TOWN OF FITZWILLIAM

PLANNING BOARD

AGENDA

TUESDAY, APRIL 3, 2018
7:00 PM

Administration:

Informational Update on Solar

Solar Conditional Use Permit Form

Scenic Road Information

Master Plan BMPs

Minutes from 3/20/18

INTERESTED IN ATTENDING OR CURIOUS ABOUT JOINING THE BOARD?
ALL ARE WELCOME!

SOLAR INFO

Questions gathered from Planning Board Meeting, 3/20/18

INDEX

- **Acreage needed for arrays?**
  - Typically 5 acres of land, shadow free, per producing 1 megawatt of power
  - Chinook Solar: 30 megawatt solar array = 150 acres
  - Another site suggests that:
    - 4 acres if it uses crystalline solar panels without trackers
    - 6 acres if it uses thin film solar panels without trackers
      - ***Why is the area required (per MW) for a thin film solar panel higher than that for a crystalline panel?***
        "The simple thumb rule is – High efficiency solar panels will require less area for the same MW capacity than lower efficiency panels. Thus, a 1 MW solar power plant with crystalline panels (about 18% efficiency) will require about 4 acres, while the same plant with thin film technology (12% efficiency) will require about 6 acres. The area required by thin film panels is about 50% more than that for the crystalline, as the latter are about 50% more efficient than the former."

Note: "trackers" refer to solar panels that pivot in order to maintain the most direct sunlight

Question: What type of panels would Chinook be using?

- **Energy Production?**
  - If the maximum capacity of energy generation is 1 megawatt, the plant will typically produce up to 800 kilowatts
  - Assuming the same ratio of production for a 30 megawatt array, Chinook Solar may produce up to 24 megawatts
  - The average NH household uses 615 kilowatts per month
  - The average commercial business in NH uses 3,555 kilowatts per month
  - The average industrial business in NH uses 47,247 kilowatts per month
    - **Note:** the 3 above averages are all lower than the national average

- **Effect of weather patterns?**
  - SNOW: Sites suggest that yes, if the solar panels are at an angel then the snow should slide off. However, research also shows that the snow doesn't always all come off at once and most solar arrays benefit from being cleaned off using a solar panel snow rake. Secondly, if the solar panels are covered with snow, they will NOT be producing energy. (See also Page 8)
  - LIGHTINING: Several sites noted that it's rare for a solar panel to be hit and damaged by lightening but it has happened.
  - HAIL: Solar panels are built and tested to withstand the impact of hail, but in situations where they are large enough they can cause damage.
  - WIND: Similar to hail, solar panels are to withstand high wind speeds. One site noted that residents using solar were mostly unaffected after the winds from Hurricane Sandy.
  - COLD: Solar panels perform more efficiently under colder conditions and can perform poorly in hot weather
  - RAIN/CLOUDS: Sunlight can still penetrate some cloud-cover however it may reduce the efficiency of the solar panel to 10-25% of its optimal capacity

- Referring to a utility-scale system up to 30 megawatts, "Clouds can cause pretty significant jumps or ramps over a very short period of time." Renne said that as solar power becomes a greater part of the energy mix, those jumps can cause fluctuations in the grid, which if unmitigated can cause surges, fluctuations, and headaches for the utility operator. Storage of the electricity generated by the sun is one way to handle those fluctuations. Another is to stabilize the grid via infrastructure and software packages."

- **What happens if the array does not meet quota for energy generation?**
  - Unable to find suitable information. This may be a question best addressed by asking Chinook Solar what they would do if it didn't meet quota.

- **Energy loss of 50 to 70 miles of transmission line?**
  - Difficult to estimate because there are unique figures that would be plugged into a formula to calculate those losses.
  - An estimate of resistive losses based on average of all energy types: "For example, a 100 mi span [of transmission line] at 765 kV carrying 1000 MW of power can have losses of 1.1% to 0.5%. A 345 kV line carrying the same load across the same distance has losses of 4.2%"
  - However, another estimate wrote: "The **overall losses** between the power plant and consumers is then in the range **between 8 and 15%.**"
  - For power plants using coal, natural gas, nuclear, petroleum: "The thermodynamic limits of this process ("Damn that rising entropy!") mean only two-thirds of the energy in the raw materials actually make it onto the grid in the form of electricity."
  - An example formula for calculating loss of a corona-free transmission line:

$$P(z) = P(0)e^{-2\alpha z} = P(0)e^{-zR_l/(Lc)}$$

$$P_{Rloss}(0:z) = P(0) - P(z)$$

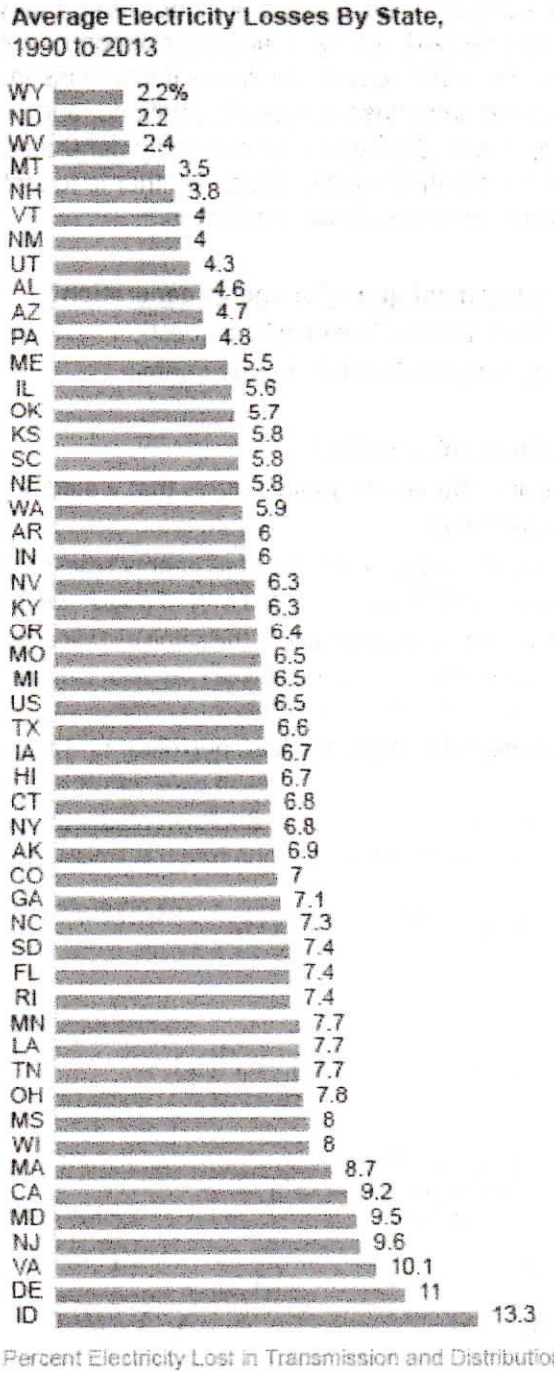
$$\%P_{Rloss} = \frac{P(0) - P(z)}{P(0)} = 1 - e^{-zR_l/(Lc)}$$

$$L = \frac{\mu}{\pi}\ln(\frac{d}{a}) \qquad \delta = \frac{1}{\sqrt{\pi \int \mu_0 \sigma}}$$

$$R_l = \frac{I_B}{2\pi a \sigma \delta}$$

To calculate, we would need additional information from Chinook Solar, such as Bessel Correction Factor, conductivity of the metal, line frequency, etc. It may be worth asking Chinook to do the calculations for us based on what their current proposal is.

- Below shows the average electrical loss by State- NH averages 3.8%



Data Source: Energy Information Administration, compiled by Inside Energy

ADDITIONAL QUESTIONS/INFORMATION

- Florida Power & Light – sister company to NextEra – mini bio of company
    - Florida Power & Light Company is the third-largest electric utility in the United States, serving approximately 4.9 million customer accounts or an estimated 10 million people across nearly half of the state of Florida. FPL's typical 1,000-kWh residential customer bill is approximately 25 percent lower than the latest national average and, in 2016, was the lowest in Florida among reporting utilities for the seventh year in a row. FPL's service reliability is better than 99.98 percent, and its highly fuel-efficient power plant fleet is one of the cleanest among all utilities nationwide. The company received the top ranking in the southern U.S. among large electric providers, according to the J.D. Power 2016 Electric Utility Residential Customer Satisfaction Study(SM), and was recognized in 2016 as one of the most trusted U.S. electric utilities by Market Strategies International. A leading Florida employer with approximately 8,900 employees, FPL is a subsidiary of Juno Beach, Florida-based NextEra Energy, Inc. (NYSE: NEE), a clean energy company widely recognized for its efforts in sustainability, ethics and diversity, and has been ranked No. 1 in the electric and gas utilities industry in Fortune's 2017 list of "World's Most Admired Companies." NextEra Energy is also the parent company of NextEra Energy Resources, LLC, which, together with its affiliated entities, is the world's largest generator of renewable energy from the wind and sun.

- **SEC Contact Information:**

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- **Germany's Solar Situation**
  - Similar rate of sunshine to Alaska

Sustainable Energy

Germany Runs Up Against the Limits of Renewables

Even as Germany adds lots of wind and solar power to the electric grid, the country's carbon emissions are rising. Will the rest of the world learn from its lesson?

by Richard Martin

May 24, 2016

At one point this month renewable energy sources briefly supplied close to 90 percent of the power on Germany's electric grid. But that doesn't mean the world's fourth-largest economy is close to being run on zero-carbon electricity. In fact, Germany is giving the rest of the world a lesson in just how much can go wrong when you try to reduce carbon emissions solely by installing lots of wind and solar.

After years of declines, Germany's carbon emissions rose slightly in 2015, largely because the country produces much more electricity than it needs. That's happening because even if there are times when renewables can supply nearly all of the electricity on the grid, the variability of those sources forces Germany to keep other power plants running. And in Germany, which is phasing out its nuclear plants, those other plants primarily burn dirty coal.
Now the government is about to reboot its energy strategy, known as the *Energiewende*. It was launched in 2010 in hopes of dramatically increasing the share of the country's electricity that comes from renewable energy and slashing the country's overall carbon emissions to 40 percent below 1990 levels by 2020 (see "The Great German Energy Experiment"). What happens next will be critical not only for Germany, but also for other countries trying to learn how to best bring more wind and solar online—especially if they want to do it without relying on nuclear power.

Some aspects of the *Energiewende* have been successful: renewable sources accounted for nearly one-third of the electricity consumed in Germany in 2015. The country is now the world's largest solar market. Germany's carbon emissions in 2014 were 27 percent lower than 1990 levels. However, an expert commission appointed by the country's minister of economy and energy has said the 40 percent target probably won't be reached by 2020. And the energy revolution has caused problems of its own. Because fossil-fuel power plants cannot easily ramp down generation in response to excess supply on the grid, on sunny, windy days there is sometimes so much power in the system that the price goes negative—in other words, operators of large plants, most of which run on coal or natural gas, must pay commercial customers to consume electricity.

That situation has also arisen recently in Texas and California (see "Texas and California Have Too Much Renewable Energy") when the generation of solar power has maxed out.
In hopes of addressing such issues, Germany's Parliament is expected to soon eliminate the government-set subsidy for renewable energy, known as a feed-in tariff, that has largely fueled the growth in wind and solar. Instead of subsidizing any electricity produced by solar or wind power, the government will set up an auction system. Power producers will bid to build renewable energy projects up to a capacity level set by the government, and the resulting prices paid for power from those plants will be set by the market, rather than government fiat.

The auction system is designed to reduce the rate of new renewable-energy additions and keep Germany from producing too much power. It might seem like an easy way to solve the oversupply issue would be to shut down excess power plants, especially ones that burn coal. But not only are the coal plants used to even out periods when wind and solar aren't available, they're also lucrative and thus politically hard to shut down. Because German law requires renewable energy to be used first on the German grid, when Germany exports excess electricity to its European neighbors it primarily comes from coal plants. Last fall, the German subsidiary of the Swedish energy giant Vattenfall started up a 1,600-megwatt coal-fired plant that had been under construction for eight years, defying opposition from politicians, environmental organizations, and citizens who want to see coal plants eliminated.
Putting a steep price on carbon emissions would hasten the shutdown of German coal plants. But Europe's Emissions Trading Scheme, designed to establish a continentwide market for trading permits for carbon emissions, has been a bust. Prices for the permits are so low that there is little incentive for power producers to shut down dirty plants.

Also helpful would be a Europewide "supergrid" that would enable renewable power to be easily transported across borders, reducing the need for reliable, always-on fossil fuel plants to supplement intermittent electricity from solar and wind. "If you want to use fluctuating renewable power, you have to upgrade the grids across Europe," says Daniel Genz, a policy adviser with Vattenfall. Efforts to build that grid are under way, but they'll be expensive: between €100 billion and €400 billion ($112 billion to $448 billion), according to a November 2015 report from e-Highway2050, which was formed by the European Union to plan for a pan-European power grid.

I've got snow on solar panels...

Most of us are thrilled with the snow that's fallen across our beloved Vermont. Yet we've heard questions from some solar homeowners about the effect of snow on their systems. What should you do about snow on solar panels in Vermont?

Should I remove snow from my solar panels?

No. We recommend against getting up on your roof to wrestle snow off your panels. The panels are dark and gather enough sun to eventually melt the snow, which will slide off the slick glass surface. Swinging a rake or shovel up there could harm a panel or catch on a roof-mount. And of course the 25-year panel warranty doesn't cover damage caused by the homeowner. Plus, getting up on a snowy roof would risk your getting hurt, which nobody wants.

But aren't my solar panels supposed to be making electricity?

Between the scant sunlight during our short winter days and the occasional snowfall, Vermont's cold months don't yield much electricity compared to the power that pours off your roof from the bright summer sun. So no, when you have snow on solar panels, we don't expect the panels to be producing. Remember that the way net-metering works is that you store up credits for the power you make and then draw them down when the sun isn't shining. When SunCommon's engineering team designed your system and determined how much electricity it will produce, we factored in the amount of sunlight Vermont homes receive over the course of a year and took account of snowfall. Not to worry if you have snow on solar panels, you'll catch up when the sun again shines brightly.

Well, what if I want to squeeze all the electricity out of my solar panels that I can?

You're of course free to knock yourself out. But for all the effort and danger of clearing off your solar panels a few days before Mother Nature would do the work for you, they'd generate the equivalent of only a partial day of summertime electricity production. Again, your system was designed with our winter darkness and snow cover in mind.

Is it true the solar panels produces more efficient electricity on clear, snowless winter days? And why?

Yes. Solar panels do produce better at cooler temperatures! Hot, hot heat is hard on electronics in the summer, so the winter months provide more efficient energy production. Even with that fun fact though, the shorter days, snowfall, and less direct sunlight are real factors in determining winter PV potential in Vermont. We calculate year-round production so that you can count on your over-production during the long, summer days helping carry you through the winter. This is thanks to our ability to net meter with the utility companies!

ROUTINE SCHEDULED PREVENTIVE MAINTENANCE

One of the most valuable techniques for identifying existing problems and preventing future problems is to walk the site and conduct a thorough visual and hands-on inspection of the PV system components. These inspections should be conducted at regular intervals, and personnel should use checklists developed for these periodic maintenance activities to ensure that the inspections are thorough and complete.

General Site Annual Inspection

At least once a year, O&M personnel should conduct a general inspection of the PV installation site. During this inspection, technicians should:

- ensure roof penetrations are watertight, if applicable;
- ensure roof drainage is adequate, roof drains are not clogged, and confirm that there are no signs of water pooling in the vicinity of the array;
- check for vegetation growth or other new shade items such as a satellite dish;
- check for ground erosion near the footings of a ground mount system;
- confirm proper system signage is in place;
- confirm appropriate expansion joints are used where needed in long conduit runs;
- confirm electrical enclosures are only accessible to authorized personnel, are secured with padlocks or combination locks, and have restricted access signage;
- check for corrosion on the outside of enclosures and the racking system;
- check for cleanliness throughout the site—there should be no debris in the inverter pad area or elsewhere;
- check for loose hanging wires in the array; and
- check for signs of animal infestation under the array.

Detailed Visual Inspection

The installation should be inspected regularly for issues that impact the physical integrity or performance of the PV system. A visual inspection should include the following actions:

- Inspect the inverter/electrical pad to make sure it does not show excessive cracking or signs of wear. The inverter should be bolted to the pad at all mounting points per the manufacturer installation requirements. Depending on the size, location, and accessibility of the system to unqualified personnel, the inverters, combiner boxes, and disconnect switches should require tools or have locks to prevent unauthorized access to the equipment.
- Look for warning placards including arc flash or PPE requirements for accessing equipment. Be sure to comply with all warning placards. If no placards are present, or if some placards are missing, make a note of it and install the missing placards during the maintenance visit. Consult the NEC and Underwriters Laboratories (UL) standards as well as the site host to determine signage requirements. PV System Operations and Maintenance Fundamentals 14 Solar America Board for Codes and Standards Report
- Inspect PV modules for defects that can appear in the form of burn marks, discoloration, delamination, or broken glass.
- Check modules for excessive soiling from dirt buildup or animal droppings. (See Array Washing Procedure for proper procedures for cleaning an array.)

• Ensure that the module wiring is secure and not resting on the roof, hanging loose and exposed to potential damage, bent to an unapproved radius, or stretched across sharp or abrasive surfaces.
• Inspect racking system for defects including rust, corrosion, sagging, and missing or broken clips or bolts.
• If sprinklers are used to spray the array, check that the water is free of minerals (demineralized) as these minerals can cause gradual performance degradation.
• Inspect conduits for proper support, bushings, and expansion joints, where needed.
• In roof-mounted systems, check the integrity of the penetrations.
• In ground-mounted systems, look for signs of corrosion near the supports.
• Open combiner boxes and check for torque marks on the connections. Torque marks are made when lugs have been tightened to the proper torque value. Ideally they are applied during initial installation, but if not, the technician can mark the lug after torquing during a maintenance visit. A proper torque mark is made with a specialized torque marking pen. The mark is a straight line through the lug and the housing. Over time, if the line separates between the lug and the housing, it shows that the lug has moved and needs to be re-torqued. Look for debris inside the boxes and any evidence of damaging water intrusion. Look for discoloration on the terminals, boards, and fuse holders.
• Open the door to the disconnect(s) and look for signs of corrosion or damage. Check to make sure the cabinet penetrations are properly sealed and there is no evidence of water ingress. Check for torque marks on the terminals.
• Perform a visual inspection of the interior and exterior of the inverter. Look for signs of water, rodent, or dust intrusion into the inverter. Check for torque marks on the field terminations.
• If a weather station is present, ensure that the sensors are in the correct location and at the correct tilt and azimuth. A global horizontal irradiance sensor should be flat, and a plane of array irradiance sensor should be installed to the same pitch and orientation as the array. Irradiance sensors should be cleaned to remove dirt and bird droppings.

Manufacturer-Specific Inverter Inspection

Each inverter manufacturer will have specific requirements for inspection, testing, services, and documentation to meet its warranty obligations. Typical requirements for inverter inspections include:

• Record and validate all voltages and production values from the human- machine interface (HMI) display.
• Record last logged system error.
• Clean filters.
• Clean the inside of the cabinet.
• Test fans for proper operation. PV System Operations and Maintenance Fundamentals 15
• Check fuses.
• Check torque on terminations.
• Check gasket seal.
• Confirm warning labels are in place.
• Look for discoloration from excessive heat buildup.
• Check integrity of lightning arrestors.
• Check continuity of system ground and equipment grounding.
• Check mechanical connection of the inverter to the wall or ground.
• Check internal disconnect operation.
• Verify that current software is installed.
• Contact installer and/or manufacturer about any issues found.

• Document findings for all work performed.

Manufacturer-Specific Tracker Inspection

Tracker manufacturers will have specific requirements for inspections, testing, service, and documentation to meet their warranty obligations. Typical maintenance or startup requirements for tracker systems include:

• Lubricate tracker by inserting grease with grease gun into appropriate grease caps per manufacturer maintenance recommendation.
• Check voltages inside the controller box.
• Use a digital level to check the calibration and positioning of the inclinometers.
• Check array for signs of parts hitting or rubbing other parts.
• Remove vegetation that is near the drive shaft or moving components.
• Check wind-stow operation.

Use appropriate (volt, ohm, dc clamp-on) meters to test:

• continuity of the equipment grounding at the inverter, combiner boxes, and disconnects;
• continuity of all system fuses at the combiner boxes, disconnects, and inside the inverter(s);
• open-circuit voltage (Voc) of all strings with the inverter off; and
• maximum power current (Imp) of all strings with the inverter on and at specified or recorded levels of power.

Additional testing (used when problems are identified or required by contract terms) may include:

• thermal images of combiner boxes (opened and closed), disconnects, inverters (external and internal at a specified operating point for a specified period of time), and modules;
• short circuit (Isc) testing of strings; • current-voltage (IV) curve testing of strings;
• insulation resistance tests (also known as "megger" tests) of conductors at specified voltage; and
• comparison of a weather-corrected performance calculation of expected output to actual output of the system. 16 Solar America Board for Codes and Standards Report

Manufacturer-Specific Data Acquisition System Inspection

Data acquisition system (DAS) manufacturers will have specific requirements for inspections, testing, service, and documentation to meet their warranty obligations. Typical maintenance or startup requirements for DASs include:

• taking voltage readings of power supplies,
• validating current transducer readings by comparing to calibrated equipment, and
• validating sensor reading by comparing to calibrated equipment.

To confirm proper functionality of the DAS, the values measured by the DAS must be verified against values from devices with traceable calibration records. Comparing the irradiance, temperature, and power measurements recorded by the DAS to values obtained from calibrated instruments will help identify sensor calibration issues that could result in the DAS data being incorrect. The PV industry as a whole is getting better at DAS installation and documentation, but it is still typical for DAS plans to be omitted or insufficiently detailed. As a result of such an omission, plan checkers often do not check for

errors in the DAS design and inspectors have nothing to compare the as-built with for compliance. If the DAS will be tied into the building information technology system, O&M personnel should be aware that building networking upgrades or routine maintenance can cause connectivity issues.

-from **Solar America Board for Codes and Standards Report**

NEXT ERA

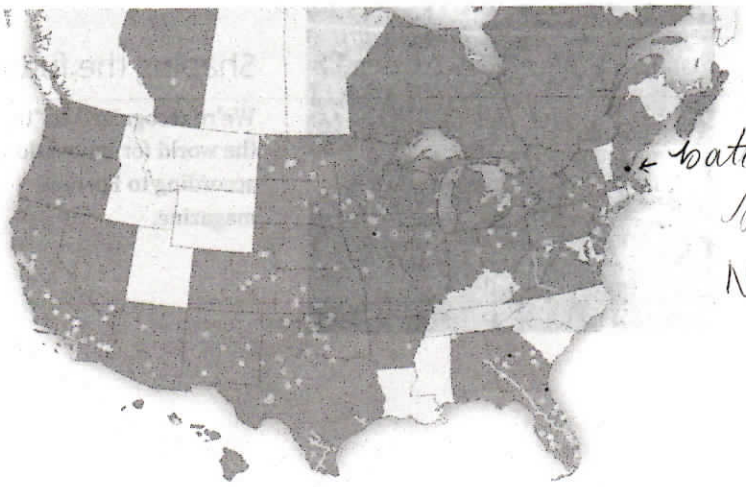
Our Work

NextEra Energy is the world's largest utility company, and we're proud to be built and based in America.

Our Values

We are committed to excellence.

OUR PORTFOLIO



battery energy storage on NH seacoast

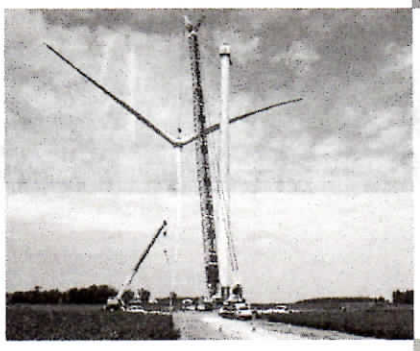
Providing Clean Energy Across North America

Leading the industry

With a market capitalization of more than $62 billion, we are the world's largest utility company. We're proud to be built and based in America.

Powering America

We generate more wind and solar energy than any other company in the world.



Investing in America

We're America's third-largest capital investor in infrastructure. And, we're planning to invest $40 billion through 2020.

Creating jobs

We're creating thousands of high-paying American jobs through our energy investments.

Shaping the future

We're recognized as "top 10 in the world for innovation," according to Fortune magazine.

Investing in natural gas infrastructure

We're making significant investments in natural gas pipelines and modernizing our fossil fleet into efficient, state-of-the-art facilities.

READ MORE
(/COMPANY/WORK/NATURAL-GAS.HTML)

Solar Power in New England: Concentration and Impact

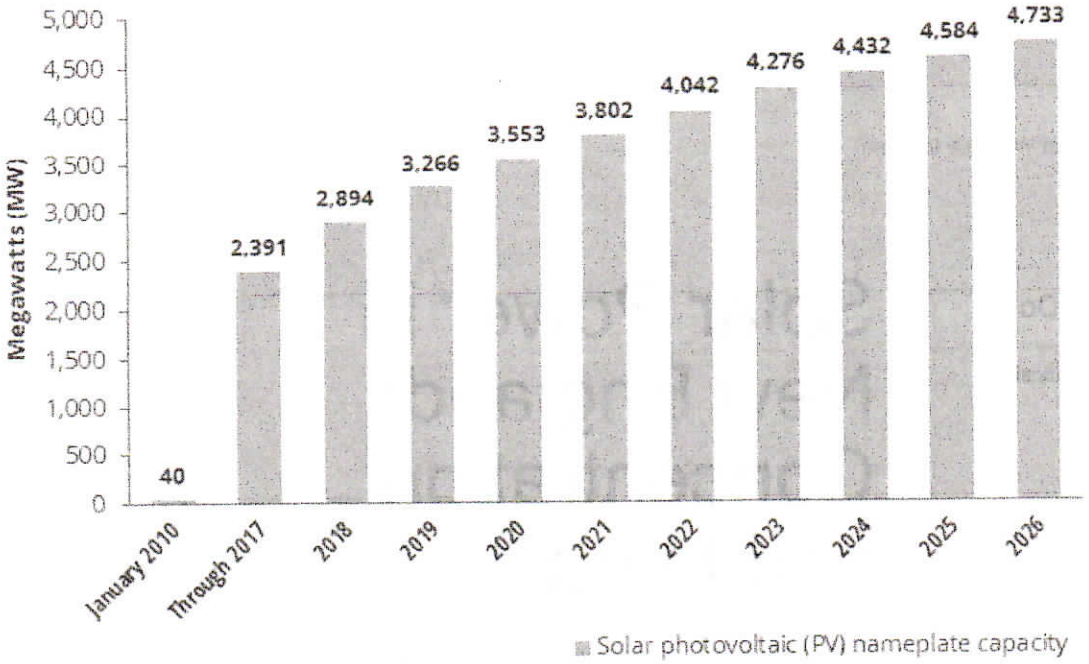
Solar power systems are rapidly being installed across the six states of New England and noticeably reducing the electricity drawn from the regional power system. But how much and when that electricity demand is reduced are critical questions when it comes to operating the grid and performing long-term system planning.

The region has about 2,400 MW of solar power. Of this, ISO system operators can only "see" about 80 MW in real time.

Solar Power Is Growing Quickly

State policies, state and federal support, tax credits, and falling technology costs are spurring remarkable growth in the installation of solar photovoltaic (PV) system in New England. The ISO's 2017 PV Forecast PDF anticipates almost 5,000 megawatts (MW) of nameplate PV capacity by 2026.

Projected Cumulative Growth in New England Solar Power



Notes: Amounts include PV connected "behind the meter," as well as PV participating in the wholesale electricity marketplace. Megawatt values are AC nameplate.

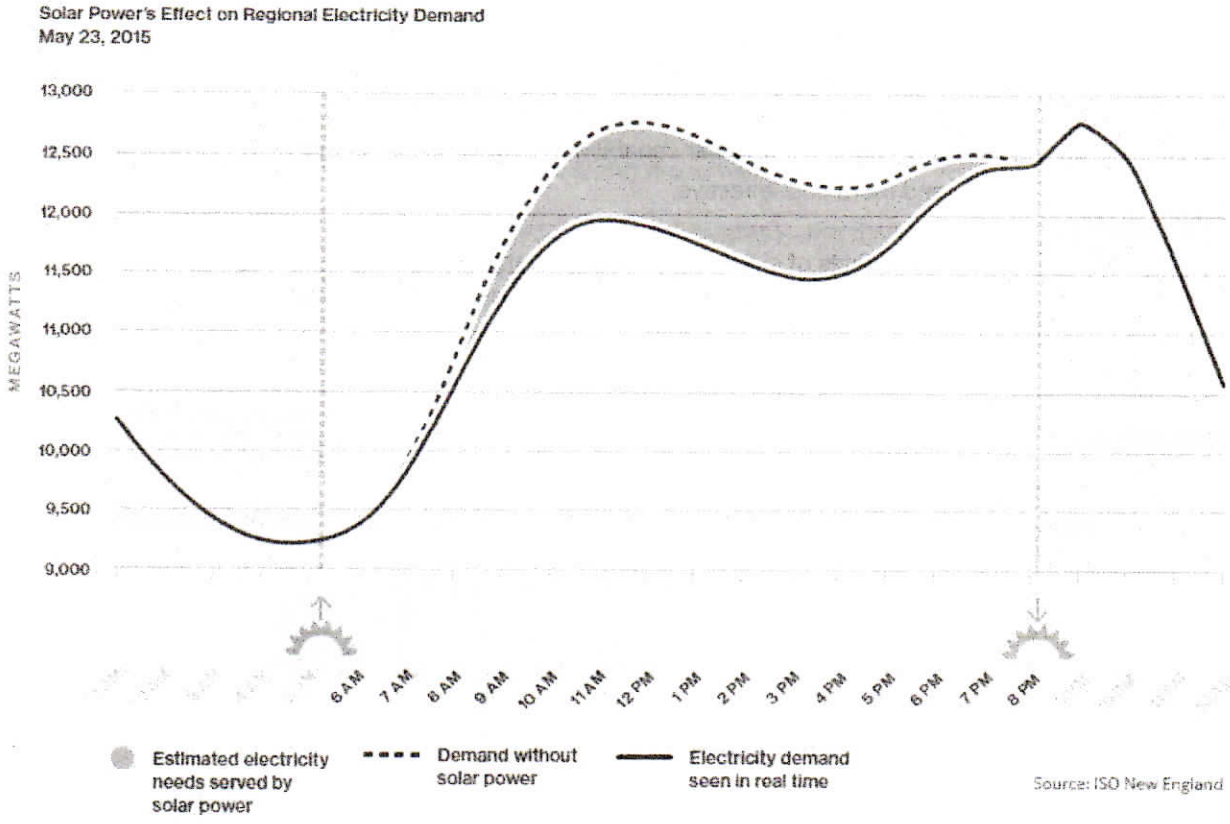
Source: ISO New England, *Final 2017 PV Forecast* (May 2017)

Regional Solar Power Reduces Demand from the Grid

The vast majority of New England's solar power is in the form of small-scale (typically 5 MW or less) systems, including residential rooftop arrays. These systems are typically connected to local utilities or behind the meter (BTM) directly to retail customers—and not to the regional power system. As a consequence:

> BTM PV reduces the amount of electricity being drawn from the grid. This is illustrated below by the region's load profile (the amount of electricity drawn from the grid by hour) for May 23, 2015: a clear, relatively cool day near the summer solstice—ideal conditions for PV production.

The output from BTM PV can't be monitored in real-time by ISO system operators. The challenge for the ISO, then, is to accurately predict the magnitude of the load-reduction caused by BTM PV in any given hour of any given day—and to quickly adjust to any load fluctuations in real time.



Output from Solar Power Systems Is Highly Weather-Dependent

ISO system operators rely on accurate forecasts of grid demand because it's critical to keep the power supply in near-perfect balance with demand at all times. But anticipating how much solar power there'll be at any moment is a complex problem. PV output depends on things like:

How high—or low—the sun is in the sky

The amount of cloud cover and haze

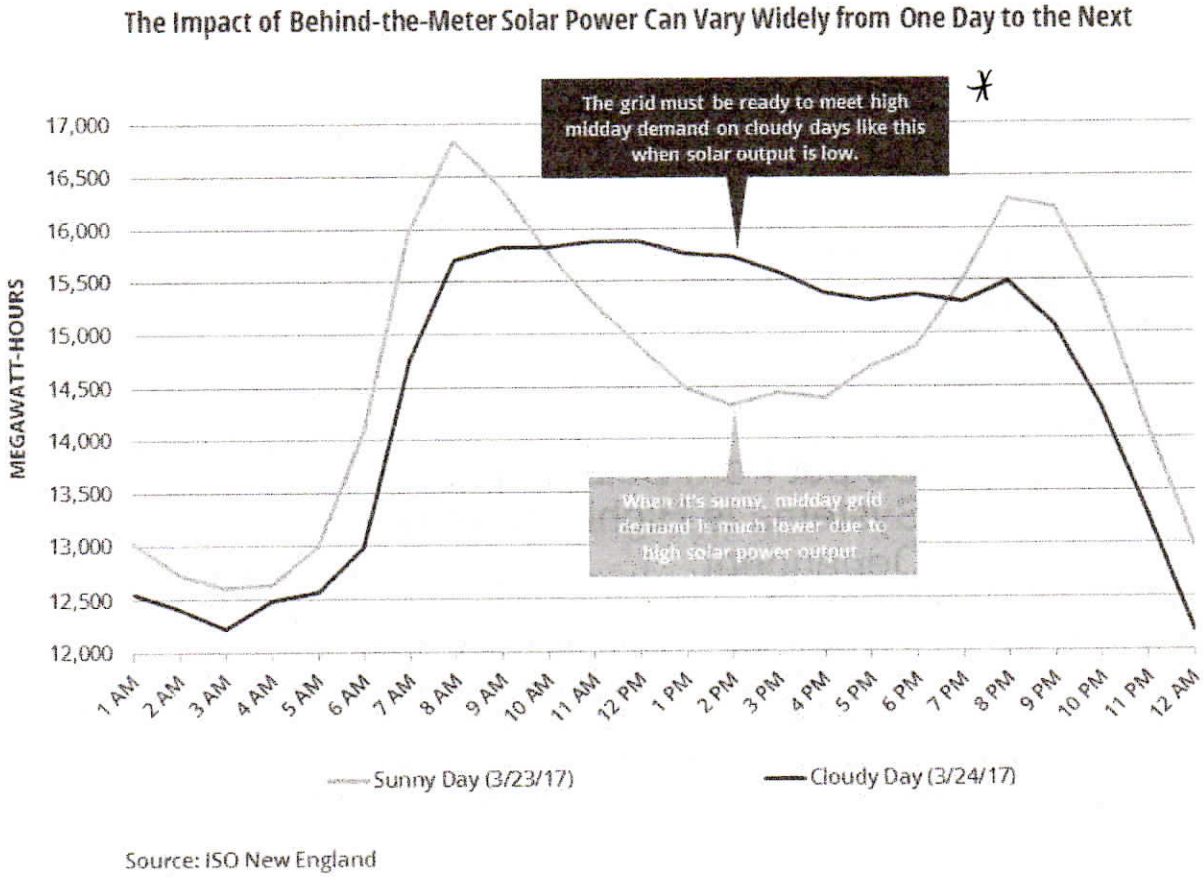
Temperature and humidity

Wind speeds

Snowfall

These changing weather conditions can lead to rapid and sizeable swings in electricity output from PV systems, which is why PV resources are called variable or intermittent. It's also why as more variable resources are installed in New England, the region will rely more heavily on other power resources that can help balance the fluctuations of the combined load and behind-the-meter solar PV, such as efficient, fast-start natural gas power plants. New storage technologies may also one day help balance solar variability, as they become larger and more cost-effective.

The effects of cloud cover can be seen in the graph below of grid demand on March 24, a cloudy day, versus March 23, a sunny day.



Source: ISO New England

* battery / storage ?

Solar Power's Impact Varies by Season and Total Amount Installed

The amount of electricity New England uses varies greatly by season—so does PV's impact. The representative load profiles below simulate the impact PV will have during each season as more and more is installed across the region. Compare:

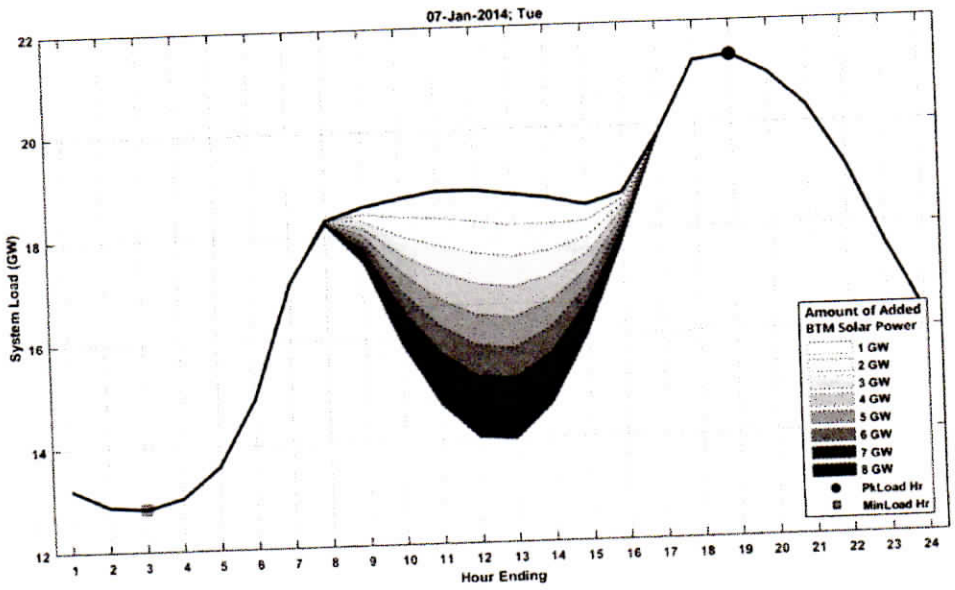
- Peak demand (the blue dots)—the day's highest level of grid electricity use — black dots
- How steep the climbs and drops become
- Minimum demand (the green squares)—the day's lowest level of grid electricity use — grey squares

Summer | Winter | Spring/Autumn

« Prev / Next »

Winter has the second highest electricity use in New England. Load reductions from PV can be significant during midday hours on sunny winter days, which, as more PV is installed, will increase the need for power resources with the operational flexibility to quickly ramp their output up or down to match the steeper curves of changing demand. Importantly, PV doesn't reduce the winter peak at all due to the timing of sunset.

Winter Load Profile with Increasing Behind-the-Meter Solar Power



Source: ISO New England

*larger charts of all 3 profiles attached in the back

The ISO Is Developing a Better Picture of the Region's Installed Solar Power

20

The ISO is studying other possible implications of PV displacing conventional power resources. Conventional resources have physical characteristics that are critical to helping regulate transmission line power flows, frequency, and voltage, which help maintain power grid reliability. Learn more in *The Basics of Essential Reliability Services,* a series of videos presented by the North American Electric Reliability Corporation (NERC).

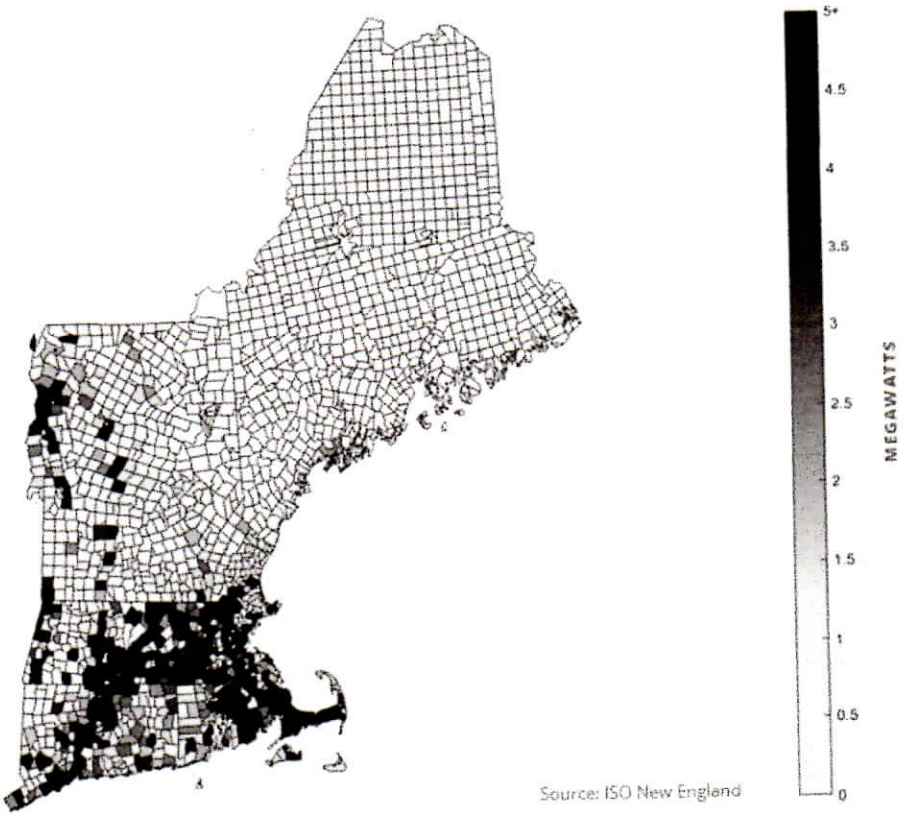
The ISO is also actively pursuing new and innovative ways to accommodate the effects of large amounts of solar power. We developed the nation's first long-term, multistate forecast of PV capacity. We've also prototyped a day-ahead forecast of regional behind-the-meter PV output based on forecasts of irradiance (the sun's strength), which helps estimate how much electricity demand will be reduced by PV, and are working to upgrade this prototype into a production-grade forecasting system (similar to the ISO's wind power forecast).

As part of this project, we're collaborating with distribution utilities to understand and track the amount and location of PV capacity across New England. The heat maps below show the aggregated installed nameplate PV capacity by town within each state through December 31, 2017. Please note that the color scale varies by state in order to more effectively illustrate the distribution of PV capacity within each state.

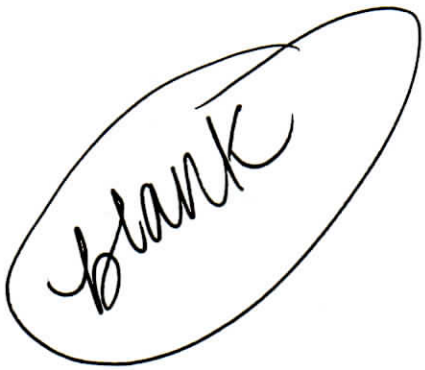
New England | Vermont | New Hampshire | Maine | Massachusetts | Connecticut | Rhode Island « Prev / Next »

Installed Behind-the-Meter Solar Power by Town

(Nameplate Capacity through December 31, 2017)



Source: ISO New England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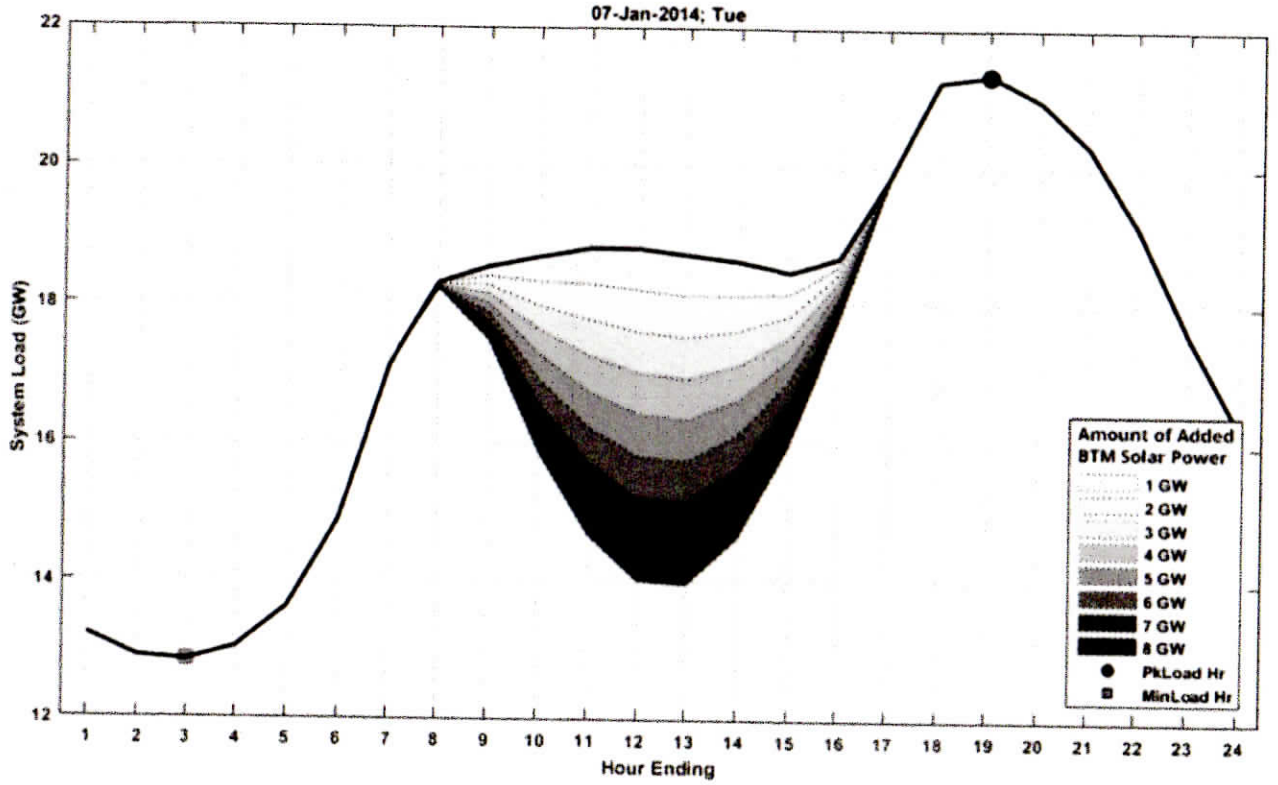
Winter Load Profile with Increasing Behind-the-Meter Solar Power

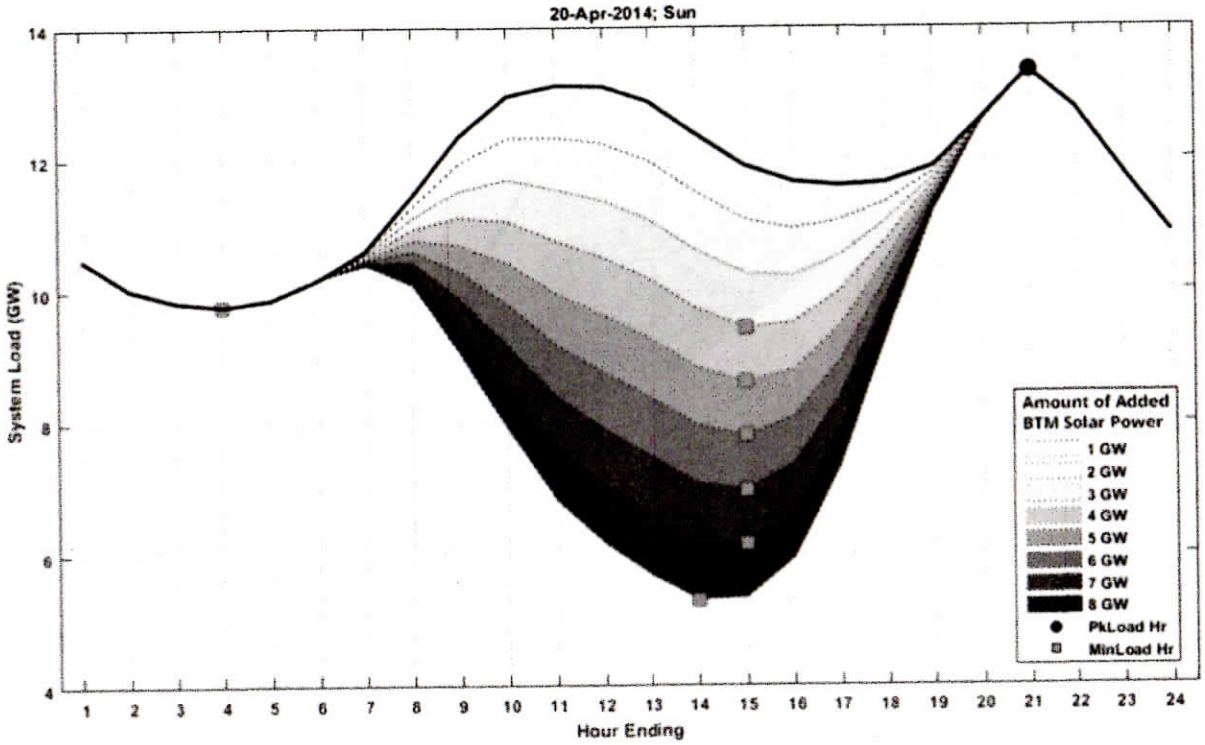
Winter has the second highest electricity use in New England. Load reductions from PV can be significant during midday hours on sunny winter days, which, as more PV is installed, will increase the need for power resources with the operational flexibility to quickly ramp their output up or down to match the steeper curves of changing demand. Importantly, PV doesn't reduce the winter peak at all due to the timing of sunset.



Source: ISO New England

Spring and autumn (shoulder seasons) generally have the lowest demand for electricity. Spring is also when PV's output is typically highest. With about 3 GW of BTM PV by 2019, more occasions are expected when demand falls so low that, to protect the system, the ISO must issue emergency requests for grid-connected power resources to reduce output (if possible to do so safely and economically) or shut down. It then becomes more challenging to meet rising demand later in the day because some resources can take many hours to start up again.

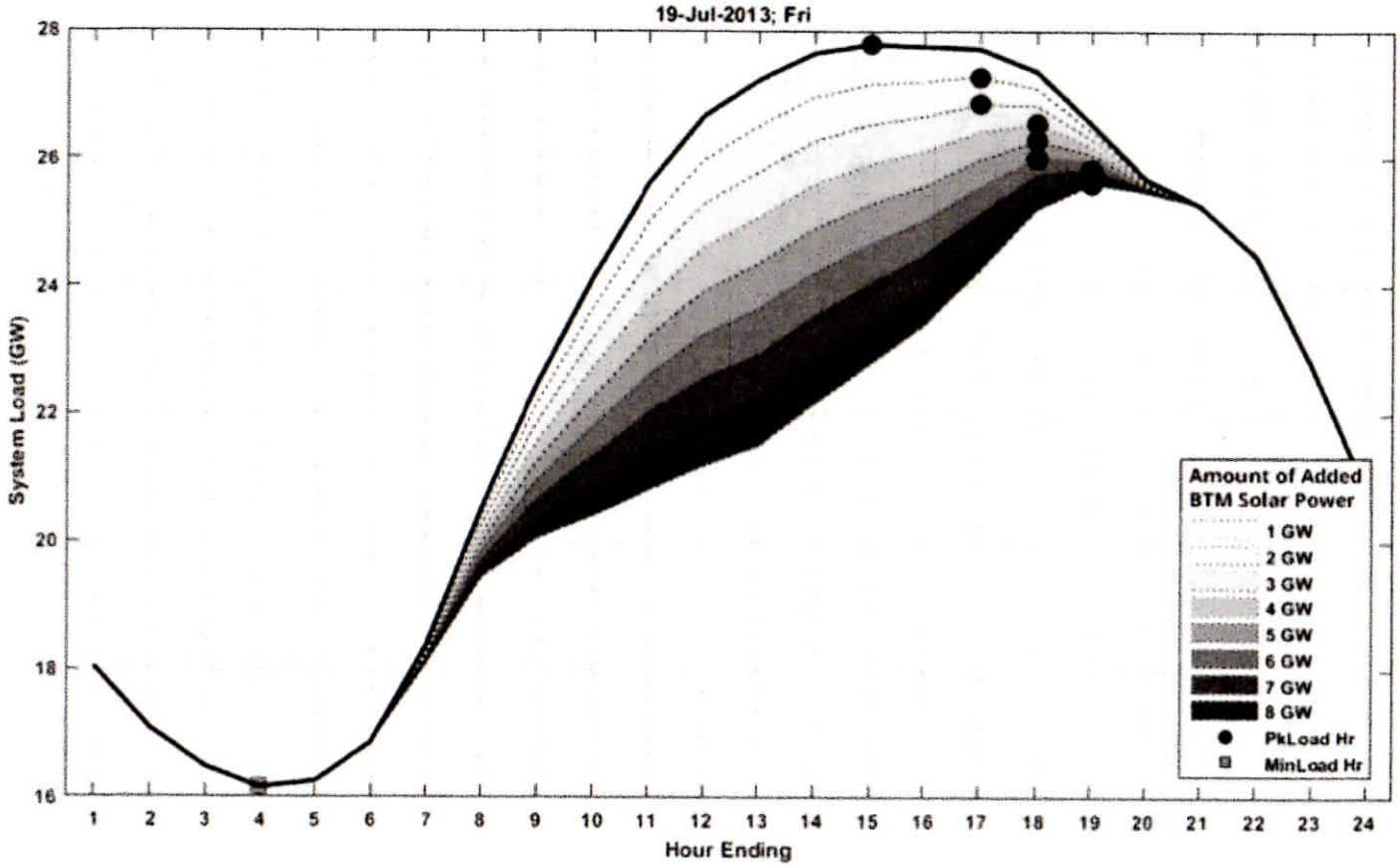
Spring/Autumn Load Profile with Increasing Behind-the-Meter Solar Power



Source: ISO New England

Summer Load Profile with Increasing Behind-the-Meter Solar Power

Summer comprises the highest electricity use in New England, largely because of air conditioning. PV clearly helps "shave the peak" when the peak falls during daylight hours. Because greater amounts of PV will shift the timing of peak demand for grid electricity to later in the afternoon or evening, PV's ability to reduce peak demand will diminish over time.



Source: ISO New England

Fitzwilliam Planning Board

13 Templeton Turnpike
PO Box 725
Fitzwilliam, NH 03447
(603) 585 - 9119
fitzlanduse@fitzwilliam-nh.gov

FOR OFFICE USE:
Date Received: _____
Filing Fee Amount: _____
Check Number: _____

Application for Conditional Use Approval - Solar Energy Systems

1. Name of Applicant/Owner _____
2. Mailing Address _____
3. Phone _____
4. Name of Owner's Authorized Agent _____
5. Authorized Agent's Phone _____
6. Location of Subject Property _____
7. Tax Map #_____ Lot #_____ Land Use District _____
8. Is the project within the Wetlands Protection Overlay District (within 75 feet of wetlands) or in wetlands?

   Yes ☐ No ☐

   If yes, what is the setback from wetlands? _____

11. Check all that apply:

    a. I am applying for a:
    ☐ Ground-Mounted Solar Energy System
    ☐ Roof-Mounted Solar Energy System

    b. The scale of the Solar Energy System will be:
    ☐ Community Scale, with intent of benefiting the Town and its residents, generates between 15 kilowatts and 1 megawatt of electricity
    ☐ Utility Scale, consisting typically of large arrays or farms with the purpose to sell power to the open market, generates ≤ 1 megawatt of electricity

12. Are other town, state, or federal permits/approvals required? Yes ☐ No ☐

    If yes, describe _____

    _____

12. Estimated start date: _____ Estimated completion date: _____

This application must be accompanied by 1) a complete site plan, **2)** list of names and mailing addresses for all abutters within 200 feet of all boundary lines, and **3)** all application fees and notice costs - checks payable to the Town of Fitzwilliam. Please reach out to the Land Use Department with any questions!

The undersigned hereby requests a Conditional Use Permit for the above referenced project from the Planning Board. I understand that prior to formal review, the Planning Board will first review this application and supporting materials for completeness and if found to be incomplete, the application will not be processed. In making this application, I also understand that any special engineering costs incurred as a result of the review of this plan must be paid by the applicant prior to final action by the Board. I further agree to grant the Town of Fitzwilliam and its agents, permission to enter upon the property for the purposes of inspection regarding this application.

_____
Signature of Owner Date

_____
Signature of Owner's Agent Date

NEW APP. FORM **
- follows wetlands
CUP layout.

DRAFT

Town of Fitzwilliam
Planning Board
Tuesday, March 20, 2018
Meeting Minutes

Member's Present: Suzanne Gray, Vice Chair; Robin Peard Blais, Secretary; Paul Haynes; Matt Buonomano; Charles Kenison, Selectman's Rep; Ross Tourigny; Terry Silverman, Chairman

Member's Absent: Carlotta Pini, Alternate; Robert Young, Alternate

Other's Present: Mark Trumbauer, Isabel Johnson, and Richard Jordan, representatives from NextEra for proposed Chinook Solar project; Dan Baker and Nancy Carney from the Board of Selectmen; Jeanne Sable, Kevin Wooley, and Barbara Green from the Fitzwilliam Conservation Commission

CTO: 7:02 pm.

Minutes from March 6, 2018. 7:02 pm.
Matt Buonomano moved to accept the minutes as written, Blais seconded, Gray asked if there was any further discussion and there was none, the Board agreed unanimously to accept the minutes of March 6, 2018 as written.

Preliminary Discussion with Chinook Solar. 7:16 pm.
Silverman opened the preliminary discussion and read the description aloud. Trumbauer introduced himself as the project lead; followed by Jordan who is an environmental and wetland scientist; and Isabel who is a biologist and environmental services project manager. Trumbauer explained their company is based out of Juno, Florida and explained how they acquired the project and that their goal today is to introduce the team and begin a dialogue between the Town and the project representatives.

Trumbauer explained that they expect the proposed solar array to be finalized in 2020. Jordan then presented 1 of 2 large-scale aerial maps in reference to the proposed project. Jordan identified the proposed location on the map and its proximity to the powerlines. Jordan added that the total property for the proposed solar array is about 520 acres. Trumbauer explained that the proposed solar array would produce 30 megawatts of power. Jordan discussed that the team will be conducting further research into wetlands and vernal pools; a soil survey; a fly over to identify contours; and a boundary line survey to identify abutting parcels.

Jordan then showed the Board the second of the 2 large-scale aerial maps. The second map delineated wetland areas in proximity to the proposed solar array and proposed substation. Jordan noted that the array would be about 190 acres due to the amount of wetlands, steep

slopes, and stream buffers, in order to ensure the current proposal would avoid these features. Jordan then discussed that their team has begun dialogue with state entities, explaining that they have begun their review process with the Site Evaluation Committee (SEC) about three months ago; have met with NH Department of Environmental Services (NH DES) several times; and are in the process of reaching out to work with NH Fish & Game and the NH Division of Historical Resources (NH DHR).

Johnson explained that their goal for mapping out wetlands in proximity to the proposed project is in order to ensure that they are avoiding these wetland areas in their design proposal. Johnson then added that they are looking for feedback from state officials who may request conditions such as higher setbacks or other changes to the proposal in order to ensure the protection of key natural resources.

Jordan discussed that the proposed areas for the solar array appears scattered on their map, but this is due to their effort to avoid these wetland areas. Jordan added that the team has been working on a viewshed analysis and has also begun dialogue with the Society for the Protection of New Hampshire Forests. Trumbauer explained the viewshed analysis to the Board, discussing that it was conducted through an intercept survey where they surveyed hikers on Mount Monadnock. Jordan noted that the feedback from the survey was positive.

Trumbauer then pointed to a third, large-scale image which showed an image of a ground-mounted solar array with scattered vegetated groundcover. Silverman asked about the variety of vegetation used and Jordan responded that it is a "conservation mix" that he will seek to be pre-approved by NH DES in order to ensure there would be no invasive species planted at the proposed site. Blais asked if there would be herbicides used and Jordan responded that they do not use chemicals to remove or control any vegetation, and that there would be no chemicals used to clean the solar panels. Silverman asked about the vegetation in the picture, which appeared scattered with dirt showing through, and if that was a typical result of vegetated groundcover post-development. Trumbauer responded that it was typical for sites and that he could provide many more images for examples. Gray asked about cleaning products for solar panels and Johnson responded that they rely on rain water for cleaning. Trumbauer added that the panels are self-cleaning and that if they were to need to clean them, they would inform the Board and would ensure it be a bio-friendly solvent.

Trumbauer then discussed that their company is very proud of their ethics for environmental sustainability and habitat and wildlife protection; adding their sister company is Florida Power and Light. Sable asked how they would deal with snow on and around the solar array. Trumbauer explained that as soon as the sun shines on the panels, even if covered in snow, the snow will slide off the panels. Sable asked about the angel of the panels and Jordan and Trumbauer responded they believe the pitch is about 35 degrees. Jordan added that the solar panels in the proposed solar array would be about 4 feet off the ground.

Blais asked about how they look at topography in an area like this and how much excavation would be necessary. Jordan responded that they would likely be removing some large boulders and a few outcropping, but estimated it wouldn't be much more than that. Haynes asked if the

main excavations would be for access and/or roads, and Trumbauer responded that was correct. Blais asked about fencing around the solar array. Johnson and Jordan responded that, by state law, it would be fenced around the 15 to 16 inverter stations at the proposed solar array, and that generally chain link fence used. Wooley asked about wildlife corridors and Jordan responded that they would be trying to design fencing so as not to inhibit those wildlife corridors. Jordan added that they leave a 6 inch gap between the ground and the bottom of the fencing to allow for turtles and other small animals to pass through.

Blais asked about the life expectancy of the proposed solar array and Trumbauer responded they expect 30 to 35 years. Trumbauer clarified for Buonomano that the 190 acre estimate is the total amount of acreage needed to accommodate the proposed solar array project. Jordan added that the total acreage of just the solar array panels alone would be about 150 acres. Buonomano asked if the 30 megawatts would be the maximum capacity of the proposed solar array and Trumbauer responded it would be. Buonomano asked if there would be any onsite storage of energy and Trumbauer responded that they are not planning on it but noted, based on rapidly changing technology, it's very possible a storage site be added in the future. Kenison asked if they had a Decommission Plan and Jordan responded it was in the works but not ready for submission.

Buonomano asked about how they would mitigate a 30 megawatt surge on the system and Trumbauer responded that the energy company they work with, ISO New England, would implement resources that would ensure it's avoided. Buonomano discussed that to produce solar energy, it costs about $0.14 per kilowatt hour whereas nuclear energy costs about $0.02 per kilowatt hour; questioning the Chinook Solar reps if they were aware of those cost differences. Buonomano then discussed an existing solar energy system in Vermont that has been and still is completely buried under snow. Buonomano questioned the Chinook Solar representatives if their proposed solar project is being built just for the tax credits. Trumbauer responded to Buonomano by saying that he believes in developing various sources of sustainable energy rather than relying on one sole source and that he morally "believes in being good stewards to the land." Buonomano lastly noted for the Chinook Solar representatives that he was not convinced nor did he recognize any positive benefits from deforesting and developing more than 500 acres of land, in a Town where forest-related activities are historically and culturally significant, for a renewable energy source that is more expensive than any other renewable.

Gray asked if they own or lease their property and Trumbauer responded that they have a long-term lease on the property and that if the owners were to pass on, they can sell the property and its fully transferable lease. Baker discussed that the past solar company who had come in for a discussion had mentioned they wanted to develop a 20 megawatt system instead of 50 megawatts, and that they wanted to tie it into 3-phase power. Baker then explained that he was mentioning this because the Town currently does not have 3-phase and that if it was economically viable for Chinook Solar to build it along Route 12, it would benefit the Town of Fitzwilliam. Trumbauer responded that they are looking into 3 different locations for interconnection and that they want to ensure it's a robust enough system to handle the load.

Silverman asked if they were planning on wiring the solar array underground and Jordan responded it will be underground, unless they run into rocks, and are proposing a new substation to wire it in to. Silverman noted that if they build a substation, they need to ensure it be silent. Trumbauer responded that their team is aware of the Town's concern on the issue of noise pollution and that they plan on ensuring the noise be completely internal to the site. Silverman asked about the wetland setbacks and Jordan explained their proposed development maintains a 50 foot buffer, however there are several crossings which encroach on the 50 feet. Silverman responded that the Town setback for all wetlands is 75 feet and more for prime wetlands.

Gray discussed that she hopes that the Chinook Solar representatives make the effort to keep the Planning Board involved throughout the process, adding that she still has numerous concerns, such as impacts to viewsheds, not just from Mount Monadnock but also from the roadways and other viewpoints.

Trumbauer explained that they are looking to hold an open house on April 19, 2018 to explain to the community what the proposed plans are and offer community outreach. Trumbauer added that they would be looking into sending mailers and researching ways of advertising. Gray noted that the only mailing that every household receives is the Town newsletter, and that they are just past the due date for submitting information for the April newsletter. Trumbauer responded that he would be able to push back the open house to May in order to accommodate a notice in the next newsletter.

Tourigny asked if they had an estimate for the amount of yards of earth to be removed from the site. Jordan responded he was unsure of the quantity but that they, as of their current proposal, expect that any excavated earth would not leave the site. Tourigny asked where the point of access was for the proposed project and Jordan noted that it is located off of Fullam Hill Road, describing it as a dirt access road. Carney explained it's a driveway for a trailer and it continues past the trailer for logging access.

Blais asked if they had any information from the NH DHR and Jordan responded that they have discussed some things but, in sum, they seemed supportive of their proposed plans. Tourigny asked what they thought was the net benefit to the Town and Trumbauer responded that upon negotiating a pilot, there would be an immediate benefit from taxation. Trumbauer additionally noted that they once they put roots down in a community, they like to give back in various ways such as infusions of money for local organizations that may need it.

The Chinook Solar Project representatives thanked the Board for their time and input, and left the meeting at 8:12 pm. The Board continued to discuss the proposed solar project.

Gray voiced her concern about making sure there is proper input from the community and reiterated that she would appreciate it if the representatives made the effort to come back. Silverman noted that they should ensure that the SEC is aware of the Town's ordinances in place, particularly those that would come in to play for this proposed project.

Tourigny asked Baker what he recalled from the previous solar meeting held a long while back, and Baker noted that they had mentioned if they are beneath 30 megawatts then they have less regulations to adhere to from the state. Buonomano discussed that he expects they very likely would need to have some type of storage, explaining how such batteries may use a substance called molten salt that is harmful to the environment.

Silverman mentioned that they may be able to reduce externalities and improve the siting of the proposed project by nominating Scott Brook to be named a Prime Wetland because it would increase their setback requirement. Gray noted she is concerned about negative impacts to valuable aesthetic features in Town. Wooley mentioned that if the site is already logged, which it seems so, then the vernal pools would be damaged or gone by spring. Sable noted she was concerned when Jordan mentioned they would be burying power lines and wiring unless they ran into rocks.

Buonomano discussed truck traffic on Fullam Hill Road and Carney noted that the board could require the company to supply a bond. Carney added that Damon Lumber has been in charge of clearing out space on that property for the proposed solar array. Buonomano discussed that a thin layer of dust can reduce the efficiency of a solar panel by 80-90%, based on his research, and discussed how pollen may be an issue.

Gray asked about the tax revenue from the pilot asked for clarification about what that was. Silverman explained that anything that comes from the pilot would be added to the total value of the town. Carney added that the county looks at the total amount received as income to the town and that they would take their percentage off the whole revenue, however the schools would not. Tourigny discussed the tax incentive and Baker explained that the pilot, to his understanding, is in lieu of taxes. Tourigny asked if it's possible to negotiate a different type of compensation and Baker and Carney responded likely not.

Joint Meeting with Board of Selectmen. 8:52 pm.

The Board of Selectmen submitted 2 letters to the Land Use Department on the morning of Tuesday, March 20, 2018. One was in regards to concerns about the Planning Board's discussion on Scenic Roads and the other noted several errors/concerns in the new Subdivision and Boundary Line Adjustment application forms. The attendance of all members from the Board of Selectmen was not expected for this meeting, however both Boards took advantage of the timing to discuss the concerns outlined in the letters.

The Planning Board addressed the Selectmen's concerns about Scenic Roads and explained how there would be no limitation on the Road Agent nor landowners. Baker noted that there was concern about how it noted trees of 6 inches in circumference or larger needing permission. Gray clarified that it said 6 inches in diameter and that the State defined it as trees 15 inches in circumference or larger. (6 inches in diameter equates to just over 18 inches in circumference.)

The Land Use Assistant clarified that since receiving the letters that morning, the errors in the dimensional regulations section had been rectified. Kenison asked why it would be necessary to

require a percolation test site for a Boundary Line Adjustment. After discussion, the provision for the percolation test site under the Boundary Line Adjustment would be moved from "Submission Items Required" and be listed beneath "The following items may be required, as determined by the Planning Board at the Preliminary Hearing," thereby clarifying it would not be a required item but would allow the Planning Board to ask for it if they found it may be necessary in an extenuating circumstance.

Baker and Carney thanked the Planning Board for their clarifications and left the meeting at 9:04 pm.

The Planning Board continued to discuss other issues, focusing mainly on Town perceptions of the Planning Board and how they may improve those negative perceptions. Gray suggested looking into some sort of community outreach or open house that may help improve relations and encourage community attendance and/or volunteering on Boards. The Board continued discussing these perceptions.

Silverman moved for the meeting to adjourn, Blais seconded, and the meeting adjourned at 9:41 pm.