtraction as an option. By removing an entire category of potential solutions, humanity is preventing itself from finding the best option. Granted, for some instances adding could be a better choice. The key, he says, is that both adding and



subtracting must be implemented simultaneously. For instance, the number of pages in *The Code of Federal Regulations* – which lists all rules written by each federal agency – has increased by 1,800% in 70 years. While many useful rules have been added to the code, agencies have neglected to subtract outdated rules, which can waste resources.

Of course, it would be impossible to discuss the constant adding of humans without considering the damage we do with this practice. More specifically, humans have been the main source of carbon emissions for a long time, leading to some devastating consequences. Klotz's solution for climate change is probably clear at this point -- subtraction. The question, however, is "how" and "in what way." According to Klotz, we must learn to triage. Most people -- whether they have taken it to heart or not -- have heard of the aphorism, "reduce, reuse, recycle." This is, after all, one of the first environmental lessons that a child learns. However, while

Klotz admits that the 3 R's are, for the most part, a step in the right direction, they neglect the most important R -- remove. Rather than becoming "carbon-neutral," countries should aim to be "carbon negative." Although Klotz has no concrete answer for how this will be achieved, Costa Rica, one of the pioneering nations in carbon removal, provides an effective solution that utilizes both adding and subtracting -- adding trees with a goal of subtracting CO2.

The final chapter addresses how we can now turn this new knowledge into wisdom -- in other words, how to use subtraction to combat climate change and other social issues. "It is by stripping down elements of the system that we find essence." Essentially, once the unnecessary information is pruned and the important information is known, it can be used. We are in dire need of such wisdom, so I suggest that people read this book. Widespread acknowledgment of the ideas outlined in "Subtract" could be the beginning of an entirely new method of approaching climate change.

Victoria Ines is a rising senior at Shenendehowa High School in Clifton Park, NY. She is passionate about working to protect both the environment and endangered species. After high school, she would like to attend college to study engineering or biology. ♻️

The Effect of Climate Change on Our National Parks

Roddy Scheer and Doug Moss

The effects of climate change can be felt all over the globe in various ways, but America's national parks seem to be suffering more than U.S. overall land mass. A 2020 study by researchers from UC Berkeley and the University of Wisconsin found that "human-caused climate change has exposed the U.S. national park area to more severe increases in heat and aridity than the country as a whole and caused widespread impacts on ecosystems and resources." Since 1895, annual average temperature of the area of the 419 national parks has increased at a rate of 1.8°F per century, double that of the U.S. as a whole. Precipitation declined significantly on 12 percent of national park area, compared with just three percent nationally.

What's driving this exaggerated response? One theory holds that national parks are feeling the heat more because they tend to be located in extreme environments to begin with. Their rarer ecosystems are in some cases fragile and less resilient to change than the average backyard or suburban park.

Some of the specific ways national parks are affected disproportionately include twice as much wildfire decimation and tree mortality from infestations and disease as non-parks lands, the melting of glaciers in northern parks in the continental U.S. as well as Alaska, a loss of bird species and biodiversity in southerly parks, and sea level rise at coastal sites everywhere.

According to Patrick Gonzalez, the study's lead author and a UC Berkeley climate scientist, climate change could increase temperatures in some U.S. national parks by as much as 16°F by 2100. "This could melt all glaciers from Glacier National Park, raise sea level enough to inundate half of Everglades National Park, dissolve coral reefs in Virgin Islands National Park through ocean acidification, and damage many other natural and cultural resources."

Some individual parks are taking matters into their own hands and channeling some of their maintenance budgets to bolster ecosystem resilience to the climate-induced changes already underway. Biologists in Joshua Tree National Park, for example, are cordoning off sections of the park to reduce the trampling of sensitive plants in particularly biodiverse areas. And Florida's Biscayne National Park is raising heat-resistant local corals they hope can play a role in stemming the tide



Yellowstone National Park, home of the Old Faithful geyser pictured here at sunset, is one of the nation's hardest hit when it comes to negative impacts from climate change. (Roddy Scheer)

of underwater biodiversity loss.

While these efforts are laudable and are no doubt helping address a dire situation, the only way to really turn things around across the board is to reduce overall greenhouse gas emissions. Gonzalez underscores the importance of energy conservation and efficiency improvements, renewable energy, public transit and other actions to reduce global warming. Unlike any other time in history,

the future is in our hands today. Whether or not our grandkids will get to see glaciers at Glacier National Park may well depend on actions we undertake today.

Links: "Human-caused climate change in United States national parks and solutions for the future," <https://escholarship.org/uc/item/9443s1kq>; Climate Change in National Parks, <https://www.nps.gov/chis/planyourvisit/upload/Brochure-ClimateChangeIn-NationalParks.pdf>; Report: Greater Yellowstone area expected to become warmer, drier with changing climate,

Links: "Human-caused climate change in United States national parks and solutions for the future,"

<https://bit.ly/Human-caused-US>; Climate Change in National Parks, <https://bit.ly/CC-National-Parks>; Report: Greater Yellowstone area expected to become warmer, drier with changing climate, <https://bit.ly/CC-Yellowstone>

EarthTalk® is produced by Roddy Scheer & Doug Moss for the 501(c)3 nonprofit EarthTalk. Contact: question@earthtalk.org, www.emagazine.com. ♻️

HUMAN HEALTH AND THE HEALTH OF OUR ENVIRONMENT



John Bos

Massachusetts State Senator Jo Comerford wrote an important op ed article in Massachusetts' Greenfield Recorder on June 24 entitled, "Bug, Weeds and Health" that immediately connected me to what Rachel Carson (Rachel C) had written about just shy of 60 years ago. This connection was prompted by Jo C's sentence, "How do we transform the ways that we prevent mosquito-borne illnesses with the well-being of our environment as the top goal?" Several paragraphs later, she nails her concern in this exquisite existential statement, "...the intersection of human health and the health of our environment."

Jo C's statement is like a pebble thrown into the pond of my environmental awareness. The pebble's splash causes ripples that attempt to reach the ever-receding shores of secure knowledge about how to avoid the increasingly unavoidable impacts of our climate crisis.

In her attempt to better understand the impact of pesticides on public health – including the "forever toxin" PFAS – Jo C has formed a task force that includes "scientific experts and representatives from organizations concerned with land conservation, river protection, wildlife protection, organic agriculture and pollinators."

This leads me back to Rachel C who began her career as an aquatic biologist in the U.S. Bureau of Fisheries and became a full-time nature writer in the 1950s. Carson's widely praised 1951 bestseller *The Sea Around Us* won her a U.S. National Book Award. Her next book, *The Edge of the Sea*, and the reissued version of her first book,

Under the Sea Wind, also became bestsellers. This sea trilogy explores the whole of ocean life from the shores to the depths. Rachel C would turn over in her grave if she were alive today to witness the decline of our ocean's health.

In the late 1950s, Rachel C began to focus on conservation. She had first encountered the subject of DDT, a "revolutionary" new pesticide lauded as the "insect bomb" (after the atomic bombings of Hiroshima and Nagasaki)! DDT was only just beginning to undergo tests for safety and ecological effects.

By late 1957, Carson was closely following federal proposals for widespread pesticide spraying. The U.S. Department of Agriculture (USDA) was attempting to eradicate fire ants. Other spraying programs involving chlorinated hydrocarbons and organophosphates were on the rise. For the rest of her life, Carson's primary professional focus would be the dangers of pesticide overuse – the focus of Jo C's op ed article.

Silent Spring, Carson's classic and best-known book, was published on September 27, 1962. The book describes the harmful effects of pesticides on the environment and is widely credited for inspiring a grassroots environmental movement that led to the creation of the U.S. Environmental Protection Agency.

Rachel C's biographer Mark Hamilton Lytle wrote that Carson "quite self-consciously decided to write a book calling into question the paradigm of scientific progress that defined post-war American culture." Her combination of "scientific knowledge and poetic writing" reached a broad audience and helped to focus opposition to DDT use. The overriding theme of *Silent Spring* is

the powerful and often adverse effect humans have on the natural world. Where have you heard that before?

In 2012 Silent Spring was designated a National Historic Chemical Landmark by the American Chemical Society for the book's role in the development of the modern environmental movement. This acknowledgement is more than perverse and ironic given the fierce opposition by chemical companies in their attempts to stop the publication of *Silent Spring*. Velsicol Chemical Corporation (exclusive manufacturer of chlordane and heptachlor) threatened legal action against the book's publisher Houghton Mifflin, The New Yorker and Audubon unless the planned *Silent Spring* features were canceled. Chemical companies like DuPont (a main manufacturer of DDT) and associated organizations produced a number of their own brochures and articles promoting and defending pesticide use. Kind of like today's brochures from fossil fuel companies touting green energy.

American Cyanamid biochemist Robert White-Stevens and former Cyanamid chemist Thomas Jukes were among Rachel C's most aggressive critics, especially of her analysis of DDT. According to White-Stevens, "If man were to follow the teachings of Miss Carson, we would return to the Dark



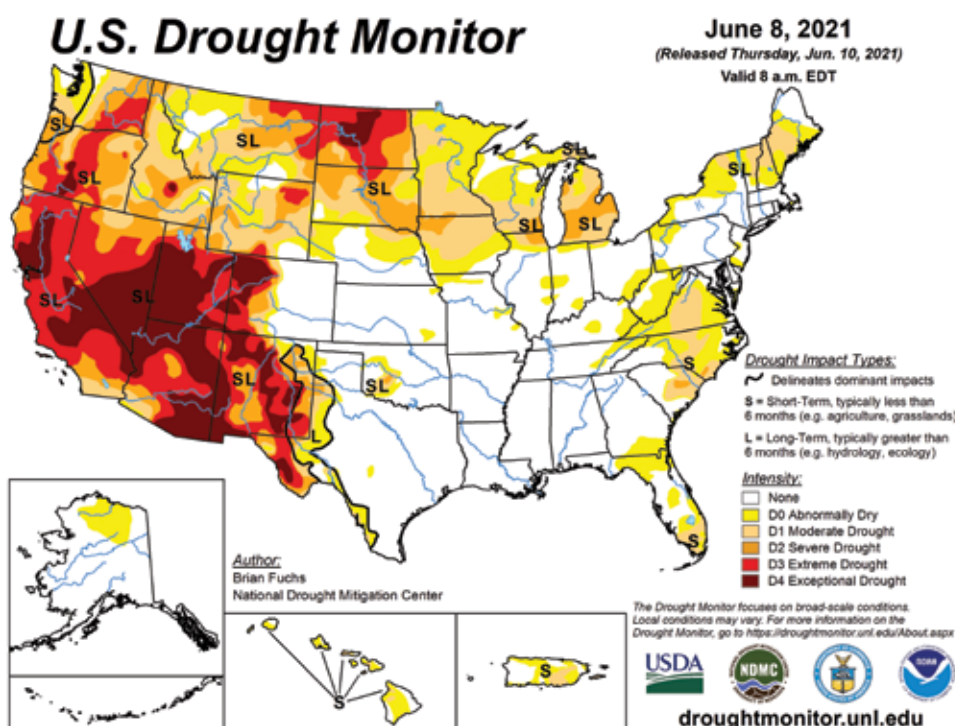
Rachel Carson "Force of Nature" (Time Magazine cover).

Agas, and the insects and diseases and vermin would once again inherit the earth." Others went further, attacking Carson's scientific credentials (because her training was in marine biology rather than biochemistry) and her character. White-Stevens labeled her "a fanatic defender of the cult of the balance of nature." What?! Upsetting "the intersection of human health and the health of our environment?"

My state senator Jo C, together with Massachusetts Congressman Jim McGovern, along with several environmental groups, hosted a public forum on July 14 to build public awareness of PFAS and to encourage widespread and sustained public action. I hope that neither she nor her counterparts throughout New England encounter the kind of obstructionism that Rachel C faced six decades ago in what is today's climate of anti-everything.

John Bos has been writing about climate change, then the climate crisis and now the climate emergency for ten years. He is a contributing writer for *Green Energy Times*, *Citizen Truth* and appears bi-weekly in the *Greenfield Recorder* in his column "Connecting the Dots." He has followed the career of Senator Comerford since she was appointed Executive Director of National Priorities Project in 2012. Comments and questions are invited at john01370@gmail.com. ☕

Double Trouble – Cont'd from p.1



I will use an analogy to explain. Suppose you want a soft-boiled egg. It is to cook for three minutes, so you can get the luscious yolk you crave. In a way, the heat of the boiling water is like the carbon emissions that trap heat. Pay attention here: Carbon emissions are not like the fire under the pot. They are like the heat of the water in the pot. And the Earth is like the yolk. When you turn off the heat, the boiling stops, but the residual heat is still there and the egg just keeps cooking. To get an egg the way you like it, you have to be proactive and take it out of the boiling water, not simply turn the

fire under the pot off and leave the egg in it. If you aren't proactive, your egg will be hard-boiled.

Carbon emissions don't heat the Earth. They make the atmosphere more able to trap heat, which heats the Earth. Once emissions are in the atmosphere, they will keep on heating the Earth for a long, long time, perhaps centuries. And now, what we learn is that the atmosphere is twice as able to trap heat as it was only fifteen years ago. Furthermore, since the carbon dioxide and methane content of the atmosphere is still going up, the ability to trap heat is still

increasing quickly.

Now, look at the Western United States. The U.S. Drought Monitor at the University of Nebraska, Lincoln, publishes drought data every week on Thursday. In its last report, nearly 60% of the West was in extreme drought, and nearly 28% was in a drought described as worse than extreme.

In California, 94.75% of the state is in severe drought or worse, and 85.44% of the state is in extreme drought, and 33.32% was in drought that is worse than extreme. There is practically no snow pack to melt, the reservoirs are so low that some are becoming unable to produce any electricity. The irrigation system is providing no water to farmers in many places. There is no rain in the forecast, as the West sits under a static heat dome. And please remember, we are talking about the state that recently produced 57% of the vegetables eaten in

the United States, according to the USDA (www.bit.ly/Vegs-2017).

As bad as things are right now, they will almost certainly get worse, unless we can act to stop them.

Stopping the use of fossil fuels is an important step, but it will not suffice because we have allowed things to go much too far already. That is why I think that net zero by 2022 would not be enough.

Unfortunately, not only have we not started getting close to net zero, we haven't even started reducing our emissions. Because we have delayed so long, we will have to start going into a strongly net-negative scheme of pollution and emissions, drawing down carbon dioxide. And we have to do that NOW. We are already suffering for the delays of the past. And that suffering will get worse, too. ☕

Weather Patterns have Changed and storms are more severe

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UNDER A WHITE SKY – THE NATURE OF THE FUTURE

By Elizabeth Kolbert

Crown Publishing 2021 \$28, 234 pages.

Book review by N.R. Mallery

Most of us have probably heard of or read Elizabeth Kolbert's Pulitzer Prize-winning book, *The Sixth Extinction*. In it, she brought our attention to the climate emergency in a way that leaves us alarmed and desperately searching for solutions. Hopefully we will find them in time to prevent the worst of the impending devastation that will come if we do not get our emissions under control.

Under a White Sky is about available solutions. They are what the people most involved have been working on as



Elizabeth Kolbert, author of the Pulitzer Prize-winning book, *The Sixth Extinction* and her new book, *Under a White Sky – The Nature of the Future*.

the climate continues to change at an alarming speed. Scientists had hoped it would not turn into an emergency so quickly, but here it is.

After days of thinking about what I learned from the book, I really don't think it is a doom and gloom portrayal of what to expect for our future and our ability to tackle the climate emergency. Kolbert writes about the latest and (perhaps) greatest research and trials in attempts to prevent the worst case scenario for the future of our planet and our existing lifestyle from unfolding.

Learning about the research and work on the problem currently under way is somewhat comforting. But there is so much at stake if they get it wrong. We surely need to put much more attention to the toughest problem humanity will likely ever have to deal with.

Kolbert's research and personal experiences with the differing solutions brought out in the book present an incredible sense of reality. Some of the solutions being explored made me a bit hopeful because they are being seriously explored. Some made me cringe and have nightmarish visions, nearly in tears for what my grandchildren might face.

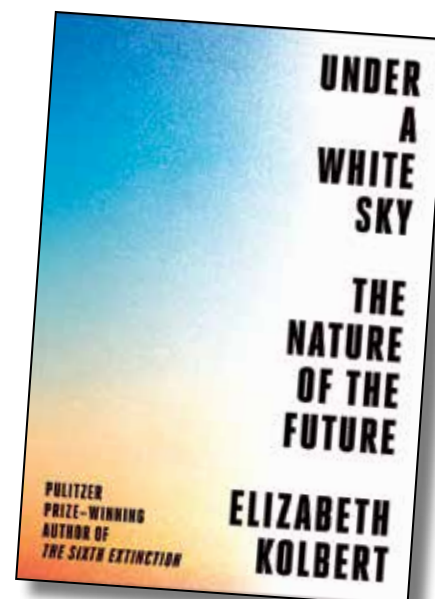
Kolbert writes about effects of a changing climate that have already become real, effects that go beyond drought, floods, and wildfires. There is an Asian Carp explosion around Chicago, while the Devils Hole pupfish near Death Valley in Nevada are driven to extinction. Corals are dying in Great Barrier Reef and off the coast of Hawaii, and giant cane toads are invading Australia.

But she also looks into solutions, including negative emissions. She bought into one of the ways that is currently in use by a company called Climeworks. This company made it possible to bury some of her own emissions, and that enabled her to write this book.

Climeworks launched its "pioneer" program in Iceland, after much research and development with their direct-air-capture operations. Kolbert explained that once captured, CO₂ has to go somewhere, and the place it goes needs to be secure. The technology this company is using is really quite simple and actually not new, having been implemented for 50 years in applications like submarines. The captured CO₂ can be deposited into basaltic rock in underground storage, where it is turned into stone in two years. The book explains the details of this.

Kolbert even explores geoengineering from labs in AU and in the USA. The information is frightening, concerning, and enlightening at the same time. She discusses the good, the bad, and the ugly she has seen in her research and travels.

Under a White Sky made me understand that we still do not have to jump into options that could possibly go very wrong. But we surely cannot waste any



time either. There are many knowledgeable, intelligent teams of people who are working hard to find solutions. Hopefully, we will not need what Andy Parker, the project director for the Solar Radiation Management Governance Initiative, was talking about

when he said, "We live in a world where deliberately dimming the f***ing sun might be less risky than not doing it."

I wish I could say that the book left me more hopeful. It did not. But do I recommend that you pick up a copy and read it? Absolutely. I just pray that humanity can still live under a blue sky, instead of one that is white.

N.R. Mallery is the publisher/founder of Green Energy Times. She lives and works sustainably in Vermont from an off-grid, solar-powered high-performance home where she grows most of what she eats from the permaculture-encouraged landscaping. ♻️

TRUST, TRUTH AND FREEDOM



Dr. Alan K. Betts

Green energy businesses in the Northeast all understand that trust is central to developing and deploying new technology. Trust depends on honest, truthful and clear explanations to the public. The climate crisis requires a long transition of more than a decade.

The COVID crisis has clearly shown how trust is central to public communication. Vermont was the first state to reach the key 80% vaccination coverage for those over age 12. Governor Scott and Health Commissioner Dr. Levine and staff held weekly on-air press conferences, explaining how to manage COVID, encouraging vaccination, and outlining the steady progress towards re-opening the state. With public questioning by reporters, it was clear that the Governor and his staff were telling the truth and could be trusted.

I am stressing this because the critical value of the truth has faded during the last five years, as the webs of lies in the public arena have grown. The Fact Checker web site lists over 30,000 false or misleading claims made by the recent ex-president during his four years in office. Of course, politicians have long misrepresented the truth to justify their political agendas and please their financial sponsors – but never on this scale. Even after he was defeated in the recent election, Trump and his supporters have continued to spread lies.

Finally, the Big Lie arrived, the opposite of the truth that Trump lost the election by a large margin. The bizarre aspect is that this term was coined by Adolf Hitler in his book *Mein Kampf* (1925) to describe the use of a lie so "colossal" that no one would believe that someone "could have the impudence to distort the truth so infamously." Trump loves big lies, so this fits him very well. He can pretend to believe in his personal Big Lie that he won the election, even though he lost.

Then I realized he chose Hitler as his hero because he admires him as a dictator who used these lies to destroy democracy. Remarkably, most of the Republican Party (but not the Republican Governor of Vermont!) have abandoned the U.S. Constitution to join him in following Hitler as the party of the Big Liars. Now many Republican states are using lies about election integrity to pass bills that restrict voting by citizens whom they fear might vote for Democrats.

The web sites of lies about the vaccines for COVID-19 are another disaster for America. Trump was responsible for the deaths of a quarter of a million or more

people from COVID by lying about its severity, and the need for testing and protective strategies such as wearing masks. Now web sites run by mostly Trump supporters are lying about the vaccines and encouraging others not to be immunized. This will prevent the country from recovering quickly from COVID. Tragically some of his own supporters who are trapped in this sticky web of lies are now suffering most from ongoing COVID infections.

So, take a deep breath and join the real living world of summer. The direct



Fake news concept. (Bits and Splits, AdobeStock_166689723)

teaching of the indigenous Aramaic leader Yeshua (known to us as Jesus) was crystal clear: "Step with me into the living world of the Creation and ye shall see the Truth and the Truth will set you free." This is about joining with the Creation, not

proclaiming human power over nature. This was and still is heresy to human power. Jesus was crucified and the early Christians were persecuted for centuries for not obeying human power and authority. But in 325AD the Roman Emperor Constantine (whose wife had converted to Christianity) summoned the Christian bishops to the Council of Nicaea and offered them a clever deal. Persecution will

end if you destroy the holistic Aramaic gospels and drop the fundamental truth about joining with the living Earth system. Rewrite Christianity as a basic creed. The Roman Church was created based on human and Imperial power, but not the Truth that sets you free.

The misuse of human power in relation to the Earth has continued and evolved for 1700 years (see *Climate Change and Society* at alanbetts.com). Today we have a real vivid choice. We must either accept the Truth that sets us free, or the many evil webs of lies that trap us in a desperate effort to destroy society.

As your summer vegetables grow, see the living truth grow in the sunshine and warm your heart. This spring we had a huge crop of spinach and lettuce that overwintered under glass. The winter climate has warmed a lot over the last ten years (as the Arctic is melting), and the broccoli planted in April are ready for harvesting. I chuckle because the warming Earth is ignoring the 139 politicians that have been bribed by the Fossil Empire to deny climate change. While these politicians choke on their webs of lies, every head of broccoli and bunch of peas that we grow is a reminder that the Truth is free, and tastes so good.

Many find it hard to face both truth and freedom, so the way forward for America seems fuzzy. Fortunately, the Earth backs the Truth every time, and humanity has so little power unless we back the Earth. Remember that trust, truth and freedom cannot be separated.

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a climate scientist: see alanbetts.com. ♻️

Bite the Frost – And Go For Net-Zero Energy House Plans

George Harvey

Gwendolen St. Sauveur has a background that almost looks like it was designed for the job she is starting to do. After earning an Associate of Applied Science degree in Architecture and Building Technology at Vermont Technical College, she spent two years at a lumber company, Allen Lumber, doing residential design and estimates. During that time, she also worked through a Bachelor of Science degree in Construction Management. She then joined a multi-disciplined engineering firm, DuBois & King, as a Mechanical Electrical and Plumbing Design Engineer. There, she assisted in the design of hundreds of commercial building systems, ranging from hospital suites to waste water treatment facilities, for seven years.

One thing that St. Sauveur learned is that there are a lot of stock designs out there that are not very good. She said that she was dismayed to have people come in with sets of plans that cost thousands of dollars, asking how much the materials would cost to build the houses they had decided on, only to discover that building them was not practical, safe, or even possible. There were plans that had stair cases that did not line up between floors. There were designs that were not energy efficient. Some people bought plans for houses too big for them, because the sizes were unclearly represented. Some plans were for warmer climates, where efficiency was not as important, and some were definitely not designed to accommodate the snow loads people should expect in the Northeast.

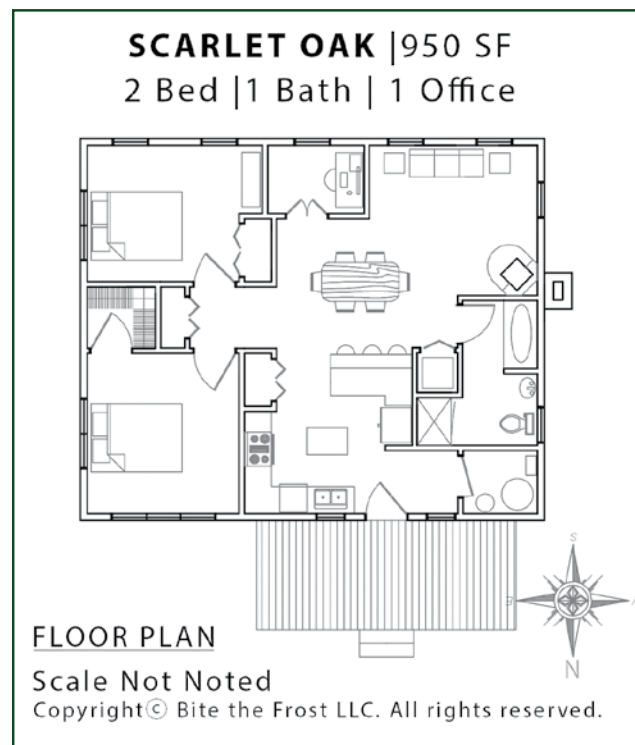
She has spent the last year working at Vermont Mechanical Inc., as a Mechanical Engineer, doing construction coordination, including for HVAC and piping systems. It is a job she calls both challenging and beautiful. One other thing it also does is to provide further education.

With greater background, St. Sauveur has not stopped learning new skills. She has become very interested in solar design, so she can design solar photovoltaic systems, currently learning to specify their components and construction.

All that learning, on the job and in college, has given St. Sauveur a deepening passion for homes that are both efficient, comfortable, and recognizably traditional in their designs. She is putting that to



Above: rendering of The Aspen home; right: rendering of the floor plan for another home, The Scarlet Oak. (BTF)



work on her own. In 2015, she started up a company that produces house designs aiming at net-zero energy use. She has named her company "Bite the Frost," usually shortened to BTF. BTF has a website, bitethefrost.com. Visitors to the site can soon see St. Sauveur's passion at work. It starts by describing the company: "BTF is a SMALL Architectural & Mechanical HVAC design firm: Specializing in space, energy & resource efficient homes." To focus on the net-zero aspect of this, the site also says, "We are extremely excited to be one of the first firms to offer Net Zero and fossil fuel free stock home plans," and "We've made it easier to build Net Zero, than ever before."

Early on in her business, St. Sauveur saw that there was a market for designs for net-zero homes that was unaddressed. She aimed to have her business fill that gap to make building easier for net-zero homes. That means contractors find it easier to build, and it also means ordinary people can find plans that are very much what they want. To do this, BTF is operated based on a set of guiding practices St. Sauveur has developed. We will mention a few.

Some building designs on the market could lead to houses that are not built to code. Some contractors seem to be willing to build houses that are not to code, and in some places, Vermont being one, inspectors let code violations slip by. St. Sauveur takes care to be sure that all designs are strictly to code. Codes met are listed on BTF's website.


BTF designs include mechanical details in the plan specifications. The mechanical details and systems designs provided are also fossil-fuel free. This is not a Net Zero requirement, but St. Sauveur says emphatically that it should be. These are elements that should not be left to chance. Having them specified also reduces the contractors' office work.

Net-zero construction requires tight buildings, but this means there is a need for ventilation and humidity controls. Leaving control of the ventilation to occupants can be a problem, because some people forget to turn the system on or off. St. Sauveur has a solution for this which is to have household ventilation on all the time, with a small fan and simple heat exchanger. Bathroom and kitchen systems to

vent humid air can be operated as needed. And BTF designs do not ventilate humid air into the attic, as some other designs do.

One big thing about getting to net-zero is to orient the house properly. One specific side of the house should be oriented to the south. St. Sauveur takes care of this by building orientation into the plan. This is made easy by making all sides aesthetically pleasing from the outside.

This leads me to an observation I have

made looking at the set of designs offered. I have always been irked that many houses seem to be built to have convenient window placement for room layouts without regard to how a house looks from any angle except the front. The BTF designs are exceptional in that regard, and all the houses look nice from any direction. To see this, go to the website given above and scroll down to see "Free Downloads." Have fun! 



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INNOVATIVE BUILDINGS FROM VERMONT

So, You Want to Build a House?— Part Two

Barb and Greg
Whitchurch

Now that you've passed the quiz on Part 1 published in the June-July issue of Green Energy Times (www.bit.do/get-house-part1), let's just dive right into Part 2.

Credentials: There are now so many designers and builders who've built to the performance standards mentioned in Part 1 that there's no reason to waste time talking to those who haven't, or who are hesitant to start. These updated standards are practical solutions. If someone starts throwing return-on-investment (ROI), or payback figures at you, ask them to show you where your health, comfort or safety figure into their equations. Resale? Repair and maintenance? Resilience in weather events? All these figures into today's home design standards.

Back in 2013, we needed to add on a cottage for Greg's elderly parents. The builder we chose (www.MontpelierConstruction.com/) happened to have one guy who was just finishing up his exam for PHIUS certification; yet that was enough to get us all on the right track. So, in the end, a bunch of newbies turned out a multiple-award-winning, PHIUS+ Certified, Net-Zero Passive House (PH) on our first try. We

worried a LOT, but it wasn't rocket science (www.bit.do/phc-vtbiz2). (For cash and tax incentives, see pages 14-15 in any issue of G.E.T.)

Strategies For Getting Everything You Wished For: Perhaps you'll turn the basement into an office a little later. You could do without the deck or the garage for a little bit. Get the granite counter tops after a year of accumulated savings on your energy bills.

We know of many folks who've initially settled for painted plywood floors in some rooms, polished wooden countertops, an

unfinished spare bathroom or such, knowing that their minuscule energy bills would allow them to address those wants even better in the near future.

Do It Yourselfers! If you can build a "high efficiency" house, you can build a PH. It's not technically more difficult. Like creating a fine meal: just a little more expense on a few items, plus more time and care with the prep, will see you through to an exceptional result. And if the value of your home is a concern for borrowing or resale, then you'll want verification along the way, as well as certification at the end. So, sign up

with PHIUS, Efficiency Vermont, or PHI for their consultation and certification services.

Cautions: The profit made by the builder

is anchored to his or her ability to pay as little as possible for materials, and to spend as little time as possible getting the project to completion. Cutting corners where the homeowner can't see them, and not fixing mistakes, are far more common than you think, and only later discovered when remodeling. Verification is the solution.

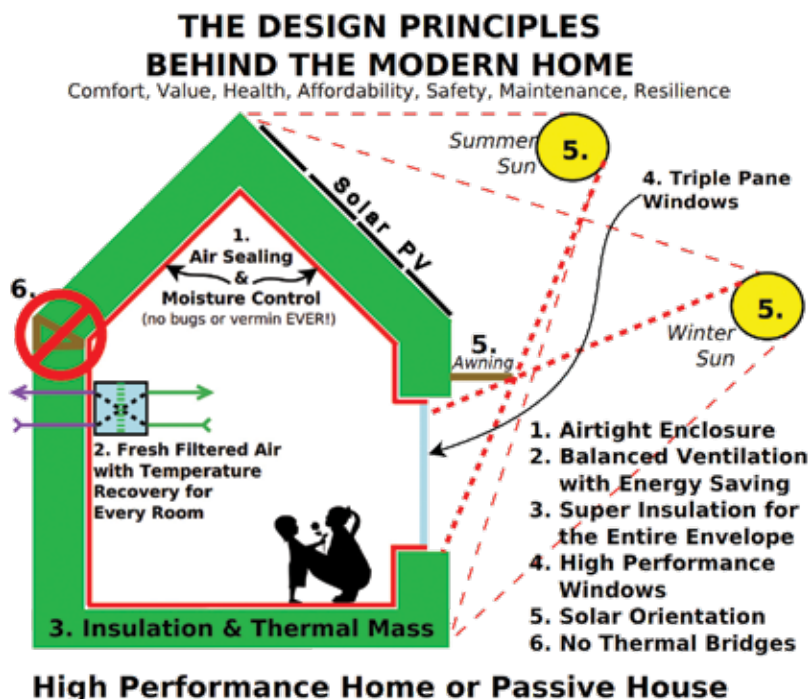
Some Perspective on Standards: Like so many other pursuits, homebuilding has evolved as an accumulation of gradual improvements over time. The "super-insulation" of 20 years ago is now considered inadequate. Healthful indoor air is only newly on the table. Safety from storing and burning explosives for heating and cooking is still a bone of contention (www.bit.do/gas-line-leaks).

But we've finally experienced an epiphany in the building industry. Like medicine and agriculture, building design has embraced science and engineering. We are no longer stuck with individuals'

making piecemeal improvements on their past work. We have Building Science now.

Certified standards based on building science use engineering

Cont'd on p.33



A Passive House in Vermont, 'way back in 2012.' (PHIUS)

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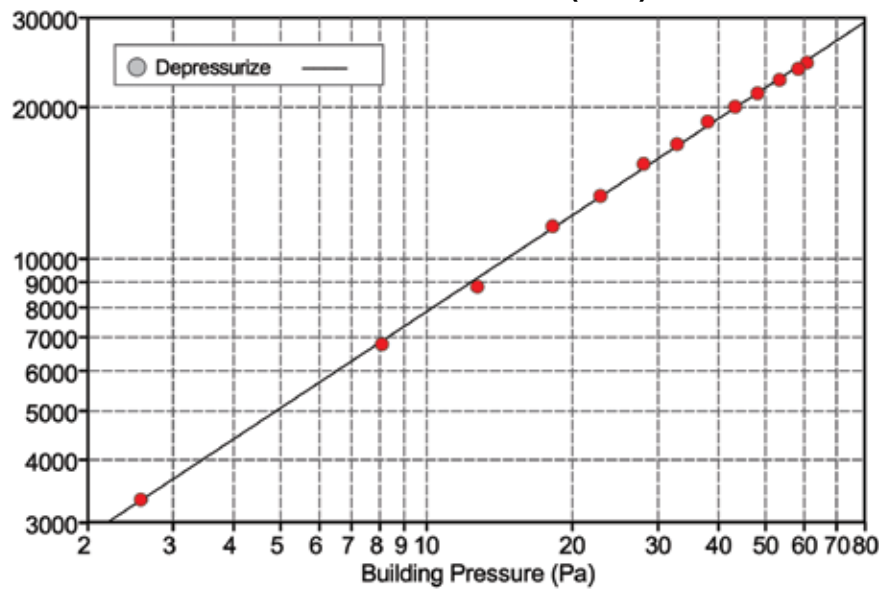
Gathering Data for A Wise Future

Nate Gusakov

Over this past year, I have been (and continue to be) spending a lot of time poking around in the attics and basements of some of the oldest institutional buildings in New England, right here in Middlebury VT. As Middlebury College begins to look beyond the Covid pandemic, its Energy2028 initiative is gathering steam (see <https://bit.ly/MiddleburyCollegeEnergy2028>). Part of the initiative is the stated intention to reduce building energy consumption (heating, cooling, hot water, and electricity) on its core campus by 25% by the year 2028. In order to measure this goal as accurately as possible, Middlebury College is gathering a lot of data about the current energy use of its large campus buildings. One of my roles in this broad initiative is to measure the amount of air leaking through the exterior walls, ceilings, and floors (collectively, the building envelope) of many of the campus buildings. Air leakage is a direct and preventable cause of winter heat loss and in a leaky commercial building, leakage may account for over 40% of heating energy use!

So, how do I measure the leakage in a 35,000 square foot building with a building envelope surface area of almost 60,000 square feet? It's the good old blower-door test, just scaled up to institutional size. Instead of a single fan, I'll use three or more fans (see picture 1) to move enough air to accurately measure the building's leakage. Instead of taking a reading at one pressure differential (usually 50 Pascals difference between inside and outside for a single-family home), I'll

BUILDING LEAKAGE (cfm)



A building air-leakage graph showing data points for leakage at different pressures. (Zone 6 Energy)

take readings at as many as a dozen different pressures to gain a more accurate building leakage curve (see picture 2). There are other factors to consider in a large-building blower door test. One example is outside air temperature. Very cold air is much denser than warm air, so flow and pressure measurements have to account for this difference and weather conditions have to be within acceptable parameters to conduct the test. Same thing goes for total building height (stack effect gets pretty intense when you get taller than three stories) and outside wind speed (Bernoulli's principle means that air moving past the measurement instruments outside will temporarily change the measured pressure, throwing off the consistent pressure differentials needed for testing).

Once the conditions are correct, the fans are set up, and the reference pressure manometers are stationed on all sides of the building and connected to the test computer via closed Wi-Fi mesh network, then the testing can commence. Once

measurements at all necessary pressures are complete, I have a very important number—namely the air infiltration rate of the whole building, expressed in cubic feet per minute at 75 Pascals (CFM75). Once I have this number, I'll leave the fans on cruise control and walk through the entire building, searching for and documenting air leaks. All of this information gets packaged into a report that contains hard data on the current performance of the building against which to measure improvements, helping the College prove delivery on its Energy2028 initiative intentions.

Nate Gusakov is a building envelope consultant and AeroBarrier installer for Zone 6 Energy. ♻️



A three-fan blower door set up to measure air leakage at Starr Hall (ca 1861), Middlebury College Campus. (Zone 6 Energy)

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Efficiency Vermont's Efficiency Excellence Network (EEN) Contractor Spotlight

The State of Heat Pumps in Vermont

A Conversation with Pat Perry, the owner of Vermont Heat Pump, LLC, of Shelburne, VT

Interview by Efficiency Vermont

Efficiency Vermont: What is your background?

Pat Perry: I worked as an electrical engineer for 30 years, and after that I started Vermont Heat Pump. I've had that business for almost 10 years now.

In a nutshell, how would you define a mini-split heat pump?

PP: Conceptually, a heat pump is an air conditioner that moves heat in either direction. You switch from heating to cooling via remote control, or via your smartphone or smart speaker using Wi-Fi. The term "mini-split" refers to the fact that the heat pump is split in two. There are separate indoor and outdoor units.

How did you get into the heat pump business?

PP: I first learned about air-source heat pumps from my brother, who had a friend in Maine who was in the business. They came and installed it, and it was great! I went from using 550 gallons of oil a year to using 100 gallons. At that time, Maine was ahead of us in heat pump awareness. No one seemed to have heard of them here in Vermont. So six months after I retired from IBM in 2012, I started the business.



How has heat pump technology changed over the years?

PP: It used to be that heat pumps were good only to about 30 degrees outdoor temperature. They were fine down South but not practical for the Northeast. Around 2010, because of concerns about the ozone

layer, the industry moved away from freon and transitioned to a refrigerant called R410a. R410a has a much lower boiling point, and this allowed heat pumps to operate efficiently at temperatures well below zero.

We are still using R410a today, but it needs to be phased out per the Montreal Protocol (on substances that deplete the ozone layer) in the next few years. We need a new refrigerant that neither is ozone depleting nor has greenhouse gas potential. Propane and CO2 are being considered, but there doesn't seem to be an industry consensus on what the new refrigerant will be.

What's your impression of the awareness of heat pumps in Vermont today?

PP: The people who have them love them, because they see how much money they save. So my experience is that every install I do can lead to five others, when homeowners talk them up. Demand is overwhelming.

The problem now is that we can't get heat pumps (as a result of pandemic-related shortages). There's a global shortage of the chips that have built-in Wi-Fi. Fujitsu has decided to deal with the shortage by offering a new model without a Wi-Fi chip, and if the customer wants, in the future they can update it.

I think that's a good design. For the units without the Wi-Fi controller, maybe the price will be lower. I think most people would be happy to save 50 dollars, and many of them never use the Wi-Fi control anyway.

What has the growth of your business been like?

PP: In my first year, I installed seven systems. The next year, it was 23; the next year, 43. The past four years I maxed out at 124 installs each year. I used to think about hiring somebody, but I didn't really want the hassle of employees, so I found a better solution. I got a couple of friends from IBM, trained them, and got them going with their own businesses.

So you created your own competitors?



PP: We still can hardly keep up with the demand. We help each other out, share knowledge, send customers to each other. For example, a single-zone unit weighs 87 pounds, and I can lift that by myself. But a multi-zone unit is 140 pounds. If somebody wants that, I send them to my friend who works with his brother. And having those [resources] allows me to go on vacation. Normally, if a unit has a problem, it's hard to find someone who will repair a heat pump they didn't install. But we all install Fujitsu. And we all will repair each other's installs.

How do people hear about you?

PP: It's mostly word of mouth. I am on Efficiency Vermont's website as a member of the Efficiency Excellence Network, and I'm listed on Fujitsu's site. And people tell me they heard about me on Front Porch Forum. ☺



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Bio-Concrete! *What is It, Why Might We Need It and How is it Used?*

George Harvey

Calcium carbonate is really amazing stuff. Of course, we all can visualize it easily. No? Well, it is the basic material in limestone, which the Great Pyramid was built of, and of marble. It is also the thing that makes many sorts of shells, including eggshells and clamshells. Bones get their strength from it, whether in fish, or chickens, or us. It is in pearls. Now is it easy to visualize?

One thing it is found in is the cement used to make concrete. It is one of the most used commodities we have. It is made by heating materials like limestone, driving off carbon dioxide (CO₂) from its molecular structure. Both the limestone and most sources of heat to make it into cement are significant emitters of CO₂.

But consider this. In nature, calcium carbonate is created without having to heat with a fire. Egg shells, clam shells, and pearls are all made by animals. Chalk was created by various single-celled life forms that deposit calcium carbonate. They used the chemical to stiffen themselves or to glue themselves to things or each other. But they need not be CO₂ emitters to do this.

For some time now, scientists have been looking at ways to use natural biological processes to make cement without heat and emissions. Instead of making a concrete block by mixing water, Portland cement, and sand in the correct proportions and letting it set, we can allow nature to do the bulk of the work. To do this, we might put the sand in a form, flood it with a liquid with the right sorts of nutrients, and employ a few billion microbes to glue the whole together.

The process of drawing down CO₂ from the atmosphere to make calcium carbonate is called microbiologically induced calcium carbonate precipitation (MICP). This is fairly new technology, in terms of what is available on the market. Nevertheless, there are a num-

ber of clearly defined needs it can meet to reduce carbon emissions related to cement and concrete.

Products based on MICP are already in commercial use in the United States, at least for making tiles for floors and walls in buildings. These are said to be both lighter and stronger than the tiles made using firing processes, with their CO₂ emissions. Tiles of a number of sizes, textures, and colors are available from Biomason, a company in North Carolina. Biomason claims their bricks have the lowest carbon footprint of any cement product on the market, eliminating a kilogram of CO₂ emissions for every kilogram of tile installed. Their website, www.biomason.com, may be worth a visit.

There are other uses of MICP. It is possible to create self-healing concrete. In this product, any cracks that form are sealed by the action of organisms

living in the concrete as dormant spores. The crack allows air and moisture to get to the spores, waking them up, and the organisms that emerge draw on calcium compounds in the concrete and carbon dioxide from the air to create calcium carbonate, which cements the crack shut, repairing the damage. The materials needed to do this are included in the concrete when it is made.

Another product is a liquid



A cement plant in Maryland. (Acroterion, CC-BY-SA 3.0, www.bit.ly/2R5ti4X)



Natural calcium carbonate, made here by a coral reef. (NOAA image, public domain)

containing nutrients to spray into cracks that have formed in concrete that is not already enabled for MICP. Similarly, products can be used to seal concrete and prevent water from leaking through it.

We looked for self-healing concrete or the materials needed to heal concrete and did not find any yet available in the United States. They are being introduced in Europe, however, by a Dutch company called Basilisk. (www.bit.ly/self-healing-basilisk)

We did find patent applications and patents that had been granted in the U.S. and internationally. We should probably expect to see these products in the U.S. market soon. ♻️

Better Concrete Here and Now

Greg Whitchurch

While it's heartening to read here about some of the research and development efforts for lower-carbon concrete, in the meantime standard concrete is contributing to irreversible climate damage.

Climate crisis disasters are driving "climate migration." A few years ago, Vermont created a commission to address the enormous stresses of soaring immigration to our sparsely-populated state. Ironically, as this influx drives bidding wars on Vermont homes and land, turning real estate sales into auctions, the use of climate-damaging concrete skyrockets as the newcomers build and renovate. And as we repair our outdated and climate-damaged infrastructure, even more concrete is employed.

We know that the cement used in concrete is a major contributor to climate change. The problem is cement's embodied carbon! (See www.bit.do/embodied-law) A LOT of carbon is released when making cement. This Girl Scout video is a must-watch: www.bit.do/cement-girlscouts.

How, you might ask, can I avoid some of concrete's CO₂ damage right now? You can start by asking your local concrete providers about their lower carbon concrete offerings or by insisting that your contractor specify low-carbon concrete.

I've contacted Vermont and New Hampshire suppliers. The two most popular cement replacement additives are fly ash and slag. Both are by-product waste from steel-making. My wife and I are installing a solar PV ground-mounted system at our home and will be using a 20% fly ash concrete mix for the foundation.

Replacing some cement with slag will result in a stronger final set, but current state requirements measure strength too early, when pure cement is stronger but before the slag mix overtakes it later on. This suggests that some engineering specifications could be updated to address these greener alternatives.

Contractors might argue to a homeowner that longer cure times interfere with their "business-as-usual" scheduling. Well, isn't that just too bad! Here's where your personal values and interests should be your guide, and perhaps serve as a learning experience for your contractor.

Do what you can, as soon as you can.

Greg Whitchurch powers his EVs with solar in Middlesex, Vermont. www.bit.do/gkw-li ♻️

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Meeting Building Performance Standards

How can energy-efficiency programs support building performance standards?

Steven Nadel

Washington DC, New York City, Washington State, and St. Louis have recently adopted mandatory building performance standards (BPS) that require many existing commercial buildings (and often multifamily buildings) to significantly reduce their energy use. Several additional cities and states are considering similar standards. This is an exciting trend, but it presents challenges for building owners who must comply.

Fortunately, existing energy-efficiency programs can help. In a new topic brief published on October 22, 2020, American Council for an Energy-Efficient Economy (ACEEE) explores how efficiency programs can best support BPS policies and how city and state officials charged with implementing them can work with regulators, so that these policies achieve their objectives of significant energy savings and greenhouse gas emissions reductions.

Energy-efficiency programs are now active in all of the U.S. jurisdictions that have either enacted or are seriously considering BPS. ACEEE interviewed state and local officials working on BPS implementation, utility and other energy-efficiency pro-

gram administrators, other experts, and some state utility regulators about the role of efficiency programs in BPS implementation. We conclude that energy-efficiency programs are critical to help jurisdictions implement BPS, because they can educate building owners and provide financial and technical assistance. Utilities and other program administrators have the skill set and resources to support successful BPS implementation. ACEEE recommends that utilities, cities, and states work together to ensure BPS success.

Regulators need to provide efficiency programs with credit toward their energy savings goals for helping building owners comply with BPS

In many states, legislatures or regulators have established energy savings goals that utilities must meet. For efficiency programs to be able to help with BPS implementation, they'll need to get proper credit for their work from the regulators overseeing them. In the jurisdictions covered by ACEEE's research, efficiency programs will receive such savings credit prior to the BPS effective dates. ACEEE

recommends that efficiency program implementors ramp up their programs prior to required compliance dates to help building owners prepare. Budgets should be adequate to meet expected needs with a focus on affordable housing and other under-resourced properties. Program implementers and regulators should work to minimize the possibility that sophisticated building owners will exhaust available program budgets and leave other owners (typically those that are smaller and have limited experience with energy efficiency) stranded without assistance.

ACEEE also found broad backing for continuing efficiency program support after initial BPS compliance deadlines to assist building owners who have not yet reached compliance and to encourage savings beyond minimum requirements. Full compliance is unlikely until multiple years after the nominal compliance date. Furthermore, depending on noncompliance penalties, noncompliance could be widespread. In these situations, program incentives will save energy and reduce emissions by helping to upgrade buildings that otherwise would have incurred penalties. In addition, ACEEE concludes that after BPS takes effect, efficiency programs

should continue to earn energy savings credits for improving affordable housing relative to current building conditions, as many of these buildings will be unable to meet BPS requirements without such assistance. For other buildings, a modified baseline should be developed that is between current building conditions and presuming buildings will be in full compliance with BPS requirements.

Overall, ACEEE finds that if efficiency programs are not involved in BPS implementation and not able to credit their efforts toward their energy savings and other goals, then compliance rates, energy savings, and emissions reductions will be lower, and in some cases BPS policies could be rolled back or weakened.

Cont'd on p.39

Build a House—Part Two

Cont'd from p.29

guides and modelling software to provide a checklist of methods and tests that ensure that you get what you want. Yet, it's still common to run across architects and contractors who dismiss these advances as "newfangled" fads. (www.bit.do/forbes-ph). Don't believe a word of that. Consider another architect.

Why are more and more countries and municipalities adopting the Passive House standard? Well, partly for its resilience in extreme weather. And partly because verification is an integral part of its process, thereby relieving governments of many of their building code oversight duties. In Massachusetts alone, the towns of Somerville, Newton and Cambridge have adopted PH as part of their building codes (www.bit.do/victorian-ph).

If your home can stand up to extreme weather events and, when the grid is down, run for days off solar, backup batteries, or your electric car, you're less likely to be one of the climate refugees sleeping in the local gymnasium.

The Whitchurches drive EVs and use induction cooking in their Middlesex, Vermont passive house. www.bit.do/gkw-li

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- no explosives storage or piping (www.bit.do/gas-house-explode)

Cost Savings:

- no kitchen or bath vent fans; balanced ventilation works better
- no vented clothes dryer; use heat pump or condensing dryer instead
- induction cooking range (faster, cooler, cheaper than gas or conventional electric www.bit.do/induction-pro)

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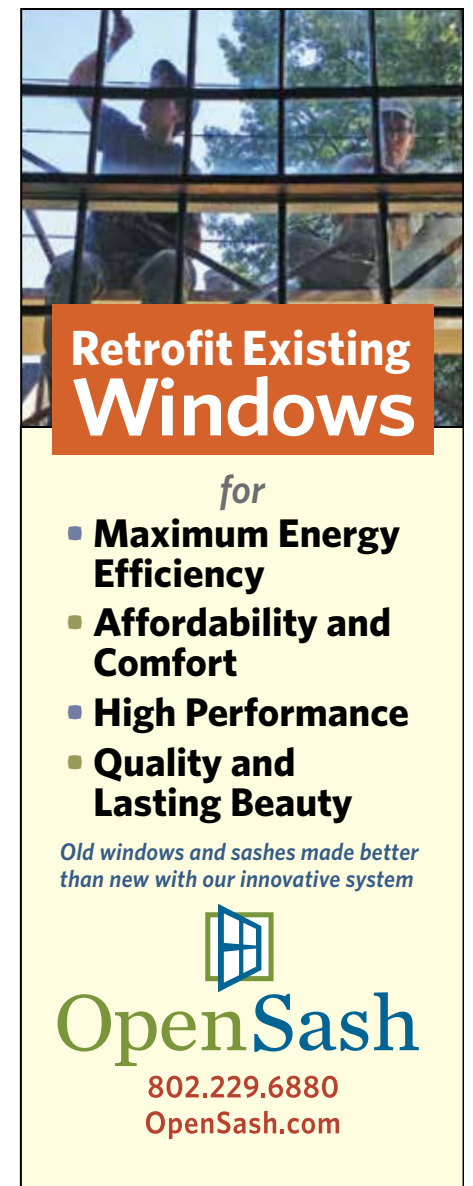
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ELMORE ROOTS' PERMACULTURE KNOW-HOW

Garlic in Love

Each night I ask the stars
up above, what is it like
to be a garlic in love?¹

This summer on the farm the trees and shrubs are so heavy with humid longing that they are just laying all over each other and filling every space with green leaves and branches. I just noticed this on one of my strolls along the paths through the meadows. We have a food forest here with nut trees leading to blueberries, currants and gooseberries leading to stream crossings and elderberries fanning out into weeping willow trees and a slope orchard.

What are these plant kingdom beings thinking about all day? Or as my mother once asked my daughter about her pet rodents, "How are they feeling?"

Sometimes they give us signs. They begin to wilt, this means "get my roots into water please, fast!" The wind is pushing them over, and they seem to look up at me and say, "Brother, go get a bamboo or black locust stake and help support my need to stand upright." Their leaves turn a bit tawny and yellow with color washed out, so I hear them asking for compost or liquid seaweed and fish to nourish them. When I am tuned in, I hear their call and follow through for them. They are our friends, our companions on the journey to consciousness.

They nourish us as we nourish and support them.

We go through life depending on plants to feed us. They depend on us to let them live in peace and harmony. Sometimes they fall in love. It is not so often you catch them in a warm embrace, as they are very modest. When we take a class on plant behavior, we learn that their whole makeup is focused on being attractive. Many plants rely on their attractiveness to get better pollination. This allows them to set seed and then there will be more of them in the world. This goes on season after season. Did you know that plants around us are trying to look their best?

We save some of our biggest and firmest garlic bulbs each year. We prepare a rich fluffy bed. Sometime in October, we gently divide the cloves and drop each one flat end down, pointy end up into the



What is it like to be a garlic in love? (Courtesy photo)

3-inch-deep holes we make with a tool called a dibble. Then we hoe over it and sprinkle some compost over the top of the whole bed. Garlic is one of the first plants up in the spring. It is also one of the first to be ready to harvest.

When they send up long tall hollow green "necks" which seem to float in the sky, you can snap these off and use this garlic green in

soups and pesto. Supposedly this helps the energy go into the garlic bulb, so you get larger garlic to harvest and store. In mid-summer, when many of the stalks are turning yellow, we harvest our crop and hang it on the wall tied gently together in bunches. They still need air and space so do not pack them tightly. We can enjoy this garlic all fall, winter and spring until it is time to visit the garlic again, growing in the summer sun.

I walk slowly over to the row of garlic. Their long necks are twirling in the sun. Some of them I leave, because they are so



beautiful and graceful like swans in the garden. Others I leave because I do not have the heart to disturb the ones who are so obviously in love.

David Fried owns Elmore Roots Nursery in Elmore, Vermont ☘

¹ This line in my song is inspired by one from a song by Mort Shuman and Jerome Felder.

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CARBON NEGATIVE PLASTIC CAN BE MADE OF AIR

George Harvey

Green Energy Times has published a number of articles about plastics. As I work on this one, one article that was printed in the August, 2015 issue stands out in my memory. It was called, "Good Plastics? Really?" (www.bit.ly/GET-good-plastics). In it, we covered plastics that are biodegradable and are not made from fossil fuels.

Now, we have word of another kind of plastic that was developed in Germany and is just now coming to market. The interesting thing about it is that its manufacture is carbon-negative.

That means making it draws down more carbon dioxide from the atmosphere than it releases. According to an article in *CleanTechnica*, manufacture of Made of Air (also the name of the maker) draws down two tons of carbon dioxide from the air for every ton of plastic produced (www.bit.ly/carbon-negative-plastic).

That might sound like some sort of smoke-and-mirrors act to some people, so an explanation may be in order. The Made of Air plastic is 90% carbon. This is not at all unusual. The basic unit in



Siding used on the Audi dealership in Munich, Germany. (Made of Air)

polyethylene is a molecule with a formula of C_2H_4 . Since that means there are four hydrogen atoms in every molecule, it really looks like the material is largely made up of hydrogen. In fact, it is, if we are just counting atoms. But when we are finding the weight, we have to take into account that the atomic weight of hydrogen is 1, and the atomic weight of carbon is 12. So, the ratio of weight in C_2H_4 is 24 parts carbon to 4 parts hydrogen. It is nearly 86% carbon, by weight.

If we consider CO_2 , we see that the atomic weight of the oxygen is 16, but

there are two oxygen atoms, so the weight of the carbon is only 27% of the total weight of the molecule. Going further, we can find that if we made a ton of polyethylene using only carbon dioxide from the atmosphere, it would actually take over three tons of CO_2 to give us the carbon we would need. So, the amount of draw-down reported by Made of Air is believable.

The plastic Made of Air is derived from waste from the agriculture and forest industries, along with some cane sugar. The company has broadly described the process.

The source materials are waste from agriculture and forestry, as mentioned above. This waste is rendered into biochar, which is made by heating the source materials.

The heat used to make biochar is usually created by burning the gases released as it is made, and the combustion does allow some CO_2 to return to the atmosphere. In the case of Made of Air, there is sufficient heat left over from the process that it can be used for other purposes.

Biochar is often used to provide fertility to the soil for gardening and farming, but in this case, it is a main part of the plastic.

It is infused with a binding material made from cane sugar. The result of this process is a thermoplastic, which means it can be cast and welded in the same ways as polyethylene and polypropylene.

Made of Air products have already been brought to market, but not in great volume. The products made from it range from frames for sun glasses to siding for buildings. Made of Air siding was used at an Audi dealership in Munich.

Made of Air claims that every step in the process of making the plastic is carbon-negative. The company is scaling up production and hopes to make about 100 times as much of it next year as it does now.

There is one thing about Made of Air that might raise a few eyebrows. As a thermoplastic, it can be reused, but the company says that it does not decompose, and the only way to release the carbon from the plastic is to burn it. The way we think these days might make this seem bad. But in this case, decomposition would put the carbon back into the atmosphere, precisely where we want it not to be. Made of Air is taking carbon dioxide out of the atmosphere and rendering it into a form we can sequester permanently. That is what we really need.

The Made of Air website can be found at: www.madeofair.com. ☘

Farmer Researches No-till Permanent Raised Bed for Small-Scale Farming

Debra Heleba

Growing vegetables in raised beds has become popular among gardeners, especially here in New England as this system helps the soil warm quickly in the spring and allows for good drainage. Jennifer Wilhelm of Fat Peach Farm in Madbury, New Hampshire sought to learn the potential of using permanent raised beds on a commercial farm scale through a two-year research project.

Wilhelm and her family started their one-acre farm in 2013. The farm's marginal soils compelled them to establish a no-till permanent raised bed system for their organic mixed vegetable operation. Beds were built by covering sod with hardwood chips about four inches deep and thirty-two inches wide with eighteen inches between the rows. Compost was laid on top.

Wilhelm rotates crops during the season and plants cover crops at the season's end to add organic matter and stabilize the beds. Black tarps cover the rows three weeks before they are planted to further warm the soil and kill any surface weeds.

Since little is known about the produc-

tivity of no-till permanent raised beds in commercial settings, Wilhelm received a Farmer Grant from the Northeast Sustainable Agriculture Research and Education Program (SARE) for a two-year experiment to investigate the system's weed suppression, soil health and yield potential.

Wilhelm researched the effectiveness of permanent raised beds for suppressing weeds. She conducted a weed-bank study where weeds were collected and identified weekly and soil cores were sent to the University of New Hampshire Greenhouse to assess weed germination that may have been suppressed by the system. The study revealed that the farm had a high diversity

of weeds but fortunately a low abundance of them. Wilhelm also monitored time spent weeding and calculated that about 3% of total farm time was spent weeding, costing the farm an average of \$547.50 per farm laborer per season.

To evaluate soil health, Wilhelm turned to Cornell University's Comprehensive Assessment of Soil Health. The assessment goes beyond a standard soil test and evaluates soil health dimensions including physical factors (aggregate stability, etc.) biological factors (organic matter and soil respiration), and chemical factors (soil pH, phosphorus levels and other nutrients). Test results showed that all soil health factors on the farm's growing areas were optimal. The beds had high organic matter suggesting that the system may effectively increase water holding capacity and prevent run-off. However, high levels of phosphorus were detected in both years of the study.

Since excess phosphorus can limit plant uptake of nutrients and can negatively affect water quality, this discovery showed Wilhelm that she needed to change the farm's fertility management practices. In addition, Wilhelm observed that first year plantings did not perform well, presumably because the wood chips robbed nitrogen from the soil, inhibiting plant growth.

For growers interested in this system, Wilhelm suggests, "Collect soil samples before beginning to get a baseline to compare with future samples. If using a carbon layer under rows, understand that it can take a full year for the system to establish the soil microbial community as well as to come to an equilibrium of the carbon-to-nitrogen ratio, which all can negatively affect yields. We suggest converting a portion of the total growing space and sowing a cover crop the first year, then rotating in cash crops until the desired area is converted."

Wilhelm also looked at the system's yield potential and concluded that after plots were established, permanent raised beds

produce consistent yields.

The research confirmed for Wilhelm that no-till, permanent raised beds can be a viable system for small-scale growers. She said, "The grant allowed us to collect data to tell a more complete story about the farm management system we use here. The data gave us confidence that the [permanent raised bed] system works well for building soil organic matter, producing high yields (after year one), and most impressively suppressing the weed seed bank." Full research results for Wilhelm's project can be found at https://projects.sare.org/sare_project/fne18-914/.

Debra Heleba is the regional communications specialist at Northeast SARE. Northeast SARE will be accepting applications for its Farmer Grant program this fall for projects starting in spring 2022. More information is available at <https://northeast.sare.org/>. ♻️



Jennifer Wilhelm of Fat Peach Farm in Madbury, New Hampshire conducted a Northeast SARE Farmer Grant research project on a no-till permanent raised bed system for small-scale mixed vegetable operations. (Photos: Carol Delaney)



Onions grow in no-till permanent raised beds at Fat Peach Farm. The beds were created with compost laid on top of hardwood chips.



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Elco Motors: Making Electric Boats Since 1893

George Harvey

In our last issue, *Green Energy Times* ran a story, "Fossil Fuel-Free Water Sports," in which we made a quick note of Elco, one of the oldest boat builders in the United States (www.bit.ly/fossil-free-boats). Elco was formed in 1892 as Electric Launch and Navigation Company. One of its earliest orders was for 55 electric launches, each 34' long, to provide transportation for the 1893 World's Fair in Chicago. Over a million people rode in those boats, and they led to growth of the company and its reputation.

Though Elco made electric boats, it also made some notable craft powered by fossil fuels. It supplied 550 80-foot submarine chasers for the First World War, and 399 PT boats for the Second World War. Perhaps the most famous boat in history was PT 109, captained by Lieutenant John F. Kennedy, later President of the United States.

Lately, various media, have run articles about electric boats that seem to make them out as a recent development. And they seem to tout the electric boat as something we might see in the not-so-distant future. Elco, however, was making noteworthy electric boats in significant numbers over 125 years ago. More to the point, Elco can set people up with electric boats today, at reasonable prices.

The information available in the news is not always accurate. A check of information on the world's first electric tugboat finds several claimants to the title, all appearing in the last two to three years. Elco, however, outfitted a tugboat with electric motors for its only power source. It has been operating on the New York Shipping Canal since 2014.

And while there are a large number of articles about electric solutions for boating that are appearing on the horizon, solutions that will be in the grasp of ordinary boat owners soon, if they are just patient, Elco has been building motors



Above: electric tugboat; right: electric catamaran. (Elco)

for electric boats, for years, based on both outboard and inboard of its own.

Elco's outboard motors have a range in size comparable to internal combustion engines of 5 hp to 50 hp. These are mounted similarly to gas-powered outboard motors, though they do also require batteries. The inboard motors are in sizes comparable to 6 hp to 100 hp. The above-mentioned tugboat has two motors, each of the 100 hp equivalent size.

Electric motors have many advantages over those powered by fossil fuels, such as reduced noise, freedom from emissions, and elimination of other pollution. And while reducing the cost of fuel, electric motors also reduce costs of maintenance. Perhaps the place this



shows to greatest advantage is the amount of time a motor or engine can be used before it needs maintenance. The internal combustion motor, with its many moving parts, might need scheduled maintenance every 2,000 to 2,500 hours. An inboard Elco motor, by contrast, has only one moving part, and scheduled

maintenance comes up every 50,000 hours. Assuming you use your boat for a full-time job, eight hours per day, fifty weeks per year, maintenance will be needed 25 years from now. If you use it less, it will need work less often.

Find much more information at their website: elcomotoryachts.com. ♻️

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HANOVER CO-OP FOOD STORES MOVES ON CARBON NEUTRALITY

George Harvey

With summer progressing, the Hanover Co-op Food Stores of New Hampshire and Vermont are about half way through an extensive set of efficiency projects at its Lebanon store. Most of the work is scheduled for completion this year. The projects are set up to allow for normal store operations and with little interference to customers' shopping. In fact, they are set up in such a way that many shoppers might not notice them at all.

Hanover Co-op Food Stores is striving toward achieving carbon neutrality by 2030. These projects may be small, individually, but they are important parts of that impressive, overall goal.

This year's work began last spring when the refrigerants the Co-op uses were changed. The new refrigerants have far lower global warming potential (GWP) than the traditional coolants. While refrigerants are to remain trapped within the system in theory, in practice sometimes there are leaks. The Hanover Co-op's proactive approach to reduce such impact is in keeping with its reputation for environmental stewardship.

GWP is measured by comparisons with carbon dioxide, which is rated at 1. The traditional refrigerant CFC-12 has a GWP

of 10,900, so its ability to capture heat warming the planet is that many times the ability of carbon dioxide. Newer, less environmentally destructive refrigerants are rated with GWP values 3 to 5, so the improvement brought about in the change is important (<https://bit.ly/3iwGQjs>).

Over the course of the summer, the store's HVAC system will be replaced. Many readers of *Green Energy Times* are familiar with this. It is an issue of vital importance to efficiency, with improved technology and increased performance opportunities that come with better weatherization.

To reduce the inconvenience for customers, the HVAC improvements will be made largely at night, when the store is not operating. The work is largely overhead, so while it is not actually being done, it will have little effect on people who shop or work there.

Limited disruption to the store will happen in the late summer to fall,



Turner Piping and Refrigeration work at night to pump out the old, less environmentally-friendly R404A gas from the refrigeration lines into the tanks. The tanks are weighed to know when they are full. (ReArch Company)

when forty-seven refrigerated cases are replaced. This is scheduled to be done in thirteen steps, one sequence per week. That means any disruption will be brief in any one area. Temporary customer inconvenience will be confined to small sections of the facility.

The last of the four steps will also come in the fall. It is to replace the store's fluorescent overhead lighting with LED lights. This step should be complete before the middle of November, so the hope is that shoppers for the holidays will not be inconvenienced at all.

The work on refrigeration is being done by Turner Piping and Refrigeration of Rutland,

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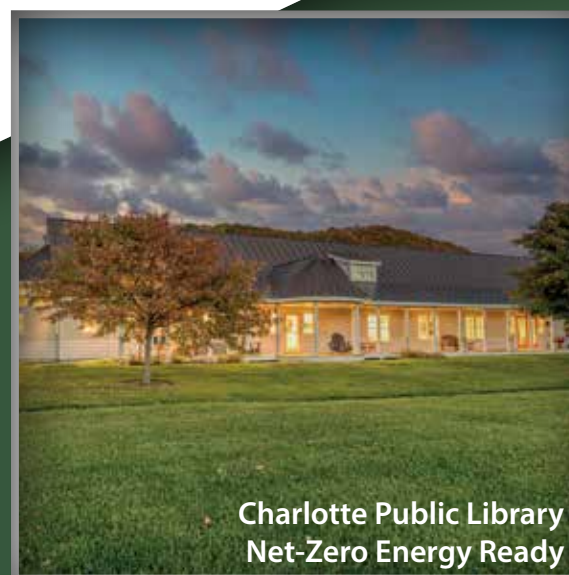
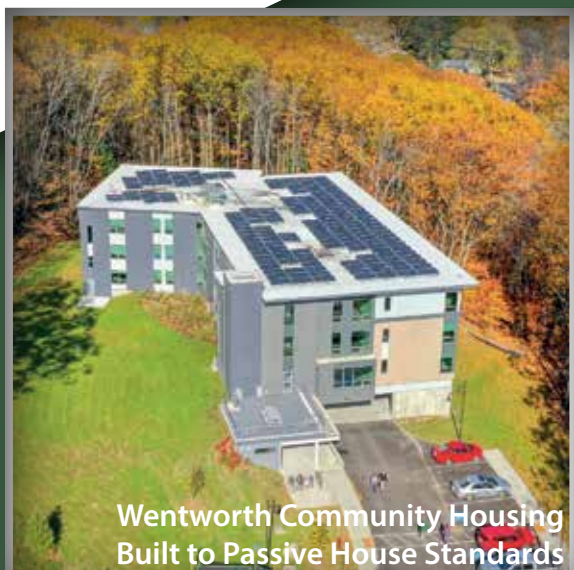
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Vermont. Vermont Mechanical of Williston, VT is doing the HVAC work. LED lighting upgrades will be performed by MEI Electric of Westfield and Williston, VT. Overall construction is managed by ReArch Company, which is in Burlington, VT.

The Lebanon Co-op Food Store is one of three large food stores, located in Lebanon and Hanover, NH, and White River Junction, VT. Hanover Co-op Food Stores also operates a smaller Co-op Market in Hanover, NH, in addition to two auto service centers and a production kitchen. The policy of Hanover Co-op Food Stores is to be engaged on environmental issues, including working on net-zero emissions.

Those who shop at the Lebanon Co-op Food Store should remember that they can also do so online. The Hanover and Lebanon stores and the Co-op Market have a common web site where orders can be placed for curbside pickup. There is an amazing number of products that can be purchased this way, 11,600 in Hanover and Lebanon, and 1,400 at the Co-op Market. The order needs to be placed at least 90-minutes before pickup on the same day. The hours of operation for curbside pick-up at Hanover and Lebanon are from 9 am to 6 pm, and for the Co-op Market they are from 11 am to 6 pm. The website for getting started is Groceries-2-Go (www.bit.ly/groceries-2-go).

For more information, please visit the Hanover Co-op Food Stores website which is at coopfoodstore.coop. ♻️

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Building Performance Standards

Cont'd from p. 33

Next steps toward implementation

BPS administrators (cities and states), with help from efficiency programs, will need to do the following:

- Bring stakeholders together and develop a common understanding of needs and intents.
- Educate building owners about the upcoming requirements and provide technical assistance on how best to bring their buildings into compliance.
- Assess workforce needs for BPS implementation and identify shortfalls and ways to address them.

Energy-efficiency programs and their regulators, with help from city and state BPS administrators, will need to lead stakeholders in developing an approach to providing ongoing technical and financial assistance to building owners seeking to comply with BPS.

We recommend that utility regulators decide how programs will receive savings credit well in advance of BPS compliance dates, so that city and state officials, building owners, and efficiency program administrators can plan their compliance and implementation activities.

Building performance standards can significantly reduce energy use and will be important for achieving long-term energy and climate goals. Energy-efficiency programs will be critical for BPS policies to be successful.

Learn more at <http://bit.ly/ee-programs-bps>.

Download the topic brief at <http://bit.ly/BPS-topic-brief>

Steven Nadel is the Executive Director of the American Council for an Energy-Efficient Economy (ACEEE). ♻️



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