Mason Energy Commission January 4, 2021

Present for this virtual meeting: Members: Dave Morrison, Kathy Chapman, Michele Siegmann, and Liz Fletcher; alternate members: Curt Spacht, Garth Fletcher, Mike McGuire, Richard Stockdale; guest: Steve Wells. Meeting started at 7:05 PM.

Agenda:

Approval of November 2020 minutes. Motion by Liz Fletcher, 2nd by Dave Morrison, and approved by roll call.

Solar on highway barn – project review. Mike McGuire's tabulations and comments, sent to members in advance of the meeting, are below with comments made during meeting in italics and blue.

Contents:

1. Highway barn info

2. Shelburne timeline

3. Solar analysis

4. Other considerations

5. Net metering 101

I. Highway barn specs

Mason Town garage electricity usage 2019 – 10,569 kwh = $2,700. / year (2019)

Roof as reported 23 feet on East edge. 18 feet on West side edge. Run = 60 feet

Roof is relatively flat – 23-18 = 5 feet rise, 60 foot run = inv tan (5/60) = 0.08333 = 4.8 degrees

Dave brought up the importance of being able to assure BOS that the roof is strong enough to hold up the panels.

II. Shelburne process

Regularly. let BOS know that MEC is researching the project to put solar panels on the highway building, then check in with the BOS at each step (Dave or Darrell discussed w/ BOS @ election 11/3)

Curt emphasized that Shelburne engaged BOS continually – important to explain the big picture that monthly bills would remain the same during the period of paying off the loan, then potentially 'free' electricity after that.

1. collect data, run internal analysis, investigate why 20 amps is a trigger point for Eversource (this memo includes the internal analysis, and some demand discussion)

2. collect bids from vendors (Mike suggests getting quotes for a 13kWdc roof mount, behind the meter, system)

3. run financial analysis (use Shelburne's model?)

MEC intends to send an email to BOS after we ask Michael Prange of Shelburne to run our numbers – Mike will reach out to him.

4. warrant article/town meeting

5. RFP

Mike: Make sure RFP people have experience in evaluating municipalities, because of Demand Charge.

6. find lender

At step 2 now?

III. Highway barn solar analysis

There are 2 factors applied to enlarge the system:

1. Sun isolation in the gulch of depot road. Mike estimates 85%, which although a 'hip shot', thinks is close. (so a +15% adder is applied)
2. Future expansion and net metering losses, for loads that need to be fed when the sun is not shining. (another +15% guestimate)

Dave: How much roof space would the initial installation use?

Mike: 520 sq ft, so there is room for more panels later.

Assuming 85% solar insolation 10,569kwh + 15% = 12,434W kwh

+ 15% over production = 14,300 kwh

A 13kW DC system at 4.8 degrees, 270 degrees azimuth = 14,275 kwh/year

(google 'PV watts' – an online calculator provided by the National Renewable Energy Laboratory NREL)

The Sun eye camera noted 80 and 85 % from both southern corners about 5 feet above ground level.

This isn't very good, but 'good enough' since the roof is higher up off the ground and we would be justified in adding 5% to this number which brings it right in at a conservative 85% insolation value, that is exactly what was used for the modeling previously performed.

Gross cost of 13kW system = $3/W ~= $39,000. (recent industry data point, not shopped for)

22% federal tax incentive 2020 = $8,580 – need an organization to take advantage of the incentive tax credit

We need more information about how a town qualifies for this. We should check what Shelburne did here.

Balance $39,000. - $8,580 = $30,420. / $2,700(/year) = 11 years 3 months to break even

Or without consideration of taking advantage of the ITC 22%, the whole $39k.

We have to pay a fee for transmission component of net metering (see below for a detailed explanation of net metering).

The relevant documents are:

RSA 362-A:9 Net Energy Metering - the NH law establishing net metering
http://www.gencourt.state.nh.us/rsa/html/XXXIV/362-A/362-A-9.htm

PUC (Public Utility Commssion) Rule 900 which implements RSA 362-A:9
https://www.puc.nh.gov/Regulatory/Rules/PUC900.pdf

Eversource - information about net metering:

https://www.eversource.com/content/nh/about/about-us/doing-business-with-us/builders-contractors/

interconnections/new-hampshire-net-metering

Eversource - two example bills:

https://www.eversource.com/content/docs/default-source/nh---pdfs/purchase-greater-than-sales.pdf

https://www.eversource.com/content/docs/default-source/nh---pdfs/sales-greater-than-purchase.pdf

-- suggestions

1. Subtract off the net metering line items and divide into the 60% of the total towns bills instead of 17% of just electric bills.

2. Show the $.15/kWHr considering the 30% inverter loss.

IV. Other considerations

A. There could be another option incorporating the town's transportation costs. Instead of net metering, a battery bank could be set up with a hybrid vehicle. The issue of utility losses would be side-stepped, and a spreadsheet showing the cost benefit of 60% of the town energy cost instead of 20% might seem more alluring to not only the board, but the voters as well. A total ROI would also be years less.

Tesla PowerWall 2

13.5 kWh capacity

10 year warranty (to 70% capacity): allows daily cycling

cost: $6,500 basic battery

$7,600 including associated hardware but not installation so, with 10 years of full daily cycling = 3650 cycles = 49,275 kWh

$6,500 / 49,275 kWh = $0.13 per kWh cost of storage

$7,600 / 49,275 kWh = $0.15 per kWh cost of storage

This is more than the $0.07/kWh Eversource raw energy cost, and uncomfortably close to the $0.16/kWh all in cost from Eversource.

Mike recommended forgetting the implementation of a battery and EV station for now. He believes it is too soon to use batteries.

Note that the above are storage costs only. The cost of generating the electricity has to be added in, e.g., the amortized cost of the solar array per kWh generated.

All batteries have limited cycle lives, so the cost of replacement has to be included in any comparisons.

Tesla's PowerWall 2 purchase price comes in at $481-563/kWh; simple batteries (KiloVault, SimpliPhi) come in closer to $650 and up, just for the basic battery. So Tesla is really the low cost leader.

B. Demand response (Mike thinks we can address this issue separately)

It is certain there is a demand charge as only residences are exempt.

Curt: We need to check with Darrell Scott to know what our actual Demand Charge is.

The charge is $18 per kW over the first 5 kW from Eversource's Aug 2020 tariff [1] :

"The kW charge, or "demand" charge, applies to non-residential rates"

"Rate G, General Service For customers whose demand does not exceed 100

kilowatts (kW).

Distribution Demand Charge (per kW of demand above 5 kW): $9.49

Transmission Demand Charge (per kW of demand above 5 kW): $7.77

Stranded Cost Recovery Demand Charge (per kW of demand above 5 kW): $0.69"

Which adds up to $9.49 + $7.77 + $0.69 = $17.95 PER kW ABOVE 5 kW

There is also a

"Rate GV, Commercial and Industrial Commercial or industrial customers with demands not exceeding 1,000 kW.

Customers must pay for necessary transforming, regulating and controlling apparatus.

Distribution Demand Charges First 100 (per kW): $6.07

Distribution Energy Charges First 200,000 (per kWh): 0.660

Transmission Demand Charge (per kW): $10.40

Stranded Cost Recovery Demand Charge (per kW): $0.65 "

which adds up to $6.07 + 0.660 + $10.40 + $0.65 = $17.78 /KW but appears to apply to ALL kW, not just those above 5 kW.

The charges are based on momentary peak demand during the month.

Per Eversource "The kW charge, or "demand" charge, is based on the greatest amount of electricity used in any half-hour period during a billing period."

So, for instance, if you use 1 kW block heaters on 10 trucks, just by themselves they would use 10 kW which means 5 kW above the 5 kW allowed,

so 5 x $17.95 = $89.75 added onto that month's bill under Rate G (much more under Rate GV Commercial & Industrial).

These demand charges do not have anything to do with how long you use that level of power, just whatever peak that for any 1/2 hour or longer period you were drawing.

Solar will make the 'peak issue' less of an issue since highway dept use and solar activity are mostly during the afternoon when there is peak sun.

Which makes it very desirable to somehow reduce that peak.

To reduce peak: Much cheaper to alternate the block heaters in 2 groups - that will take longer to warm up the engines but will halve the peak demand.

Or possibly run them for 29 minutes with 1-minute gaps between - though that may depend on exactly how they measure the 1/2-hour period. Mike mentioned that the new "smart meters" can time in 15 second intervals)...

Also make sure to turn heaters off before using an electric welder (a Miller 210 can draw 6 kW) or other high loads.

Behind the Meter: In commercial/industrial settings there is increasing use of "behind the meter" battery systems, often without solar systems, whose main purpose is to "shave peaks". They store energy during low-cost times and use it to generate electricity as needed to offset peak demands. These inverters can be set to limit the amount drawn from the grid if they still have some stored energy available. I think you can set them to charge their battery if demand is below X and to discharge when the demand tries to exceed that level.

C. Average sunlight value over the town vs. just the highway barn might be needed for Shelburne model

V. Net metering 101

A net metering solar PV system feeds its electricity into your house's electrical system. Any energy used in the house decreases the amount "bought" from the grid; any excess is exported ("sold") to the grid.

A special meter is installed (free by Eversource) which measures two separate values: energy from grid into the home ("bought") and energy from the home to the grid ("sold").

Think of it as being at any moment in one of these 3 conditions:

1) at night: no solar, all your electricity is "bought" from the grid

2) during sunlight hours:

    2a) more solar than you are using: the excess is "sold" to grid.

    2b) less solar than you are using: the deficit is "bought" from grid.

At the end of each monthly billing cycle the amount of energy you've "sold" to the grid is subtracted from the amount you purchased. If the left-over is positive you are billed for that amount; if it is negative, then you are credited for that excess sold above the amount bought. Any credits are applied against the next monthly bill. If credits remain at the end of the billing year you are sent a check.

Of course you pay more for the energy you buy from the grid than you are paid for the energy you sell back to the grid. According to Dan Weeks of ReVision Energy, in 2020 the split in NH was about $0.17/kWh to buy versus $0.11/kWh to sell.

Here is how Eversource charges are calculated, at present (11/2020), for the standard Residential Rate R (in ¢/kWh):

Charges which apply to the total kWh you've bought.

0.982 ¢/kWh Stranded Costs

0.743 ¢/kWh Network Benefits

0.055 ¢/kWh Consumption tax

1.780 ¢/kWh TOTAL for all bought (imported)

Charges which apply to the net kWh (bought-sold), 0 minimum.

7.068 ¢/kWh Energy (default source)

3.011 ¢/kWh Transmission

4.508 ¢/kWh Distribution

14.587 ¢/kWh TOTAL for net import (bought-sold, 0 minimum)

Credits which apply to the surplus you've "sold" (sold-bought, 0 minimum)

7.068 ¢/kWh Energy

3.011 ¢/kWh Transmission

1.237 ¢/kWh Distribution, 25%

11.206 ¢/kWh TOTAL credits for surplus exported (sold-bought, 0 minimum)

Fixed monthly charge

$13.81

So your total bill adds up to

$ 13.81

+ ¢ 1.780 X TOTAL bought kWh

+ ¢ 14.587 X NET kWh (bought-sold) no less than 0

- ¢ 11.206 X SURPLUS (sold-bought) no less than 0

Remember that any generated energy you use while it is being generated is "off books" - it doesn't show up as either bought or sold. It simply was not imported and was not available for export. It directly reduces your bill by (1.780 + 14.587) = ¢ 16.367 per kWh, the best deal of all.

That being said, most consumption occurs during the morning and evening peak hours while peak generation occurs during mid-day, so there is relatively little overlap.

The following examples assume NO overlap - the least profitable case - by counting all kWh consumed as "bought" power, and all kWh generated as "sold" power. Sometimes described as a "no self-use" case.

Example 1: using 600 kWh, NO SOLAR, net 600, no surplus

$ 13.81

+ ¢ 1.780 X 600 = ¢1068 = $10.68 total bought kWh

+ ¢ 14.587 X 600 = ¢8752 = $87.52 net kWh (bought-sold) no less than 0

$112.01 Total bill, averaging to ¢ 18.67/kWh

Example 2: using 600 kWh, generating 400 kWh, net 200, no surplus

$ 13.81

+ ¢ 1.780 X 600 = ¢1068 = $10.68 total bought kWh

+ ¢ 14.587 X 200 = ¢2917 = $29.17 net kWh (bought-sold) no less than 0

- ¢ 11.206 X 000 = ¢0000 = $ 0.00 surplus (sold-bought) no less than 0

$ 53.66 Total bill, averaging to ¢ 8.94/kWh

Example 3: using 600 kWh, generating 600 kWh, net 0, no surplus

$ 13.81

+ ¢ 1.780 X 600 = ¢1068 = $10.68 total bought kWh

+ ¢ 14.587 X 000 = ¢0000 = $ 0.00 net kWh (bought-sold) no less than 0

- ¢ 11.206 X 000 = ¢0000 = $ 0.00 surplus (sold-bought) no less than 0

$ 24.49 Total bill, averaging to ¢ 4.08/kWh

Example 4: using 600 kWh, generating 800 kWh, net 0, 200 surpluses

$ 13.81

+ ¢ 1.780 X 600 = ¢1068 = $10.68 total bought kWh

+ ¢ 14.587 X 000 = ¢0000 = $ 0.00 net kWh (bought-sold) no less than 0

- ¢ 11.206 X 200 = ¢2241 = $24.41 surplus (sold-bought) no less than 0

$ 0.08 Total bill, averaging to ¢ 0.01/kWh.

Example 5: using 600 kWh, generating 1000 kWh, net 0, 400 surpluses

$ 13.81

+ ¢ 1.780 X 600 = ¢1068 = $10.68 total bought kWh

+ ¢ 14.587 X 000 = ¢0000 = $ 0.00 net kWh (bought-sold) no less than 0

- ¢ 11.206 X 400 = ¢4482 = $44.82 surplus (sold-bought) no less than 0

$ 20.33 CREDIT, averaging to CREDIT of ¢ 3.34/kWh used

Which raises an interesting optimization problem. Ignoring, for now, the $13.81 fixed fee, the rest of the bill is zeroed out when

Costs = Credits, which is to say when

1.78 x Used = 11.206 x (Generated - Used)

1.78 Used = 11.206 Generated - 11.206 Used

1.78 Used + 11.206 Used = 11.206 Generated

12.986 Used = 11.206 Generated

which results in zeroed out variable parts of the bill when

Generated = 12.986 Used/11.206 = 1.16 Used,

i.e., generate 16% more than you use.

To also zero out the $13.81 fixed fee we simply need to generate an extra $13.81 worth of surplus which itself is worth $ 0.11206/kWh So $13.81/0.11206 = 123 kWh.

So, a zero bill occurs when you generate 1.16 x used + 123 kWh.

For the 600 kWh examples above this works out to

1.16 x 600 + 123 = 819 kWh or 136% of used, as seen in Example 4.

*Most importantly, the highway barn solar discussion should be about saving **everyone** money. Garth will try to help with this goal by tabulating the lighting bill at the end of 2021 to determine the savings.*

Liz Replacement

Richard Stockdale was asked by the committee if he would consider becoming a member of the Mason Energy Commission. Richard said he would think about let us know his decision soon.

Building Inspector Recommendations Status

Liz put together a concise document of recommendations and emailed it to the building inspector, as well as to MEC members. He has not responded to her emails yet.

Website Walkthrough   masonnhenergy.org

Curt shared his screen and showed us the layout of the website. No one has subscribed to the website, besides the MEC members. There was some discussion about the pros and cons of including a blog on the website. The consensus was that having miscellaneous energy articles in the 'other' section was sufficient – no need to add a blog.

There is a photo of Mark Arsenault's solar installation with HAREI members. It was pointed out that his panels are split cell panels – they can absorb light partially.

Visual Tour Update

The completed alternative energy visual tours are posted on the masonnhenergy.org website. Kathy shared that Darrell Scott is currently working on the geothermal video but is having trouble with the audio on PowerPoint. Darrell will work on a passive solar video next. He is planning on making the link available on his Facebook page, directing people to the masonnhenergy website.

Other Items

The topic of community solar came up. Mike explained that three phase power is necessary for such an endeavor. There is three phase power on Route 31 in Mason.

Mike asked if there exists a list of towns that pay dues to NH Clean Energy – an easy way of communicating with like-minded towns nearby. We have not found one on NH Clean Energy’s website.

The meeting was adjourned at 9:05 PM. Michele made the motion and Liz seconded it. A role call was taken to vote on ending the meeting – all voted in favor.