Special Town Meeting 2024

Frequently Asked Questions on the Battery Storage Project

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Project

What is being proposed?

The request before the Town at the Special Town Meeting is for borrowing authorization for a $10.4 million dollar battery, battery control system, and associated ancillary costs to be installed within the Town of Concord. The borrowing will be done by the Light Plant with the interest and principal to be paid for by the electricity ratepayers.

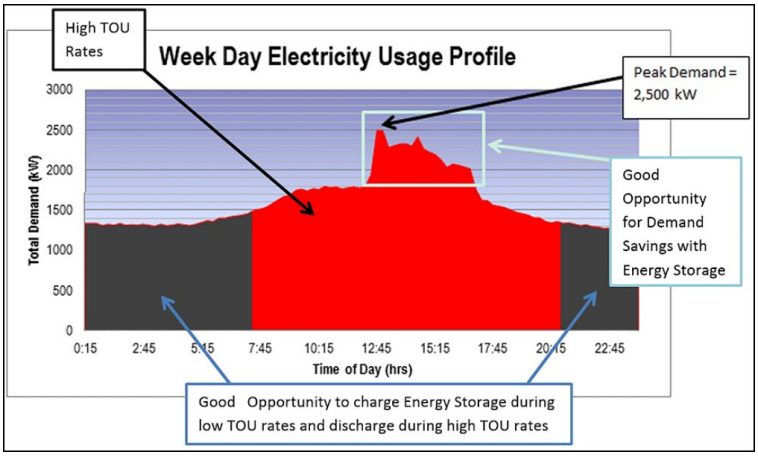
What will the battery be used for?

The battery will have three purposes, in this order:

- To absorb the solar saturation[1] during the shoulder months (March/April and September/October) when demand is relatively low and solar production is very high.
- To allow Concord to continue to develop in-town solar installations.
- To be used to reduce Concord's total demand when there is an anticipated peak load for ISO New England. (This is known as peak shaving.)

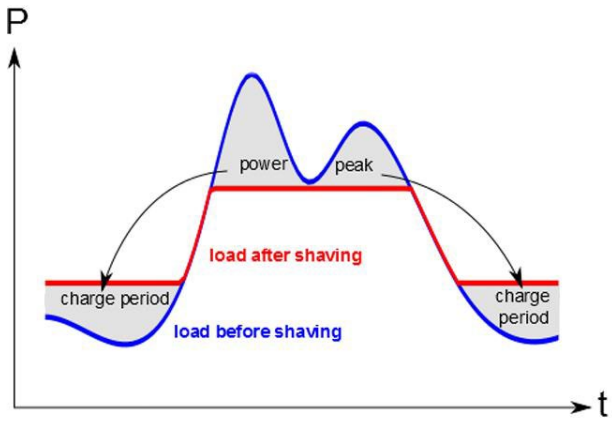
What is peak shaving?

Peak shaving is the process of lowering demand (either by turning off or down things that use electricity or by dispatching power from a battery) when the grid in New England is experiencing heavy usage (a peak). CMLP's grid bills are determined by how much electricity our system uses during each of the 12 monthly peaks and also during the single highest usage hour of the year. By shaving our usage during the peaks, CMLP can reduce costs significantly.



Source: NREL (link)

[1] Solar saturation is the presence of an excess of electricity produced by photovoltaic solar arrays relative to the load or demand on the grid at the time.



Source: Batteryblokk

How was the size of the battery determined?

The battery needs to be large enough to achieve the three purposes above (address solar saturation, allow future solar development, reduce our peaks).

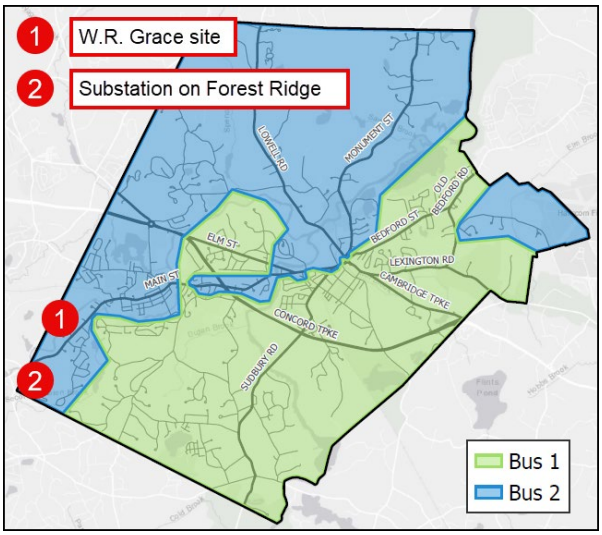
A battery has two dimensions. The first is the maximum amount the battery can charge or discharge at any given time (megawatts or MW.) The second is the length of time over which the MW can be stored (megawatt hours or MWh).

The more megawatts in the battery, the greater the peak savings. The more megawatt hours, the more hours of solar CMLP can absorb and the easier it is to hit the peaks – especially going forward as others attempt to do the same thing, thereby pushing the peak to unusual times per year.

For context, a 1 megawatt hour (MWh) can power 1 home for about 1.2 months or 750 homes for an hour.

Where will the battery be installed?

The wording of the article allows for flexibility of placement, but CMLP is closely exploring either the W.R. Grace solar site or the Forest Ridge substation.



What is the former W.R. Grace site?

The W.R. Grace site refers to a superfund site on the border with Acton. The Town of Concord took ownership of the land in 2016 and later, through a power purchasing agreement, developed 5.4 megawatts of solar (DC).

Learn more on the EPA's website here.

Who will do the engineering work required to install the battery?

This would be a combination of internal resources and third-party contractors. This will be the second battery that CMLP is installing (after the one located at the new middle school).

Who will setup and install the battery?

A third party contracted through a bid process will be selected to provide the battery and install it.

Who will determine when to charge and discharge the battery?

At least initially we will be using a company to make manual adjustments to the schedule we program in the battery controller. Once CMLP has completed its roll out of SCADA, some of the real-time data from load profiles and advanced meter data will shape the charging and discharging of the battery. Agreements to control batteries often come with guarantees that ensure you hit the peak a certain percentage of the time.

There are several companies that exist to manage battery dispatching. Final selection depends on cost thresholds and procurement rules, so we don't know who that will be yet.

Energy New England, of which CMLP has owner equity, provides Distributed Energy Resource Management. You can learn more about these services here.

Why does this have to happen at a special town meeting now?

The state's sudden announcement of the closure of MCI-Concord expedites a trend that was underway for a while. If we do not start the process of battery procurement now, we will be at risk of having equipment fail or of blackouts once the MCI-Concord load goes away.

Why was this such a surprise?

The closure of MCI-Concord was a surprise, but the trend of increasing solar saturation has been known for a number of years. Concord's Climate Action Plan, written in 2017, targeted 60MW of solar by 2030. CMLP has been making plans to add battery storage since 2018.

Impact

How much solar development will this battery allow in the future?

If a battery size of 5MW/15MWh is installed, it will allow for about 3-4MW of additional regular rooftop solar to be added in Concord. Larger installations of solar may require additional batteries or curtailment strategies so we don't end up in this place again in the future.

What is the impact on the electrical distribution system if this article passes?

If this borrowing is authorized and the battery built, it will ensure that solar production does not exceed demand and cause distribution problems. See the next question for specific results if solar production exceeds demand.

What is the impact if it doesn't pass?

If it doesn't pass, then we may get to points in time in the near future when solar production exceeds our demand. This will cause power protection devices to cut power to businesses and homes that share that transformer. It also means we cannot continue to allow people to install additional solar.

Are there any environmental impacts of this project?

The batteries would be installed at either an industrial substation or a former superfund site currently housing a 5.4MW DC/4.5MW AC solar array. Some site work, like a concrete pad, would be required. There are no other current expected uses for this site.

What would a yes vote mean?

A yes vote would authorize CMLP to borrow up to $10.4 million dollars. In this case, CMLP would move forward with analysis of the full range of options, including a third-party financed system, and make recommendations to the Light Board at open sessions during public meetings. Authorizing the borrowing will not equal an automatic purchase of a battery of this size and cost. Even if CMLP purchases a battery, it could be cheaper after going through a competitive bidding process.

What would a no vote mean?

A no vote would not authorize CMLP to borrow $10.4 million dollars.

Does the battery improve our resilience in the event of an emergency or natural disaster?

Depending on the size, batteries would be able to provide power in the event of a grid failure. But this single battery would likely not be enough to provide enough load for an entire transformer (bus), so the real answer is not yet, but if enough batteries were installed (like the 60MW proposed in the Climate Action Plan), and they were deployed and configured to allow this, then yes, for a period of time.

Technology

What are the pros and cons of a bigger or smaller battery?

A larger battery costs more up front, but allows more solar to be developed in town without compromising the distribution system and generates more cash flow from peak savings. Economies of scale make larger batteries more cost effective on a dollar per installed megawatt basis

A smaller battery is a lower upfront cost option, but it won't allow as much solar to be developed in town and creates lower future cash flows. Investing in several smaller batteries over time rather than one technology all at once would allow CMLP to take advantage of future technology improvements in battery storage.

What is the battery technology going to be used?

The technology will depend on the vendor selected. Due to price, availability and space, the technology is likely lithium (LFP or NMC).

What is the expected life of the battery?

Batteries typically have a guaranteed number of charge/discharge cycles before they drop below a threshold of capacity (usually 80%). Manufacturers of grid-scale batteries will guarantee a capacity for any number of years you choose and will replace individual modules to get that capacity. Manufacturers will guarantee any capacity for any duration but obviously will charge more for a longer duration. The expected guaranteed lifetime is 15-20 years.

What happens after 20 years?

The procurement contract will have provisions for the proper recycling of expired cells and modules.

Are batteries a new technology? Is there a chance that this won't work?

The first grid-scale battery was a 5MW/1.25MWh system installed in 2012 (in Oregon).

In Massachusetts, Sterling Municipal Light Department installed their first battery in 2016. You can learn more about their project here.

The manufacturer of the battery and the vendor who sells it to us will guarantee it will work.

Who will manufacture the battery?

Because we will need to go through a bid process, we cannot know the manufacturer until we have issued an RFP and selected a bidder based on the criteria specified in the RFP.

If there is a problem with the battery, who will fix it?

The vendor who sells the battery will warranty it and guarantee a level of uptime. They will monitor the condition and operation of the battery system and proactively address any detected issues.

How do we make sure that the battery does not have any adverse impacts on the distribution system?

The battery will be carefully managed and monitored by third parties. Any unusual activity will be monitored 24x7x365.

How will the battery be kept safe?

The location, whether it is at the former W.R. Grace site or the Substation on Forest Ridge Road, will be secured from the general public. All facilities will be secured and locked to prevent entry.

Will the battery be a fire hazard?

Lithium phosphate batteries are remarkably stable and safe. In fact, the rate of electric car fires is 25.1 per 100,000 cars sold, whereas the rate of internal combustion engines is 1,529.9 per 100,000 cars sold (source). What is true, however, is that if a lithium phosphate battery catches on fire, it is very difficult to extinguish.

Any battery modules will be kept in secure containers and have adequate cooling and fire suppressions systems to prevent thermal runaway and limit any issues to a small number of cells or modules.

The Fire Department will be involved in the planning process to make sure that we follow the latest recommendations from the State Fire Marshal as well as the National Fire Protection Associations guidelines, which are summarized here.

Are batteries environmentally friendly? Are there Rare Earth Elements inside these batteries?

The battery chemistry will be chosen in the bid selection process. There is a good chance that it will be a lithium iron phosphate battery, which does not contain nickel, manganese, or cobalt, which, while not technically Rare Earth Elements, are still rare and mined in problematic ways.

How long does the inverter last?

The inverter is expected to last 10 years. The cost of a replacement inverter is included in the model (see below).

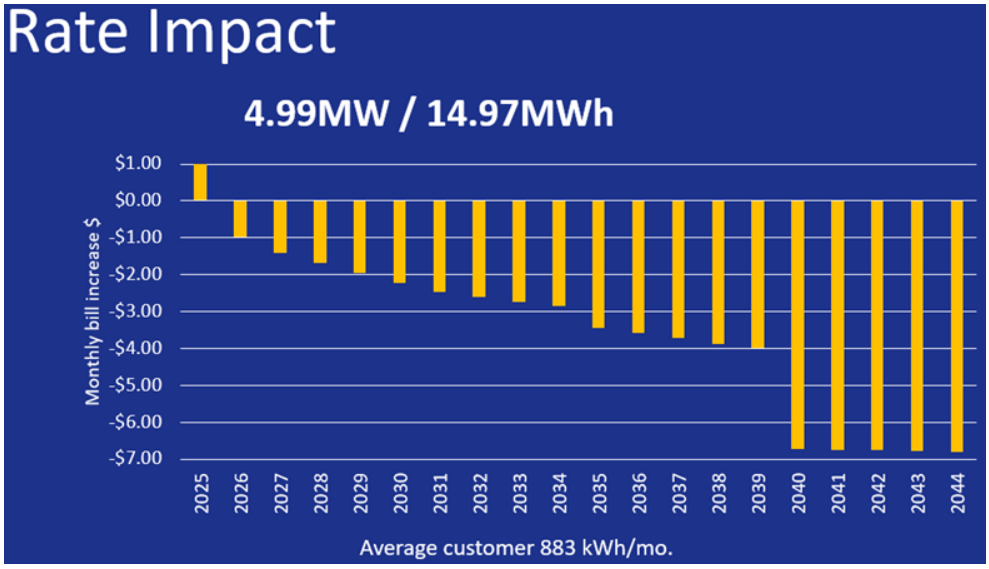
Finance

If this passes, how much will it cost taxpayers?

Nothing. This is financed by electric ratepayers, not taxpayers.

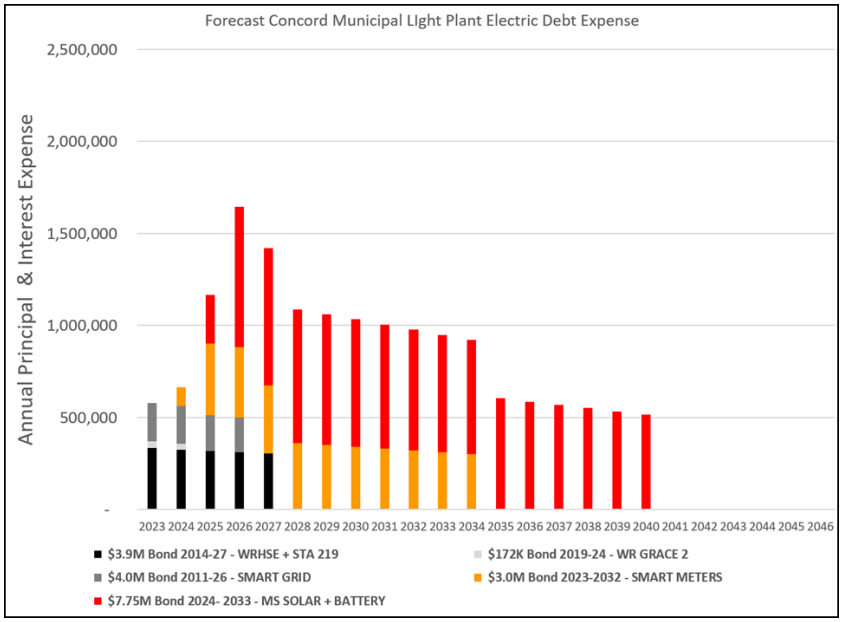
If this passes, how much will it cost ratepayers?

With a 4% interest rate and a 20-year project, it is expected to **save** the average homeowner $841.08 (this assumes a median usage of 883kWh/month). Below is the expected *monthly* bill impact of this project.



If this passes, how much total debt will we have?

We currently have $3M of debt authorized for the Advanced Metering project plus $7.5M for the Middle School solar and battery project. There are two other small projects listed below. The total authorized debt if this passes would be $21.4 million. The annual principal and interest payments look like this:



Are there economic benefits to installing a battery?

Yes! See the rate impact summary above. It will also allow for further solar expansion which helps the environment and supports the clean energy sector.

Are we getting an Inflation Reduction Act (IRA) credit when we buy this?

Yes. The Light Plant will be eligible for a 25.5% credit under the rules of the Inflation Reduction Act. This equals about $2.6 million. The battery project itself would cost $10.4 million, and this credit would be received after 1 year and be used to pay down the principal. In the end, the project just needs to pay back $7.8 million of principal.

The Town will hire a consultant specializing in Elective Pay to ensure we maximize the credit received.

Are we borrowing $10.4 million?

If we do an outright purchase (as opposed to a model where a third-party finances the project), the amount we borrow depends on the size and cost of the battery. If the battery project costs total $10.4 million, we would issue a BAN (Bond Anticipation Note) for the full amount, and then once we receive the $2.6 million Inflation Reduction Act credit, we will finance the remainder (hopefully when interest rates have fallen further). This would be approximately $7.8 million financed.

Will the purchase of this battery require us to hire additional staff at CMLP?

No. No additional staff will be required since the battery will be constructed and managed by a third party.

Will this change the amount of the PILOT paid from the Light Plant to the Town?

The current PILOT is calculated based on a formula created by the CFO and Light Plant Director with approval from the Town Manager, and it is based on the audited financials kWh of electricity sold within a year, so the purchase of this battery would not impact the PILOT under today's formula.

What was the methodology used to calculate the economic impact of the battery?

For the battery proposal for Special Town Meeting, CMLP prepared a 20-year financial forecast that subtracts debt-related and operating-related costs from the battery's expected revenue by year. Below is a list of assumptions used in the forecast.

Battery Energy Storage System		
Power (Apparent DC)	4.99	MVA
Energy (BoL DC)	14.97	MWh
Power factor	1	
One-way efficiency	97%	%
Average auxiliary load at stand-by	0.004	MW
Auxiliary loads peak power	0.036	MW
Power (Active at POC)	4.8363	MW
Discharge duration	2.997597	h
Energy Discharge (active at POC)	14.49728	MWh
Cycles per year	365	
EPC work by	CMLP	
Capital Cost	$603.36	$/kWh

Energy		
Energy price	60	$/MWh
Energy price annual escalator	1.5%	%
Financial		
Sales tax	0	%
Borrowing interest rate	4%	%
Inflation Reduction Act	25.5%	yes
WACC	12%	
Forecast Accuracy		
RNS & LNS accuracy	83%	%
ICAP accuracy	90%	%
Capacity reserve margin	30%	%

Capital Cost and Debt Service Expense

In addition to the conservative $603/kWh cost for the battery energy storage system itself ($9MM,) the following additional upfront, capitalizable costs have been assumed: Engineering $200k, Shipping & Duties $375k, and Installation & Balance of Plant $750k. In year one, CMLP borrows the full $10.3MM at 4%. First year principal expense is $690k ($10.3/15) and first year debt expense is $415k ($10.3*4%) In year two CMLP receives a payment from the IRA elective pay program of $2.64MM. The credit is used to reduce the principal owed to $7MM ($10.3MM minus $690k first year principal payment minus $2.64MM.) In years two through 15, the annual principal expense is $468k. The interest expense in year two is $281k – declining each year as the loan balance diminishes.

Operations and Maintenance Expense

The model assumes the battery will be dispatched once daily. Energy losses assuming $60/MWh values power are about $20k per year, escalating at 1.5%. First year managed services expense is assumed to be $30k. First year insurance expense is assumed to be $40k. Each escalates at 2.5% per year. We expect to replace the inverter in year 10 when it will cost ~$830k. Each year money is set aside, earning 2.5% interest such that the full $830k is available in year 10 to pay for the inverter. Annual opex starts at $150k in year one and grows to $200k in year 10. After year 10, opex drops to $115k in year 11 because money is no longer set aside for a future inverter replacement.

The total capital and O&M cost is $1.25MM in year one, falling to $0.9 in year two and subsequently thereafter to $0.6 in year 15. In years 16 through 20 the cost is merely O&M as the loan expense has been fully paid.

Battery Revenue

The lion's share of the battery revenue derives from peak expense reduction. CMLP pays about $178,000 per megawatt per year in transmission-related expenses and $47,000 per MW/yr in capacity-related expenses. If CMLP can reduce the volume of electricity it imports from the grid

during the grid's peak hour, these expenses can be reduced. If CMLP knows exactly when a peak will occur, it can schedule the battery to release the maximum capacity available, which will reduce our imports from the grid and our peak expenses. It is not always easy to forecast when the peak will occur. In the model we assume that we can correctly guess the monthly peak 10 out of 12 months per year (83% forecast accuracy.) We assume we can correctly guess the annual peak hour 9 out of every 10 years (90% forecast accuracy.) It is easier to identify the annual peak than the monthly peak.

If we can reduce CMLP's load by nearly 5MW (4.836 in the first year, declining to 3.458 in year 20;) then we save $178,000 *4.836 MW * 83% = $714k in transmission expense and $47,000 * 4.836 * 90%=$205k in capacity expense. We gain a further $100k in energy arbitrage by filling the battery during low cost hours and discharging it when we would otherwise be paying the highest market prices to meet our local peak load.

Total revenue in year 1 is $714k + $205k + $100k = $1.019MM . In year 2 it is $1.085MM.

Cash Flow

Year 1 cash flow is negative ($1MM revenue less $1.25MM expense = ($0.25MM).) Reducing debt expense in year 2 by using the IRA credit turns cash flow positive ($1.1MM revenue less $0.9MM expense = +$0.2MM.)

As debt expense attenuates and expected transmission and capacity expenses increase, the forecasted net cash flow increases. The 20-year NPV is +$3.1MM using a 12% discount rate. If you were to self-fund the investment, the IRR would be 8.5%.

Background / Process

How long will it take for this to become operational?

If borrowing authorization is approved, staff at the Light Plant will present all options to the Light Board and look for approval of a recommendation based on the best possible financing and procurement options.

Next we will go out to bid on this project and then have a much better idea of the timeline. It is expected to be operational 18 months after final permit are attained.

Have alternatives been explored to dealing with the solar saturation issue?

Yes! We have explored:

- Curtailment – powering down solar sites
    - Our current contracts only allow for curtailment in the event of an unpreventable emergency (like fire) but not because of an issue like solar saturation.

    - The solar site at W.R. Grace is not owned by CMLP, and as such we cannot power it down unless there is an unexpected electrical emergency (fire, life safety).
- Curtailment – discharging solar into the ground
    - This is both dangerous and illegal, so we cannot do this.
- Batteries built by third parties
    - They prioritize peak shaving over grid resilience, which is reversed from CMLP's goals. Regardless, we continue to investigate this route.
- Increasing load during critical times
    - This can be done by a lot of individuals in small ways or a few companies in bigger ways. The first is less reliable but likely doesn't require a capital investment.
- Pushing power back to Eversource
    - This work, called a **metering domain**, is underway. Prior to doing this, we need to install a SCADA system and replace or reconfigure many pieces of equipment on our distribution network. As a result, it is expected to be done no sooner than 2 years from now.
- Readjusting the locations served by the transformers so they are better balanced
    - Moving a portion of the town served by one transformer to another is a very time-consuming and expensive process. It requires significant engineering, planning, dangerous switching and work. After it is complete, one or two medium-to-large projects can require that the changes be reversed.

Who is moving the article and why?

The Town Manager on behalf of the Concord Municipal Light Plant. The seed of this started with the Solar Implementation Task Force, who was working at the Select Board's request to try to expand solar development in Concord. Unfortunately, the warrant closed prior to the announcement of MCI-Concord's closure. To move forward with this vital process, the Select Board opened a warrant for a Special Town Meeting to be held within the Annual Town Meeting in late April/early May.

At what times of the year is the battery most critical?

For addressing solar saturation it would be most critical during the shoulder months (March/April and September/October). For shaving the peak, whenever the peak occurs. Summer peaks are often on the 2nd, 3rd, or 4th day of a heat wave between 3-7pm.

What is the relationship between the Solar Implementation Task Force, the Concord Municipal Light Board, and the Concord Municipal Light Plant?

- The Solar Implementation Task Force was seated by the Select Board after a citizen's petition at the 2023 Annual Town Meeting.
- The Municipal Light Board is appointed by the Town Manager.
- The Municipal Light Plant acts as a Town Department, with the staff appointed by the Town Manager.

Who is supporting this article?

- The Solar Implementation Task Force voted unanimously to support this article (link here)

- The Concord Municipal Light Board voted unanimously to support this article (link here)
- The Finance Committee will be voting on this soon.
- The Select Board will be voting on this soon.

Are batteries mentioned in the Climate Action Plan?

Yes. It sets a target of 60MW by 2030.

You can read the plan here. Here are a few snippets:

IMPLEMENTATION STEPS	PLANNING CONSIDERATIONS	
	TIME FRAME	KEY PARTNERS
1. Evaluate options for the installation of a utility-scale energy storage battery system. Evaluation considerations to include: a. Technology options b. Ownership vs. lease or PPA models c. Additional financing options and grant availability d. Renewables integration potential e. Cost-benefit analysis for CMLP and ratepayers, including potential stacked value streams (e.g. upcoming MA Clean Peak Standard credits) f. Siting considerations (optimum substation location; proximity to existing and potential solar sites) g. Potential to support building and transportation electrification h. Potential for key town facility microgrid integration i. Resiliency benefits	**2021-2022**	• CMLP • Concord Municipal Light Board

Indicators of Success

How we generate electricity is a huge determinant in Concord's ability to meet its climate action and resilience goals. With a municipal utility, we have an opportunity to accelerate the adoption of non-fossil fuel electricity generation and these indicators will help keep us on track. We can use the indicators below to track our progress.

Indicator	Baseline Data	Baseline Year	2030 Target
GHG Emissions from electricity generation[16]	54,234 $MTCO_2e$	2016	0
Percent carbon-free electricity[17]	54%	2018	100%
Total MW capacity of residential renewable generation installations in Concord[18]	3.5 MW	2020	5.44 MW
Number of homes with rooftop solar[19]	358	2020	558
Number of homes with battery storage[20]	9	2020	109
Total MW capacity of solar generation on town property[21]	7.57 MW	2020	20 MW
Total MWh capacity of battery storage on town property[22]	0	2020	60MWh

If the Climate Action Plan specifies 60MWh of battery storage, will CMLP return at future Town Meetings for another 40MWh of battery storage?

CMLP believes that the current request under the 2024 Special Town Meeting (Article 1) is required to stabilize the grid and ensure we do not have negative impacts from the Town's solar saturation.

We are not moving this project forward simply to achieve the goals stated in the Climate Action Plan.

Future solar projects will require battery storage components, which will help work toward achieving this goal.

Do other municipal light plants install batteries on their distribution networks? What about the investor-owned utilities?

Yes to both. Sterling, Groton, Holyoke, Reading, Wellesley and many other MLPs all have or will have batteries.

How will the final scope of the project be determined?

If Town Meeting authorizes the borrowing of $10.4 million, then the Light Plant staff will continue collecting information on alternative financing options (leasing a battery vs. buying one, for example), along with analysis on the benefits and drawbacks of considering a small, medium, and large battery. This information will be presented to the Light Board, which will vote to support a project.

The Town Manager, CFO, Treasurer, and Select Board all play a role in the issuance of debt, and they will play a part if a battery is purchased (for an amount that requires borrowing).

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