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Disasters Hit 90% of USA in 2022

George Harvey

Hurricane Sandy hit the United States just over ten years ago. It formed as a hurricane on October 22, 2012, and dissipated on November 2. It caused about $65 billion in damages in this country, nearly all of which happened after it had weakened and was no longer a hurricane.

When the extent of the damage was understood, the U.S. Department of Housing and Urban Development (HUD) undertook a project, Rebuild by Design (RBD), with help of a number of non-profit organizations and funding from philanthropists. The purpose was to enhance preparedness and resilience.

At its start, RBD was a design competition, a function it has continued to fulfill through the years. It has, however, undertaken projects of other kinds. Recently, it created a book in pdf format, Atlas of Disaster (AOD), which has maps providing in-depth information about disasters in this country, at both the state and county level.

AOD is by no means trivial. It is over 340 pages long and has about 250 maps. The pdf file can be accessed at https://bit.ly/atlas-of-disaster, but we might suggest checking your computer to be sure you have disk space and memory for it, because the file is over 174 megabytes. When

Ortley Beach, New Jersey. (Office of the Governor of New Jersey)

I loaded AOD to look at it, the sheer size of it degraded performance of my computer enough that I had to shut the power off to reboot.

As other atlases do, AOD has a fair amount of text explaining and building upon the maps. But it goes into details of weather disasters on a state-by-state basis, with coverage for each county that has seen disasters. It gives a visual display of federal assistance, energy reliability, social vulnerability, and risks, with maps for each state, with its counties, together with a table giving information relevant at county level.

According to the text, 90% of the counties in the United States

Cont'd on p.3

Sustainability Strides in Chocolate-Making

Jessie Haas

Chocolate is good for us, body and soul, a source of copper, antioxidants, and joy. But good for the planet? Often not. Chocolate has an unfortunate association with child labor, slavery, deforestation, and habitat loss.

But there's more to the story. Pressure on the industry has led to change, with some big names like Hershey and Lindt leading the way. Smaller local companies are also doing stellar work, leading to good chocolate choices for every budget.

In 2019, Hershey embarked on a Science Based Targets initiative (SBTi) aimed at reducing the company's greenhouse gas footprint in alignment with limiting global temperature increase to 1.5 degrees C, the most ambitious designation available through the SBTi process. Hershey has entered into purchase power agreements enabling construction of three utility-scale solar farms. The most recent is a 140 megawatt solar and storage installation in Texas. Significant investments in manufacturing efficiency have reduced emissions and operating costs. 77% of electricity used by Hershey in 2021 was renewable or zero emission. The company phased out coal in India plant, transitioning to using rice hulls as biofuel.

Since 2015, the company has reduced packaging weight by 25 million pounds and has set a new goal of having 100% of plastic packaging recyclable, reusable, or compostable by 2030. It has also committed to ending deforestation across its supply chain by 2030 and to protecting water sources. Locally, employee volunteers recently planted 75 native trees at Hershey's technical center campus to filter storm water going into Chesapeake Bay. These will absorb over 200,000 lbs of CO2 over their lifetime. Volunteers also planted 600 trees on a nearby dairy

Cont'd on p.15

Hershey Signs Up for More Solar

WITH National Grid Renewables

Hershey's first utility-scale solar farm located in Camden, NC. The solar project is a 20 MW facility on 218 acres of land which reduces CO2 emissions by 32,025t/yr. (BayWa r.e) Hershey's Chocolate Bars (AdobeStock/547065949 & 332976356)

A Climate Scientist's Review of COP27

Dr. Alan K. Betts

The COP27 meeting in Egypt continued the annual discussion of key climate change issues and whether we are on target to keep the warming of the planet below 1.5ºC. Teams of people brought their enthusiasm from around the world, including many young groups to encourage decisive action to reduce climate change, but their access was limited. In contrast, there were 636 fossil fuel lobbyists to ensure their companies' profits were protected.

At COP26 in Glasgow, 153 countries made net-zero commitments, many for 2050, and put forward new or updated emissions targets, known as Nationally Determined Contributions (NDCs) that would probably limit the global rise of temperature to 2ºC. The global climate disasters in the past year make it obvious that we are already past critical thresholds, with 2020 the warmest year at 1oC above the 1880-1900 reference average. At COP26, nations agreed to phase out coal and fossil-fuel subsidies, and all agreed to make more ambitious emissions targets by the end of 2022.

However, since then, only 24 countries have revised and updated their emission-reduction targets. Australia is the standout where the new Labor government has pledged to cut emissions by 43% by 2030, and has laid out plans to increase investment in solar, electric vehicles and renewables to decarbonize. However, Australia is also making huge profits as the

Floods in Pakistan destroyed food systems and left 4000 homeless. (factly.in)

Cont'd on p.18

Electric Snowmobiles P.39 >>

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Concentration of CO2 in the Atmosphere

417.51
parts per million (ppm)
December 5, 2022

Learn more at www.CO2.earth.

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GREEN ENERGY TIMES (G.E.T.)

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A huge special thank you to all of our contributing writers:
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Ad Design/Layout ..... NR Mallery, PJ Fischer
Printing ..... Quebecor Media Printing using recycled-content paper as available and plant-based, environmentally safe inks.

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Our mission is to create Energy Awareness, Understanding and Independence – Socially Responsible Living.

Solar Power works! … anywhere under the sun!

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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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AdobeStock_482150038

LETTER FROM THE EDITOR-PUBLISHER

Here we are about to welcome 2023! The climate is still changing faster than we are getting our emissions down. Winter is here — as we continue to deal with the high costs for fuel — for heating and at the gas pumps. There ARE solutions. We again bring them to you in this last edition of 2022.

In this edition we continue to show how the Inflation Reduction Act (IRA) can help you with the costs involved as you make the jump to freeing yourself from the grip of the fossil fuel companies. I have never heard about anyone who has gone solar, PV particularly, and regrets doing so. Who can complain about not paying an electric bill or paying a much lower monthly bill? I know that I have not had an electric bill for 20 years. I have no complaints.

Solar continues to soar in the northeast and around the world. We are excited to share the floating solar project in our own region. The Cohoes, NY community just approved the project. Read the story on page 8. France is requiring all large parking lots to be covered with solar (p. 10). We hope we will soon follow their example in the U.S. northeast and throughout the country. Think of the jobs just waiting to happen!

Sustainable and affordable heating options are developing and available today. The incentives for geothermal are amazing, making it an affordable option. Check out the larger Heating Efficiency section on pp. 24-29.

Building does not stop in the winter as you will read in our Building Efficiency section (pp. 30-35). Keep those high-performance projects going — the costs far outweigh the value of a lower cost of living when you choose to build for efficiency. The Inflation Reduction Act, state incentives and rebates make better options super-affordable for energy-efficient appliances such as induction cookstoves. In the end, we can be rewarded with a healthful home and cleaner environment.

I want to take a moment to thank all of the volunteers who work hard to make sure you can find copies of *Green Energy Times* near you. We want to welcome two new distributors to our team: In the Connecticut River Valley, we are pleased to welcome Paul Dunne, whose home is solar-powered and who has been a *G.E.T.* reader for years. Todd Tucker has joined us to help with the outreach for the Greater Burlington region. Todd's home is solar-powered and he drives an electric car. Welcome Todd! Our team efforts are more sustainable than ever.

We also wish to thank our very qualified and excellent writers, some of whom volunteer their help. I want to thank them all for their enthusiastic efforts to help our message prevail.

Our *G.E.T.* team, along with our supportive advertisers are what, together, make *G.E.T.* happen. Thank you all for your support and help. I wish everyone a wonderful holiday season and a hopeful, healthful New Year.

– Nancy Rae Mallery,
Editor-Publisher,
Green Energy Times

Kudos to the *Green Energy Times* Team
Helping *G.E.T.* Save the Planet

G.E.T. *staff*

George Harvey has been writing for *Green Energy Times* for over ten years. He has put *G.E.T.'s* news blog posts up daily since 2013.

His interest in energy dates back to his childhood in Illinois, when he learned that coal-burning steam engines would no longer be allowed to enter the city of Chicago. That was about 1953. He loved the look and sound of steam engines, which he could hear in the distance while he was lying in bed going to sleep. But he became aware of the simple fact that just because you enjoy something does not mean it is good for everyone.

George Harvey recording Energy Week with George Harvey and Tom Finnell at the BCTV studio in Brattleboro, Vermont. (Screenshot)

During the 1980s and 1990s, he operated a household heated with wood he cut with an electric chain saw, grew vegetables for his family in his garden, and reduced his electric load as much as possible. He replaced incandescent light bulbs with fluorescent lights as soon as it became reasonable to do so. In 2001, he bought a Prius, which had just been introduced to the American market.

When he moved to Brattleboro, VT in 2004, his apartment was heated with propane. He turned the thermostat down so low that the propane company responded by putting him into its highest price category. He did the necessary calculations and found that it would be cheaper to use a cheap electric resistance heater than to burn propane, even when the electric was running on cow power.

He has given up his car and walks nearly everywhere he goes. This means he goes food shopping several times each week, because anything he buys must be carried home in a backpack.

He likes to grow plants. He has planted apple, crab apple, cherry, and peach trees where he lives, even though they are not his property. He grows six different varieties of citrus trees and has bought three different kinds of figs. The warm weather trees are potted, and brought in during the winter. They do bear fruit nicely.

George Harvey has operated a blog aggregating news on energy and climate change, posting every day since 2012. The blog, geoharvey.com, has links to news articles of the day, and now has links to well over 50,000 of them. Each week, he and a friend co-host a TV show, "Energy Week with George Harvey and Tom Finnell." It has been produced 500 times at BCTV in Brattleboro and is rebroadcast by 40 stations.

George Harvey is motivated by a hope that our children's children can live happy lives without destroying the planet. ♻

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Vermont's Climate Plan is Built on a Foundation Made of Paper – It's Time to Meet the Moment

Jonathan Dowds, Deputy Director, Renewable Energy Vermont

Vermont has a plan to combat climate change: accelerate our transition to electric vehicles (EVs), switch our heating and cooling systems to electric heat pumps, and power it all with electricity that is increasingly green and renewable. There is a lot to like about the plan, in addition to protecting the environment, EVs and heat pumps will save most Vermonters money in the long run. But the plan rests on a foundation made of paper, because Vermont's most consequential energy policy – our Renewable Energy Standard or RES – papers over our region's fossil use and does not move the needle when it comes to making our region's power supply greener and more renewable.

The RES requires utilities to get 75% of their electricity from renewable sources by 2032, but this topline requirement is ineffective when it comes to increasing renewable generation and combating climate change. Vermont's Department of Public Service has confirmed as much, stating that it only has a limited impact on regional renewable development. Our RES – unlike similar laws throughout the northeast – only requires utilities to get a small fraction of their electricity from new renewables. As a result, utilities meet their overall renewable energy obligation by retiring renewable energy credits from older hydroelectric facilities. The problem is that none of these hydro facilities are generating more electricity because we passed the RES. And if the hydro facilities do not generate any more electricity because the natural gas plants located throughout New England do not generate any less. While, legally speaking, Vermont's electricity may have become more renewable, the region's overall renewable generation and carbon emissions have not changed much at all.

To be clear, it is not the utilities that are at fault here. By using old hydro credits to meet the renewable requirement, they are following the letter of the law while keeping their costs as low as they can. If they opted to spend more on renewable credits that have a real impact on regional carbon emissions, they would likely face pushback from the Public Utility Commission. Utilities are incentivized to sell the credits from the new Vermont projects that do reduce emissions to Connecticut, Massachusetts, and Rhode Island and to replace them with credits from older hydro projects that do not. The system is working, but it is a bad system.

The good news is two components of the RES are making a difference for renewables and the climate. The first is a requirement that utilities get 10% of their electricity from new in-state renewable energy like net-metered solar on rooftops. Because this requirement actually increases the amount of renewable electricity on the grid it does displace fossil fuel generation and reduce emissions. The second is a requirement for utilities to help customers reduce their fossil fuel use, typically achieved by incentivizing heat pumps and electric vehicles. Again, because these technologies are more efficient than their fossil fuel counterparts the switch reduces overall greenhouse gas emissions. The problem is that these requirements are just too small to match the moment.

The decision to use old renewables to satisfy the overall renewable energy target was not an accident. It was a strategic decision made in 2015 to keep costs low. But it was a mistake, albeit one made with good intentions. It is clearer than ever that the overall renewable energy target provides only the illusion that we are doing our part on climate. Now we know.

It is time to update that RES so it provides a solid foundation for climate action. This summer Rhode Island updated its Standard to get to 100% renewable electricity, and Vermont should do the same. While we raise our overall target, we need to make sure that as much of this electricity as possible is coming from new renewables rather than simply taking credit for existing generation. Doubling or tripling the requirement for new, in-state renewable generation would be good policy too. This is a way for us to take responsibility for the impact of our energy usage (Vermont is currently 49th in the share of the electricity that it uses that is generated in-state) rather the exporting these impacts to vulnerable communities elsewhere. Since the cost of wind, solar, and storage have all declined dramatically and the Inflation Reduction Act will cover 30% to 50% of the cost of renewable energy projects, there is no excuse not to invest in real energy transformation with real climate benefits. It is time to meet the moment. ♻

Disasters Hit 90% of USA in 2022 – *Cont'd from p.1*

have gone through weather disasters during the years 2011 through 2021. Some of them had as many as twelve declared disasters during those years. The counties include the homes of over 300 million people, which is 93% of the country's population.

For the purpose of the atlas, a "major disaster" includes "any natural catastrophe (including any hurricane, tornado, storm, high water, wind driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance …"

The disaster coverage does not have details on damage from heat waves, because the federal government does not keep data on the losses they cause. Even so, the subject is addressed with estimates. AOD says, "Under baseline climate conditions, the U.S. could lose an average of approximately $100 billion annually from heat-induced lost labor productivity, which could double to nearly $200 billion by 2030 and reach $500 billion by 2050. This includes loss of agriculture due to lower labor productivity and lower crop yields."

While the atlas includes federal disaster relief from HUD, the Federal Emergency Management Agency, and the Department of Agriculture, it does not include costs of help from the Army Corps of Engineers or the Small Business Administration. Nor does it cover all costs of disasters that are covered.

So, we can safely conclude that as extensive as the information is, AOD really only tells us part of the story. There is more, and that makes the overall picture look even worse. Also, as huge as the cost of disasters is, it is increasing and will continue to do so.

Natural disaster and its consequences. Hurricane Ian destroyed homes in Florida. (AdobeStock_536221815/bilanol)

One of the things AOD does cover is social vulnerability. This might deserve a comment. Amy Chester, the Managing Director of Rebuild by Design, spoke to the issue as AOD was released. She said the data surprised her, because people in more affluent areas were getting more financial help for recovery than those whose needs were greater. The reason for this turned out to be that the relief is proportional to the market value of the loss, not to the need.

Though AOD does not address it, we might consider those among us who do not believe in climate change. It is clear that not all disasters relating to weather can be attributed to climate change, a fact many of them are aware of. Also, they sometimes point out that records are still being set for cold temperatures. Nevertheless, an examination of the position may not be tenable, given the facts and history. For example, fifty years ago, records were being set for both cold and heat in roughly equal numbers, but today, for every cold weather record set, about ten are set for heat, according to a recent report from CNN (http://bit.ly/3UepBV3).

The number of climate disasters is growing rapidly, and with them the damage is growing. Because we need to know what the causes of weather disasters are, attribution science is being developed. Through it, many disasters can be shown to have clear connections to climate change. In some cases, dollar values can be put on specific damage that has happened due to climate change.

The AOD is designed to be highly useful to people who are engaged in planning for resilience, relief, and mitigation. It is a tool that people engaged in such activities would do well to study.

The Rebuild by Design website is www.rebuildbydesign.org. ♻

Let's Get Engaged

Public Service Department Releases Public Engagement Plan to Guide the Review of Vermont's 2023 Renewable Electricity Policy and Programs

On December 1, the Vermont Public Service Department released its proposed public engagement plan to guide a comprehensive review of Vermont's renewable and clean electricity policies and programs. This engagement process will help implement a core recommendation of the Comprehensive Energy Plan, published in January of 2022, which calls for consideration of comprehensive adjustments to Vermont's Renewable Energy Standard as well as related renewable energy programs – including consideration of moving toward 100% renewable or carbon-free electricity.

"Our energy and climate plans call for electrification of heating and transportation" said Department Commissioner June Tierney. "Vermont must ensure the electric sector is increasingly low carbon, while keeping rates as low as possible so that all Vermonters can benefit from this transition. The time is ripe to conduct a comprehensive review of electricity policy to ensure that Vermont is meeting its energy and climate policy targets equitably and at least cost."

The proposed plan has been informed by responses the Department received through the Request for Input (RFI) it issued earlier this year and envisions public engagement opportunities over the next 13 months split into three core phases:

- **Phase 1 – Awareness and Education** (November 2022 – March 2023), will focus on broad outreach, especially to frontline & impacted communities, to raise awareness of this effort and create educational opportunities to build capacity to engage in future conversations. This will include educational webinars and other outreach with identified partners.
- **Phase 2 – Policy and Program Review** (April – August 2023), will focus on reviewing existing programs and policies and developing recommendations for changes through continued stakeholder engagement and supporting technical analyses. Public engagement opportunities are expected to include venues like interactive workshops and surveys or polling.
- **Phase 3 – Recommendations and Reporting** (September – December 2023), will focus on finalizing and drafting recommendations and producing summary reports on the process taken to arrive at those recommendations. Drafts of the documents would be reviewed and revised through public comment periods. The reports are expected to be finalized in advance of the 2024 Legislative Session.

The Public Engagement Plan is intended to be a proposal for how the review of renewable electricity programs and policies could occur based on feedback received during the RFI and available Department resources. By design, it leaves room for flexibility as new ideas about or needs for public engagement emerge throughout the process. The Department welcomes public opinion on this proposal. The Public Engagement Plan and supporting documents can be downloaded from the Public Service Department website at bit.ly/3uwTndl. Feedback can be submitted through an online public comment form accessible at bit.ly/3PctgBJ, or via email at PSD-REPrograms@vermont.gov. Feedback will be reviewed by Department staff as it is received on a rolling basis. ♻

EPA Awards $965M to Electrify School Buses

Green Energy Times Readership Area Allocated $23.6M for 60 Buses

Martin Wahl

On October 26 the Environmental Protection Agency announced nearly $1 billion in awards to 391 U.S. school districts to replace aging, fossil-fueled school buses with 2,468 cleaner, mainly electric models.

This is the first round of funding from the Clean School Bus Program, which the 2021 Bipartisan Infrastructure Law created with a $5 billion investment for low- and zero-emission school buses over the next five years.

The rebates will go to school districts in all 50 states, the District of Columbia, Puerto Rico and American Samoa. Seventeen school districts in the *Green Energy Times* readership area (New Hampshire, Vermont, and parts of New York and Maine) will receive $23,610,000 for 60 electric buses:

The EPA received around 2,000 applications requesting nearly $4 billion in funding for the 2022 Clean School Bus (CSB) Rebates. In response to the overwhelming demand, EPA almost doubled the first round funding level from $500 million to $965 million. For a complete list of the awardees, visit https://awsedap.epa.gov/public/extensions/Clean_School_Bus/Clean_School_Bus.html#CSB_Data

School districts identified as priority areas serving low-income, rural, or tribal students make p 99% of the projects; they were selected through a lottery. Awards to school districts ranged from $30,000 to $987,000. Applicant organizations receiving awards included school districts, school bus and related charging equipment manufacturers and sellers on behalf of schools and school districts, as well as individual schools.

(Wikipedia/H. Michael Miley)

New Hampshire's U.S. Senator Jeanne Shaheen, lead negotiator of the Bipartisan Infrastructure Law, celebrated the selection of two of her state's school districts being included among the awardees. New Hampshire's U.S. Senator Maggie Hassan also helped negotiate the bill; both spearheaded efforts to include investments for clean energy and climate resiliency.

New Hampshire School Districts Rumney and Henniker School Administrative Unit (SAU24) received awards.

According to Rachel Lane, Vice President of Electrification & Sustainability for Student Transportation of America (STA) that runs the buses for Henniker, the location of the buses among SAU 24's schools depend on various implementation constraints which will be evaluated as the project moves forward. Charging-infrastructure design factors will include the ability to support routes, site layout, optimal charging to minimize electric bill impacts, as well as the ability to future-proof the design.

The deadline for awardees to receive new buses, install eligible charging infrastructure, and replace old buses is October 2024.

After a career in data product management, Martin Wahl has worked in biofuels since 2006, currently with Lee Enterprises Consulting, a large bio-economy consulting group. Dividing his time between California and New Hampshire, he serves on Corte Madera, California's Climate Action Committee and is a Newfound Lake Region Association member. ♻

Green Energy Times Area EPA Clean School Bus Program Awardees

State	School District Name	Jurisdiction	Applicant Organization Name	# of Electric Buses	Total Awarded
ME	Castine Public Schools	Castine	Castine School Department	1	$395,000
ME	Dayton Public Schools	Dayton	Dayton School Department	4	$1,580,000
ME	RSU 12	Somerville	W.C. Cressey And Son, Inc.	2	$790,000
ME	RSU 20	Searsport	Dattco Inc	2	$790,000
ME	RSU 57/MSAD 57	Waterboro	Dattco Inc	2	$790,000
ME	Waite Public Schools	Waite	Town Of Baileyville	1	$395,000
ME	Wells-Ogunquit CSD	Ogunquit	Thomas Built Buses, Inc.	11	$4,345,000
NH	Henniker SAU Office	Henniker	Navistar Inc	4	$1,580,000
NH	Rumney School District	Rumney	Navistar Inc	3	$1,185,000
NY	Duanesburg Central School District	Delanspon	Duanesburg Central School District	1	$305,000
NY	Hartford Central School District	Hartford	Hartford Central School District	12	$4,740,000
NY	Marathon Central School District	Marathon	Marathon School District	3	$1,185,000
NY	Newfield Central School District	Newfield	Newfield School District	3	$1,185,000
VT	Caledonia Central Supervisory Union	Danville	Caledonia Central Supervisory Union	1	$395,000
VT	Taconic And Green Regional School District	Sunderland	Bennington-Rutland Supervisory Union	4	$1,580,000
VT	White River Valley Supervisory Union	South Royalton	White River Valley Supervisory Union	3	$1,185,000
VT	Windsor Central Supervisory Union	Royalton	Windsor Central Modified Unified Union School District	3	$1,185,000
		Totals	**17**	**60**	**$23,610,000**

EVs Use Less Energy than Gas Vehicles

Shared by loyal reader, Jim Wick
From a Quora post by Steve Baker

How is the grid holding up with all new electric cars being sold in 2022?

FACT: There are about 2 million electric cars in the USA.

FACT: Average driver does 30 miles per day…so 60 million miles driven per day.

FACT: You need about 1kWh per 4 miles driven in a typical EV.

FACT: The USA consumes 3.9 trillion kWh per year - over 10 billion kWh per day.

So, we need 15 million kWh per day to keep those EV's on the road.

Hence the EVs add somewhere around an eighth of one percent of the total US demand.

BUT: It's better than that…

FACT: Most EV owners charge their cars overnight almost all of the time.

FACT: During the night, there is MUCH less electricity demand so both the grid and the power stations are under-used.

FACT: The oil refineries, oil and gasoline pipeline pumps and gas station use a LOT of electricity - and with reduced gasoline consumption - there will be savings.

It is estimated that it takes 8kWh of electricity to get one gallon of gas from oil well to gas tank. An electric car can drive 32 miles on 8kWh - and since the average MPG of cars in the USA is 25.4 mpg - that means that replacing a gas car with an electric car actually REDUCES the amount of electricity we need.

I only just thought of this (truly!), and when I googled it to try to verify it, I found that I'm roughly correct!!

Overall, the extra load on the grid is very, very nearly zero, and if that math is right, we'll actually save electricity by switching to EV's!

That will be true even if 100% of all vehicles in the U.S. were electric.

Sorry - one less bit of fake news to spread fear, uncertainty and doubt.

Steve Baker is a software engineer, 3D graphics geek, gadget maker, and blogger at LetsRunWithIt.com.

**Share a RiDE. WaLK.
BiKe.TaKe a BuS.
TaKe a TrAiN.
DriVe ElecTric.
Go Solar.**

Electric Vehicles Know-How for Cold Weather

Wayne Michaud

Winter driving can reduce EV range in a way comparable to lower gas mileage in an ICE vehicle. Preheating your EV while it is still plugged in can help reduce winter range loss. (AdobeStock_222789774/teksomolika)

A northern New England - north country winter scenario:

It's 15°F out and my car is sitting in the driveway with an accumulation of snow and ice. I need to drive to an appointment in 20 minutes. Now, my last car was an internal combustion engine (ICE) vehicle, so in this weather, typically, I'd use my remote starter to let the engine and interior completely warm up and melt off much of the snow and ice. I confess that this not only wasted gas, it caused carbon emissions that contributed to climate change, and it polluted the air since the catalytic converter didn't function to reduce tailpipe toxins until the car started moving. My car of today warms up in a similar manner. I start it remotely with the key fob and it quietly "preconditions" itself while being plugged in to an outdoor outlet. In twenty minutes, I sweep off the melting remnants of snow and ice, unplug it, and as long as the windshield is totally defrosted, off I go in my warm car. But this warmup process is virtually guilt-free: no gas, no oil, zero tailpipe emissions. That's because this car is an all-electric vehicle (EV).

Let's take a close look at the two main considerations related to how EVs perform in cold weather: traction and range.

TRACTION

With traction, we will not only look at how EVs perform on their own, but how they compare with ICE vehicles. The majority of EVs are front-wheel drive (FWD), but there is somewhat of a trend toward the "old school" rear-wheel drive (RWD) as EV RWD traction can be less susceptible in slippery conditions than ICE vehicles due to the heavy battery pack bearing more weight to the rear axle. FWD works better for ICE vehicles as that is where the engine sits. As to the instantaneous torque of any EV, controlling them in slippery conditions can be more of a challenge, though this can be mastered with the right touch.

The ultimate in traction for all vehicles is AWD (also in conjunction with winter tires). An increasing number of EVs offer this feature, usually known as "dual motors." How does an ICE vehicle's AWD function compare with an EV's dual motor? In the former, the system delivers power primarily to one set of wheels, front or rear. When slippage is detected at one axle, power is diverted to the other axle. Dual motors on EVs are individual electric motors at each axle with no physical connection between them. These motors allow for precise control over the power sent to each wheel.

In winter driving, assuming EVs have winter tires and traction control, they can hold their own verses ICE vehicles, overall. A plus with EV winter traction is the combination of the low placement of the battery and its weight. A possible minus is some EVs have lower ground clearance, though a few of the pricier ones offer adaptive air suspension systems.

RANGE

In general, EVs will lose 20 to 25% of range in winter. Even ICE vehicles can lose 20% of fuel economy in the cold. But in frigid temperatures, EVs can take a 40 to 50% range loss hit, especially when using the main heating system. This can be a deal-breaker for many people, even considering the real benefits of choosing an EV: no gas, half the maintenance costs, no tailpipe carbon emissions or pollution, purchasing incentives, great acceleration, etc. Now people in sustainability-minded Scandinavian countries, motivated in part by higher gas prices, plus EV purchasing and accessibility incentives, are not dissuaded by the range issues where EV sales are 25% or higher. But, for an EV with a range under 200 miles, this concern cannot be discounted in longer commutes.

Why do EVs lose range in cold temperatures? Lithium-ion batteries, which typically power EVs (as well as laptops and smartphones), are quite sensitive to cold. The electrolyte fluid inside battery cells becomes more inert. And this can have an impact on the effectiveness of other systems, such as regenerative braking (which recovers some battery range) and the slowing down of charging. Fortunately, there's hope on the horizon to minimize range loss in cold. In development are solid state batteries which are non-liquid, making them less sensitive to cold. And research, even in lithium-ion batteries, shows that their anode design can be modified to maintain much of their rechargeable storage capacity in sub-zero temperatures.

TIPS TO MINIMIZE RANGE LOSS

- Heating, the biggest culprit in range loss, can be minimized by being prepared for the cold with warm clothing. To cut range loss significantly, purchase an EV equipped with a cold weather package including heated seats and steering wheel. Aftermarket heated seats can be installed for $300 to $500 per seat.
- Precondition (pre-heating/pre-cooling) your EV while it is still plugged in before driving, whether garaged or outside; some EVs are equipped with cabin preconditioning that can be set in advance.
- Driving conservatively, i.e., smooth acceleration, avoiding speeding, and softer braking, are great smart driving tips for ICE vehicles; this applies for EVs to extend range, especially in cold weather.
- Check tire pressure: under-inflated tires increase rolling resistance which reduces range.

Before you know it, you'll adapt to EV cold weather limitations to reap their many benefits, just like a Scandinavian!

Wayne Michaud is Executive Director of Green Driving America Inc., a non-profit that advocates for and educates on transportation efficiency and cleaner transportation. The organization's "The Clean Transportation Path" presentation has been endorsed by Drive Electric Vermont. ♻

ELECTRIC PLANES TAKING FLIGHT

George Harvey

It has been over six years since Solar Impulse 2 completed its 16½ month circumnavigation of the Earth, in July of 2016. That plane was powered entirely by solar panels on its upper surfaces, with a battery system to keep the motors running at night. Nevertheless, the idea of an electric airplane still seems rather bizarre to many of us, especially when the plane is designed for commercial passenger flights.

The story of Alice, an airplane being introduced by a company in Washington state, shows how things are changing. It is a commercial passenger plane powered by two electric motors. It has come a long way in a relatively short time, though it be a while yet before it is ready for customers.

Alice is a product of Eviation. The company was founded in 2015 in Tel Aviv. By 2019, a prototype of Alice was put on display at the Paris Air Show. Eviation moved to Arlington, Washington in 2020, and is continuing development of the aircraft there.

Assembly of the first Alice production model began in 2021. Then, on September 27, 2022, Alice was flown in its first test flight at Grant County International Airport in Moses Lake, Washington.

The test flight was not intended to last long. The plane was in the air for only eight minutes. During that time, however, it was able to reach an altitude of 3,500 feet, and the test was considered a great success. The version of the plane flown in the test is a passenger aircraft that can carry nine people. It has a range of roughly 250 miles, which it can cover in about an hour. It is designed to carry a load of 2,500 pounds.

Rendering of Alice. (Eviation)

Airplanes must go through a long certification process before they can be delivered to market. Eviation will have to work through that process until at least 2025. After that, there will be a year or two of further testing. This means it will probably be 2027 before the first aircraft are delivered to customers.

Some people might think that this is a minor development. After all, the plane is only capable of short flights carrying few people, compared with the airplanes most of us might think of when someone mentions commercial passenger planes. But it turns out that there are reasons why companies might want to have exactly such an aircraft.

Several companies have already placed orders for Alice aircraft, showing a level of interest most of us might find astonishing. After announcing a successful test on September 27, only a bit more than five weeks passed before Eviation announced that the value of the order book for Alice had passed $2 billion. Yes, $2 billion.

Of course, the orders did not all come in during a period of five weeks. There were some regional airlines in the United States and Europe that had ordered airplanes before the test flight in September. One company, Cape Air, had ordered 75 planes. That was not the only order, just the largest.

It would appear that the electric airplane is idea whose time has come. ♻

Are Plug-In Hybrids an Important Transition Option?

Alan Betts

The author driving his Prius Prime plug-in hybrid during the winter in Pittsford, Vermont. (Courtesy photo)

An article in the August issue of *Green Energy Times* debunked the webs of lies about electric vehicles (EVs) that have reduced their sale in the US, where only 5% of new cars sold in 2021 were EVs. Globally the U.S. is second to the bottom in this EV transition. Contrast northern Europe where in Norway, the global leader, 86% of new cars were EVs last year.

One of the strange aspects of the discussion of the transition from gasoline to electric cars is that I have never seen an accurate analysis of the huge impact that efficient plug-in hybrids can make in reducing gasoline use. So here is my analysis based on owning a Toyota Prius Prime plug-in for five years. We have driven a total of 48000 miles through all conditions, summer and winter, and to-date averaged 164 mpg. These figures are on the dashboard when I turn the car on!

How is this possible, when the car has an all-electric range of only 30 mi (less in winter), and the dealer claims that running on gasoline as a hybrid it only gets 54 mpg? I was stunned our first year, so let me explain. First, the plug-in Prime is probably the most efficient vehicle of its type, and it is way beyond a simple hybrid. With computer control on the two coupled engines and electromagnetic braking, its battery is large enough to always recover substantial energy from slowing down, coming down hills or even large mountains (see below).

Many of my trips in Vermont of about 30 miles total between Pittsford and Rutland run all electric. However, consider a 60-mile trip to Burlington, which is twice my electric range. Running on gasoline on rural roads at 50 mph the Prime will average 65 mpg. This means my average with half-trip electric is 130 mpg. If I can plug in a level two charger, which recharges in two hours, this will be my average for the return trip also. If I cannot recharge in Burlington, my 120 mi round trip with only 30 miles on electric will average just under 87mpg. So, for reference a 95-mile trip starting charged uses just one gallon of gas for a 95mpg mean.

These give a realistic sense of the capabilities of an efficient plug-in hybrid. A related perspective is that whether running on electricity or gasoline the Prime is the most efficient car available. At 164 mpg, I have reduced my gas consumption by 85% compared to perhaps 25 mpg for a summer-winter mean for some less efficient hybrids. Practically I have to add about five gallons of gas to my 10-gallon tank every month to drive 10,000 miles per year. A 6-kWh electricity recharge costs about $1, and we have solar panels in an array to pay this.

Now running on the highway at 65 mph, the Prime will still average 60 mpg, so its highway range on its 10-gallon gasoline tank approaches 600 miles – more than any other car. At 75mph and a heavy foot, this drops about 10% to the 54 mpg reported by test drivers!

Consider this 2100 mi long-distance trip lasting 14 days that my wife and I made through mountainous terrain from Vermont through the Canadian Atlantic provinces to the Nova Scotia coast. This illustrates the remarkable overall efficiency. We were able to plug-in a regular 110V socket on all nights except one for the 6 kWh recharge to give us our nominal 30 mile electric range. Our trip average was 82 mpg, which means that going up and down long mountains we still averaged 65 mpg, because energy recovery going downhill typically slips the car back into all-electric mode.

Don't forget that maintenance is much less than for gasoline cars – we are advised to change sparkplugs every ten years, and soon we will have to change the rear brake pads at 50,000 mi. In addition, the Toyota Prius Prime only costs about $27K after credits.

I have been amazed that the technical press and even the Toyota dealer do not provide realistic data and analysis. I think because usage will vary widely, the dealer does not want to be held responsible for misleading the public. Enough smart drivers understand that the waiting list for these cars is months long.

But the energy-aware community can grasp reality: a 120-mile local commute in a Prius Prime starting with a 30-mile electric charge averages 87mpg and reduces daily gasoline consumption by about 70%. It is satisfying buying so much less gasoline for a quiet, comfortable efficient car. The U.S. and the planet badly need this for the transition away from fossil fuel.

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

What the IRA Means for EVs

Union of Concerned Scientists

(AdobeStock_214768138/Oleksandr)

Among the climate-focused policies in the Inflation Reduction Act are significant changes to the electric vehicle (EV) tax credit for consumers. While the maximum credit of $7,500 for new EVs remains the same as before, many of the details have changed. Most importantly, the tax credit was formerly capped once a manufacturer reached 200,000 sales. This meant that consumers buying EVs from General Motors and Tesla could no longer take advantage of the credit. The new version of the tax credit removes this cap and instead sets the credit to expire after 2032 for all EVs regardless of manufacturer. Plus, starting in 2024, the credit will be transferable to dealers, meaning that buyers could benefit from a lower up-front cost instead of having to wait to claim a credit on their income tax return. And, for the first time, the new legislation adds a credit of up to $4,000 for some used EVs.

Some of the new provisions limit which vehicles and buyers are eligible for the tax credit. Changes to the credit include requirements for final assembly in North America and critical mineral and battery-component sourcing and manufacturing requirements. The new credit will also have a price cap that will make many luxury EVs ineligible, and an income cap that excludes high-income earners from the credit starting in 2023.

In the short term, the new restrictions mean fewer EV purchases will qualify for the federal tax credit, making it harder for some to buy an EV. However, as manufacturers increase their North American production capacity, the new credit will help many more drivers make the switch from gas to electric. This will be important as we accelerate the transition to EVs this decade, aiming to meet President Biden's national goal of having zero-emissions vehicles make up half of all new car and truck sales by 2030.

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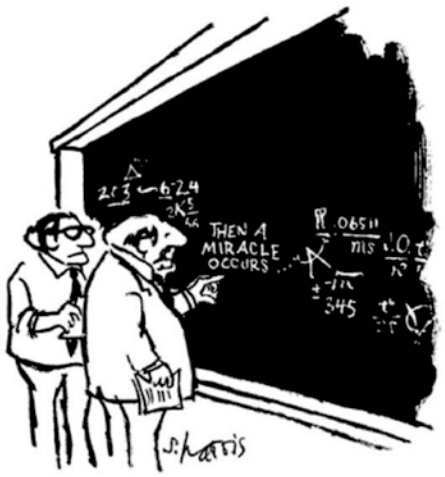
Trying is Believing Drives EV Acceptance

Car dealers know you must get test drives to move vehicles

Mike Bailey

Over 2000 years ago, the story of Doubting Thomas showed that some people just need a hands-on demonstration to accept what's already in front of them. Today it's essential we understand this lesson to successfully fight misperceptions and false beliefs that keep us from eliminating carbon emissions by 2050.

Keeping global warming below two-degrees Celsius will require major changes across every sector of the world economy in the next two decades, such as cutting transportation emissions to zero.



"I think you should be more explicit here in step two."

Sidney Harris

Despite prices of electric vehicles (EVs) continuing to decline, and proof they're more reliable, economical to operate, and better performing than similar gas-powered cars, we still have far to go in getting people to consider them for purchase. In fact, a recent Pew Center research report found that adults in the U.S. are split down the middle, with half opposing upcoming plans from Detroit to phase out production of internal combustion engine (ICE) vehicles.

However, change does happen, and it can come quickly. Overall, new car sales struggled in the second quarter of 2022 due to tight inventory, high prices, and economic uncertainty. But EVs were a positive area of growth, with battery-powered electric vehicles jumping to record highs while ICE sales declined. And this difference was even greater in the European and Canadian markets than in the United States.

The Problem to Be Solved

Resources for the Future, an independent, nonprofit market research company, found that a major source of American's reluctance is their lack of prior exposure to EVs. Sixty-five percent of respondents didn't know anyone who has driven an EV, only 13 % understand that maintenance costs are lower than for a gas- powered car, and 50% believe that an EV has the same or higher cost per-mile as an ICE. Facts don't seem to matter.

As with Thomas, personal experience is often needed in order to change our opinions. But how?

Consider the Ambition Loop

The "Ambition Loop" is a positive feedback cycle in which bold government policies and private sector leadership reinforce each other to make rapid improvements in power, transportation, and land use. This concept was developed through the joint efforts of an impressive group of leading international organizations: the World Resources Institute, We Mean Business, and the United Nations Global Compact.

During the recent COP27 in Egypt, Alok Sharma spoke about the Ambition Loop as a 'virtuous circle' where business, government and civil society drive climate action and push each other to go further, faster.

That event was hosted by The Climate Group, a major international non-profit organization (with offices in London, New York, New Delhi, Amsterdam, and Beijing), whose RouteZero is a global showcase of ambitious commitments and bold actions on zero-emission vehicles (ZEVs). According to their website, "Accelerating the shift to ZEVs is essential if we're going to win the race to zero… In support of this aim, RouteZero brings together leaders from around the world taking the steps today that can make this a reality tomorrow."

One case study, from the Province of Québec, is a practical, economical, and easily duplicated approach. The electrification of Québec's driving schools is helping both new drivers and influential people in the automotive world experience for themselves the real-world benefits of new technologies. [www.theclimategroup.org/our-work/resources/electrification-quebecs-driving-schools]

The E-roule Electrification Project [https://e-roule.com] is funded by the Ministère des Transports using $4.5 million to accelerate the replacement of ICE vehicles used by driving schools with battery electric vehicles (BEVs). The climate group states, "The project focuses on raising the profile of EVs to ensure that learner drivers understand the benefits of a green transportation alternative."

In 2021, a fleet of 1,450 vehicles was operating at 486 driving schools in Québec. In the first year of this project, 30 driving schools from the private sector were involved, with ten fully replacing their fleet with BEVs. Now, in the second year, over 110 schools are participating and more than 35,000 new drivers have been reached with this hands-on experience.

Performance Matters

The United States and Canada have similar overall sales rates of EVs. Second quarter results show a 6.6% market share in the U.S. versus 6.9% for our neighbors to the north, but that's where the similarities end.

ZEVs account for 10.5% of cars in the province of Québec, almost double the market share in the New England states.

Québec has about one-fourth of Canada's population but accounts for almost half of the country's ZEV registrations. The latest statistics show EV sales there increased by 35% while gas-powered car sales fell 15%.

And their success with electrifying driving schools is being noticed here and around the world. Driver education programs that feature EVs are popping up in major cities like Los Angeles and Atlanta, with students even willing to pay a premium to enroll at the Tesla Driving Schools in Florida.

According to Volkswagen, "E-mobility in driving schools is a hot topic. Switching to electric cars is a logical step for driving schools for many reasons: they are environmentally friendly, modern and reduce running costs." And Ford supports the trend with three driving schools in Norway and one in The Netherlands where students in the Mustang Mach-E use the driver assist technology for parking and can easily adjust settings to fit their preferences on the responsiveness of acceleration and braking.

With driving schools going electric, can car rental agencies and ride share services be far behind?

Mike Bailey is a trustee of SolarFest.org, whose focus is renewable energy education. ♻

Solar to Float in Cohoes, New York Reservoir

George Harvey

Cohoes, New York, is a working-class city with a population of about 17,000. Its municipal electricity bills run to $660,000 per year. People have looked at how to use clean energy to provide power to the city from a local source, but the problem of how to do it did not appear to have easy solutions. There is almost no money available, and there was very little land that could be used for the project.

Cohoes water reservoir. (Google Earth via NREL)

A solar array is floated on a dam, river, reservoir, or lake to reduce evaporation and keep the solar PV panels cool for optimal performance. (Adobe stock/534786576/Tsvetan)

When Theresa Bourgeois, Cohoes' director of operations, and City Planner Joe Seman-Graves started doing some serious research on how to find a solution, Seman-Graves had an inspiration. It was to develop a floating solar array on the city's water reservoir.

With that thought, they focused on learning as much as they could about floating solar systems. They discovered that the technology had been proven, it was already in use in various places around the world. There were, however, comparatively few such systems in the United States, and none of them was owned by a municipal government.

Things started to brighten up when their research came to reports that had been done by the National Renewable Energy Laboratory (NREL) on the potentials of floating solar systems. In 2018, NREL had done a report on how they could be used in this country. This report is "Floating Photovoltaic Systems: Assessing the Technical Potential of Photovoltaic Systems on Man-Made Water Bodies in the Continental United States" (FPS), and it is available at bit.ly/NREL-FPS.

One thing Bourgeois and Seman-Graves found in the report was that the reservoir at Cohoes had already been identified as having potential for a floating solar array. And while they saw that no municipal floating solar arrays had yet been built, there are almost 25,000 man-made bodies of water on which floating solar systems could be built. They could identify 492 such reservoirs in the state of New York.

That is exciting news – much more than a casual reader might realize, at first glance. Since a floating array at Cohoes would be the first of its type to be built in the United States, it could be a prototype system, a system that can prove the concept for this country. Also, given the great number of systems that can be built, it can prove very important, because there are quite literally thousands of systems that might be built by people who have studied it.

With this, they began to look at more reasons to build floating solar arrays on reservoirs. With some help from John Erickson, director of research operations at Rensselaer Polytechnic Institute's Institute for Data Exploration and Applications, they were able to put together visuals comparing potential locations for floating solar arrays with locations of low- to moderate-income communities. They found the correspondence compelling. It shows that communities with reservoirs that have potential for floating solar systems often stood to benefit quite a lot from them.

With their research in hand, they started visiting state and federal agencies, along with others possible sources, looking for help with financing a floating solar array. The quality of their research was sufficient that Cohoes was able to get significant government funding, including $3 million in federal funding, along with a $750,000 grant from National Grid. This covers well over half of the cost of the system, which is expected to be $5.9 million.

The array is scheduled to be installed, according to the city, and it should be working by the spring of 2025, at the latest. When that happens, 60% of its electricity will be used to reduce the city's costs for electricity. The other 40% can be used for other purposes, such as helping some of the residents whose needs are greatest.

There are other benefits to this system, however, because it points the way toward broader future development. The estimate from NREL is that about 10% of the nation's electricity can be provided by similar systems. This would be electricity, provided by the sun, without any need to develop land that can be used for other things. In addition, there is the benefit that floating solar systems reduce evaporation of the water they are on. They will help decarbonize the country, and they will help reduce air pollution. ♻

MEET YOUR SOLAR INSTALLERS

GREEN EARTH ENERGY, BRANDON, VERMONT

George Harvey

Green Earth Energy (GEE) is a very unusual business. Based in Brandon, Vermont, it is a subsidiary of McKernon Group. We should make sure that the reader does not get a wrong impression from that statement. The word "subsidiary" might make some people think in terms of big business. With fifty employees, McKernon Group hardly qualifies for that term as a representation of its size. It hardly compares with Amazon or Tesla as a big business.

In another way, however, McKernon Group really is big – it has a lot of ability and experience. McKernon Group proudly calls itself "an environmentally responsible Vermont custom home builder devoted to the finest quality, sustainable building practices that encompasses a wide variety of construction styles."

Left: This home in Shrewsbury, VT has a 9.0kW system with microinverters providing solar credits to offset the home's energy consumption for the past eight years. Right: In 2014, Vermont Sun Fitness in Center Middlebury, VT installed a 8.2kW system on the standing seam roof and a 50.3kW system ballasted on a flat roof. The inverter system is a SolarEdge with optimizers. (Courtesy photos)

The main part of McKernon Group is devoted to architecture and design, with a focus on aesthetics. It builds houses and business structures. One subsidiary, Vermont Woodland Cabinetry & Millwork Inc., does fine cabinetry, and the connection it has to architecture and design should be obvious. Another subsidiary, Urethane Spray Foam Insulation, takes up questions of building efficiency, which is vital in new construction. GEE is the McKernon Group's solar installer, and it deals with other energy products, such as heat pumps.

To a person who has been paying attention to the issues of renewable energy, efficiency, and climate change, the benefits of combining these business components in a suite of subsidiaries seems rather obvious. Putting them together with design and construction is something we might expect to find as a standard business model in many places. Nevertheless, we don't see it, and that is puzzling. Perhaps McKernon Group has invented a business paradigm – one that should be in widespread use.

Of course, our focus here is McKernon Group's solar installer. GEE specialize in heat pump installations, residential ground or roof mount solar, and larger solar commercial fields. McKernon Group was founded in 1987, so it had built a fair amount of experience by 2006, the year GEE was founded. Since that time, GEE has installed about 11 megawatts of solar photovoltaics (PVs). The company installed close to 800 kilowatts of PVs in 2021 alone, and that was a time when the world was suffering from Covid-19, and solar installers were suffering from global supply issues.

Heat pumps are important to GEE, and a recent installation serves as an example. GEE finished installing heat pumps into the guest rooms at Snowed Inn in Killington, Vermont. That installation, which is one of GEE's larger heat pump retrofits, used Samsung VRF heat pumps for the sixteen rooms.

GEE generally uses Hanwha Q Cell solar panels (manufactured in the U.S.) and SolarEdge inverters for its solar systems. The company also has a lot of experience with batteries and can do both grid-tied and off-grid installations. It uses a variety of types, including Fortress Power's lithium iron phosphate models and the SolarEdge lithium-ion batteries.

The technical details of the types of things GEE can install really do not do justice to what might be the company's greatest strength, however. With the McKernon Group's strength in design, GEE has an ability to provide solar systems that address the aesthetics of the site of installation. This is an important issue, because a lot of people are particular about the appearance of solar panels sitting on a roof or out in a field. And after all, if people are to spend some money having solar systems built, we might hope that at the very least, they would be pleased with the appearance of the result.

It is not surprising that GEE emphasizes that it deals with each installation on an individual basis when it offers descriptions of its strengths. Many customers may appreciate the fact that in the case of this company, custom design might be more likely to consider the questions of the lay of the land, what kinds of trees are to the north of the array, and how its layout fits with the look of the roof.

GEE is not stuck in aesthetics, however, and it does a lot of solar installations for commercial and industrial customers, in addition to the residential systems where a pleasing design is of great importance.

Jim Crawford, who is responsible for solar sales and project development at Green Earth Energy said, "I think we are on the happy medium of energy efficiency and affordability. We inform the customer and let them make their own decisions." He added, "We focus on aesthetics for both solar and heat pumps." For people who take interest in the way their homes look, that might be very important.

The Green Earth Energy website is greenearthenergypv.com. The McKernon Group website is mckernongroup.com. ♻

France Requires Parking Lots To Be Covered in Solar Panels

– why aren't we doing this here in the U.S.A.?

George Harvey

In November, the French Senate passed legislation that mandated installation of solar covers over large parking lots. All parking areas with spaces for 80 cars or more will be subject to new law, regardless of whether they are new or already in use.

Parking areas that can accommodate 400 or more cars are subject to somewhat different rules than smaller ones. The timeline for installation is somewhat different, as is the percentage of the lot that must be covered. In addition, there are certain exemptions for parking areas where solar installations might have a negative environmental impact.

According to the French government, the total amount of power produced will be 11 gigawatts (GW). It also said that is the equivalent of ten nuclear power plants. That news requires some explanation, because the solar capacity needed to replace 1 GW of nuclear capacity would be something over 4 GW. So, 11 GW would produce nearly as much electricity as three nuclear reactors. We do not have an explanation of what appears to be a discrepancy.

To get 11 GW of solar capacity installed would require covering a lot of parking lots. In fact it might require covering twice as many as there are in France. But there is an explanation for this, which is not hard to find by doing a little research. As it happens, the parking lots have only part of the area that will be covered. Sidewalks and other open areas where people might gather can provide more. Some vacant lots, roadsides, areas along railroads, some kinds of buildings, and even types of farmland will be used for solar power.

The climate crisis and the energy crisis precipitated by Russia's invasion of Ukraine are only part of the reason for the action on solar power in France. Another factor has been the discovery of stress cracks in French nuclear reactors. Even though the units affected happen to include about half of the reactors in France, a decision was made to shut down all of those units for repairs, which is a long-term project. Since nuclear power provides 71% of the electricity in France, the country has had to import quite a lot of electricity while the repairs go on.

One lesson of this is that an energy portfolio benefits from being diversified. This implies that there should be a limit on the percentage of the power supply that comes from any one technology. At 71% nuclear, France was probably too dependent on a singls power source. In this case, over a third of all the country's power capacity was affected.

Solar covered parking lot at Disneyland, Paris. (Jay Black, Unsplash, bit.ly/3Vu1rHJ); right: Solar parking lot project at Fort Hunter Liggett. (US Army Corps of Engineers)

France is providing an important part of the solution to its energy problems by installing solar photovoltaics (PVs) to diversify its electricity sources. Clearly, there will be new solar PV installations completed in the near future will not all result from the new law. There will still be rooftop and utility scale solar as it had been under development without the bill. Moreover, France is looking at windpower, both offshore and on, to increase its production of renewable energy. But it is not stopping with just solar and wind. Other types of renewable energy are being developed. One of these is energy from ocean currents.

It is sad that the French people are feeling the effects of a power reduction. But it appears that they may benefit from developing new, reliable, clean resources.

We should be doing this here in the Northeast. What a great business opportunity! We should be doing this across the country. Why aren't we seeing a lot more of this sensible solution for clean renewable, affordable electricity? ♻

SOLAR CELL PIONEER WINS MILLENNIUM TECHNOLOGY PRIZE

The 2022 Millennium Technology Prize has been awarded to Scientia Professor Martin Green of the UNSW Sydney, Australia, for his innovation that has transformed the production of solar energy.

The €1 million global award for technology, conferred every two years, recognized Green's leadership in the development of the Passivated Emitter and Rear Cell (PERC). Since its development in 1983, the PERC has gone on to become the most commercially viable and efficient silicon solar cell technology for use in solar panels and for large-scale electricity production, accounting for almost 90% of the global solar cell market.

Green developed the PERC with his team by improving the quality of both the top and the rear surface of standard silicon solar cells. When sunlight – in the form of particles called photons – enters a cell, it excites the electrons within the silicon. In this excited state, electrons can move through the cell, creating electric current.

The improved surface of the PERC allows the electrons to maintain this excited state – or move freely – for longer, resulting in greater and more efficient energy generation. The PERC has helped increase the conversion efficiency of standard solar cells by over 50% in relative terms from 16.5% in the early 1980s to 25% in the early 2000s.

The innovation has greatly reduced the costs of using solar panels, making solar energy more affordable than fossil-based alternatives. PERCs can also provide an energy supply to homes without them needing to be connected to a grid, ensuring a reliable power supply for remote communities.

At left, Scientia Professor Martin Green of the UNSW Sydney, Australia receives the 2022 Millennium Technology Prize. (Courtesy photos)

Professor Green said, "It is a great honor to have been selected to receive such a prestigious prize. It not only recognizes my contribution to photovoltaics [the conversion of light into electrical power], but also the achievements of my students and research colleagues at UNSW, as well as those of the broader photovoltaic research and commercial community.

"I believe the Prize will increase my credibility as a spokesperson for what needs to be done to address climate change. We need to switch from fossil fuels to renewable energy to sustain the trajectory of human civilization on our shared planet. The pace of change is accelerating and the world will shift to solar and wind energy over the coming decade. I believe a huge transformation of historic significance is underway."

Green and his team are currently working on combined cell technologies to reach 40% solar cell efficiency by exploring options such as stacking cells on top of one another.

Green said, "Solar cells are increasingly being used to replace large power stations that use fossil fuels. In 2021, 20 countries or regions including Australia, Chile, Germany, Greece, Italy, Netherlands, Spain, Vietnam and California (US) generated between 8% to 25% of their total electricity supply from solar energy, with this number growing quickly.

"The rapid cost reductions in solar energy that my work has facilitated have come just in time, right at the point when the importance of acting immediately to address climate change has become overwhelmingly obvious." ♻

Sundog Solar Makes Sustainable Music at Snow Pond

A Solar Feat and a Portent of Things to Come

George Harvey

Snow Pond Center for the Arts is a truly remarkable place. It sits in Sidney, Maine, a town with a population of 4,650, in the central part of the state. Nevertheless, Snow Pond has the second largest outdoor amphitheater in North America, Bowl in the Pines. Last summer, singer-songwriter, Michael Franti, performed in it before 2,700 people. Clearly, Snow Pond draws people from beyond its immediate area.

Founded in 1937 as the New England Music Camp, Snow Pond developed a devoted set of children, families, alumni, and others over the years. This should be no surprise, because it was widely known for the quality of its instruction, in addition to its recreational and cultural activities as a summer camp. Over time, it became clear that despite the sparsely populated area it was in, and despite the cold winters, the demand for its services teaching music and arts did not end when fall arrived.

In 2014, Snow Pond took a major step forward by growing beyond its seasonal status. Christa Johnson, Director of Development, explained, "Compelled by our summer programs' positive impact on thousands of youths, particularly those in under-resourced rural areas, Snow Pond is committed to providing year-round arts opportunities on a scale that would make a substantial difference for youth in central Maine. … Although our Sidney campus is the hub of our performances, events, and camps, we strive to weave the arts into the fabric of the local community through free arts education programs throughout Kennebec County."

Micheal Franti Concert at Bowl in the Pines. (Snow Pond)

As impressive as this is, there is more. Snow Pond has taken a strong position on the environment, and this has led to its acting on efficiency and reducing carbon emissions. One of its projects is a solar array. John Wiggin, Snow Pond's Executive Director, commented, "This exciting solar project is designed to replace 100% of Snow Pond's electrical usage."

You might see some big implications in that simple statement. Snow Pond's electricity is all coming from a solar array, and just one of the many things that it is used for is evening concerts at the second biggest amphitheater in North America. This is big!

Top: Sundog Solar installed a 250kW (AC) system built with bifacial modules at Snow Pond Center for the Arts. Aerial view of Snow Pond Center for the Arts in Sidney, Maine. (Courtesy photos: Sundog Solar)

To build its solar project, Snow Pond turned to Sundog Solar, which is based in Searsport, on Penobscot Bay. Danny Piper, Sundog's owner, told us a good deal about the solar array and its design.

Clearly, this is not a trivial project. It is a 250-kilowatt AC (kW) system built with bifacial modules made by Vikram, an Indian manufacturer. The project also has four SMA Sunny Tripower Core 1 62.5 kW inverters. It is ground mounted and grid-tied. Snow Pond is able to net-meter its energy so it can run full-time on electricity that it is making or through bill credits on what it has banked earlier.

So far, everything may seem normal, except, possibly, for the system's size. But as we indicated earlier, while the Snow Dog story is a great success, it is also a cautionary tale about the Maine solar market.

Maine recently began to pull itself out of renewable energy doldrums, but the path it chose seems to have been planned somewhat incompletely. The fact that Snow Dog was able to have Sundog build a nice, big array does not mean that anyone else interested in installing a solar system will be able to duplicate that task.

Maine is largely rural. Its grid substations are mostly not very big. When the opportunities for new solar arrays opened up recently, large companies filled out the available capacity of the substations as quickly as they could. This led to a condition in which even small projects under 25 kW may have a hard time getting approval from utilities for connection to the grid.

Piper told us that in some areas, the applications for connecting new solar systems have gone from a 10% failure rate to 60%. That means a solar system that has been requested by a customer and designed by an installer may be stopped by a utility simply because there is no more capacity available at the substation for development. And that means Sundog and other solar installers often lose money designing systems that do not get approved.

This situation is worsened by the fact that Maine does not have a spot market for electricity. If it did, a customer with a battery could deliver energy to the grid when the demand was high and the supply struggling to meet it. Without some mechanism to address the situation, installers like Sundog have been struggling, not to find customers or financing or siting permits, but just to get approval to connect systems.

People who want to build solar systems should not just lose hope. Sundog is installing plenty of new systems, though Piper believes he could build more. But given the urgency of environmental issues, we should really press states to be more effective in promoting renewable energy. The capacity issues emerging in Maine lessen the options for the state to continue to reach its renewable energy goals without the consideration of socializing the grid infrastructure upgrades needed to reach a higher percentage of solar contribution to the state's renewable portfolio standards. ♻

CANNABIS FARM LOWERS GHG EMISSIONS

George Harvey

It was not all that long ago that federal and state laws were pretty unforgiving of those who grew, distributed, or used cannabis or marijuana. Though there were a few legal growers, licensed to grow it for such things as medical research, it was grown primarily for use as an illegal drug.

It was possible for authorities to find cannabis that was grown outdoors by aerial surveillance techniques, including some based on color analysis of photographs. The result was that many growers had to hide their operations to stay out of trouble. One way they tried to do this was to give up outdoor growing and move the crop to greenhouses, but it still could be detected. Then, the crop was moved indoors, where it was grown under grow-lights. Even the grow-lights attracted attention from their light in windows, however, and so the crops were finally moved to rooms without windows.

Maine Solar Solutions installed a 10-panel rooftop solar array on the garage at Upward Organics. This adds to the 15-panel ground-mount solar array installed previously for a total of 9.25kW. Upward Organics grows large crops of organic, medical cannabis which requires lots of electricity. (Photos: Karen Alterisio)

Of course, the high-security cannabis growers had to do more with their energy use than grow-lights. The temperature had to be right for the plants. So did the humidity. That is just a start of energy costs of cannabis production. Referring to indoor cannabis growing, a paper published by the journal *ScienceDirect* states, "This article estimates the energy consumption for this practice in the United States at 1% of national electricity use, or $6 billion each year. One average kilogram of final product is associated with 4,600 kg of carbon dioxide emissions to the atmosphere." (https://bit.ly/SD-cannabis)

This means that indoor production of a pound of cannabis would produces 4,600 pounds of CO_2, and since a gallon of gasoline burns to produce 20 pounds of CO_2, indoor production of a pound of cannabis would produce as much CO_2 as burning 230 gallons of gasoline. That would drive a car that get 25 miles per gallon 5,700 miles.

Colorado provides a shocking example. A *Smithsonian Magazine* article points out that in Colorado, "the weed industry's greenhouse gas emissions (2.6 megatons of carbon dioxide) exceed those of the state's coal mining industry (1.8 Mt of carbon dioxide)." (https://bit.ly/SM-colorado) And an article published at *Arstechnica* last year says if all growers in Colorado moved outdoors, it would decrease emissions associated with the product by 96%, while reducing the state's electricity demand by 1.3%. It also says moving from indoor production to a greenhouse would cut emissions by half (https://bit.ly/AT-colorado).

For those of us who take some interest in cannabis, there is some good news. New state laws have been decriminalizing marijuana, and the federal government has become more interested in other things. Even those who take little or no interest in cannabis (I can attest that such people do exist) can be happy that the indoor growing methods are no longer needed in many places, especially for licensed growers, and that means a reduction in the electricity demand and carbon emissions.

Some cannabis growers happen also to be committed environmentalists who are working to reduce greenhouse gas (GHG) emissions, even to the point of having net-zero emissions. We have an example of a cannabis farm in Maine that is working hard to do just that.

Nate Burdick is an outdoor enthusiast who is very conscious of the environmental impacts of the things he does. He founded Upward Organics in 2018 on ten acres of land. One goal was to grow organic, medical cannabis for dispensaries, caregivers, and patients, using the most environmental practices. This implied that the crop would be hand grown and given as much exposure to sunshine as possible.

The growing methods seems similar to those of organic farming. Burdick uses a high-quality compost that is produced in Maine, complete with lobster shells and rich in worms. The shells supply a large amount of chitin, which helps plants' immune systems. Air circulation kills respiratory pathogens that might be present in cannabis grown indoors. When sunlight is low in winter, additional light comes from LEDs. Upward Organics uses no pesticides to grow its crops.

According to the Upward Organics web site, growing cannabis outdoors has a number of benefits in addition to just reducing GHG emissions. Sun grown cannabis can have a superior effect as well as greater terpenes, flavonoids and cannabinoids. According to information at the Upward Organics web site, their cannabis has a richer terpene profile than cannabis grown indoors, with positive effects for the immune system, cerebral blood flow, cortical activity, and anti-inflammatory activity, while killing respiratory pathogens. Upward Organics products can be found at Atlantic Farms, Forest City Reserve, Living Soil Cannabis, and Seaweed medical wholesale partners.

When Burdick started Upward Organics, it was off-grid. It had fifteen solar panels, and a wood stove was supplied with firewood cut on-site. But he discovered that growing cannabis, even outside, uses a lot of electricity. So, when the time came to improve the systems being used, there was a lot of expansion for energy and efficiency.

Burdick had Maine Solar Solutions add ten panels on the garage to the 15 ground-mount panels already in use (mainesolarsolutions.com). The total solar capacity is 9.25kW. One greenhouse now has a climate battery under it to store heat from warmer weather to use later. He also hired Briburn Architects in Portland, Maine, which specializes in green and net-zero buildings, to build their home and garage. Chris Briley was their designer (briburn.com).

Burdick hopes that by redefining "sustainable" within the cannabis industry in Maine, cultivators can team up and learn best practices from one another. ♻

Many thanks to our sponsor:

UPWARD ORGANICS

A GROWING INTEREST IN GREEN HYDROGEN

George Harvey

There seems always to be a lot of news about "green hydrogen." It is clearly a big issue. Companies, including oil and gas companies, have committed to enormous spending on the technology. According to one article in Recharge, it is projected to grow at a phenomenal rate, over 50% annually, for the next ten years (https://bit.ly/3NMPbPk).

There is a lot to green hydrogen, however, so it might be best to step back and take a look. Hydrogen is said to come in different "colors." What is called gray hydrogen is made using fossil fuels, and emissions are released. Blue hydrogen is made the same way, but the emissions are said to be captured. Pink hydrogen uses electricity from nuclear power. Green hydrogen is made using electrolysis powered by renewable energy, usually wind, solar, or hydro-power. There should be no greenhouse gas emissions associated with green hydrogen.

Green hydrogen has attracted a lot of interest because it is seen as part of the solution for climate change. Big companies, including big oil and gas companies, are investing heavily in it. For example, BP has taken a lead in the Asian Renewable Energy Hub, a huge project in northwestern Australia that will make green hydrogen, or green ammonia made with it, for sale in Asia. The cost of the project may exceed $1 billion per gigawatt (GW). The first 15 GW of wind and solar capacity, which were to power the project, were approved in 2020. Beyond that, another 11 GW of renewable generating capacity were being developed for the project at that time.

Coradia iLint, the first 100% hydrogen-powered rail route. (Alstom image)

Other big projects are being developed in the U.S., Europe, and elsewhere. An important issue is that making and using green hydrogen can be done without contributing to climate change. Hydrogen can be burned directly in internal combustion vehicles, but there seems to be agreement that such use is far from optimal. It can be used more efficiently in a fuel cell to produce electricity.

Of course, since green hydrogen can be used in fuel cells, the hydrogen can be created and used on the spot to produce electricity as needed. So, it can be the basis for yet another system for storing energy.

Green hydrogen can also be used as a partial replacement for natural gas, and it is being injected into gas lines in some parts of Germany. Conversion to using 100% hydrogen in current natural gas lines is not yet done, as there are technical issues with replacing natural gas. Appliances would have to be altered for it, and it is not certain that it is even feasible to use it in such a manner.

One major use of hydrogen is as a chemical feedstock. For example, it is used with atmospheric nitrogen to make ammonia. The ammonia, in turn, has a very wide variety of uses, the most important of which may be for making fertilizer. When Russia reduced supplies of natural gas, the availability of fertilizer was reduced because it had been made from natural gas. Now, with green hydrogen, a supply can be maintained sustainably, without carbon emissions.

Part of the problem with green hydrogen has been that it has been expensive to make. As more electrolyzers come online, however, we can project with some confidence that the cost of green hydrogen will decline, according to Wright's Law. In fact, it is quite possible that renewable energy may become the least expensive source of hydrogen in not many years. Another part of the problem is that it is expensive to store and transport.

Nevertheless, many companies and countries have been investing many billions of dollars in the development of generating facilities, even though there is not much market for the hydrogen they will produce. Clearly, they have the idea that if the hydrogen is available, someone will buy it.

We might imagine that they are taking quite a risk on this. But we should note that a lot of engineers and financial leaders at a lot of companies have come to the same conclusion at the same time, agreeing that it is a good investment. While this is not proof of the soundness of the investment, it may indicate that it is not entirely foolish.

The market for green hydrogen is already developing. The first trains to use it for fuel are running in Germany, according to an article at CNN (https://cnn.it/3UsDBeY). It will be interesting to see where this goes. ♻

ARE EV BATTERIES RECYCLABLE?

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Jessica Dunn

As electric vehicle (EV) sales continue to increase, questions about how these cars and their batteries will be disposed of have been top of mind for current owners, future buyers, policymakers, and many experts in the automotive industry.

EVs are a newer technology, and their batteries require different end-of-life processing than gasoline vehicles. Luckily, lithium-ion battery recycling research and development has been going on for years and there is an existing and growing repurposing and recycling system in North America for these components. The map below is from recent research that explores the network of companies already recycling and repurposing batteries – these include recycling companies such as Redwood Materials, Li-Cycle, and Ascend Elements. The industry is quickly growing capacity for future recycling, with planned facilities in Nevada, New York, and Georgia, to name just a few.

First reused and repurposed, then recycled

After a battery's first life in a car and before it is recycled, it can be reused, refurbished, and repurposed.

If the battery isn't damaged during its use in an EV, such as in a car accident, these batteries have additional usable capacity – an estimated 80% of the original rated capacity. This means that if the battery was manufactured to store 100 kWh, it can now store up to 80 kWh. In order to make use of the remaining capacity, the batteries can be broken down to salvage smaller components for reuse and refurbishment, or they can be repurposed and used in a less demanding application, such as stationary storage.

For stationary storage, companies such as RePurpose Energy and B2U Storage Solutions are repurposing these batteries to be used for renewable energy generation support. They connect multiple EV batteries together, along with battery monitoring and cooling technology, to create a larger battery that is about the size of a shipping container. The battery stores solar electricity generated during the day and supplies electricity at high-demand times in the evening. As the grid becomes cleaner, added grid storage becomes more necessary to support the generation variability of renewable sources. These used batteries are a great way to both extend the lifespan of a product that has already been manufactured and support the renewable energy transition. After this second-life use, the batteries are then ready to be recycled.

What's valuable in a vehicle battery?

Lithium-ion batteries contain many valuable materials worth recovering and saving from a landfill.

Prior to recycling, the battery is disassembled and shredded using large machinery, breaking the battery into small pieces. Once the shredding is completed, the materials are sifted and separated based on size. This divides them into three different categories: plastics, ferrous materials, and non-ferrous materials (also called black mass). The black mass consists of the critical materials, cobalt, lithium, nickel, and manganese, which can individually be recovered using a hydrometallurgical process.

Hydrometallurgical recycling begins with leaching to create a solvent that contains the critical materials. The individual materials are then recovered using solvent extraction, precipitation, and purification. Hydrometallurgy is well known in the metals industry as a similar process is also used to extract the materials from ore after it is mined. Many US-based lithium-ion recycling companies use a variation of this process and report a material recovery rate of 95%–98%.

Can we use recycled materials to manufacture new batteries?

Yes! Once materials have been recovered, they can then be processed and used in the manufacturing of new lithium-ion batteries. This is a preferable source to using virgin ore because it reduces the amount of mining necessary to produce EVs.

Recent research has shown that by 2050 recycled materials could supply 45–52% of cobalt, 22–27% of lithium, and 40–46% of nickel used in the United States light- and heavy-duty vehicle fleet. Efforts across the United States to increase the sales of EVs are underway – places like California expect to have 100% of all car sales be electric by 2035 – so being able to recycle batteries and reuse the metal within them is a critical step in the transformation to a cleaner transportation system.

Recycling is key to making EVs greener

EV batteries currently represent about half of the lithium-ion batteries (by mass) that are being recycled, which also includes consumer electronics and waste from battery manufacturing. With 3.8 million EVs on the road today in North America and sales growing year over year, the number of EVs retiring in coming years will continue to increase as they eventually are totaled or age out of the fleet.

This increase will result in vehicle batteries comprising a much higher percentage of the recycling stream; retirements are expected to be 6 to 7 times higher in 2025 than in 2020 and 20 to 40 times higher in 2030. Companies recycling these batteries are setting themselves up to accommodate this upcoming wave by expanding their capacity.

These recycling companies are securing a battery stream by partnering with auto manufacturers. For example, major automakers are partnering with Redwood Materials, a recycling company based in Nevada. Redwood is not only recycling but will soon be closing the material loop by manufacturing battery components with recovered materials.

Redwood Materials has also implemented a recycling program to learn more about the location of retired and uncollected batteries, and how to decrease the costs of transporting these batteries to the recycling facility. Transportation from their location of retirement to the recycling plant is expensive, representing about 50-60% of the recycling costs. These costs are due to the special packaging and requirements needed for shipping retired batteries and their large size and weight. But, transportation costs can potentially be decreased if a more efficient collection system is developed.

Researchers have been modeling potential reverse logistics networks and now Redwood Materials is completing research of their own through a learning-by-doing approach. Their new Recycling Program consists of picking up and recycling any retired lithium-ion battery in California at no cost. They are also working with dealerships and dismantlers in order to collect as many batteries as possible.

California battery recycling requirements

As you can see, there is a lot happening in the industry space. And while there is currently no recycling requirement in the United States, California passed a bill that indicates recycling may be a priority for the state.

Assembly Bill 2832 passed in 2018 creating the California Battery Recycling Advisory Group. This group consists of automotive and battery manufacturers, government agency representatives, and public interest groups.

In addition to the California work, the federal government is also paying attention. In the Bipartisan Infrastructure Bill, funds were allocated toward battery recycling research and development. This is in addition to the funding of the ReCell Center, a lab created by the Department of Energy that is focused on decreasing costs and increasing yields of recycling.

Battery end-of-life is very important for ensuring that batteries are safely disposed of and that materials are recovered and used again in battery manufacturing. While there is a lot going on to push forward the uptake of EVs and replace gasoline cars for good, many people are simultaneously working to make sure that EV batteries are being reused, repurposed, and recycled.

Jessica Dunn is a senior analyst in the Clean Transportation Program, specializing in lithium-ion battery sustainability. She conducts research on material circularity and reducing battery impacts through repurposing and recycling. ♻

Wind Turbine Technologies Advance with Recyclable Blades

George Harvey

The wind turbines that generate electricity for power grids are not small. In fact, they are gigantic. The largest have blades that are a good deal longer than a football field, including end zones. And, of course, they weigh quite a lot. They are supposed to last longer than twenty years, but they do fail earlier than that sometimes.

Siemens Gamesa SG-14-222 turbine. (Siemens Gamesa)

Wind turbine blades are not easy to design and build. They have to be as light as possible and somewhat flexible, but strong and stiff enough to hold up to the wind. Ideally, they have some built-in system for dealing with lightning. For most sites, they should be capable of being heated to prevent ice buildup. Usually, they are made with fiberglass and resin to provide for these needs, but there are additions ranging from carbon nanotubes for strength to copper wire for electrical conductivity.

The result of all of this is that wind turbine blades, which can be massive, have historically been difficult to recycle. Reusing them has been investigated, including such things as cutting them up to make such things as foot bridges and bicycle shelters. But a really good recycling system would need changes to the list of materials used to make them.

Siemens Gamesa, one of the world's largest wind turbine manufacturers, has been putting a lot of effort into building new blades that are easier to recycle. Over a period of ten months, they developed a new type of recyclable blade. According to Marc Becker, CEO of the Siemens Gamesa Offshore Business Unit, they started the design project in September of 2021, and they actually began field testing at the Kaskasi wind project in the North Sea, north of Heligoland, in July of 2022.

The Kaskasi wind farm has 38 turbines and a nameplate capacity of 342 megawatts (MW). The turbines, each of 9 MW, are huge – far bigger than any normal, land-based wind turbine. The blades for the turbines at the Kaskasi wind farm are 81 meters long. That's almost 265 feet, for each blade. Clearly, the length is one of the big reasons that a machine of this size would be so hard to put up on land – it's hard to turn a corner with a 265-foot long trailer in tow.

The new blade technology was not used on all the turbines at the Kaskasi wind farm, but according to Siemens, a number of them do. Of course, the company will have to let them spin for some time to find out whether they are as good as they need to be, so the test will go on for a while.

The materials in the blades can be separated by a mild acid, but the components will not be recycled into new turbine blades when that is done. Instead, they will be made into other products, ranging from suitcases to the casings for flat-screen TVs. Siemens made it clear that all of the materials in the new blades can be recovered and reused, without any need to use other resources.

The blades are to be marketed under a RecycleBlades brand name. RecycleBlades will also be available for SG 14-222 DD and SG 14-236 DD turbines. These are the new 14-GW Siemens Gamesa turbines, which are among the largest on Earth. The blades for these turbines are 108 meters and 115 meters long respectively. A football field, with end zones, is just a bit less than 110 meters. ♻

Hershey, Chocolate, Solar

Cont'd from p.1

farm, part of a project to create riparian buffers to protect streams on dairy farms supplying Hershey. The company is in its 25th year of supporting the Chesapeake Bay Foundation's educational programs; it has been part of large scale reforestation projects in the Chesapeake Bay watershed with the Arbor Day Foundation. The cocoa supply chain is 100% independently verified, and Hershey is partnering with dairy and sugar suppliers on sustainable practices.

Lindt-Sprungli also emphasizes traceability. Since 2020 their cocoa bean supply chain has been 100% traceable and externally verified. Knowing the source of the beans allows Lindt, through its Farm Program, to help growers improve productivity, conserve biodiversity and natural ecosystems; diversify incomes, and reduce of the risk of child labor.

Lake Champlain Chocolates of Burlington, VT, a certified B-Corp, uses 100% fair trade cocoa and buys cream, maple syrup, and honey from local farmers. A new line of chocolates, the Restorative Moments Collection, features organic ingredients and donates 10% of net profits to the Conservation Nursery at the Intervale Center, a tree farm that grows hardy native tree varieties that thrive in the Vermont environment. The Conservation Nursery, with the help of 100 volunteers plants over 30,000 trees a year, creating riparian buffers that will help sequester over 4,000 tons of carbon over the next five years. Lake Champlain Chocolates has been using Forest Stewardship Council (FSC) certified paper and cardboard as much as possible; they now plan to use 100% post-consumer recycled fiber from New Leaf Paper for all chocolate bar wrappers, saving trees, energy, water, and carbon emissions. Lake Champlain also participates in the Raise the Blade sustainable lawn care campaign. Consolidating manufacturing to their Williston site is also reducing emissions, eliminating trucking to the company's Burlington site.

The team at the Diamond Chocolate Factory in St. Mark's, Grenada, where Jouvay is made. Rt: The Jouvay USA team in front of the Walpole, NH factory (l-r: Larry Burdick, Jon Grenier, Jacob Burdick, Joshua Sullivan, and Marietta Burdick) (Courtesy photos)

Jouvay, a new chocolate manufacturer in Walpole, NH, is taking the Bean to Bar concept a step further. Jouvay is the project of the Burdick family, founders, and until recently, owners of L.A. Burdick Chocolate. Their relationship with Jouvay goes back nearly 20 years. On a trip to visit a friend in Grenada, the Burdicks sampled chocolate and talked with farmers about the economics of the business. Typically buyers pay pennies on the dollar for cocoa beans, then ship them to Europe, where they are turned into couverture, a finely-ground confection high in cocoa butter which is used for enrobing bonbons. Couverture sells for $10 per pound to bonbon makers, who work their magic and sell the finished product for $60 per pound. Larry Burdick wanted to create a more vertical model that would leave more of the profits on the island. He worked to find a building and second-hand chocolate-making equipment. His wife Paula, meantime, founded the Cocoa Farming Future Initiative, with a model organic farm and composting facility, educational resources, and community programs. In 2014 the Diamond Chocolate Factory opened. It is majority-owned by the growers, with the Burdicks and one other funder owning 30%. The processing emphasizes flavor, with superior ingredients and a long extraction process, selling couverture and other ingredients worldwide.

In November 2021, in a small factory in Walpole, the Burdicks pulled their first bars made with the products of their factory. The bars are striking, with special ingredients like rose petals and ginger pressed into the surface rather than mixed in. Jouvay also sells cocoa tea balls, a mix of spices and cocoa nibs designed to be boiled in hot water and sweetened to taste. Islanders use condensed milk; New Englanders might consider maple syrup or honey. Jouvay products are sold at the Putney (VT) Coop, King Arthur Flour (Norwich, VT), Claremont (NH) Spice, and Yolo Cafe (Keene, NH). They can also be ordered online.

Tavernier Chocolates in Brattleboro uses traceable, single-origin, direct trade chocolates, sources other ingredients from local farmers and foragers, and pays particular attention to the impact of its packaging.They use no plastic bags or box dividers. Boxes are 100% recyclable, and made from recycled materials. Cellophane bags are 100% biodegradable and compostable, and the company recycles or composts all food and paper waste. Farmhouse Chocolates creates organic, fair trade, soy and corn oil free chocolates in Bristol, VT., and uses environmentally friendly packaging. Primo Botanicals of Troy, New York, creates chocolates using cocoa grown sustainably by indigenous farmers receiving a fair price for their crop and gives one percent of profits to organizations promoting rematriation, reparation and regeneration in North and South America.

Other environmentally-aware brands can be found at food coops. There are many delicious choices.

Jessie Haas lives in an off-grid cabin in southern Vermont with husband Michael J. Daley. She is the author of over 40 books, most recently The Hungry Place.

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

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.

• We now have a wood stove change-out program and a pellet boiler adder for income qualified homes. All information is at www.RERC-VT.org Adders for the pellet boilers can be an additional $8,000!

• 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 info at at fpr.vermont.gov/woodenergy/rebates. Unfortunately this FPR web site is now longer up-to-date. There is good info. there still but some is outdated.

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.

• GMP rebates available through December 31, 2021

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.

• More info on the 2021 IRS Tax form at https://www.irs.gov/pub/irs-pdf/f3468.pdf

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: 75% off eligible project costs, up to $2,000. Moderate income Vermonters get 75% off up to $5,000.

• 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: $400 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.

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.*

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

Vermont's GMP Extends Rebates Through 2022

Green Mountain Power (GMP)is extending its popular rebate programs through all of 2022 to help more customers save money while reducing carbon emissions.

In 2021, GMP customers saved with more than 7,000 rebates when they made the choice to switch away from fossil fuel at home and on the road – for heating, driving, mowing their lawns, and electric motorcycles. Rebates include a $1,500 rebate on all electric vehicles, plus an extra $1,000 for low- and moderate-income customers, and a $400 base rebate on cold climate heat pumps with an extra $800 in incentives for income-eligible customers in partnership with Efficiency Vermont.

The Vermont Natural Resources Council (VNRC) cut costs with GMP incentives while completing the renovation of a historic house in Montpelier to serve as new office and expanded meeting space.

"One of our goals was a net-zero building, and GMP's incentives were a huge help in swapping out an old, inefficient oil-burning boiler for cold climate heat pumps," said Brian Shupe, VNRC's executive director. "GMP's incentives also helped us install an electric vehicle charging station to help staff and visitors convert to electric vehicles."

In 2021, the rebates and customized projects with business customers around the state will offset more than 173,000 metric tons of lifetime carbon emissions – the equivalent of taking 38,000 gas-fueled cars off the road.

Learn more about GMP's rebates on electric vehicles and charging at www.bit.ly/GMP-rebates-2, and heating and yard care at www.bit.ly/GMP-rebates-3.

NEW HAMPSHIRE

Renewable Energy Incentives Offered Through the NH Department of Energy

NH DOE: All of NH DOE's programs, save the Residential Solar Water Heating and Residential Solar/Wind Rebate Program Rebate Program are now OPEN.

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: https://bit.ly/NH-DOE_CommercialIndustrialSolar or at (603) 271-3670.

Residential Solar/Wind Rebate Program is currently closed.

Residential Solar Water Heating Rebate Program is currently closed.

While we try to keep things up to date, incentives are always changing. Please be sure to check with the appropriate sources provided for the latest information.

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. https://bit.ly/NH-DOE_CommercialIndustrialWoodPellet

Residential Wood Pellet Boiler/Furnace

- 40% of installed system up to $10k
- Must meet thermal efficiency and particulate emissions standards

Contact: https://bit.ly/NH-DOE_ResidentialWoodPellet for more information and current program status.

LOCAL INCENTIVES

Many towns provide property tax exemptions for renewables. Check your town website for more information.

- *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.energy.nh.gov/energy-information.
- Plug-In Hybrid Electric Vehicles (PHEV), and $300 on Electric Motorcycles.

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, EFI.

- 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.

New Hampshire Electric Cooperative (NHEC) offers a slate of additional programs hat are available for NHEC members only. They include:

Electric Vehicle & Charging Incentives:

- Up to $1,000 incentive on the purchase or lease of a qualified EV (Residential).
- Up to $300 incentive to install Level 2 or larger charging stations, w/ Off-Peak charging rate (Residential).
- Up to $2,500 incentive to install Level 2 or larger charging stations (Commercial & Municipal).

High Efficiency Heat Pump Incentives:

- $500 per ton, w/enhanced rebates up to additional $500 per ton; 2% financing available. (Residential & Commercial)

Business Programs

Includes programs for: small and large business, new equipment and construction, seminars, lighting incentives, and catalog, and low and no interest financing programs.

Visit www.NHSaves.com/ for information about NH business incentives for electricity efficiency.

NH Weatherization Assistance Income-Eligible Programs

Home Energy Assistance and NH community action Weatherization Assistance Program. Financial assistance paying fuel bills, and free weatherization improvements for qualified applicants. Funding from U.S. Dept. of Energy, NH utilities.

Visit www.bit.ly/GET-NH-4 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.

NEW YORK

RENEWABLE ENERGY INCENTIVES OFFERED IN NEW YORK

There are 169 programs and incentives available at: http://dsireusa.org (enter your zip code).

Also visit https://www.nyserda.ny.gov/All-Programs for the latest NYSERDA solar, ground source and air source heat pumps, EV, residential, and commercial incentives.

Select New York State utilities offer incentives for heat pump systems. Please check with your local utility for more information or to learn more about heat pumps, available rebates, and financing options on the NYS Clean Heat program website at https://cleanheat.ny.gov/.

Clean Energy Incentives and Tax Credits for Renewable Energy

• SOLAR: The federal investment tax credit (ITC), which was scheduled to drop from 26% to 22% in 2021, will stay at 26% through 2022.

• ADVANCED WOOD HEAT: A 22% investment federal 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% federal tax credit was also extended for geothermal heat pump projects that begin construction in 2022. NY homeowners are eligible for a 25% State tax credit up and additional incentives could be available from their utility provider.

• AIR SOURCE HEAT PUMPS: Most utilities also offering incentives on both central air source heat pump systems as well as mini-splits.

Electric Vehicle Charging Station Make-Ready Program

- National Grid and other utilities will do an analysis of your business or municipality to evaluate installing EV stations and accessing the type of EV needed for your fleet. Learn more information from their website: (https://bit.ly/NG-EV-MakeReadyProgram.

Check out your local utility's website for was to save more on your energy-efficient projects:

- **National Grid:** https://ngrid.com/3H7hBPU
- **Central Hudson**: https://bit.ly/CENHUD_SaveEnergy
- **NYSEG**: https://bit.ly/NYSEG_SaveEnergy
- **PSEG Long Island:** https://bit.ly/PSEGLI_SaveEnergy
- **RG&E:** https://bit.ly/RGE_SaveEnergy

MAINE

EFFICIENCY MAINE

All incentives and rebates are subject to change without notice. For information on Efficiency Maine's programs go to efficiencymaine.com or call 866.376.2463

Home Insulation: Weatherization rebates up to $9,600 for income-eligible homeowners and up to $5,500 to other Mainers. See bit.ly/EffME_HomeInsulation. Residents can estimate home energy efficiency with the calculator at bit.ly/EffME_SavingsCalculator. To find a vendor go here: https://www.efficiencymaine.com/at-home/vendor-locator/.

Heat and Cooling: Rebates and financing for the installation of high-efficiency equipment. To find out more about heating solutions, for your home go to: https://www.efficiencymaine.com/heating-solutions/. For business heating and cooling solutions go to: https://www.efficiencymaine.com/at-work/heating-and-cooling-solutions/. Homeowners can estimate their annual heating costs for different heating systems using the Home Heating Costs Calculator here: https://www.efficiencymaine.com/at-home/heating-cost-comparison/. To find a vendor go here: https://bit.ly/EffME_VendorLocator. To find a qualified partner for business solutions, go here: https://bit.ly/EffME_BusinessSolutionsPartner.

Heat Pumps: Residents of any income are eligible for heat pump rebates up to $1,200. Income-eligible residents qualify for rebates up to $2,400, and businesses are eligible for incentives up to $4,800. Learn more at the Efficiency Maine heat pump website, bit.ly/EffME_HeatPumps.

Heat Pump Water Heaters: $850 mail-in rebates or instant discounts on heat pump water heaters. Learn more at bit.ly/EffME_WaterHeatingSolutions. A Water Heater Cost Calculator to estimate savings is at bit.ly/EffME_WaterHeatingCostComparison.

Electric Vehicle Charging Solutions: Charging at a single-family home is convenient and inexpensive. Most EV drivers do over 80% of their charging at home using either a Level 1 charger cord or a faster Level 2 charger. For public sites or multi-family residential sites, installing EV charging can increase employee satisfaction, show sustainability commitments, strengthen relationships with customers and attract new ones. See bit.ly/EffME_Work_EVCharging.

Electric Vehicles (EVs): Efficiency Maine offers instant rebates for eligible battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) at participating Maine car dealers. Learn more at https://www.efficiencymaine.com/ev/.

The standard rebate is $2,000 for a BEV and $1,000 for a PHEV. Higher rebates are available for low-income customers, governmental entities, and select nonprofits. For a limited time, Efficiency Maine offers a promotion for businesses with five or more vehicles registered in Maine, paying rebates of $4,500 on a BEV or $3,500 on a PHEV for the first 50 vehicles on a first-come, first-served basis. Maine businesses can also receive up to $8,000 for the purchase of an all-electric commercial van for business use. See bit.ly/EffME_EV_Rebates.

Commercial: Efficiency Maine has programs for businesses of all sizes, including multifamily buildings with five units or more and Maine's largest energy customers, businesses, for profit or nonprofit; municipalities; schools and higher ed facilities; industrial facilities; non-residential facilities; multi-family and condominium buildings with five+ units. To learn more about incentives for energy efficiency solutions, how to get started, and program details, visit https://www.efficiencymaine.com/at-work/. To find a contractor participating in Efficiency Maine programs as a Qualified Partner: https://bit.ly/EffME_BusinessSolutionsPartner.

Appliances: $50 rebates available for ENERGY STAR® certified clothes washers: bit.ly/EffME_ClothesWasher_Rebate

Room Air Purifiers: $25 rebate available for ENERGY STAR® certified room air purifiers: bit.ly/EffME_AirPurifier_Rebate.

$100 "DIY" Winter Prep Rebate toward the purchase of select weatherization and insulation products. Complete promotion details, a list of eligible products, and a claim form can be found on the Efficiency Maine website at https://www.efficiencymaine.com/at-home/100-diy-winter-prep-rebate/

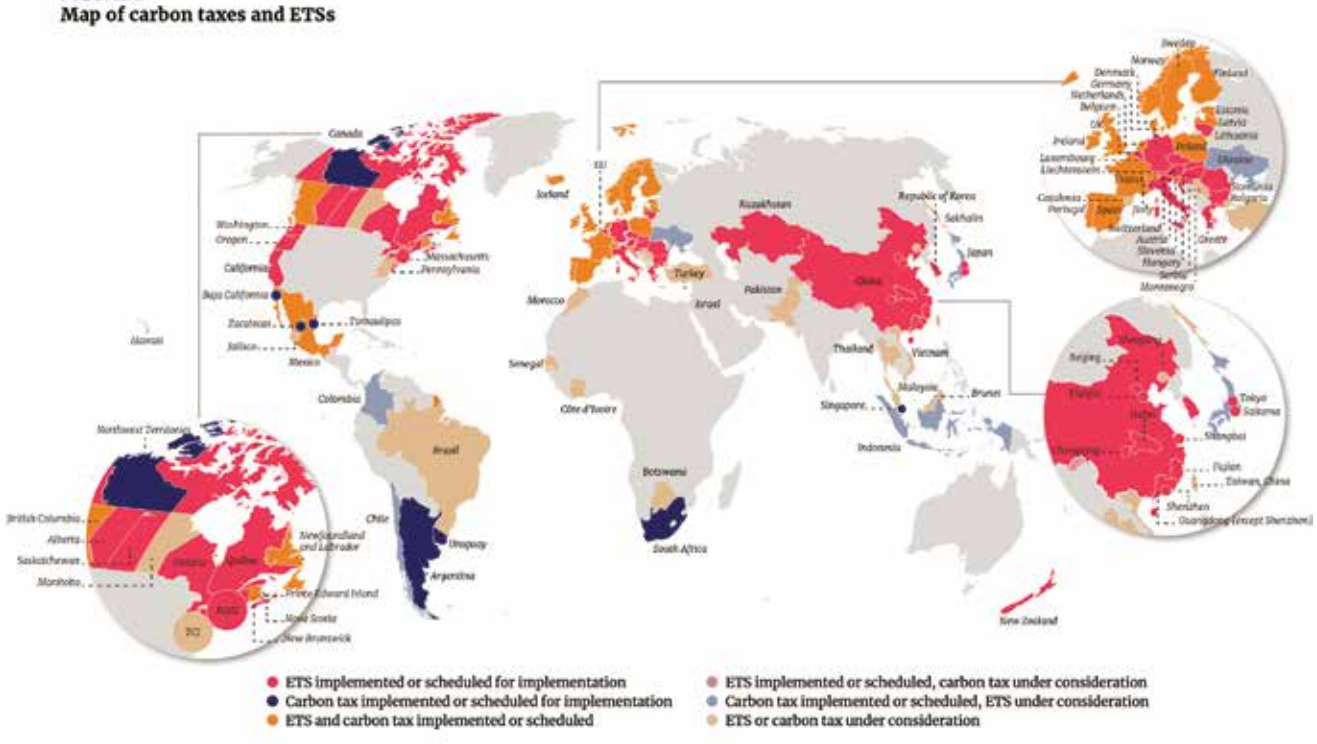
CARBON PRICING IS INEVITABLE. WHEN WE DO IT MATTERS!

John Gage

The next major development in human civilization, the transition from fossil fuels to clean energy, is underway. Countries that produce the solutions enabling this transition will enjoy economic and employment benefits for decades. The Inflation Reduction Act is a big step forward. However, much more is needed to drive the U.S. investment, innovation, and change required to achieve critical climate goals. A high price on climate pollution will do that, enabling the U.S. to lead this next step in human progress.

Experts have long recommended one foundational policy to address global warming: carbon pricing. Some doubt Congress can overcome powerful pushback from the fossil fuel industry to charge it for its pollution, but internal and external pressures are mounting. Public alarm about climate change is growing. Cash-back carbon pricing is a proven popular solution with growing bipartisan support. Businesses increasingly support carbon pricing because of the predictability it provides and the competitive advantage it offers against dirtier-producing countries. Carbon pricing is spreading around the world, and U.S. exporters will soon pay carbon pollution tariffs in trade with a growing list of countries until we price it here.

FIGURE 1
Map of carbon taxes and ETSs



Countries with carbon taxes and emissions trading systems (ETS). Source: World Bank, "State and Trends of Carbon Pricing 2022", Washington, DC. Doi: 10.1596/978-1-4648-1895-0. (Creative Commons BY 3.0 IGO)

Addressing a Market Failure

When pollution is free, we get too much of it. Economists warn that until the cost of climate pollution is reflected in the price of fossil fuels, market actors will fail to reduce it at the pace and scale required:

- "We cannot solve the climate crisis without effective carbon pricing." - US Treasury Secretary Janet Yellen.
- "Explicit carbon prices remain a necessary condition of ambitious climate policies" - IPCC.

The fossil fuel industry enjoys global subsidies of $5.9 trillion annually, mostly in unpaid environmental costs (IMF). We can address the market's failure to account for those external costs by charging coal, oil, and gas producers a steadily rising pollution fee based on the carbon in their products. This price signal will engage the market's invisible hand, guiding carbon-reducing investments, innovation, and decisions throughout the economy.

What Price?

At COP27, leaders recommitted to limiting global warming to 1.5˚C above preindustrial levels. According to the IPCC, this requires reducing greenhouse gas emissions by 50% by 2030 and to net-zero by 2050. Over seventy countries have committed to net-zero targets (UN). Economists have

Cont'd on p.23

A Climate Scientist's Review of COP27 – *Cont'd from p.1*

number one exporter of coal, and it claims it is not responsible for those emissions! Likewise some Middle Eastern countries are developing 'green' economies, which frees up more oil for export.

Following COP26, the UN appointed a high level Expert Group: "Integrity Matters" on the Net-zero Commitments of Businesses, Financial Institutions, Cities and Regions. The main conclusion that Secretary General António Guterres presented at COP27 is that "greenwashing" is prevalent. Essentially, climate change denial has been replaced with greenwashing, which is dishonest advertising by the fossil fuel and financial industries that pretend they are doing something to deal with climate change, when in reality this is tiny compared with their huge profits. A fine example is the Exxon-Mobil "Advancing Climate Solutions" July 2022 Progress Report. They plan a 20% reduction in emissions by 2030 by reducing the emissions from the leakage of methane and its flaring: they should have done this decades ago. They plan for net-zero emissions from its 'operated assets' by 2050, and they hope to develop a business strategy that is resilient to net-zero emissions by 2050, whatever that means. This is the company that knew disaster lay ahead in 1978 when their own chief scientist did the global warming analysis. Yet for 45 years, they have bribed politicians, funded fraudulent advertising and continued to extract and sell oil globally.

There was no consensus at COP27 on the key issue of phasing out all the fossil fuels: the fossil fuel lobbyists made sure of this. The observers who were there as citizen lobbyists were not allowed in the negotiation rooms. The global warming threshold of 1.5ºC was nominally kept, but it is slipping away (as may 2ºC).

The second big issue at COP27 was loss and damage payments from the rich countries (responsible for most of the emissions) to the poor and middle-income countries that historically emitted very little but are suffering the current climate extremes without the resources to deal with them. An agreement to set up a 'loss and damage' funding facility was reached; and this was regarded as the rare victory at COP27. It is a promise to begin a process to establish a fund of voluntary contributions, but who will contribute and how it will be managed will be left to COP28. This agreement in principle was only reached because Pakistan, the Chair of the G-77 coalition of 170 developing countries (plus China), kept pushing for agreement into Sunday morning, long after the meeting's nominal closure on Friday. The climate disaster in Pakistan this year killed 1700 people, flooded one third of the country, destroying homes and causing massive destruction of crops. Pakistan cannot afford the reconstruction. Also pushing were the Pacific island nations who sent a delegation led by Vanuatu asking for a 'loss and damage' climate fund. As the climate warms, Category 5 hurricanes are becoming more frequent. Damages have reached $600 million in a single year, a major fraction of the annual economy. Their reefs are dying, and they are critical to their life and food supply, and rising sea level is an existential threat. They have asked for payment for these losses as their way of life is destroyed.

China does not want to contribute as it was given 'developing country' status in 1992 and contributed far less historically to emissions, even though now it is now a major producer as the second largest global economy.

In a just world, the fossil fuel companies would be major contributors to this climate fund as they are making trillions in profits every year, but their strategy has been to bribe politicians to 'deny climate change' and protect their business from any responsibility for damages. The EU would like the fossil fuel industry to contribute. The U.S. has the largest economy and is the biggest historic contributor of emissions. However in the present 117th U.S. Congress, 139 climate science deniers have accepted more than $61 million in lifetime direct contributions from the oil, gas, and coal industries. I would assume the fossil fuel lobbyists at COP27 had millions in bribes available to ensure their companies do not have to pay.

This agreement to establish loss and damage funding represents progress, but the U.S. claims it does not include liability or compensation provisions. Generally speaking, a stable climate is incompatible with U.S. business-as-usual capitalism, since its key objective is to maximize profits.by exploiting people and the Earth's resources, which include the fossil fuels. The U.S. avoids discussing these key issues in global forums, which constrains progress at these COP meetings.

In a different context the Russian attack on Ukraine has impacted fuel supplies and costs in Europe as well as globally. It has indirectly nudged renewable energy development, but also the development of more natural gas transport to replace the loss of Russian supplies. However, the massive secret destruction of the Nord Stream 1 and Nord Stream 2 pipelines (presumably by Russia) is worrying to Norway and the UK, as they have networks of natural gas pipelines under the North Sea. Since NATO support is preventing Russia from capturing Ukraine, Putin may resort to the semi-clandestine destruction of critical underwater NATO facilities.

As always COP27 deferred many critical issues to the future, so watch for follow-up! Mounting challenges make agreement very difficult, but climate catastrophes will nudge us.

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

COP 27 ACCOMPLISHMENTS

"This COP was about implementation, implementation, implementation - nobody arrived at COP27 thinking we've got another five or ten years and we need to come up with a plan. Everyone I met was focused entirely on making action happen on the ground, which includes deploying carbon capture, utilization and storage (CCUS) solutions to tackle industrial emissions. We had some incredibly constructive conversations with policymakers, industrial companies and investors – all of us coming together to agree on the critical steps to scaling CCUS, kickstarting new projects and delivering industrial decarbonization."

– Quote from Carbon Clean CEO, Aniruddha Sharma

Winning Businesses in the News

G.E.T. *Staff*

Energy Catalyst Technologies

There is an accelerator for climate technology manufacturing called Scale for ClimateTech. It assists hardware-focused cleantech startup companies' growth by helping to build teams, users, and relationships with suppliers. By doing these things, it works to transform business operations.

Scale for ClimateTech recently held a clean energy pitch competition in New York City, highlighting five innovative, new manufacturers of clean energy technologies. One of these was the Double Hybrid heat pump from Energy Catalyst Technologies (ECT), which took the grand prize of $20,000. This is to help them finalize their manufacturing process. "By this winter, we will have 11 homes that are heated by Double Hybrid heat pumps," owner Matt Desmarais said. "We plan to launch our third generation Double Hybrid in the spring, which can replace a hot water boiler and reuse all the existing infrastructure."

Matt Desmarais of Energy Catalyst Technologies

ECT specializes in a patent-pending geothermal heat pump that produces hot water and hot air at the same time. The water is sufficiently hot to be used in such existing systems as baseboards and radiators, and this saves a lot of money for customers. *Green Energy Times* published "Groundbreaking Technology Provides Lower Cost Option for Geothermal" on ECT in June 2022 (bit.ly/GET-ECT-6-22).

ECT is based in Albany, New York. The website is www.EnergyCatalyst.org.

Resilient Buildings Group

In its November issue, *Business NH Magazine* recognized the top ten business to watch based on their fast revenue growth rates. Resilient Buildings Group was listed as number four of all the state's businesses.

Resilient Buildings Group (RBG), based in Concord, New Hampshire, has a mission to protect its customers from the uncertainties of energy. As it works to improve existing building stock, RBG says, it can reduce energy use by 50% to 70%. When its expertise is put to use in new buildings, it can help achieve passive certification. RBG also has experience with LEED certification.

While it has a strong focus on reducing energy use through electrification, it also works on issues of air quality. This is especially important because efficient buildings are well air-sealed and need carefully designed ventilation.

Resilient Buildings Group leaders, Dana Nute, President and Chase Pennoyer, Vice President of Operations. (Courtesy photo)

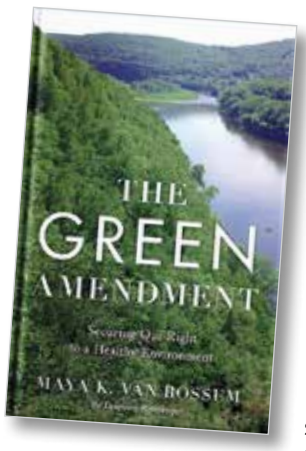
RBG works with larger buildings, in the range from 10,000 to 250,000 square feet. Its work is mainly on retail and office buildings, and multi-unit residences. It has completed over 250 projects in ten states.

RBG's website is www.resilient-buildingsgroup.com. ♻

Pure Water, Clean Air, a Stable Climate and Healthy Environment: Protect these Rights for all Communities

An Interview with Maya K. van Rossum, author of* The Green Amendment, The People's Fight for a Clean, Safe, and Healthy Environment, *November 1, 2022. She is founder of Green Amendments for the Generations, the Delaware Riverkeeper and Leader of the Delaware Riverkeeper Network

By Janis Petzel, MD



JP. In your book, you gave numerous examples of how the Green Amendment provided a legal backbone to fight bad environmental events from happening. Do you have examples of how it may have influenced a formerly dirty industry to change how it operates, for example, a housing development that was careful to preserve the environment?

Maya: First and foremost, the Green Amendment applies to government action rather than directly applying to the actions of private industry. The goal of all constitutional rights is to ensure that as government undertakes its work – passing laws, issuing regulations, and rendering permitting decisions – it is doing so in a way that does not infringe upon the rights of the people. With Green Amendments, the rights being protected are environmental rights. Industry will most certainly be watching how Green Amendment constitutional environmental rights protections influence government decision making and will work to meet honor these protections, knowing that if they try to skirt the law, they will create unnecessary hurdles for the projects they want to advance.

JP: Would you tell me about being "the" Delaware Riverkeeper? I'd like to understand it better. Would you please tell me what it means, and what it means to you?

Maya: Yes, there is only one 'Delaware Riverkeeper' and I am the person with the honor of bearing that title.

Several decades ago, the concept of having a "Riverkeeper" to take personal responsibility for a waterway and to give it a voice in our human world was founded on the Hudson River. John Cronin was the first Riverkeeper in the U.S. In my watershed, activists saw the value and power of having a Riverkeeper, and this idea of a person demonstrating the importance of taking that personal responsibility day in and day out to fight for the river and so we decided we wanted that concept for the Delaware. The Delaware Riverkeeper Network was founded and shortly thereafter I became the person to bear that title. At the time we were part of a larger organization – just starting as an initiative thereof – and so it was up to the board with input from our community to make the decision that I should bear the title a few years into the founding of the organization.

As the Delaware Riverkeeper I am the Riverkeeper for the mainstem Delaware and all of its tributaries, so my role covers the entire watershed. But, as I say to people all the time, the job of giving a river a voice in our human world cannot be accomplished by one person, it requires a community, and that is what the Delaware Riverkeeper Network is, it is a community of activists, experts, lawyers, and all people who care, working together to protect our River and its watershed.

After the Delaware Riverkeeper Network was founded, others were inspired by what was happening on the Hudson and the Delaware and now there are Riverkeepers, Soundkeepers, Baykeepers, Inletkeepers, Lakekeepers on other waterways. People wanting to learn if there is a waterkeeper in their watershed should check out the Waterkeeper Alliance.

Q. It's a shame the Green Amendment did not pass in Maine. I'm interested for this review but also as a volunteer activist from the state--is there any chance of a second go at getting this passed in Maine?

Maya: Securing a constitutional amendment is a higher hurdle than legislation, that is one of the powerful benefits – while it is harder to get, once secured it is very unlikely to be lost due to that higher hurdle as well as the personal sense of environmental entitlement passage engenders.

The effort to secure the Maine amendment (what is being called The Pine Tree Amendment) is ongoing. The Maine Youth Action is stepping up in a leadership role, and the original two people I talk about in the book, Michelle Henkin and Andy Burt, are still very engaged. We are looking forward to making great progress in the coming year. I expect Senator Rick Bennett will continue as a champion on the Senate side. On the house side I think Representative Margaret O'Neill will continue as lead. They both have been powerful voices in the legislature to compliment what has been happening in the grassroots. If the Maine amendment passes that will be superb! But if not, we will just have an even stronger foundation to start from on the next go around.

JP: How has the Green Amendment process worked in other states?

Maya: In every state where we are working it is taking more than one constitutional go around to secure passage – that is because it is both a higher hurdle but it is also a new concept for people to learn about, and, as you can imagine, as soon as industry gets wind of it, they start to come out of the woodwork in opposition (interestingly their opposition generally plays out behind the scenes in private meeting rooms because even they know how stupid they sound to say that the people shouldn't have a right to clean water and air).

Our Green Amendment in New York took two passes to win – and in that state the process requires each legislative house to vote twice in support in consecutive legislative sessions. The first year it passed the house but not the senate, so we had to go back to the beginning, the second year we got passage in both houses and so were able to move on to that second vote which was also secured in 2021. The amendment then went before the people and passed with over 70% of the vote.

In New Mexico we are on our third year and each time the support and awareness is better and better.

In Delaware this will be the second year.

New Jersey is a few more years in. It has been stymied by legislative leadership using the legislative process to prevent a hearing – the same happened in New Mexico.

Wing Dam on the Delaware River. Lambertville, NJ is on the left and New Hope, PA is on the right. (Flickr/James Loesch)

I could go on for each state – they each have their story, but everywhere a Green Amendment is advancing communities are dedicating to keeping up the work until success is achieved because they can see the power in having a constitutional right to pure water, clean air, a stable climate and healthy environments, and to ensuring all government officials have a constitutional obligation to protect these rights equitably for all communities.

JP: Thank you for talking with me, Maya. Where can people find the Delaware Riverkeeper Network, find your Green Amendment for The Generations organization and purchase your book?

Maya: The Delaware Riverkeeper Network website is https://www.delawareriverkeeper.org/. Green Amendments for The Generations is www.ForTheGenerations.org and from there you can find the website and/or web page for your state. If you want to find a copy of my book and a way to order it from your favorite book outlet, or to order it directly from my organization, go to https://forthegenerations.org/the-green-amendment/. Wherever you buy the book from, every penny of profit is dedicated to environmental protection, I don't take a penny, because for me this is all about saving the world, not making money.

Maya is the Founder of Green Amendments for the Generations and author of the award-winning book Green Amendments. *van Rossum is also the Delaware Riverkeeper, leading the watershed-based advocacy organization, the Delaware Riverkeeper Network, for over 30 years in its efforts to protect the health of the Delaware River and its tributaries. (Courtesy image)*

Janis Petzel, MD is a physician, grandmother and climate activist whose writing focuses on resilience, climate, and health. She lives in Islesboro, Maine where she advocates and acts for a fossil-fuel free future. She serves on the Islesboro Energy Committee and is a Climate Ambassador for Physicians for Social Responsibility. ♻

WATERKEEPERS IN OUR MIDST

Jessie Haas

Today the water in the Connecticut River is clear and much cleaner than it was many years ago. (Courtesy photo)

Many of us are old enough to remember when canoeing on the Connecticut River (or many other waterways in the Northeast) posed a health hazard. Swimming was unthinkable. The waters were turbid and ran the color of whatever substance the nearest papermill was using. That has all changed. Vermont scuba diver, Annette Spaulding, reports that when she was diving in the Connecticut River thirty years ago, she could barely see her hand in front of her face. Now the water is clear, making diving safer and more productive. River cleanup is partly responsible for her discovery, a few years ago, of the lost Indigenous petroglyphs in Brattleboro, VT.

The Clean Water Act had a large role in giving states and other entities the tools to prevent river pollution. Also responsible is a group of people and organizations doing the work of stewardship. They are variously known as River Stewards or Waterkeepers, and work on and for many of the bodies of water in our area, including Lakes Champlain and George, the Hudson, Connecticut, and Black Rivers, and several bays and estuaries. A Riverkeeper, according to Delaware Riverkeeper Maya Van Rustem, is "a person demonstrating the importance of taking ... personal responsibility day in and day out to fight for the river." Clearly, however, this is not a one-person job. Van Rossum is theoretically responsible for the entire Delaware River watershed, but in reality it is a community of activists, experts, lawyers, and volunteers, that protect and watch over the river.

The Riverkeeper idea was pioneered in the Hudson River Watershed, where John Cronin became the first Riverkeeper in the United States. Vermont's first Connecticut River Steward was State Representative David Deen of Westminster, an avid fisherman and member of Trout Unlimited—not coincidentally, an organization whose mission is to "protect, reconnect, restore, and sustain coldwater fisheries and their watersheds."

Riverkeepers and their ilk have multiplied greatly. Now there are Lakekeepers, Baykeepers, Soundkeepers, and Inletkeepers all over the world. You can find out which ones operate in your watershed by going to the Waterkeepers website. Many waterkeepers work under an umbrella organization like the Conservation Law Foundation (CLF) or a local association such as the Lake George Association.

The model has produced some important new science. Chris Navitsky, the New York Lake George Waterkeeper, has conducted some breakthrough research on how a particular species of algae found in near-shore areas can help identify and prioritize cleanup efforts. This has led to two important projects in the watershed; a septic system replacement program at Dunham's Bay in the Town of Queensbury, and a septic system prioritization and remedial action plan in the Town of Lake George. This earned Navitsky a prestigious award from the New York Water Environment Association. Other projects include a road salt reduction program, a state-of-the-art nitrate removing woodchip bioreactor for the Town of Bolton, and a low impact development certification program.

Citizen science is a big part of waterkeeper success. The Black River Action Team (BRAT) in Springfield, VT has run an annual river cleanup day for 23 years. River Dippers collect water samples through a grant from Trout Unlimited. Opportunities to volunteer in the Upper Valley of the Connecticut River include counting fish, pulling invasives while canoeing or kayaking, and tree planting for river bank stabilization and wildlife habitat.

In Maine and New Hampshire, the Great Bay Estuary comprises 13,000 acres extending inland from the mouth of the Piscataqua River, including Great Bay, Little Bay, and numerour rivers and creeks, all vital habitat for fish, birds, and other wildlife. The watershed is also home to 52 cities and towns, the redeveloped Pease Airforce Base, and over 400,000 people—and still growing. And the estuary is in trouble. A parasite infestation in 1993 all but wiped out the oyster population, which went from 1,000 acres of beds to only 50. The oysters once filtered the entire Great Bay in just two or three days; the remnant took a year and a half to do the job. Eelgrass, which provides habitat and protection from storm surges, has also declined both in acreage and biomass. Realizing that this loss coincided with increasing pollution, CLF in 2007 leveraged the Clean Water Act to force greater regulation. The EPA focused on reducing nitrogen pollution from sewage treatment plants. Facing stiff pushback from municipal officials, CLF launched the Great Bay-Piscataqua Waterkeeper program in 2012. Jeff Barnum, a local recreational fisherman, became waterkeeper. One of his early successes was an oyster shell recycling program, in which shells from local homes and restaurants were used to establish new oyster beds. He organized a group of over 30 volunteer advocates to attend hearings and meetings where issues affecting the bay were on the agenda. Seven cities whose municipal sewage systems discharge into the bay have entered into agreements with EPA to make upgrades to reduce nitrogen pollution. Next Barnum focused on lawns, another major source of excess nitrogen. He educated homeowners, businesses, and hardware and garden store managers who sell the polluting products, about how to use them wisely. Meanwhile, perfluorinated chemicals (PFCs) from firefighting foam used at Pease are becoming a problem.

Through it all, Melissa Paly, the new Waterkeeper continues Barnum's workof building a commnuity that cares about, and for, this beautiful body of water.

Waterkeeper is an honorific applied to the point person protecting a body of water. However, all waterkeepers emphasize that they cannot possible do this work alone. We are all the Waterkeepers.

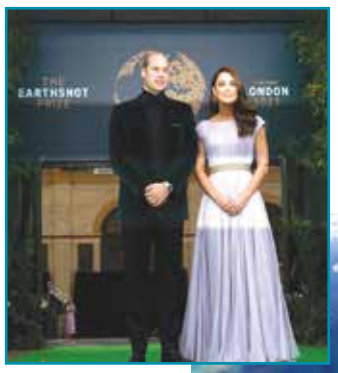
Jessie Haas lives in an off-grid cabin in southern Vermont with husband Michael J. Daley. She is the author of over 40 books, most recently The Hungry Place.

Sources: New Hampshire's Great Bay - Waterkeeper; Home - Waterkeeper; Connecticut River Conservancy – Clean water. Healthy habitat. Thriving Communities. (ctriver.org); Home | blackriveractionteam (blackrivercleanup.wixsite.com) ♻

WATERKEEPER® ALLIANCE

The Royal Visit to Boston / Earthshot Prize

George Harvey



The Earthshot Prize was founded in 2020 by William, now Prince of Wales, and Sir David Attenborough to encourage environmentalism. Every year, awards are given out to winners in each of five categories: Build a Waste-free World, Clean Our Air, Fix Our Climate, Protect and Restore Nature, Revive Our Oceans. This year, the awards were £1 million ($1.21 million) each.

We might note that this year, the awards ceremony itself was unusual. It took place in Boston, Massachusetts, despite the fact that none of the winners were from North America. The Prince and Princess of Wales both attended, but the winners only attended virtually, from the places where they lived and worked. The event will take place in a different place every year and was planned to be in Boston long in advance, so that should not be a big surprise. On the other hand, the reason none of the winners attended is worthy of note: if they had all gone to Boston, travelling would have had a large carbon footprint.

The Prince and Princess of Wales at the 2021 Earthshot Prize ceremony. (U.S. Ambassador to the U.K.) The Great Barrier Reef is 1,400 miles long and has many endangered species. (Luka Peternel, CC-BY-SA 4.0, bit.ly/CC-by-sa-4)

The Winners

Build a Waste-free World was awarded to Notpla, a start-up based in the U.K. It makes packaging out of seaweed and plants as an alternative to using plastic. Its products can be used for a wide variety of needs, from holding liquids to coating the insides of food storage containers.

The Clean Our Air award went to Mukuru Clean Stoves, a Kenyan organization founded by Charlot Magayi. It provides low-cost, clean-burning stoves that use processed biomass to reduce indoor pollution. They can reduce fuel consumption by up to 60%, while eliminating up to 90% of toxic fumes, compared with open fires.

Fix Our Climate was won by 44.01, a business based in Oman. It eliminates CO_2 by mineralizing it in peridotite. The process consists of pumping carbonated water into seams of peridotite deep underground. 44.01 plans to eliminate a billion tons of atmospheric carbon dioxide by 2040.

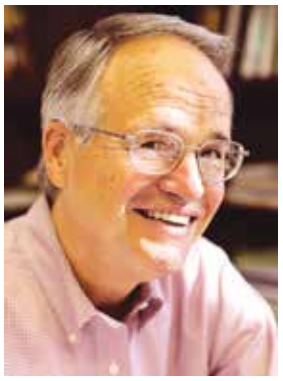
Protect and Restore Nature was awarded to Kheyti, a start-up based in India. It offers what it calls a "Greenhouse-in-a-Box" to protect small farms from the effects of climate change. Kheyti has already helped one thousand farmers increase their crops, while they use less water and pesticides.

Revive Our Oceans was won by an Australian organization, Indigenous Women of the Great Barrier Reef. It is made up of a group of indigenous women who combine knowledge of nature and digital technologies to protect and restore the reef. The organization is considered to have cultural significance.

The Earthshot Prize is funded by philanthropists and organizations. The initial budget of £50 million will allow for awards of £1 million to each of the five recipients every year until 2030. ♻

Local Author of *They Knew*, Calls for Transformation to Overcome Greed and Apathy

Roger Lohr



James Gustave Speth, who lives in Strafford, VT and is known as Gus, gave a talk to his neighbors at the Universalist Church in town regarding his life and thoughts on environment and related politics. He has been quoted that today's environmental challenges and climate change are really about selfishness, greed and apathy that can only be overcome with cultural and spiritual transformation.

He divided his biography into three parts. The first part of his dissertation was about growing up in Orangeberg, SC where segregation ruled. He described how segregation was "just accepted" in the South and referenced the 1968 Orangeberg Massacre that occurred where police shot into a crowd protesting racism that resulted in three deaths and 20 people getting wounded.

He attended Yale and Oxford Universities in the sixties and was involved with a grant proposal awarded by the Ford Foundation to create the legal defense fund for the environment.

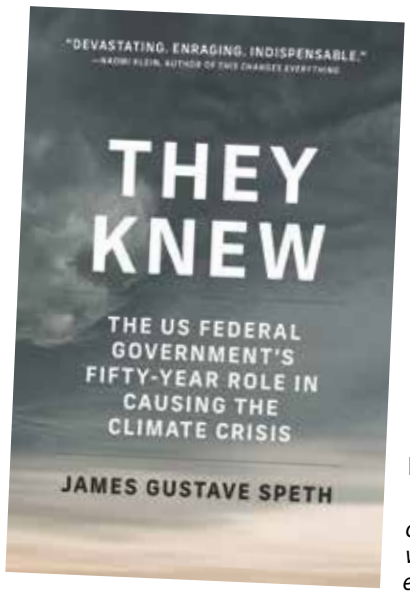
During the Jimmy Carter administration, Speth was a member and chairman of the U.S. Council of Environmental Quality, which was responsible for creating many of the EPA guidelines on clean air and water. Later he was chair of the United Nations Development Group and United Nations Development Programme.

Speth served as Dean of the Yale School of Forestry and Environmental Studies, and he helped to found the Natural Resources Defense Council where he was a senior attorney. He stated that he never lost a lawsuit when forcing government action on water, wetlands and nuclear power. Speth commented that a *Friends of the Earth* report sent to the White House 40 years ago was spot on for solar power and energy efficiency. He said that action based on the report was unfortunately scuttled by Ronald Reagan when he became president.

Working for the World Resources Institute for a decade, Speth expanded concern for environmental matters on a global scale for soil conservation, water, climate and such. He visited 115 countries and saw conditions around the world. At the end of his time with the United Nations he felt good about the programs and progress on the planet, but by 1972, he concluded that environmentalism was not going well. He produced three books including *Red Sky in the Morning, Bridge at the Edge of the World and America the Possible* (in 2012). The messages in these books were about the superficiality of how the country and the world were addressing the environmental issues and the manifestations of the political economic system, that included factors such as gender, treatment of children, healthcare, education and democracy.

Speth was at the Vermont Law School, known for legal perspectives on environmental issues, when he linked economic and political concerns such as capitalism, corporate supremacy, consumerism, and profit and growth at all cost, as wrongheaded values that are root causes of environmental concerns such as pollution and climate change. He felt that these are factors that must be addressed because they often determine environmental outcomes. He commented that the power of money had become more important than the power of the people. He now echoes the call for transformative change to address these issues and speaking to his neighbors he laid out six key elements:

1. America is in deep trouble at this time and things will probably get worse (Inflation Reduction Act notwithstanding).
2. The severity of the climate situation will not allow for the easier solutions in the future.
3. Hope must be kept alive.
4. There is a need to resist. Don't accept the unacceptable. Keep fighting but don't expect to win.
5. There is a need to be "crisis ready" for when the time comes. Expect climate chaos to consume all of our energy. Prepare for massive mobilization.
6. Begin and pursue to plant seeds now for system change. Consider alternative political economy that provide automatic good outcomes for the planet. Identify new political economy and begin to move in that direction.



The newest Speth book published on MIT Press in 2021 is entitled, *They Knew: The US Federal Government's Fifty-Year Role in Causing the Climate Crisis*. The book analyzes how administrations from Carter to Trump (including Obama) continued aggressive support of a fossil-fuel based energy system despite having information about the climate crisis and its connection to fossil fuels.

Speth feels that the GDP (gross domestic product) is a measurement that does not account for the planet and peoples' well-being, and an alternative measurement should be devised to incorporate human and planetary factors. Regarding political economy and its outcomes, Speth commented laconically, "We're in a hell of a pickle, but there's a lot we can do." He referenced Greta Thunberg as a representative of the younger generation that is loudly voicing demands. He cited the need for an explosion in citizen action. He predicted that victimization, fear and alarm are going to grow as the climate situation worsens. The societal transformation would need to rein in corporations and have their charters based on serving the public interest. The scaffolding will need to crumble down and new foundations will need to be built.

Roger Lohr of Lebanon, NH, who owns and edits XCSkiResorts.com, has published articles and promotional topics on snow sports, sustainability, and trails in regional and national media. ♻

Is Achieving 1.5°C Possible?

John Bos

How do we talk about issues that really matter, such as our climate crisis? Philosopher Hannah Arendt argued in *Men in Dark Times* that "the exchange of ideas, perspectives and arguments is essential to democracy and humane societies." And, I would add, our climate crisis.

Therefore, I believe that Fatih Birol, executive director of the International Energy Agency, the global authority on energy, slammed scientists and activists who have claimed that the recent COP27 UN climate summit killed off hopes to achieve the 1.5°C target.

"It is factually incorrect," Birol said, "and politically it is very wrong. The fact is that the chances of 1.5°C are narrowing, but it is still achievable."

Birol said that the claims at COP 27 that the 1.5°C limit was dead were coming from an unusual coalition of scientists, activists and fossil fuel industry incumbents.

He maintains that the world can still limit global heating to 1.5°C, and to claim that the target is now out of reach is to play into the hands of fossil fuel proponents. That said, many people these days avoid "hot-button" topics such as climate change because the issues are so complex, or because they don't feel prepared to handle the strong feelings and beliefs that come back at them.

Back in the day, I read that civil discourse is a way to invite deep engagement with people whose beliefs were different from mine. Civil discourse did not mean prioritizing politeness or comfort over getting to the heart of an issue. If we are going to ask people to listen to us and engage civilly, we have to ensure that we are communicating in an equitable space.

This Tuvaluan girl is holding her sign at a site she picked as an example of environmental degradation. Tuvalu is expected to become covered by the ocean in under 25 years, displacing the entire population. (newsandletters.org)

What in this weary warming world might possibly define an equitable space? A space in which we could discuss our environmental concerns with, for example, people who have supported their families by working in coal mines for most of their life? Or on an oil rig in the Gulf of Mexico? Or in a concrete factory?

Without equity, civility can feel repressive. In 2019, the NPR series "Civility Wars" explored how the call for civility "can feel like an effort to stifle people's outrage over injustice or hate." At a time when we are facing so many urgent public concerns, meaningful and constructive discourse is not possible if voices of protest are silenced. It should surprise no one that the 13 Pacific Island countries most vulnerable to the rising ocean expressed legitimate moral outrage in strong terms. They insist that big oil companies pay for mounting damage from ocean storms and sea-level rise caused by their carbon emissions.

This begs the much larger question about how to reach any kind of climate change mitigating agreements with the petroleum industry when, at this moment in time, oil companies have enjoyed a phenomenal year. Oil profit margins are up to a whopping $10 billion. The cost of carbon dioxide reduction to the fossil fuel industry is seen solely as a threat to its bottom line.

What we must achieve across all industries is how to speed up technological progress, investments, and reducing the lead-time to shift away from carbon-intensive processes and practices. At the same time, we must somehow manage transitions for workforces, communities, assets, and the environment, all in accord with each other.

Fatih Birol points to the surge in clean energy investment this year in the wake of the Ukraine war and soaring fossil fuel prices. He noted that COP countries' targets on reaching net zero greenhouse gas emissions will result in a temperature rise of 1.7°C, and that is only if all pledges are fulfilled. Nonetheless, he finds this within striking distance of the critical 1.5°C limit.

For Birol, the economics of the transition to clean energy are clear, with wind and solar power now cheaper than fossil fuels across much of the world. More countries were seeking to expand clean energy sources as a matter of national security and of industrial policy.

The International Energy Agency "is an evidence-based organization," Birol told the *Guardian*. "To say that 1.5°C is dead and that we will never reach a peak [in emissions] before 2030 is dogmatic and in my view not a data-driven conclusion. Proponents of the existing energy systems will be the beneficiaries if the obituary of 1.5°C is written," he warned.

The 1.5°C climate target was set at COP 21 in Paris in 2015. To say that progress toward this goal has proceeded at a snail's pace over the past seven years is a profound understatement.

So, back to the fundamental question. How do we talk about issues that really matter, like our climate crisis?

John Bos is a contributing writer for Green Energy Times. *His biweekly column "Connecting the Dots" is published every other Saturday in the* Greenfield Recorder. *He is the project director for a new book of 50 poems and related photographs from nature that he and three other cancer survivors created as a thank you to Cancer Connection, a non-profit support agency in Northampton, MA. Questions and comments are invited at john01370@gmail.com.* ♻

New Climate Extremes

Dr. Alan Betts

Extraordinary climate extremes around the globe that appear to reflect the Earth's perspective on climate have continued since my last update in August. After talking to people here in Vermont, I am now using "Mother Nature's perspective" on climate, as most grasp its meaning at once. It has also two profound benefits: the first is the shift to the indigenous world view. The second is it quietly removes the male chauvinist bias that has dominated western thought and politics for almost two thousand years. This bias was created within Christianity at the Council of Nicea in 325 A.D., when the Emperor Constantine destroyed the indigenous Aramaic teachings of Yeshua (to us Jesus) which were based on the living Creation, in order to create a Roman Catholic Church that met his needs for male human power and authority.

Hurricane Ian's catastrophic storm surge was so powerful that it piled up boats on land in downtown Ft. Myers, Florida marina. (Dylan Federico)

In the climate world, post-tropical storm Fiona with wind gusts still up to 100 mph struck Nova Scotia and Prince Edward Island on September 24, 2022, leaving them without power. It was the most extreme storm ever to hit eastern Canada with expected damages that may approach a billion dollars. You may recall that back in late-June and early July last year an extreme heat wave set massive fires in British Columbia (BC) when temperatures in the forest town of Lytton BC reached a record 121oF. Then in mid-November 2021, an atmospheric river brought extreme flooding to BC that caused massive mud and debris slides that closed the Trans-Canada Highway and national railway line. This shut off exports of liquid natural gas from the BC mines and exports from the Alberta tar sands. Canada has no intention of closing these profitable industries, but from Mother Nature's perspective these fossil fuel industries and exports are contributing to the destruction of life on Earth, so storms targeting Canada will continue.

On September 28, 2022 Hurricane Ian after damaging Cuba, maneuvered to target Florida. It slowed down and amplified to nearly a category 5 storm. It struck the west coast near Fort Myers after passing over Sanibel Island, causing catastrophic damage from winds, storm surge and flooding, and substantial loss of life. Torrential rain led to still more flooding, which is likely to continue on the slow-moving St. John's River into November. Hurricane Ian then crossed Florida, redeveloped over the Gulf, and moved north to hit South Carolina. Florida governor DeSantis could be one of the Earth's targets as he is a 'climate change denier' who doesn't support renewable power and has a largely neo-fascist political agenda that has no respect for life on Earth. Unfortunately for politicians and other important people, Mother Nature can read all our minds.

On the other side of the world the flooding of the coal mines in eastern Australian continues. Back in the first week of July 2022, Sydney had a catastrophic flood when a huge storm cell brought a year's worth of rain (about 4feet) in three days to some areas. Recently from October 13 through 23, 2022 there were more huge floods across Victoria, New South Wales and up into Queensland. Some areas received four times the mean October rainfall in 24 hours. These flooding extremes are making parts of eastern Australia unlivable, but the political system refuses to discuss how their coal mines are destroying life on Earth. Australia is the second largest exporter of coal globally. Companies which are mining more than ten billion tons of coal per year are enjoying cash profit margins of about 45%. Rather than discuss the link between climate change and coal mining, the extraordinary claim has been made that Australia is not responsible for the climate consequences, since their coal is burnt elsewhere! Mother Nature disagrees. An exceptionally long La Nina in the Pacific which contributes to these floods is continuing.

Exxon-Mobil's chief scientist told management in 1978 they had to act swiftly to save the Earth's climate and he was told to keep quiet. After waiting forty-plus years for humanity to act, Mother Nature is taking over the climate system to protect life on Earth. This is incomprehensible to our political and financial leaders as it is a threat to capitalism, whose purpose is to make money exploiting people and life on Earth. The ongoing takeover by Mother Nature is incompatible with the unspoken concept of capitalism that "Humanity is in charge, because we are the only intelligent species on Earth." The Fossil Empire will have to spread more webs of lies and bribe more politicians to try to avoid facing change. When you are making trillions destroying Mother Nature and the lives of our children, these are trivial costs, but they will be a total failure as the destruction of the Fossil Empire is now inevitable.

The takeover by Mother Nature seems fearful to some at first, and it is if you live on the coast as sea-level rises and storms increase. However, when you realize that your actions on her behalf are transparent to Mother Nature since she can read your mind and support you, your perspective changes to one of gratitude as new worlds of possibilities open to you and your colleagues.

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

CARBON PRICING – Cont'd from p.18

calculated the carbon prices required to achieve those goals:

- "For a 2050 net-zero CO2 emission target, prices are US$34 to US$64 per metric ton in 2025 and US$77 to US$124 in 2030" - Dr. Noah Kaufman et al. in Nature.
- "Estimates for a Below-1.5°C pathway range from $135–$6050 / tCO2e in 2030" - IPCC.

Viability and Durability

A carbon tax could have a regressive impact on households and impose a competitive burden on manufacturers of energy-intensive goods. For those reasons (as well as manufactured resistance by the fossil fuel industry and free-market fundamentalists), political reluctance to price carbon has delayed important federal legislation for decades.

To address regressivity, ensure the policy is popular when implemented, and support the high price required, experts recommend giving the money collected from fossil fuel producers to households in monthly per-capita cash-back rebates:

- "Carbon pricing is most effective if revenues are... returned to taxpayers corresponding to widely accepted notions of fairness" - IPCC.
- "To maximize the fairness and political viability of a rising carbon tax, all the revenue should be returned directly to U.S. citizens through equal lump-sum rebates." - Economists' Statement.

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To protect business competitiveness, economists recommend applying a commensurate carbon tariff on imports and rebating exporters to "level-ize" the built-in cost of climate pollution in trade with free-polluting countries:

- "To prevent carbon leakage and to protect U.S. competitiveness, a border carbon adjustment system… would enhance the competitiveness of American firms that are more energy-efficient than their global competitors. It would also create an incentive for other nations to adopt similar carbon pricing." - Economists' Statement.

Carbon Pricing Signals

Several trends indicate U.S. carbon pricing is coming soon.

1. Carbon pricing has spread to 68 countries and regions, and prices are rising. The EU's price recently tripled to $80 per ton of CO2. Canada uses "Carbon Cash-Back" and will reach $135 per ton of CO2 in 2030 (World Bank). All but two developed countries have a carbon price on fossil fuels.
2. U.S. exporters will soon pay some countries' carbon prices on exports of energy-intensive goods, starting with the EU's Carbon Border Adjustment Mechanism (CBAM). They won't have to pay when the U.S. is pricing carbon. Canada, Japan, and the UK are also considering CBAMs.
3. Businesses recently pressured the Senate to ratify the Kigali Amendment to the Montreal Protocol to reduce hydrofluorocarbon climate pollution. Why? To avoid future trade restrictions and for a competitive advantage (Grist). The Senate ratified this international climate treaty with strong bipartisan support. Carbon pricing will be next for similar reasons.
4. Support for "Carbon Cash-Back" is growing in Congress. All but one Democrat senator supported including a variation in the Inflation Reduction Act (Inglis). The House's Energy Innovation and Carbon Dividend Act has 96 co-sponsors.
5. 33% of all Americans are now alarmed about climate change, up from 18% in 2017 (Yale CC). National polling by CLCouncil and Yale Climate Communications find 70-75% support the Carbon Cash-Back solution. In New Hampshire, 75% of the 45 towns that have voted on it passed a resolution asking for legislation of Carbon Cash-Back at the state and federal levels.

Carbon pricing is inevitable. But whether Congress does it in time for the U.S. to lead the global transition to clean energy and give the world its best chance for a safe climate future is up to us. Please tell Congress you support Carbon Cash-Back at cclusa.org/write-cfd.

John Gage volunteers with Citizens' Climate Lobby as state coordinator for NH. ♻

Lowering Your Carbon Footprint for 2023

Have you ever felt like reducing your own greenhouse gas emissions is too big of a challenge to tackle? We know it can be hard to make big changes to your lifestyle or habits. But there are things you can do around your own home to reduce your carbon footprint.

Almost all forms of energy emit greenhouse gas emissions. That means saving energy ties directly to reducing greenhouse gas emissions. How do we know?

Since 2000, the investments that Vermonters have made in energy efficiency – saving electricity and heating fuels – will avoid over 12 million metric tons of greenhouse gas emissions. That probably just seems like big number, so let's put it another way. Avoiding over 12 million metric tons of greenhouse gas emissions is like taking all of Vermont's cars off the road for over four and a half years.

It is hard to feel like you, personally, can have an impact on reducing greenhouse gas emissions. But those emission reductions were made up of hundreds and thousands of individual actions from Vermont businesses and homeowners alike. What do these actions look like? We've got a list of some tried-and-true methods of reducing your carbon footprint. Even better: many of these actions will also save you money on your energy bills.

Change out your lightbulbs

We know, you've heard this one. Honestly, we're ready to stop talking about it too. The thing is, it's still an effective and low-cost way to reduce your electric use. ENERGY STAR® LEDs are far more efficient than other lights, and they last longer. You could also consider smart lighting to have more control and avoid leaving lights on when they're not necessary.

Get smarter - with your thermostat, that is

Heating is the second largest source of greenhouse gas emissions in Vermont. Most Vermonters still primarily heat with fossil fuels that emit carbon dioxide, like fuel oil, propane, or natural gas. Any time you use less heat, you're also emitting less. Programmable thermostats can be set to turn down automatically based on your daily schedule. Smart thermostats go one step further to learn and adjust based on your habits, the weather, and your preferences.

Look for the ENERGY STAR logo

When you're replacing an appliance, choose an ENERGY STAR certified appliance, or look for the Efficiency Vermont Smart Choice label in stores. These products have been tested to ensure they meet high standards for energy efficiency. The more efficient, the more savings in your pocket, and the fewer emissions in the atmosphere.

Compare efficient appliances on the Efficiency Vermont Marketplace.

Choose a cleaner, quieter model

Ever wish you didn't have to inhale gasoline fumes while you're mowing the lawn? Electric lawn mowers are battery operated and don't rely on any liquid fuel (many of them even run with the same battery pack as your cordless drill or other power tools). Electric mowers are often lighter and quieter than their gas-fired alternatives. Going electric for your lawn will help you remove another source of emissions from your routine. Your local electric utility may also have rebates to help offset the upfront cost of a new mower.

Up your home efficiency

Weatherization means sealing up air leaks throughout your house and adding insulation to keep warm air in and cold air out (and the reverse in the summer). Weatherization can help you spend less money on heating, keep you more comfortable, and help reduce greenhouse gas emissions. In fact, weatherization is one of the most cost effective tools we have to reduce greenhouse gas emissions in Vermont.

Step into a new heating system

Once you've weatherized, you might consider a non-fossil fuel heating system to help you reduce your emissions even more. Efficient electric heat pumps and advanced wood heat systems can keep you toasty all winter long, save you money on your heating bills, and help reduce your carbon footprint. Because Vermont's electricity generation today is more than 60% renewable, efficient electric systems result in far less emissions overall. These options can help reduce your use of a fossil fuel system or even replace your whole heating system, depending on what you choose.

Consider a hybrid or all-electric car

Driving vehicles powered by fossil fuel is the biggest source of emissions for Vermonters. Because we're a rural state, many Vermonters rely on a car to get to work, run errands, or see family. Switching out your gas vehicle for an electric car can make a big impact on your own emissions. Electric cars are much more efficient than gas cars.

Reprinted with permission from Efficiency Vermont's blog post at EffVT-reduce-carbon-footprint. ♻

New and Expanded Ground-Source Heat Pump Tax Credits

Charles R. Goulding and Jacob Goldman

The Inflation Reduction Act (IRA) greatly expanded the tax benefits for ground source heat pumps (GSHP) for both commercial taxpayers and for system designers effective January 1, 2023.

GSHP tax credits increased from 10% to a potential 50% tax credit and the EPAct Section 179D designer tax incentives for government buildings and nonprofits increases from $1.80/s.f. to a potential $5.00/s.f., for projects completed after January 1, 2023.

GSHP is one of the few energy efficiency measures that can qualify for both the $5.00/s.f. tax incentive and the 50% tax credit. Since the inception of EPAct 179D for in 2006, government building designers have always been eligible for tax incentives.

Now, designers, including geo-specialists, HVAC design and build contractors, engineers, and architects can also earn 179D tax benefits for nonprofit projects. Including nonprofit hospitals, nonprofit universities and schools, museums, houses of worship and a myriad of other nonprofits now qualify.

The primary thing to note is that a designer is the person who creates the technical specifications, not a person that installs, repairs or maintains the property. Tax incentives also are available for the primary designer of:

- Government buildings (including, federal offices, military bases, courthouses, post offices, labs; state offices and universities, transportation facilities, courthouses; and, county/local offices, K-12 public schools, town halls, police and fire departments, libraries, and municipal parking garages)
- Tribal governments (including shopping plazas, hotels, offices, casinos, etc.)

Alternative Energy Credits (ITC, Section 48)

Technology	Base Credit	5x Bonus Credit (2022)	Made in USA (2023)	Energy Community (2023)	Low Income (2023)	Range
Solar Technologies(2022)	6%	30%	2%/10%	2%/10%	10%/20%	6%-70%
Ground Source Heat Pump(2022)	6%	30%	2%/10%	2%/10%	0%	6%-50%
Microrturbine	2%	10%	2%/10%	2%/10%	0%	2%-30%
CHP(2022)	6%	30%	2%/10%	2%/10%	0%	6%-50%
Microgrid Controller(2023)	6%	30%	2%/10%	2%/10%	0%	6%-50%
Standalone Energy Storage Systems(2023)	6%	30%	2%/10%	2%/10%	0%	6%-50%
Thermal Energy Storage Systems(2023)	6%	30%	2%/10%	2%/10%	0%	6%-50%

(ETSI)

Transferability

For the first time, the up to 50% GSHP tax credits can be transferred to another taxpayer. Taxpayers with small tax liabilities will be able to sell their tax credits to taxpayers with larger tax appetites. For example, REIT's will be able to sell their credits to help subsidize the installation of these alternative energy technologies.

Direct Benefit

State and local government buildings and nonprofits are eligible for the same tax credit amounts, in cash, from the federal government. Historically, these non-taxpaying entities would require the creation of entities with tax equity partners and then would need to purchase the alternatively generated energy through a power purchase agreement in order for a party to capture the tax credit. Now, these non-taxpaying entities will receive a direct payment of the tax credit amount from the Federal government.

Tax Planning

GSHP service providers should develop a tax planning strategy. The potential EPAct benefits are so large that geothermal project design specialists without the tax capacity to utilize all the incentives should consider taking a team approach and share the tax incentives with other design team members that have the tax capacity.

Although we most commonly work on two party designer splits, we have processed up to six party designer splits. The key is not to waste the excess tax incentives.

Ground-Source Heat Pump

There exists some confusion on when GSHP projects start to qualify for the 6% base alternative energy credit. Section 13102 of the IRA has the following subsections:

- Subsection (d)(2) of IRA defines that in 2022, the ground source heat pump tax credit is 6%
- Subsection (q)(2) and subsection (b) defines that in 2023 through 2032, the ground source heat pump tax credit is also 6%
- Subsection (d)(2) and subsection (b) defines that in 2033, the ground source heat pump tax credit is 5.2%
- Subsection (d)(2) and subsection (b) defines that in 2034, the ground source heat pump tax credit is 4.4%

The items above define the "base credit" and then section (k) creates the 5x bonus. This goes into effect in 2022 as defined by subsection (q)(1) since subsection (k) is not listed in subsection (q)(2). This means that bonus credits go like this:

- 2022 6% x 5 = 30%
- 2023 though 2032 6% x 5 = 30%
- 2033 5.2% x 5 = 26%
- 2034 4.4% x 5 = 22%

Please note the Domestic Content Bonus Credit and the Energy Community Bonus Credit are only available for projects placed in service in 2023 or later.

To qualify for the ground source heat pump (6% base credit), construction must begin prior to January 1, 2035. Qualified equipment (upstream of the heat pump) includes bore field and heat pump. As defined in Section 48(a)(3)(A)(vii):

> Equipment which uses the ground or ground water as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure, but only with respect to property the construction of which begins before January 1, 2035.

In addition, downstream equipment may qualify as well for the 6% base credit. According to tax interpretation derived from §1.48-9(c)(10)(iv), at least 75% energy used by equipment must be from ground source. If not, equipment does not qualify as ground source heat pump property.

This may include downstream (after heat pump) items such as pipes, ductwork, heat exchangers, and diffusers. Items that do not use ground source energy do not qualify.

Increased 179D Deduction Levels
(Effective 1/1/2023)

Building Square Footage	Minimum Deduction Level ($2.50 Per Square Foot)	Maximum Deduction Level ($5.00 Per Square Foot)
50,000	$ 125,000	$ 250,000
100,000	$ 250,000	$ 500,000
250,000	$ 625,000	$ 1,250,000
500,000	$ 1,250,000	$ 2,500,000
1,000,000	$ 2,500,000	$ 5,000,000

*For projects meeting prevailing wage and apprenticeship standards

(ETSI)

Conclusion

GSHP projects are eligible for both tax credits and EPAct 179D energy tax incentives. Specifically, the new and expanded commercial GSHP tax credits and other energy tax incentives should give the green industry fuel to further innovate, grow, and thrive.

Jacob Goldman is the vice president of Energy Tax Savers, Inc. based in Syosset, NY. Charles Goulding is an attorney, CPA and President of Energy Tax Savers, Inc. ♻

Breaking Ground for First Community-Networked Geothermal Heating and Cooling Installation

Carrie Klein. Reprinted with permission from HEET's blog at https://bit.ly/heet_2022Nov23.

Framingham, Massachusetts is the site of the first gas-utility-run networked geothermal system, ever! Once complete, this network of water-filled pipes, heat pumps and boreholes will provide heating and cooling to a community of over 40 houses, apartments, and commercial buildings, including low-income housing.

How did we get here?

The Home Energy Efficiency Team (HEET) first pitched the idea of networked geothermal (shortened to NetGeo or GeoNet) as a clean heat business model to gas utilities in winter of 2017. Then, along with Buro Happold Engineering, we launched a technical and economic feasibility study to determine how well NetGeo could work in Massachusetts and how much it would cost.

Researchers Sumeet Sinha and Yaobin Yang attach a fiber optic cable to the water pipe.

Thanks to the study's exciting results, in 2019, Eversource Gas filed a request to build three geothermal networks in Massachusetts. The next year, the Department of Public Utilities granted Eversource approval to build one of those installations.

Each step along the way has been a first and has required careful consideration (time!) from the Department of Public Utilities, from Eversource, and from the host city and participants. The site selection process itself had the wonderful challenge of many sites vying to be chosen.

A Growing Network of Interest

HEET is communicating with gas utilities, municipalities, and others across the country, all interested in the potential of NetGeo. (These utilities are in Minnesota, Vermont, DC, Philadelphia and more). National Grid is announcing the first of four upcoming NetGeo installations before the end of the year. The model has even gained the support of some gas worker unions such as the pipefitters.

Why? NetGeo offers utilities a business model to phase out natural gas, while workers get to apply their skills to green technology, and the public gets non-combusting, healthful, safe and affordable heating and cooling.

Research Team

In preparation for utility-run systems like the one in Framingham to become a reality, HEET has convened notable scientists and experts from across the country to evaluate NetGeo as a viable pathway to zero-emissions heating and cooling. Massachusetts Clean Energy Center awarded HEET a $5 million grant for the multi-year research effort called 'Learning from the Ground Up', or LeGUp. Participating institutions include Boston University, MIT, Salem State University, University of California Berkeley, National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory.

Test Boreholes

The first step in the Framingham NetGeo installation was to drill three test boreholes for heat exchange. The holes go 600 feet deep and contain a loop of pipe filled with water. Water picks up the heat of the earth (about 55 degrees Fahrenheit all year in Massachusetts). Water will then be piped to buildings, where a heat pump will transfer heat inside the building or pull heat back into the water, raising or lowering the indoor temperature.

Measuring Temperature with Fiber Optic Cables (see pictures)

Members of our LeGUp research team from UC Berkeley attached a fiber optic cable, or a wire that senses temperature, to the pipes in each borehole. This data gives us a more accurate understanding of the conductivity of the bedrock to help inform Eversource's design.

The Result

This is what we're getting excited about? A pipe sticking out of a pile of dirt? That's right! When complete, you won't even see this pipe stub.

As our research team lead Asha said, "All the exciting stuff is happening underground." But actually, a lot of exciting stuff happened above ground, too.

Photo taken the moment data was received from 600 ft underground! (Courtesy Photos)

What's Next?

Eversource will use the data from the test boreholes to finalize their design and then begin the construction phase, drilling more boreholes, laying pipes in the street and connecting them to local buildings.

We're excited to continue gathering data as more NetGeo projects move forward throughout the state and use what is learned to optimize this technology for a wider scale transition from gas to geo. We'll be sure to keep you updated on our data collection and analysis!

Carrie Klein is Communications Director at HEET, where she has led efforts to educate the public about methane reduction efforts and solutions. Carrie has a background in environmental science, journalism, filmmaking and visual arts. She is passionate about making a renewable energy future possible in Massachusetts and beyond. ♻

Amish Couple Embraces Solar Power and a Mini-split

Dan Vastyan

As inverter-driven mini-split technology gains HVAC market share by roughly 30% each year, it's being embraced in even the unlikeliest of places.

Eastern Indiana is home to a growing Amish community, where members are drawn to the rural surroundings and the opportunity to continue the farming lifestyle that they're known for. Sticking close to the land, however, doesn't necessarily mean being uncomfortable or using old technology. At least not anymore.

One Amish couple found a creative way to ease the rigors of harsh Indiana weather which includes humid summers and severe winter conditions.

Tom Neuenschwander, owner of Cardinal Air and Mechanical, in Linn Grove, IN, received an inquiry this past spring about replacing a window air conditioning unit with a mini-split at an Amish farm. Air conditioning was the priority, but the homeowner also wanted to use the system as a source of heat. The most interesting facet of the conversation was that the home is entirely off-grid, using a 12-kWh photovoltaic solar array and 24V, 450 AH battery bank as its sole source of electric power.

Neuenschwander founded Cardinal Air in early 2020 and has already expanded the full-service mechanical company to seven employees. Having worked in the HVAC field since he graduated high school, he knew that mini-split installations would provide an area of rapid growth and has made ductless systems a focus since the beginning.

"We buy Fujitsu mini-spits through Chris Smith at Plumbers Supply Company in Fort Wayne," said Neuenschwander. "He helped us find the right size Halcyon unit for this application, given the unique nature of the power supply."

The two-story, 2,000-square-foot home was originally heated by a coal stove, and cooled, partially, by a 6,000 BTU window air conditioner. A larger or second window unit couldn't be used because the solar array and battery bank were not sufficient to handle a bigger load. The owners wanted to learn if they could improve their cooling performance with a mini-split, without the need to increase solar capacity.

The property is powered by a 12 kWh photovoltaic solar array. The power is stored by a 450 Ah battery bank, the sole source of power to the home. (Courtesy photos)

"We had to size the mini-split to the source of power, not to the cooling load of the home," said Neuenschwander. "In addition to the window unit, the small solar array powers a freezer, refrigerator, and a few lights. Domestic hot water is produced by a propane-fired tank."

"Our biggest consideration was wattage draw," he explained. When we looked at the Fujitsu specs, we found that peak draw from a 9,000 BTU Halcyon system on start-up is about 1,300 watts. The same system idles at 300-400 watts, with high draws around 600 watts. The battery bank could supply enough power to cover a 9,000 BTU unit, but not a 12,000 BTU system."

When Cardinal Air purchased the system, they ordered a 115v model to match the transformer on the farm. Otherwise, the installation was quite ordinary. Cardinal Air standardized on Fujitsu as their brand of choice due to ease and simplicity of installation.

After having the unit in operation through all of summer 2022, the owners reported that the new mini-split cools the entire downstairs, instead of the one large room that the window unit used to serve. Beyond that, the mini-split uses substantially less power than the window unit, despite its 34 percent greater capacity. This becomes evident when numerous consecutive cloudy days prevent good solar harvest.

"The homeowners reported that the mini-split now runs non-stop, whereas the window unit would deplete the battery bank after a day or two of cloudy weather," said Neuenschwander. "It's energy efficient enough at idle that it barely places a draw on the batteries. They're cooling about 600s.f. with it. The only downstairs room that doesn't quite stay at temperature is the kitchen, due to the floorplan. The humidity is gone, though. Oh, and the unit is a lot quieter than the window unit."

Tom and Laura Neuenschwander, owners of Cardinal Air and Mechanical, in Linn Grove, IN.

"Because the system is sized to the power supply and not the heat load of the home, the owners know they'll need supplementary heat," continued Neuenschwander.

Cont'd on p.32

Efficiency Vermont's Efficiency Excellence Network (EEN)

Contractor Spotlight: Al Jeffers & Sons, Townshend, VT

Interview with Tim Jeffers, President

G.E.T. *Staff*

Al Jeffers and Sons, Inc. team (Courtesy photo).

G.E.T.: How did you get started in this industry?

Tim Jeffers: The business started in 1977 as a partnership with my father, my brother, Joe, and me. So, it became Al Jeffers & Sons, Inc. We are in the plumbing and heating, ventilation, and air conditioning (HVAC) business. My father was a pipe fitter in the navy and was a plumber his whole life.

Our business is very different from what it was when we started out. The equipment and controls used today are very different from the equipment we used back then. Over that time, we have constantly been working at keeping updated on the knowledge and skills necessary to provide our customers with the most efficient and reliable systems possible. We have experience with most HVAC systems including wood and coal furnaces and boilers, oil, propane, solar, electric, and heat pumps.

The company was always dedicated to doing the highest quality work at an affordable cost. To do this, we need to keep up-to-date on technology. Efficiency Vermont has been important to us in this work, because it helps us get the training we need. It also makes certain that we have the qualifications needed to provide customers with the highest quality work.

G.E.T.: What is your service territory?

TJ: Our work is in southeastern Vermont. We service about 2,000 customers, some with us since 1977.

G.E.T.: What projects do people try to do themselves that really should be done professionally?

TJ: People actually try to install their own mini splits. They are trying to do a job that requires training and certification, but they think they can learn how to do it by watching a short video on the Internet.

It is really sad that they do this, because they often spend the money on the mini split, spend the time they put into trying to install it, and then wind up with a system that they can't run. Unfortunately, we usually can't help them. We have to keep our work to standards that we can't guarantee [compliance with] if we attempt to make repairs on amateur installations that may have any number of hidden faults in them.

The HVAC equipment we install is sophisticated. No one should ever assume they can learn in minutes what we have been training on constantly for years.

G.E.T.: If you could only choose one type of project to reduce someone's carbon footprint or improve efficiency, what would it be and why?

TJ: If I had to pick one type of project, it would be bringing a fossil fuel, forced hot air heating system up-to-date. It is possible for some of these systems to be altered with a heat pump. A DX (direct expansion) coil can be installed to move heat from the heat pump into the existing ducts.

Such work also takes a trained professional. The old combustion systems could be built with rather sloppy designs and still be made to work. Heat pump technology is less forgiving in badly designed systems. The heat pump has to be installed, sized, and balanced properly, and existing systems sometimes have to be modified to take heat pumps.

If it is done right, altering a ducted heating system to run on a heat pump can be really great.

G.E.T.: What is it in your field of specialty is most valuable (related to energy efficiency or the EEN) that our readers ought to know about?

TJ: The most valuable thing is continuing education about installation of the latest equipment. A lot of plumbers became less relevant 20 years ago because they did not keep current with the changes in technology and practices.

G.E.T.: Why should people use an EEN member over someone else?

TJ: EEN vets its membership and verifies continuing education. EEN members are committed to the education and being as up-to-date as possible.

G.E.T.: What are the best ways to finance projects (or what incentives are available) for residential or commercial projects?

TJ: I tell the customers to contact Efficiency Vermont. They have lenders who can help customers with finances.

G.E.T.: What are some questions you recommend customers ask when selecting someone to do work to meet energy efficiency goals?

TJ: I Anyone who wants to install an HVAC system should realize that it is an investment. They should vet the installer. They should ask installers why they recommend the systems that they do. Customers should ensure the system meets their expectations for comfort and efficiency both now and in the future. They should ask how many of that type of system have they done. ♻

Hazards from Using Natural Gas in your Home

Cookstoves, Heat, Hot Water and Pipes

Jessie Haas

A study released by Stanford in January 2022, revealed the disturbing information that natural gas cooking stoves routinely release methane, an extremely potent greenhouse gas. Methane is twelve times more potent than carbon dioxide, though it doesn't linger as long in the atmosphere. Climate scientists believe that controlling methane emissions in the near-term is crucial to preventing temperature rise as we work to decarbonize our economy. Stanford scientists measured releases from 53 California cookstoves. They found that three quarters of the releases from cookstoves occur while the stove is shut off. This is leaked from loose fittings and couplings that connect the stove to gas pipes. The Stanford study found little difference between brands of stove, and between older and newer stoves. Though newer stoves have less leaking, according to *Wirecutter*, the fundamental problem occurs behind the stove, in the piping. Stoves using a pilot light leaked less than those using an electronic sparker. Researchers estimated that up to 1.3% of the gas used in stoves leaks into the atmosphere. That's a trivial contribution per individual household, but since there are more than 40 million gas stoves in the U.S., the emissions have about the same climate change effect as the carbon dioxide from half a million gas cars.

This information has caused much consternation among homeowners, both for environmental and health reasons. For perspective, cookstoves use a minuscule amount of natural gas compared to other household uses. Stoves represent only 3% of home use of natural gas in the United States, versus 29% for water heating and 69% for space heating. The impacts for health are greater, however, because people spend a lot of time in their kitchens and don't usually cuddle up to their hot water heaters or furnaces. *Wirecutter* also notes that the health impacts of cooking are somewhat independent of the source of heat. Any kind of cooking gives off fine particles and volatile organic compounds (VOCs) which can cause or aggravate asthma and other lung conditions. The indoor pollutants emitted by natural gas stoves include nitrogen dioxide (NO_2), carbon dioxide (CO_2), and formeldahyde.

It is estimated that up to 1.3% of the gas used in stoves leaks into the atmosphere. This seems trivial, but since there are more than 40 million gas stoves in the U.S., the emissions have about the same climate-change effect as the carbon dioxide from half a million gas cars.(www.bosch-home.com)

NO_2 is a toxic gas that can trigger breathing problems even in low concentrations. A 1992 study shows that children living in homes with gas stoves have a 20% increased risk of developing respiratory diseases. RMI (formerly the Rocky Mountain Institute) and three other environmental groups issued a report in 2020 labeling gas stove emissions a threat to human health. This is why ventilation is so important in kitchens. In further bad news, a California study released in October by the journal *Environmental Science and Technology* showed that natural gas stoves also leak benzene into the home, even when turned off. These are most dangerous in small, poorly ventilated kitchens, but pediatrician Philip J. Landigran told the *New York Times* that there is no safe threshold for benzene.

What's a homeowner to do? There are good reasons to turn to electricity for cooking, especially if the grid source is clean and renewable. But not everyone is ready to do that, and many people are genuinely devoted to cooking with gas. It is possible, however, to pull your stove away from the wall and tighten the connectors to the stove and the nearby pipes. The American Gas Association recommends that this be done only by licensed professionals. It's worth noting that methane leaks occur all along the natural gas supply chain, from drilling and fracking to processing and pipelines. Incentives to tighten the supply chain and eliminate methane leakage form part of the climate initiatives in the Inflation Reduction Act passed in 2022.

One important note: If you happen to cook and heat water with propane, you do not have a methane problem. Propane is a byproduct of natural gas production and does not contain methane. It also emits very little CO_2 when burned. The danger with propane is that, though not a poison, it can smother you if inhaled. Heavier than air, it sinks if leaked, and may collect in basements and other low-lying areas, where it is at risk of exploding if ignited. In daily use, however, it is fairly clean. In the big picture, propane is part of the fossil fuel industry, with all its attendant hazards. Fortunately for propane users, there is no methane leaking into your home or your only planet.

Environmental organizations have been focusing on gas stoves because they are considered a 'gateway appliance.' Buyers want gas stoves; they usually get gas everything-else as well. If people can be persuaded to replace gas stoves with electric, they are more likely to switch water heaters, clothes dryers, and furnaces to electric, too. Healthcare advocates are also pushing for the switch, and there is increasing evidence to support them.

Jessie Haas lives in an off-grid cabin in southern Vermont with husband Michael J. Daley. She is the author of over 40 books, most recently The Hungry Place.

Source Links: "Gas Stoves Leak Methane Even When Turned Off, Study Finds," The New York Times *(nytimes.com); "Your Gas Stove Is Likely Leaking Cancer-Causing Benzene into Your Home" (gizmodo.com)* ♻

Building High-performance Homes Through the Winter

Green Energy Times Staff

Building season doesn't need to stop in the winter. Some high-performance builders know how to keep their work flow moving comfortably forward in the winter for many reasons. We asked some in our area how they do it. Here is what we learned.

Above: Panels in a climate controlled warehouse. (Silver Maple Construction); Top rt: Installation of prefabricated roof trusses. (Unity Homes); rt: Framing in the winter. (Wright Builders)

Silver Maple Construction, New Haven, VT

Any clever construction company in the Northeast plans its "build cycle" so foundations go in and frames go up in warmer months, so sites can be dry and protected by the time snow falls. A roof, a shell, installed windows, and temporary heat make gloves-off winter work almost bearable. Unfortunately, the slightest delay can scramble the plan and leave carpenters starting every morning with snow blowers, plows, and shovels. Also, homeowners on budgets feel frustrated with charges for snow removal. Maximizing time on construction rather than weather mitigation makes everyone happier.

Silver Maple Construction has been building in Vermont for over 15 years and it seems most of those years included working outside in winter. Potential customers talk about a busy season and a slow season without realizing that our only two seasons are "foundation" season, with no freezes, and "roads posted" season. We have to fit projects around those two seasons. Despite everything we know about framing in the snow, we can get off-cycle, and after that we spend time trying to re-set, just like other cold climate builders.

We've invested in snow blowers and shovels. We've paid for plowing. We've tried to keep our crews in warm work gloves and hand warmers, good socks and toe warmers, and lots and lots of hot beverages.

A warm solution. More recently we have focused on panelizing frames, which means Silver Maple Construction can convert a weather-exposed jobsite into a sheltered workspace quickly. Custom house plans are made for framing sets. The framing sets are made into framing panels in our climate-controlled warehouse. If the job site is not ready to receive these, they are stacked and wrapped, protected from the elements. As soon as the site is ready, the panels are delivered and framing commences. Erecting panels is faster than traditional stick framing, so our crews and the materials are out of the elements as quickly as possible. Then both homeowners and carpenters get to enjoy, rather than shake their fists at Vermont's falling snow.

Wright Builders/EarthKind Homes, Northampton, MA

Every project is unique. Some require winter construction, with additional planning, but that enables year-round construction and earlier occupancy. Winter work does cost more, but owner needs may be urgent.

We consider winter and how it will impact construction, starting with site work and foundation preparation. Site grading, clearing, a solid base coat of driveway asphalt, and utility work preparing for a spring completion, all happen before road work deadlines or asphalt plants closing in mid-November.

If we are excavating the foundation in the winter, we may need to cover the ground to keep the frost out using heated blankets or a thick layer of straw. Digging through hard ground takes longer and increases costs. We assess what the site contractor can complete before winter and prepare the site for easy access.

We consider the type of foundation. A full basement and a slab on grade with 4-foot frost walls are different. Hot water and concrete mixes with additives add winter costs, as do labor and blankets to cover foundations after a pour.

Next comes framing and rough-in mechanicals. Working with cold hands and bundling up in thick layers slows progress and increases costs. But high winds and winter weather can limit work as snow is removed or stop it completely.

With the building enclosed, we still need heat for flashing and air sealing. Fuel costs and heater rentals can get expensive for uninsulated buildings, but a building needs some warmth to pull wire and run pipes efficiently. Air infiltration rates in our buildings are very low, so once we are enclosed and insulated, the heating bills become reasonable, and work inside can continue at a normal pace.

Tenting, and temporary heating may be required to complete exterior work, such as masonry, stone, or painting. If this work can wait to spring, there can be major savings.

Every building has its own challenges and winter construction means specific planning. Costs and earlier occupancy have to be weighed. Planning is crucial, but it leads to cost reductions.

Unity Homes, Walpole, NH

Unity's off-site construction methods allow us to build homes year-round, once the foundation is in place. We prefabricate the floor, wall, and roof panels of our homes in the controlled conditions of our factory in Keene, NH. All of the framing, sheathing, insulation, windows, and doors are preinstalled in the panels. We then "flat pack" the panels in bundles, shrink wrapped for protection, and truck them to the jobsite for installation.

A typical Unity home requires about a week of work on site to assemble the panels into the weathertight home shell. The assembly work is not difficult to do in the cold or even in snow, because the detail work has been completed in the shop, and the heavy lifting is done by a crane on site. We seal the joints between panels with double gaskets, rather than with caulk or foam, because the gaskets work well in any weather.

Once the shell of the house has been completely assembled, finishes can be installed on the exterior, and the mechanical rough-ins can begin on the interior. And because the shell is already insulated and the windows and doors are installed, a modest electric heater is all that's needed to maintain comfort.

Unity's off-site methods work well for the general contractors who finish the shells, because the exterior is essentially weather-protected when we're done on site, and the subcontractors finishing the interior have a comfortable environment in which to do their work. One comment represents what we often hear from contractors who work on Unity projects. It is, "I don't want to build any more houses the conventional way!" ♻

Many thanks to our sponsor: unity homes

The Wall Doctor of Vermont Is Moving Forward with Gordon's Window Decor

Motorized room-darkening, EcoSmart roller shades are premium, energy-efficient window coverings that look great and save you money on your energy bills. (Courtesy photo)

Bill and Judy Galdi started the Wall Doctor in 1986 quickly becoming a fixture in the community. Now, after 37 years Bill has decided to retire and has sold the Wall Doctor to Gordon's Window Décor of Williston, VT to ensure the continuation of service and quality that his customers have come to expect and deserve.

"Judy and I took great pride in creating a locally owned business. She would be happy to see it passing to the next generation and staying local. It will be exciting to see new ownership take our quality brands and customer service to the next level." said Galdi.

"It's really an honor that Bill felt that Gordon's was the right choice for him and his clients." said Kelly Clements, President of Gordon's Window Decor. "I have always respected the Wall Doctor and am eager to bring it under the Gordon's umbrella".

Gordon's Window Décor started in founder Gordon Clements' basement in 1986, and has since transformed into a locally and nationally recognized name, supplying custom-made window treatments and soft goods from their Williston showroom and production facility.

Kelly Clements, Gordon's daughter, joined the company in 2002 and took over ownership in 2015. "I have a passion for this industry. Helping people feel more comfortable in their spaces is incredible, keeping manufacturing local is incredible, being a part of a team committed to Continuous Improvement is incredible, and now to be able to carry on Bill's legacy of quality and expertise- that is incredible."

The business will transfer to Gordon's Window Decor on January 1, but The Wall Doctor's showroom in Williston will be open through Feb., offering deep discounts on stocked paint and wallpaper. Elizabeth DeCecco, owner of Corduroy and Pine Interiors will be taking on the wallpaper portion of the Wall Doctor's business. ♻

Amish Embrace Solar Power and Mini-split

Cont'd from p. 28

"At this point, they just don't know at what outdoor ambient temperature that will occur. So far, they say that the mini-split sure beats starting a fire in the stove to knock out the shoulder season chill."

The owners have no plans to expand the solar array, but are considering expanding the battery bank and potentially installing a Fujitsu unit upstairs. For now, they're thrilled with the comfort improvements and energy savings they've made to their off-grid residence.

Dan Vastyan is President of Common Ground, Uncommon Communications, LLC. ♻

A 9,000 BTUH mini-split heat pump replaced an A/C unit at the Neuenschwander's off-grid residence.

Energy Efficient Refrigeration

Wes Golomb

After heating and cooling, two of the larger residential energy consuming devices are the refrigerator and freezer. It's no wonder. These appliances are used 24/7 accounting for about 17% of residential energy consumption.

Incremental improvements in the cooling process and the thermal performance are continually making refrigerators and freezers more efficient. What makes a unit more efficient? Physics tells us that every time we convert energy from one form to another, some of it is lost as heat. Higher efficiency motors and compressors mean more of the energy is going into cooling and less heat is being generated. Better insulated and sealed units keep more room heat out. Similarly, more efficient defrosting mechanisms contribute to higher overall performance.

As a result, replacing an older refrigerator can save as much as 30% of the energy being used for cooling. Refrigerators with the freezer on top use 30% less energy than similar side-by-side models.

It makes sense that smaller refrigerators use less energy. There is less area to cool and less surface area for heat to get in.

According to the EPA, the optimal refrigerator temperature is 37° F and should never go above 40° F.

If you have an older refrigerator, it may not maintain a steady temperature, so it's a good idea to put two thermometers, one in the back on top, and one in the front on the bottom, and check the temperature regularly.

Refrigerators and freezers are more efficient when they are full. The mass of the cold food actually helps to keep the temperature steady. If you have an empty refrigerator, you can put several jugs of water in it or make and keep bags of ice in the case of an empty freezer.

Obviously, the less time you keep the doors open, the more efficiently the unit will run. Cleaning out the dog and cat hair and other flotsam that collect in the back where the warm air is exhausted also helps to keep the efficiency up.

The EPA recommends refrigerators between 16 and 20 cubic feet. A 16 cubic foot refrigerator is usually enough for a household of two or three while a 20 cubic foot model should suffice for a household of four or five.

ENERGY STAR® offers the following six tips for shopping for an energy-efficient refrigerator.

1. Measure the space for the fridge. Leave at least a 1-inch clearance around the unit for adequate airflow. Don't forget to factor in how much space the door needs to swing open in relation to adjacent walls, cabinets and appliances.

2. Consider your family's needs, and get the right size. What is the standard size of a refrigerator in cubic feet? Fridges come in many different sizes, but the most energy-efficient refrigerators are usually 16 to 20 cubic feet.

3. Consider opting out of the icemaker and dispenser. Yes, they're convenient and reduce the need to open the door, which in turn helps the freezer maintain a consistent temperature more easily. But they do increase a refrigerator's energy use by 14 to 20% and usually increase the purchase cost of the fridge as well.

4. Look for a fridge with an "energy saver" switch. This switch lets you turn down or off the heating coils that prevent condensation. This enables you to better control the anti-sweat heaters in the fridge, which can lower your refrigerator energy costs by 5 to 10%.

5. Choose an ENERGY STAR®-certified refrigerator. Turn your energy-efficient refrigerator search into an easier task — make a beeline to ENERGY STAR® refrigerators. These models typically exceed general appliance efficiency standards and often qualify for rebates.

6. Compare the actual energy use number on EnergyGuide labels so you can find the most efficient refrigerator.

One of the houses I followed in my book, Warm and Cool Homes, is an off-the-grid, straw bale home built more than 20 years ago by Andrea and Jeff Burns. A small solar array has provided their power for years. The Burns' use a 20 cubic foot Sun Frost refrigerator and a separate freezer they purchased when they moved in. Both of these run on DC power and use about one quarter of the energy of a comparable refrigerator and freezer of that time. DC powered cooling appliances were more efficient than similar AC models and are still currently available.

[Editor's Note: Off-grid living does not mean you have to buy a special DC refrigerator. While the Sun Frost was the choice for years, it is actually not necessary. For many years now most ENERGY STAR refrigerators work fine off the grid, as long as you have good battery storage.

For example: My own 2-door Amana refrigerator has a bottom freezer with the ice maker inside and is working fine after 20 years, off the grid with a 3.8kW solar system. (There is not a special opening for the ice on the door, which does result is lower efficiency).

Efficiency Tips:

- The two things that consume the most electricity in a home today are water and refrigerators, so it is a good idea to keep this in mind.
- The most efficient refrigerators have two doors. A top freezer is the most efficient. However the difference is not much if you prefer the freezer to be on the bottom.
- ENERGY STAR appliances all have rating guides to show the tested performance of each model. For off-grid, choose the ones that use the least amount of electricity. For most of our readers, who are on the grid, just read the ratings and choose the most efficient one that you want. Shop for your appliances locally with confidence!
- The best way to assure efficiency with your refrigerator and freezer is to not keep the door open any longer than absolutely necessary. The point is to keep food cool and safe to consume and last longer. The motor has to work harder when it has to continually cool the unit back down.**]**

The common practice, from days gone by, of putting your old refrigerator in the basement or garage for keeping a few beers cold does not save any electricity or money! Why not recycle it? In NH, NHSaves will haul away and recycle your old refrigerator and freezer and pay you a $75 rebate. They will also pay up to a $50 rebate when you purchase a qualified energy-efficient refrigerator. Check out NHSaves.com for details. If you live outside of NH, you can find out about rebates where you live. In

Cont'd on p.34

Smaller Homes Make Sense – A Book Review

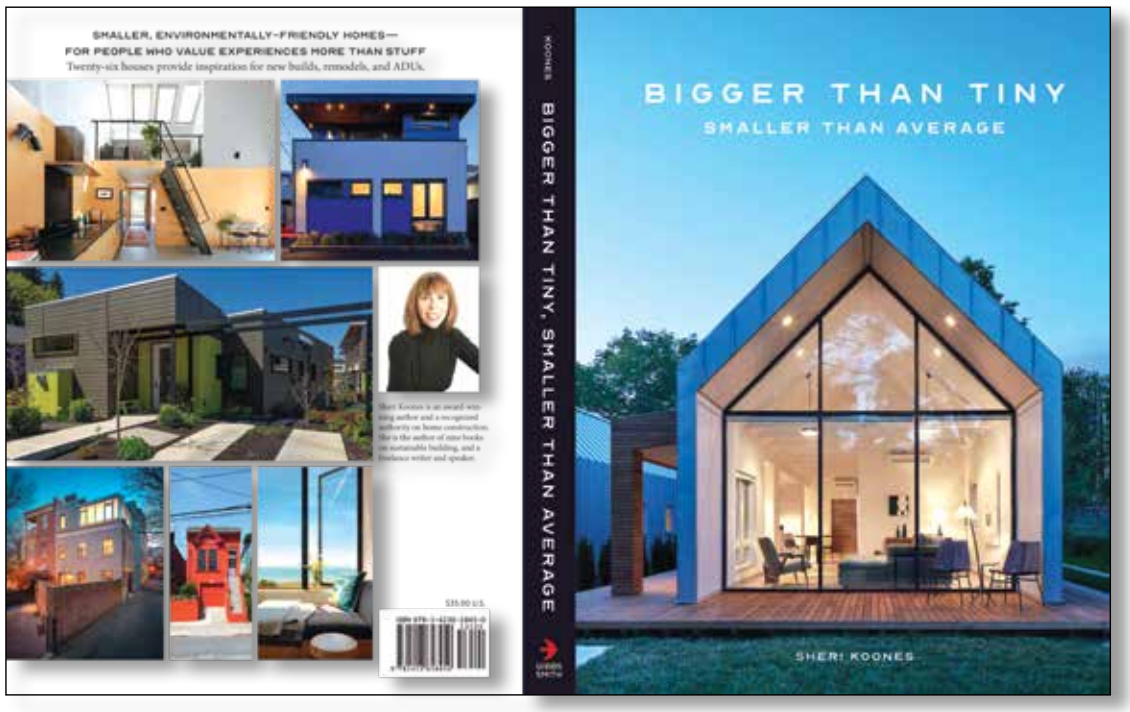
BIGGER THAN TINY, SMALLER THAN AVERAGE

by Sheri Koones. Published by Gibbs Smith, Layton, UT, 2022

Reviewed by Janis Petzel, M.D.

When my husband and I decided to build our house in 2013, we loved the idea of a tiny house, for energy efficiency, mindful use of space, and their cuteness. But due to restrictions on the sub-divided land we bought, we had to build an 1800 square foot home. As it turned out, I am glad it's not smaller. But I am also glad it's not bigger.

Bigger Than Tiny, Smaller than Average by Sheri Koones showcases homes that border on tiny house size (400 to 600 square feet) up to around 1800 square feet. If you are wondering, the average new home in the U.S. is 2500 square feet. With our older housing stock in New England and upstate New York, the average home size in our region is 1660 to1815 square feet (2019 data, bobvilla.com).



Smaller, environmentally-friendly homes for people who value experiences more than stuff. (Courtesy image)

Koones, the author of this and ten other books on sustainable homes, presents a nicely photographed collection of 26 new or remodeled homes designed by various architects around the U.S. and Canada, from prefab modern to an old-fashioned balloon framed cottage. My favorites from a creative inspiration point of view were the urban remodels of an old carriage house, and a car repair garage. Each respected the history and character of their neighborhoods but made the residences comfortable and functional.

The homes in this book from Maine, Vermont, rural New York and Nova Scotia may be of particular interest to *G.E.T.* readers since they were designed for our four-season environment.

The description of each home includes a floor plan and at the end of each chapter, a focus on an energy efficiency or building technique, such as making space for an all-electric vehicle and charger, building a house on piers so flood water can pass under it without harming the structure, thermal mass for passive heating and cooling, ideas for non-traditional siding or bi-fold glass doors, HVAC requirements for an air-tight house, and increasing home density in urban settings, etc.

You can get ideas for your own home. These might include, for example, tucking computer workstations in unused space, designing smaller bedrooms and bathrooms, open floor plans with multipurpose rooms, and good use of space around stairwells. The book has a useful list of sources at the end. Photos of the interiors are all excellent.

One idea new to me was Venetian blinds on the outside of the building. The author is right, traditional window shades are great, but the heat is already inside the house when it hits them. These Venetian blinds automatically open to let in light and close to keep heat or cold outside, even if snow piles up.

The homes in this book are designed to be energy efficient, some with solar panels, some not. But if you are looking for ideas on non-traditional structure – yurts, straw bales, or 3-D printed homes, such as the one recently produced by the University of Maine – you'll need a different book. Koones does showcase prefab homes, for which she is an expert – see her *Prefabulous* books for example.

Most of the featured homes in this book fit great into their rural, urban and suburban neighborhoods, with a couple of exceptions. The Hygge House sits heavy, like a fallout shelter in a group of older beach houses on Lake Chaplain. It jars and detracts from the charm, in my opinion.

I loved the Passive House LA, even though I am not fond of stark, modern architecture. But it looks like a prickly (but cool) bunker in a neighborhood of small houses with front porches. It is not welcoming. But passive homes like this would improve local air quality, increase availability of good housing and make utilities affordable. Can't we design homes to have it all, neighborliness and efficiency?

This book could have used a cost estimate for each featured home. These homes look expensive. Energy efficient homes are cheaper to maintain and heat, but as pricey as any house these days to build. I'd love to see Koones write a book on how to build an attractive, energy efficient home with a smaller than average price tag.

Janis Petzel, MD is a physician, grandmother and climate activist whose writing focuses on resilience, climate, and health. She lives in Islesboro, Maine where she advocates and acts for a fossil-fuel free future. She serves on the Islesboro Energy Committee and is a Climate Ambassador for Physicians for Social Responsibility. ♻

Refrigeration – Cont'd from p. 33

Vermont make sure to visit Efficiency Vermont at efficiencyvemont.com. In New York go to the NYSERDA website at nyserda.ny.gov or dsireusa.org. In case you have not explored information for your state on our Incentives pages 16 and 17, be sure to do so.

If you are considering replacing your refrigerator and freezer you might check out the following EPA guides.

Purchasing and Maintaining a Refrigerator bit.ly/3uxHTWK

Energy Star Refrigerator Product page: bit.ly/3iPnN7N.

Wes Golomb is a clean energy advocate and author of the recently published book and video series Warm and Cool Homes, *Building a Comfy, Healthy, Net-Zero Home You'll Want to Live in Forever.* ♻

Improving Sustainable Building Practices with BIM

Rose Morrison

Global warming is no longer something humans can ignore. Rising oceans, temperatures and extreme weather have already negatively affected coastal areas on the Pacific and Atlantic coasts and everywhere in between. The time has come to start thinking sustainably for the future.

The construction industry can benefit significantly from going green, because it is one of the biggest culprits of energy consumption and carbon emissions. Building operations are responsible for 40% of annual carbon dioxide (CO_2) emissions, but there is hope through building information modeling (BIM). This software provides the following six benefits for organizations aiming for sustainability and the resulting higher performance buildings.

1. Better Construction Planning

The benefits of BIM start with the planning process. This software means project managers can view the entire project before any contractors hit the hammers. These professionals can use 3D models to see the design and detect issues before proceeding. BIM improves the efficiency of projects and produces better results.

One of the benefits of BIM is its ability to protect workers — the software can detect hazards before anybody sets foot on the site. BIM features visual risk analysis and safety evaluations so every employee is safe on-site.

2. Improved Cost Prediction

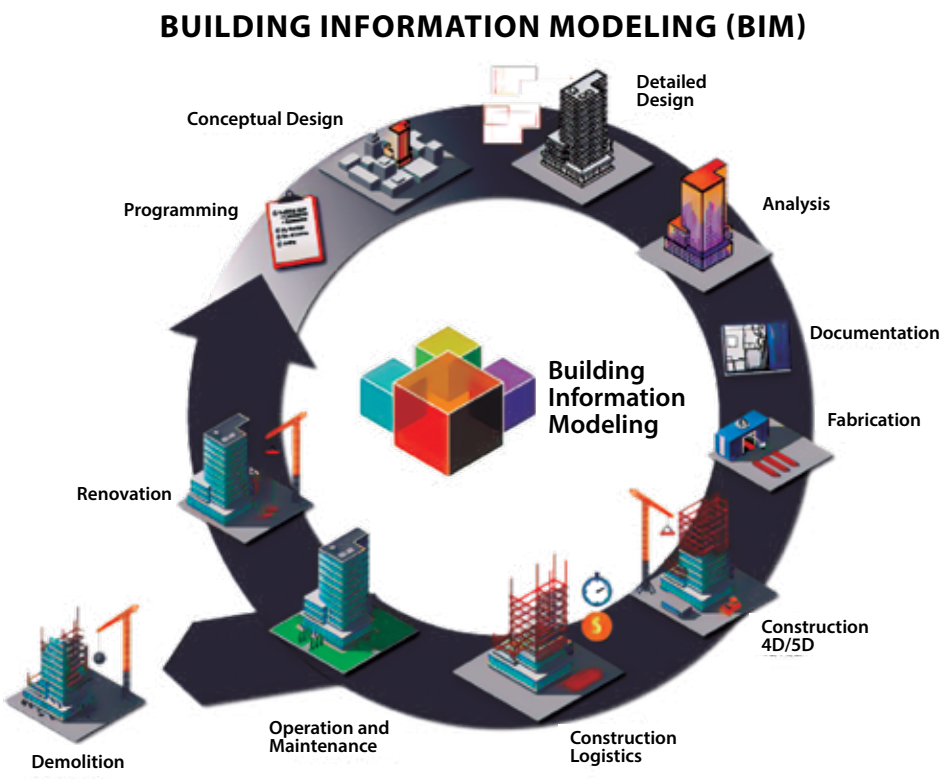
Saving money for construction companies has become paramount, especially with supply chain issues. Labor shortages, backlogs and other problems have contributed to inflation and rising costs for the building sector. BIM can mitigate the situation by giving accurate estimates before a team begins construction.

For example, project managers can use BIM software to estimate materials costs and shipping expenses. Tools like BIM 360 can also help professionals determine the cost of labor and shipping prefabricated pieces. They can use this information to save money and find the best time to buy sustainable building materials.

3. Increased Time Efficiency

A project with frequent delays will cost the business and the client more money, so on-time completion is crucial for all parties involved. BIM can speed up the process with faster design and construction.

Time is a concern for builders, in part, because of the energy consumed during construction. Machines consume fuel and emit greenhouse gases into the atmosphere, so delayed projects mean more energy consumption and damage done to the surrounding environment. Increasing efficiency on the construction site means fewer carbon emissions and a better workflow.



Building information modeling (BIM) benefits sustainable construction. (Courtesy image)

BIM helps by improving communication efficiency with all parties involved. The stakeholders, clients, architects and everybody else can see the designs because they're on the software. They all can see the models, the design notes, the estimates and much of the information they may need. BIM eliminates information silos and miscommunication, which can lead to unwanted delays.

4. Optimizing Green Design

Project managers can improve sustainability with the construction process, but what about the buildings themselves? BIM provides architects with digital models of the structures and allows them to see multiple renditions of the project. These alternatives show designers where they can make improvements regarding energy consumption and performance.

Being mindful of energy performance of all buildings is paramount for the construction industry to become more sustainable, as buildings are responsible for about 40% of the world's energy consumption. Finding ways to make these structures more energy efficient will reduce the enormous carbon footprint of the real estate industry and build a more sustainable future.

One way to increase sustainability is with zero-energy buildings. These structures are part of the United States' goal for all commercial buildings to have net zero emissions by 2050. To accomplish this feat, construction companies need to implement elements of green design, such as high levels of insulation and sealing smart HVAC systems, and also including energy-efficient appliances, and more.

5. Reducing Waste

Material waste at the construction site is another significant issue. Construction can already harm the surrounding environment. Project managers should be conscious of any waste. They can reduce this negative environmental impact by implementing BIM software.

Architects use BIM in the planning process to accurately count how much they need for the materials. Clash detection is a critical feature that helps designers avoid rework. Reworking is costly for projects, requiring additional materials architects could have avoided if they had found the mistakes in the planning phase.

Another area construction professionals can reduce waste in is the type of materials they use for building. Steel is among the most common components in buildings and is one of the worst offenders regarding CO_2 emissions. Every ton of steel releases nearly two tons of fossil carbon into the atmosphere.

BIM comes to the rescue because it can show architects where they can reuse materials. Using recycled steel and other material choices can significantly reduce their carbon footprint without compromising structural integrity. Recycled materials lower the amount of waste and costs.

6. Managing Properties Sustainably

Sustainability in construction continues after the building is over. Once a team finishes a project, it can use BIM to manage properties in the future. Technology has evolved to make building management much more accessible. Digital models can provide exact details of buildings so that construction companies can make better sustainability decisions.

One of the primary concerns for high performance building management is the HVAC system. Over time, these mechanisms can become less efficient without proper maintenance. BIM can include recommendations for maintenance schedules for the mechanical systems.

Building owners who want to change details about their property can refer to BIM. The software will guide them on building-specific requirements and sustainability practices. Using BIM will assist building owners with renovations and expansions to ensure they follow eco-friendly and high-performance practices.

Using BIM For a Sustainable Future

In the 21st century, the construction industry remains one of the highest energy consumers. The future of this sector must turn toward higher performing sustainability practices because the clock is ticking — humans are already seeing the adverse effects of global warming. One way to improve sustainability is by using BIM. These six benefits show why construction professionals should use it for the whole building process.

Rose Morrison is a freelance writer with a passion for sustainable topics in the built environment. She is the managing editor of Renovated.com *and regularly contributes to a number of reputable sites, such as* BioFriendly Planet, NCCER, *and the* National Association of Realtors. *For more from Rose, you can follow her on Twitter.*

Sources available in the online posting of this article at greenenergytimes.org. ♻

RESOURCES

350-Vermont: General group that coordinates a variety of statewide actions. **www.350vermont.org**

American Council for an Energy-Efficient Economy: aceee.org

American Solar Energy Society (ASES): www.ases.org

Backwoods Solar: Specialty: solar, off-grid - **www.backwoodssolar.com**

Carbon Tax: carbontax.org

Clean Energy NH: www.cleanenergynh.org/

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

Consumer Guide to Home Energy Savings, Heating, Appliances, Refrigerator Guide, Building Envelope, Driving: http://aceee.org/consumer

Dept. Public Svc. (CEDF): publicservice.VT.gov/energy/ee_cleanenergyfund.html

Dsireusa.com: Renewables & Efficiency. Find state, local, utility, & federal incentives for renewable energy & energy efficiency. **www.dsireusa.com**

Efficiency VT: A must-go-to site for immeasurable amounts of info. **www.efficiencyvermont.com**

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

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

Energy Star Federal Tax Credits: www.energystar.gov/about/federal_tax_credits.

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

Fossil Fuel Freedom: Group working to make Vermont's energy plan 100% free of fossil fuels:

To join this group go to: **groups.google.com/group/fossil-fuel-freedom-**

Home Energy Saver: Interactive site to help you identify & calculate energy savings opportunities in your home. A lot of great information! - **hes.lbl.gov**

IREC/ Interstate Renewable Energy Council: RE educational info. **www.irecusa.org**

NABCEP/ North American Board of Certified Energy Practitioners: This organization that tests & certifies PV system installers. Individuals are Certified, companies are not. **www.nabcep.org**

NESEA/ Northeast Sustainable Energy Assoc.: www.nesea.org

National Association of Energy Service Co. (NAESCO): www.naesco.org

National Renewable Energy Laboratory (NREL): www.nrel.gov

NeighborWorks® Alliance of Vermont: Low-cost energy loans - **www.vthomeownership.org**

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

New York Solar Energy Society (NYSES): www. nyses.org

NFRC independent rating & labeling system for the windows, doors, skylights **www.nfrc.org**/

NH Energy Divison: www.nh.gov/osi/energy/index.htm

Renewable Energy World: www.renewableenergyworld.com

Renewable Energy Vermont: www.revermont.org

SEIA/ Solar Energy Industries Association: The SEIA Tax Manual to answer your solar related tax questions. **www.seia.org**

SmartPower: www.smartpower.org

Solar Components: www.solar-components.com

Solar Jobs: Listed by city, state, and district, **SolarStates.org**

Solar Power Rocks: Impressive data and info ,including per state. www.solarpowerrocks.com/

Solar Store of Greenfield, MA Stock & install a wide variety of solar & environmentally friendly technologies. **SolarStoreofGreenfield.com**

Tax Incentives Assistance Project (TIAP): www.energytaxincentives.org

The Office of Energy Efficiency & Renewable Energy (EERE): develops & deploys efficient & clean energy technologies that meet our nation's energy needs - **www.eere.energy.gov**

Vermont Energy and Climate Action Network (VECAN): works to start and support town energy committees as a powerful, people-powered response to realizing a clean energy future. www.vecan.net.

VPIRG: understand the clean energy resources available to VT - **www.vpirg.org/cleanenergyguide**

VT Energy Investment Corporation (VEIC): nonprofit organization that issues home energy ratings for new & existing homes. 800-639-6069 - **www.veic.org**

Vermont Passive House: www.vermontpassivehouse.org/Resources/

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

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– David Fisher, commonwealth of Pennsylvania.

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Larry Plesent

Ingredient of the Month

Clean and Green at Home in 2023

AdobeStock/386123607

Modern Americans have been conditioned to believe that every surface needs its own individual specialty cleaner. While this is a terrific boost to someone's bottom line (not yours), here is the inside information on how to be eco-nomical while being eco-logical.

To clean and maintain the average home or office, you only need three things; something nontoxic that foams, something nontoxic to YOU that kills germs and does not foam, and an unscented simple polishing cleaner for the bathroom porcelain and tile.

If you have sensitive skin or thin undyed hair, I also recommend a great organic bar soap like Vermont Soap's shea butter bar soap.

For the sake of brevity, I will only recommend products that I have tested and actually use. Most of these products are made by Vermont Soap in Middlebury, VT. As a product formulator, I founded Vermont Soap thirty years ago to manufacture nontoxic cleaning and personal care products everyone can afford.

With no meaningful definition of "natural" in sight, Vermont Soap subscribes to USDA organic food standards. Certified organic means audited natural. If you are ever confused about food, cosmetic or cleaner safety, USDA organic is your safest bet every time. Look for the logo.

Here are my favorite green household cleaners:

Izaroma is a 70% ethanol spray with peppermint essential oil. Izaroma is a cleaner, a sanitizer and a mild solvent. I love Izaroma. Simple elegant and awesome.

Use Izaroma to clean reading glasses and sunglasses, as a germ-killing bathroom odor masker and bathroom sink and toilet surface cleaner. Spray some onto toilet paper or a paper towel to make instant non-plastic wet wipes. Clean the film off the inside of a car windshield. Spray on your hands when washing alone is not enough. Spray the hairs out of your electric shaver, and spray onto toothbrushes after using them.

For a great, gentle polishing cleaner, check out Bon Ami's 1886 formula. This is made from feldspar, a soft mineral just a bit harder than talc. Make sure it states 1886 on the label or you grabbed the wrong stuff. Bon Ami contains a little tallow soap, so if you are a strict vegetarian just make your own scrubbing cleaner from baking soda dampened with castile liquid soap.

Castile liquid soap (CLS) is the mainstay of the nontoxic household. By now you have probably heard about it and might have tried some when camping. For green cleaning, I recommend Liquid Sunshine, a Vermont Soap product that is specially formulated for cleaning.

I do a lot of laundry, and only use CLS. First, wet laundry stains and work in well before washing. Use CLS as you would any detergent concentrate. One quarter to one third cup per laundry load will do it.

The concentrate rule holds true for dish washers, too. Use the same measurement as you would a detergent concentrate.

Get yourself some decent refillable foamer pumps. These have special aeration screens inside that make the liquid come out in your hand like soap whipped cream. Be sure to dilute your CLS 50% to 60% with water before using or the pump will not work correctly.

Pump straight CLS onto your spongy dish scrubber. You can foamer out the soap if you only have a couple of items to wash. This method works better than pouring it directly into the wash water. Presoak the tough stuff. You can use the same CLS in the sink and in your automatic dishwasher.

CLS makes a terrific floor cleaner for all sealed floors such as wood floors, tile floors, and vinyl floors. Use one ounce (a shot glass) in 1.5 gallons of warm water. Works well with string mops and sponge mops and floor scrubbing rags and brushes.

Laundry, dish, hand foamers, floors. What else will CLS do?

Dampen a cotton rag with foam and rub into sealed woodwork. People will ask you how you found time to refinish your woodwork and furniture.

Get yourself a plant mister spray bottle from the hardware store. Fill it to an inch and a half from the top with water. Now add a small amount (about 5%) of CLS. And mix gently. Spray it into a sink. There should be a small amount of foam present. If it is too sudsy, dump some out and add more water. If there is little or no foam, add a bit more soap.

These diluted spray cleaners are super handy. I use them to clean the insides of vehicles. It does a great job on vinyl and other plastics. CLS is a good window cleaner, too. Use with balled up newspapers to polish the glass. Perfect for dusting, wiping down any sealed surface, and keeping your kitchen sparkling. I know a restaurant that used it on their tables every day for ten years without a soapy build up. During COVID they switched to Izararoma.

Your spray cleaner does double duty in the garden keeping aphids, jewel bugs and other common pests at bay. Spray your plants three days in a row, spraying both sides of the leaves well. An hour later, you can give your garden a good water spray down to remove it. Kills wasps, flies, grasshoppers and caterpillar moths. Make it as strong as you need; up to 15% is fine for nearly all green plants. I like to spray my vegetable garden a few hours before a rainstorm and let nature do the rest of the work.

Great-grandma Kate raised two boys and a husband using soap and water, a bottle of vodka, and some baking soda. I think she knew what she was doing.

Larry Plesent is a writer, philosopher and grandfather living in the Green Mountains of Vermont. He is the former CEO of Vermont Soap in Middlebury, VT (now retired) and the author of The Reactive Body Handbook*, www.reactivbody.org.* ♻

Elmore Roots' Permaculture Know-How

Seaberries of My Dreams

David Fried

There are four questions horticulturists and gardeners need to ask:

1. Would you like a cup of tea?

2. Do astronauts always take this drink into space or only to Mars?

3. What has narrow soft olive green leaves, interesting twisted trunks and branches and can stand drought and wind and tough weather conditions? Does it also produce a well- loved and very tasty fruit? Yes, an olive tree!

4. What has all of the above, is pretty new to North America, grows more like a large bush, protects itself from deer and goats and can take our zone three climate of 40 degrees below zero in northern Vermont? It is the super hardy seaberry!

Seaberries are easy to grow and quite attractive. Nothing else we grow looks anything like their shade of green. They rustle in the wind. All twelve million little long thin delicate-looking leaves reminding me of olive groves in Greece, bamboo forests in Hawaii, seaberry bushes on our farm.

In spring the males have very tightly bunched flowers, and the females have flowers spread all over the place. These female flowers become bright orange fruits that hug tightly onto the stems for a few weeks. We harvest them either by careful plucking on a ladder or by cutting short branches and freezing them so they come off the twigs easier later on.

Seaberries grown at Elmore Roots are easy to grow and have a great flavor to use in your drinks. (Courtesy photo)

Seaberries have a flavor that makes you stop and say, "Wow!" The closest thing is a rosehip or a tangerine. But really the flavor reminds me of that new drink in the 1960s or early 70s named "Tang." We kids liked it because we heard that was what the astronauts were drinking up in space.

Seaberries are very easy to grow. They like well drained earth and sun. They grow very large thorns to protect themselves and their crop. You have to harvest them like a gladiator or a bee. Go in swinging with full protection of hands, arms and eyes, or reach in softly and gently on a windless day.

You can plant one or two males (one for backup pollination) and six to eight female plants. The females make the fruit. Our shrubs have grown to ten feet tall and six feet wide. We keep the height and width in check by harvesting the whole branches of fruit so it will be easier later on to get the frozen berries off. Trimming the branches back also helps to keep the fruit more within reach. Even after this rough care, the seaberry still looks good with its olive-like leaves and its Dr Seuss-like shape.

This fall we pressed seaberries with some of their leaves in our cider press along with apples. It makes a very pleasing and healthy drink. We have supplied seaberries to at least two local beer companies for seaberry beer. We handed some leaves and berries to friends who were fighting coronavirus or did not want to get it. We read that studies in Korea showed that people having seaberries seemed to be less likely to get the virus.

Seaberry is an easy and fun plant to grow. Sit back with your seaberry cider or seaberry beer and imagine going to the moon and back with an astronaut. Or come over to the farm, and I will give you a warm mug of seaberry tea. I am sipping seaberry tea right now. It is soothing and simple with just a little tartness from the occasional dried orange berry in the tea. Ah, homegrown food forest tea, there's nothing like it.

David Fried of Elmore Roots Nursery, playfully writing about flowers and fruits and life. ♻

Farm-to-School Learning: Cornucopia Project

Jill McLaughlin

From teaching high schoolers how to bend conduit pipes to showing kindergarteners the power of the sun with UV beads, our ReVision Energy climate education team has found that the best way to teach kids is through hands-on learning. That's why we were so excited to learn about Cornucopia Project, led by Executive Director (and solar champion!) Lauren Judd. A hands-on nutritional education nonprofit based in New Hampshire's Monadnock region, Cornucopia Project focuses on "farm-to-school learning" which includes garden education and healthful food prep, using locally grown foods.

Left: Student farmers bunch harvested garlic scapes for summer CSA members; right: Ellie Rupp, removes hornworms from trellised heirloom tomatoes. (Cornucopia Project)

"Learning about nutrition through agriculture and food preparation is fun and effective," explained Judd, who started as a part-time garden educator five years ago, and is now the Executive Director. Cornucopia Project started a micro farm across from the (solar-powered!) ConVal High School, where student farmers grow food for their local cafeterias as well as a CSA open to the public. They use organic growing practices, and use the farm to show the whole ecosystem surrounding food production and distribution.

The micro farm is situated in the greater Peterborough area. The farm, along with eight elementary school gardens, serves students of the ConVal school district. Cornucopia Project also provides nutrition education in the Keene area district schools and regional private schools. They will bring garden education to any school that requests it and, thanks to recent grant funding by the USDA, they are massively scaling up youth impact, expanding their network of volunteers and partner organizations. When they started out, they were reaching 250 students a year; now they are at 1000 students and on track to reach 2000, as part of the national effort to address childhood nutrition.

"We've grown through meaningful partnerships with schools, partner nonprofits, and other organizations throughout the region to include as many young people as possible," said Judd, "When we teach in gardens or at our farm we're exploring from an interdisciplinary approach to make connections with nutrition, environment, agriculture, and community."

Stewardship

ReVision Energy and Cornucopia Project also share a core value: stewardship. At ReVision this desire to protect the nature around us often takes the form of volunteering in our communities – trail cleanups or beach cleans. Cornucopia Project spreads a similar message about respect for our local land.

"We want to make sure that whatever activities we're doing in this space ensures that this land and this place can be enjoyed for a very long time," explained Judd. "So that means having that responsibility, teaching responsibility for food, land, soil, and what it means to really caretake for this place that provides us with everything we need."

While Cornucopia Project has emphasized the role of the sun in their garden lesson plans, the educational farm has not required much electricity until recently. With such high demand for the Student Farmers Program and CSA, the farm has started to expand into a year-round project. They recently acquired high tunnels through a USDA NRCS agreement to extend their growing season, and are starting to explore their energy needs.

Judd herself is a solar champion, with solar being installed on her barn roof this spring, and the nonprofit's board is also excited about renewable energy. "There is definitely an increased need for electrical resources at the farm, and we think solar energy can best represent our mission as a nonprofit and continue our presentation as a demonstration to the community of what your own micro farm can look like. We want folks to come visit, for this to be a resource and an example for members of the community," she said.

Get Involved

Want to help Cornucopia Project further its mission and bring more hands-on nutrition education to the Granite State? Here are some ways to get involved.

Donate to their year-end appeal. This helps them show how much impact they can deliver in 2023.

Volunteer! If you're local to the Monadnock region, they can organize group or individual volunteer projects for you.

Bring Cornucopia to your school! If you're a teacher or have an affiliation with a school or youth group and want to get involved in hands-on nutrition education, reach out to Admin@cornucopiaproject.org.

Jill McLaughlin is the Digital Content Manager for ReVision Energy, an employee-owned solar company based in Brentwood, NH. ♻

Many thanks to our sponsor:

Cornucopia PROJECT
Planting seeds for a lifetime of healthy eating

Go Fast, Go Silent, Go Clean on an Electric Snow Machine

Michael J. Daley

Imagine you acquired a passion for snowmobiling before your climate consciousness awakened. Imagine the twinge of conscience before each ride as you pour ten gallons of liquid fossil fuel into the tank to then spew out into pristine nature at fifty times the emissions of an automobile burning the same amount of fossil juice. The conflict between values might be enough to lead to a heroic act of self-sacrifice where you vow to park the machine for good.

But wait! The electric propulsion revolution is about to come to sleds. Taiga Motors, a small Montreal- based startup, is getting the credit for introducing the first production model electric snowmobiles to the general public. Their first deliveries began in March 2022, just seven years after the company undertook the challenge. They are priced around $15,000; competitive with high end gas models. They can accelerate 0 to 60 mph in three seconds – incomparable performance! They are nearly silent and, of course, non-polluting in operation.

The company's three co-founders, Paul Achard, Gabriel Bernatchez, and Sam Bruneau, worked on electric powertrains during their engineering studies at McGill University. Inspired by Tesla's approach, they set out to reconceive the snowmobile as an electric vehicle, not simply to replace the gas motor with an electric one. In 2019, they introduced the snowmobiling industry to their prototype, TaigaTS2, to what appears to be universal acclaim with one reservation --- you guessed it, range.

Taiga's current production models will deliver 60 to 86 miles per charge. Typical gasoline snowmobiles have a range between 100 to 200 miles per fill up. Not so great a difference at the low end, however, you can fill up on the trail but currently recharging in the great outdoors is not an option. Nevertheless, Taiga has achieved a remarkable benchmark. As anyone familiar with EVs and batteries knows, cold reduces total available capacity and snowmobiling is nothing if not synonymous with cold! Unlike EVs whose range will degrade 20% or more in the cold, Taiga's 27 kW-hr battery pack is guaranteed to deliver the rated miles even at extremely low temperatures.

Taiga's Nomad electric snowmobile offers the benefits of being a clean, quiet, low maintenance machine. (Taiga Motors)

Unless you do major long-distance touring or adventure into the outback without a map, the current range is adequate for most recreational uses. Interestingly, just as with early electric vehicles, the most appropriate function for these models will be as parts of fleets at ski resorts where charging infrastructure can be made readily available.

Industry sources are confident Taiga's success and appeal to riders with performance and environmental values will encourage traditional makers of snowmobiles to accelerate the introduction of electric models or risk being left in the snowdrifts of history. Investors seem to agree as well. A recent public offering for the company generated $100 million in capital. Most of that will be used to build a new manufacturing facility in Shawinigan.

You can check out the specifications and make pre-orders for the Taiga models on their website at https://www.taigamotors.com/. Given the accelerating pace of innovation in everything having to do with electric propulsion, we are certain our next article on snowmobiles will contain a much longer list of choices.

Michael J. Daley is a life-long renewable energy educator and advocate, except for a brief time in high school when he though nuclear power was cool. He lives in a tiny, off-grid cabin in Westminster, VT with his wife, Jessie Haas. ♻