CONCORD MUNICIPAL LIGHT PLANT
ELECTRIC | BROADBAND | ENERGY MANAGEMENT

Date: April 3, 2025

To: Municipal Light Board: Warren Leon, John Dalton, Brian Foulds, Bianca Taylor and Chris Schaffner

From: Jason Bulger, CMLP Director

Subject: Agenda for virtual Light Board meeting on **Wednesday, April 9, 2025, at 7:30 A.M.** (link below)

7:30 AM	1.	**Call to Order**			
7:30 AM	2.	**Meetings and Minutes**	5 Minutes	Chair	

- Vote to approve the minutes of March 12, 2025.

Upcoming Meetings:
Apr 29, 2025; May 14, 2025; Jun 11, 2025; Jul 9, 2025; Aug 13, 2025; Sep 10, 2025; Oct 8, 2025

7:35 AM	3.	**Chair's Update**	5 Minutes	Chair	Information
7:40 AM	4.	**Director's Update**	10 Minutes	Director	Information
7:50 AM	5.	**Broadband Update**	5 Minutes	BB Mgr.	Information
7:55 AM	6.	**CMLP Staff Introduction**	10 Minutes	Director	Information

Background: The Light Plant currently employs 41 staff across several divisions. It can be beneficial for Light Board members and the public to understand who works at the Light Plant and in what capacity.

Purpose: CMLP staff from one or more divisions will introduce themselves and explain their daily and routine functions at the Light Plant.

8:05 AM	7.	**Solar Policy Revision**	25 Minutes	Director	Discussion/Vote

Background: The current solar Interconnection Agreement requires installations over 50kW to be paired with battery storage. CMLP is considering amending the agreement to require battery storage or for the installation to curtail any excess generation as determined by staff based on the specifics of the application.

Purpose: Staff will review the current requirements and broadly discuss proposed changes. Future additional modifications may be discussed but not voted.

8:30 AM	8.	**Peak Shaving Tool Efficacy**	20 Minutes	Asst. Director	Info./Discussion

Background: Using a variety of inputs, CMLP sends out an email a few times each year asking customers to be mindful of a system peak for electricity usage. The goal is to reduce the peak load, leading to savings for all customers on capacity charges.
Purpose: A Concord resident and prominent economist has made this process a topic of study and has concrete data on the efficacy of the program.

1175 ELM STREET, PO BOX 1029 | CONCORD, MA 01742-1029 | T: 978.318.3101 | F: 978.318.3105

9:00 AM	9.	**Liaison & Public Comments**	5 Minutes	Chair	Information
9:05 AM	10.	**Adjourn**			

Distribution: Select Board (1 copy)

Kerry Lafleur	Carole Hilton	Joe Repoff	Eric Simms
Jan Aceti	Laura Scott	Jeff Cosgrove	Cameron McKennitt
Karlen Reed			

Join Zoom Meeting
https://us02web.zoom.us/j/83853970051?pwd=akVzemJRQk8vNTJRUnNlOS9NNDFuQT09

Meeting ID: 838 5397 0051
Passcode: 661712

One tap mobile

+16468769923,,87335757488#,,,,*680327# US (New York)
+16469313860,,87335757488#,,,,*680327# US

Link to view recordings of previous Light Board Meetings:
https://www.youtube.com/playlist?list=PL1TTzrWEKOOn0RlJ2MdE2SnNZMWYeoeat

Link to view the Director's Updates (also in meeting packets):
https://concordma.gov/1106/Municipal-Light-Board

Link to view the Broadband Monthly Updates:
https://www.concordma.gov/3148/Monthly-Updates

1175 ELM STREET, PO BOX 1029 | CONCORD, MA 01742-1029 | T: 978.318.3101 | F: 978.318.3105

Concord Municipal Light Board Minutes
March 12, 2025
- Draft -

Pursuant to a notice duly filed with the Town Clerk, a meeting of the Concord Municipal Light Board was held on Wednesday March 12, at 7:30 AM, via a Zoom meeting. Present were Board Members: Warren Leon (Chair), John Dalton, Bianca Taylor and Brian Foulds. Also in attendance were Jason Bulger, CMLP Director; Carole Hilton, CMLP Customer Service Manager; Joe Repoff, Assistant Director; Laura Scott, Assistant Director of Power Supply and Energy Management; Donna DeGray, Customer Service Supervisor; Karin Farrow, CMLP Office Administrator; Cameron McKennitt, Select Board liaison to the Light Board; Karlen Reed, Finance Committee liaison to CMLP, and residents: Chris Schaffner, Jim Terry, Brad Hubbard-Nelson and Fran Cummings.

Note definitions for acronyms used in these minutes:

- **CMLP**: Concord Municipal Light Plant
- **CSS**: Customer Service Specialist
- **RTMJO**: Request to make Job Offer

CALL TO ORDER
Mr. Leon called the meeting to order at 7:32 AM. Meeting recording will be posted to the Minuteman Media YouTube page as soon as it is available.[1]

MEETINGS & MINUTES

Mr. Dalton moved to approve the February 12, 2025 minutes as distributed. Mr. Foulds second the motion and with all members in favor, the motion carried.

CHAIR'S UPDATE – presented by Warren Leon (Timestamp 1:01)

- Chris Schaffner, as the newest Board Member (pending his official swearing-in), was invited to introduce himself.
  - Chris has been a resident since 2012 and is a Concord business owner (Green Engineer). He has experience engineering green buildings and working with Mass Save.
- Mr. Leon offered his seat to the other Board members at the monthly Chairs' Breakfast on the occasions he couldn't make it.

DIRECTOR'S UPDATE – presented by the CMLP Director (Timestamp 5:07)

- One of CMLP's three Customer Service Specialists has left to return to work in his hometown of Hudson at their Light Plant. We thank Rick for his 2.5 years of service to CMLP and wish him the best.
  - Recruitment for the position has begun, and to date we have received 131 applicants.
- We have sent HR two Requests to Make a Job Offer for Grade 3 Lineworkers.
- Energy tariffs are now in place at 10% for Canadian hydroelectric power. They were suspended initially but did go into effect earlier this week.
  - Since we anticipate this being a common question, we are in the process of preparing a post on our web page for further explanation.

[1] Minuteman Media YouTube Link: https://youtu.be/DZsLWaSZCU4

  - CMLP has two different exposures to Canadian hydro-electric power. The first is on the spot market, and the second is in a contract we have with Hydro Quebec.
  - CMLP enters into power purchase agreements with generators for a certain amount of power, covering about 80% of our needs. The remainder is purchased on the spot market. The spot market is a blend of many sources, some of which include hydro from Quebec.
  - ISO-New England says that over the past 5 years, Canadian imports have supplied about 11% of electricity demand. For the number of MWh CMLP typically buys in a year, that would be about a $31,000 increase on an annual basis (compared to $23M we spend annually).
  - Contract language for our hydro power contract appears to protect us from international tariffs. because of the definition of the delivery point, which is in Massachusetts.
- The governor has announced large changes to the Mass Save program, namely a $500M reduction in the program over the next few years.
  - Our efficiency programs were forecasted and voted last year, so we don't anticipate any changes at this time, but we are certainly sensitive to rising costs and will be taking a close look at the programs and their impacts for the budget cycle later this year.
- This Saturday, on March 15 from 1-3:30pm we are having more Green Homes tours. Visit https://concordma.gov/greenhomes to sign up.
- Today is the last day we'll be working with our contractor to install new advanced meters. We'll have about 50 left afterward, and staff will handle those.
- Tree trimming is about 50% complete at this point. We always have a few issues, but it's gone well overall so far.
- All staff will be doing CPR/First Aid/AED training next week.
- The SCADA system is fully procured and we expect to have kick off meetings very soon.
- We just completed an infrared survey of our overhead system along with some key underground areas. This helps identify hot spots where insulation or connectors are failing. We just received the report and will take steps to remediate all the issues discovered.
- CMLP has been involved in all of the 250th preparations, including developing a response plan.
- Finally, I just want to thank staff for their response last Friday. The extreme wind caused several problems -- mostly trees or limbs coming down. We tracked about 20 issues, with the biggest being an outage of about 9 customers.

BROADBAND UPDATE – presented by the CMLP Director (18:52)

- We are working on grant opportunities for the Residential Retrofit grant that would provide last-mile costs to expand access to low-income housing in Concord.
- The new 10G equipment bid is being published soon.
- The team is working on expanding the outdoor Wi-Fi in areas where we have smart gateways.
- Technicians have spliced in the permanent fiber for the new middle school.
- We have moved fiber on some poles in areas where there is development going on.
- The Broadband Manager is working on recruitment to fill the 2nd Network Engineer position.

TIME OF USE BILL PRINT UPDATES & DISCUSSION – presented by the CMLP Director (23:38)

- The Board had asked staff to maintain flexibility as much as possible with the bill print programming with NISC, the Light Plant's software vendor.
- We will be crediting solar on a time-of-use basis that matches the time periods we charge for electricity consumption *or* more – and possibly more complicated – periods throughout the day.

    - The vendor confirmed this is possible with 15 register sets.
    - We do need to lock down the specifics as soon as possible.
- We asked about heating/cooling degree days, and that is data that is possible.
- The only other open item is collapsing the variable distribution

The Board had a few comments: Mr. Leon clarified that the Board had previously decided against heating/cooling degree days. [He is right on that fact that the Board wished to omit this; see earlier minutes.] Ms. Taylor wanted to keep the bill as simple as possible.

TIME OF USE COMMUNICATION PLAN & OUTREACH - presented by the CMLP Director (30:13)
- The Director shared a presentation on the Time-of-Use communication plan and mentioned that a more detailed plan was in the meeting materials packet.
- More educated customers are more likely to be able to save money on their bills and perceive this as a positive change.
- Tools will be available for customers, including side-by-side bill examples, bill calculators, and programs that can shift load for customers automatically with no direct intervention.
- CMLP will reach customers through bill inserts, social media, workshops, email campaigns and more.
- Six months ahead of time is the sweet spot for giving people enough time to be aware of but not forget about what's happening.
- Some challenges mentioned are starting the messaging too early or late, conveying accurate information while not overwhelming the public, effecting behavioral change, lack of engagement, and confusion with too much information.

The Board made a few suggestions, including utilizing the Concord Bridge. Mr. Foulds encouraged focusing on the ability for TOU to lower people's bills over other communication points. Mr. Dalton agrees and wants to empower customers to make choices and suggests we be careful about the promises we make.

Mr. Leon wants to know if we can keep track on a monthly basis how many customers' bills have gone down. Mr. Bulger stated that it sounds complicated, but that the team would look into it. The savings should be evident in aggregate because kWh usage would remain the same or increase but revenue would be flat or decrease.

Mr. Foulds asked that the SmartHub include raw meter data so he can do his own comparison and research.

COST OF SERVICE STUDY INPUT - presented by the Asst. Dir. of Power Supply and Energy Management (48:19)
- Ms. Scott framed the goal of the cost of service study is to scientifically allocate the costs based on load profiles – both demand-related costs and per-kWh costs – and to create a methodology for setting rates.
- The plan going forward is to send a proposed scope of work to three selected vendors to get quotes and move forward with a selection so the vendor can start work on April 9, 2025.
- The consultant will propose prices for the time of use periods and recommend which costs should be recovered from fixed vs. variable charges.
- The vendor will come on-site for a day to review the current rates and objectives in designing the new TOU rate.

- The timeline was reviewed, with a first draft of the report due by June 9, a presentation to staff on June 16, a presentation to the Board due on July 9, and the final report due on July 23, 2025.
- The Board objectives were summarized and shared.

The Board had questions and feedback. Ms. Taylor asked about communicating the goal of keeping costs low to customers, and Ms. Scott made note of that. Mr. Dalton asked, regarding the ETS rate, if it might be appropriate to add that if they find the TOU rates do not meet the objectives of the ETS rate, then they will propose an alternative strategy.

The Board asked to get an earlier view of the draft to make sure there was adequate time for feedback and for the vendor to take that feedback into account. The group offered a second meeting in June that focused solely on this. Ms. Scott changed the June 11th date to serve as the first presentation to the Board.

Mr. Foulds asked to add to the Board Objectives the desire to separate the pass-through costs and distribution costs: delivery and power supply. Mr. Leon asked about the overcollection of commercial customers and whether or not the scope was written in a way that would remove the Board's opportunity to consider the philosophy of which rates' cost of service are funded, overfunded or underfunded.

Mr. Leon asked if the Cost of Service Study consultant could propose one set of rates that aim to be as accurate as possible, and another set of rates as simple as possible to allow the Board to weigh in on the strategy.

Staff will circulate the draft RFP and wait for Board member feedback prior to issuance.

Mr. Dalton asked about considering a special rate for heat pumps; Mr. Foulds was fiercely opposed to special incentive rates. He stated that in the past, CMLP had up to 35 rates, which had unintended consequences, and we have been paring them back over the years. A rate like this would require a separate meter and associated overhead, and he would prefer just seeing a monthly credit.

LIAISON AND PUBLIC COMMENTS (1:20:52)

- Mr. McKennitt had no specific comments.
- There were no other public comments.

EXECUTIVE SESSION: POWER SUPPLY CONTRACT (1:21:45)

Pursuant to the Commonwealth of Massachusetts Open Meeting Law Purpose for Executive Session #10: to discuss trade secrets or confidential, competitively sensitive, or other proprietary information to discuss a power supply contract.

Ms. Taylor made a motion to move into executive session. Mr. Foulds provided the second and with a unanimous vote, the meeting entered into executive session.

ADJOURN

Mr. Foulds moved to adjourn the Executive Session. Ms. Taylor provided the second and with a unanimous vote, the meeting was adjourned at 9:39 AM.

Concord Municipal Light Plant Updates

April 9, 2025

Contents

Organization and Industry

- CMLP is closely watching changes on the state and federal level that may have implications on the Light Plant's operations and projects. These include:
    - The Inflation Reduction Act funds were frozen by an executive order (to ensure they align with the administration's energy policies), but some have been released for specific projects. There are multiple challenges in court for these Congressionally-approved funds.
    - The Trump administration terminated grants for two clean energy projects and initiated a review of approximately 300 others funded by the Department of Energy (DOE). One affected project aimed to reduce energy use and greenhouse gas emissions in low-income multifamily buildings in Massachusetts and California.[1]
    - FERC signaled they would respond to ISO-NE's proposed interconnection reforms on or before April 4, 2025. There is no word yet on what action might have been taken. Order 2023 would create a cluster study approach for studying multiple interconnection requests simultaneously instead of the current process of handling them in a serial fashion. The goal is to prevent lengthy delays in the study of interconnection requests.

[1] https://apnews.com/article/trump-energy-department-clean-energy-wind-solar-batteries-hydrogen-fossil-fuels-cf1dff9ee771c566765e9ca3e3599d91

- On October 17, 2024, FERC issued Order No. 904 on Compensation for Reactive Power within the Standard Power Factor Range. Here is a great write-up explaining what this means. https://www.mcguirewoods.com/client-resources/alerts/2024/11/fercs-elimination-of-reactive-power-compensation-to-be-effective-early-2025

- ISO-NE issued an RFP to upgrade transmission between northern Maine and demand centers in southern New England. It is written to prioritize projects that can have a completion date before 2036.

- CMLP staff attended the Massachusetts Light Commissioners Association monthly presentation on the Clean Heat standards. The group continues to hold meetings discussing highly relevant topics.

- CMLP is finalizing our planning surrounding responses during the 250th celebration on April 19th. We will have 17 staff present spread across multiple locations, and we will be ready to respond to any kind of issues that might arise.

- The CMLP tariff information page was updated to communicate that, while the 10% Canadian energy tariffs did take effect in early March, the power coming across the border was suspended only two days later, leading to a very small amount of impact on ratepayers.

- With the new legislative year, the joint committee on Telecommunications, Utility and Energy (TUE) has reorganized with Mark Cusack the chair within the House. Michael Barrett continues to serve as chair on the Senate.

- The Reading Municipal Light Department (RMLD) announced 6.3% rate increases for residential customers, and a 7% increase for commercial customers.[2] Hingham increased rates 6% for the third year in a row following a comprehensive rate study conducted in 2023.[3]

Energy Management

- The Green Home Tours took place on March 15th. CMLP and ENE staff were present at the Green Homes to answer questions from participants. CMLP staff also followed up with participants who requested services (home energy assessments, heat pump coaching or EV support) and/or information about specific energy efficiency and electrification measures and the rebates and tax credits on offer.

[2] https://wilmingtonapple.com/2025/03/31/rmld-announces-6-3-rate-increase-for-residential-customers-7-0-for-commercial-customers/

[3] https://www.hmlp.com/public-information-session-on-january-2025-rate-increase/

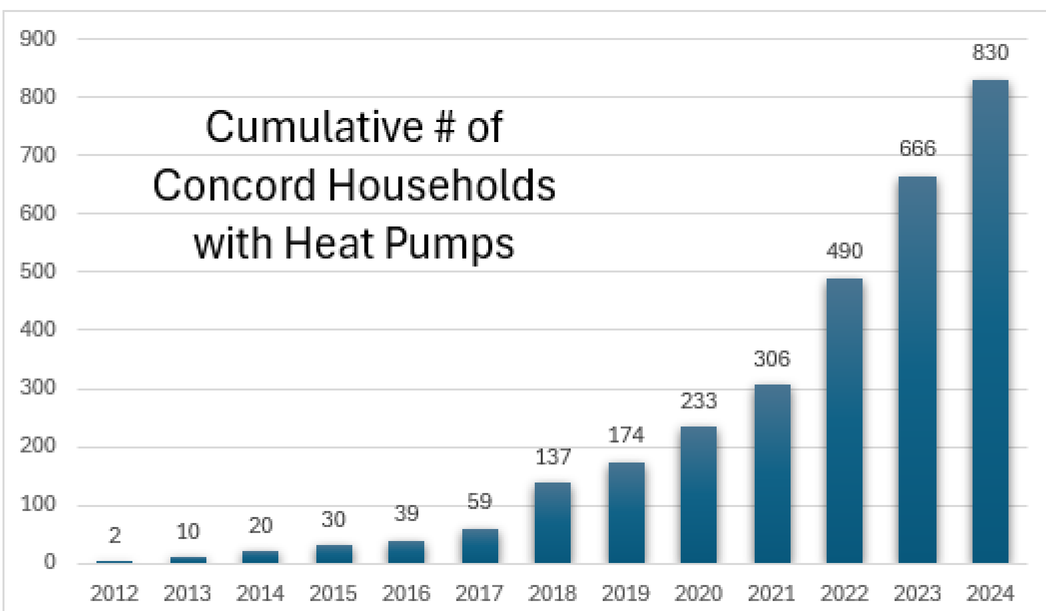
- CMLP staff has compiled a list of Energy Management webpages, email templates and partner organizations that needed to be brought up to date each year when rates, rebate policies and measure costs change.
- Energy Efficiency & Electrification Specialist Pamela Cady has completed a tally of Concord households with new heat pump installations in 2024, using CMLP's rebate data and drawing on Building Dept electrical inspection data and heating/cooling coaching service data to identify installations that didn't receive a rebate from CMLP.

  The number of households with new heat pump installations in each year going back to 2012 is as follows:

Year	Yearly # of Households w/ New Heat Pump Installs
2012	2
2013	8
2014	10
2015	10
2016	9
2017	20

Year	Yearly # of Households w/ New Heat Pump Installs
2018	78
2019	37
2020	59
2021	73
2022	184
2023	176
2024	164

The cumulative number of Concord households with heat pumps each year is as follows:



Battery Storage and Solar Project Updates

- CMLP is negotiating a site license agreement with the school superintendent or School Committee. After a final legal review, it is hoped that we can move forward with the issuance of the RFP.
- The new building housed students following the February break. There is a YouTube video showing off the building: https://www.youtube.com/watch?v=m6r4SYALcso

Advanced Metering Project Updates

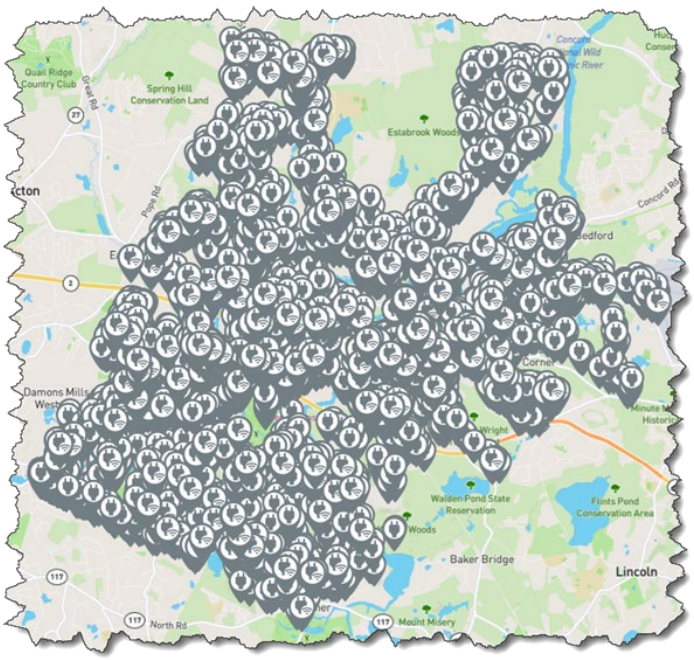
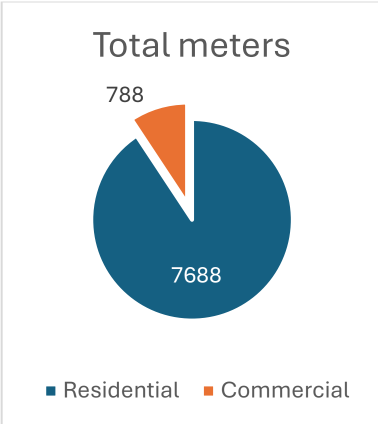
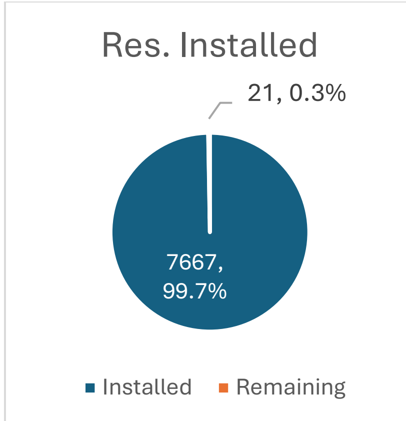
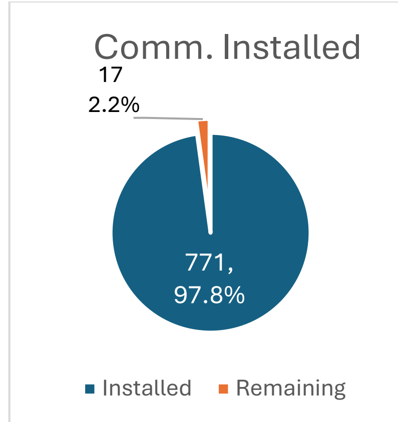


Figure 1: April 2025 Meters

- We are wrapping up the last of the AMI meters installations with under 50 meters left to install.
- Eaton, the vendor who manages the AMI meter system, is working on electric project close-out, which includes final analysis of the meter communication. There may be a need to modify gateway or relay locations, add additional gateways or relays, or make other network modifications.
- We are still struggling with the IP Link meters, but Eaton has recently prioritized assistance by allowing us to work with other vendors.







Engineering and Operations

- Line Supervisor Mike Hoogendoorn attended NEPPA's regional General Foreman's roundtable last week.
- Engineering staff has attended several solar plus battery pre-construction meetings and conducted in-service battery witness tests.
- We are excited to welcome Nickolas Ferguson on April 14, 2025 in the position of Lineworker, 3rd Class. Nik has great experience, and we are excited for him to be a part of the team.
- We are working on getting final approval on an offer for a 2nd Class Lineworker and hope to be able to report on a start date for the next Light Board meeting.
- Engineering and Line teams have assisted with the setup and connection of power for AT&T Cell-on-wheels (COW) to support 250th celebration.
- By the time of the Light Board meeting, we will setup power for two Verizon COWs to support 250th celebration.
- We have conducted building improvements, including three door replacements – two at operations center and one at Substation 219
- In March we de-energized and removed old electrical infrastructure from Sanborn School ahead of demolition.
- Due to our existing vendor changing operations, we identified and vetted new vendor for testing and certifying of electrical gloves.
- As required, we submitted voltage reduction test results to ISO-NE.
- A modular office has been built in the warehouse for an employee who has to work out there. It will be climate controlled and also protect against airborne particulate and fumes from the garage.

Power Supply

- CMLP continues to work on expansion of solar at the landfill along with battery storage. Multiple meetings with vendors took place in the last month. We continue to try to develop shared savings models that support CMLP's primary need of handling solar saturation.
- The Board voted to extend the current NextEra contract until 2039, so we prepared and sent in those documents to Energy New England for execution.
- CMLP has officially enrolled in MMWEC's Connected Homes program. Run by Virtual Peaker, this program allows customers to enroll devices like electric cars, chargers, thermostats, and battery storage into a program that can shed load when peaks are called. Initial enrollments will provide a flat bill credit for each device enrolled; once time-of-use rates are out, then the savings will be built into the rate itself by helping customers move their electricity usage without any action required on their part. Staff are working with MMWEC's team on implementation, and we expect a broad announcement in coming months.
- A team consisting of the Director, Assistant Directors, and Customer Service Manager has selected Utility Financial Solutions (UFS) to conduct this year's Cost of Service Study. We are working on finalizing the contract and will be able to update the schedule once the procurement stage is complete.
- We continue working on the planning and marketing of the Time-of-Use rate rollout. We are getting a proposed statement of work to multiple vendors to see what they can accomplish.
- The team produced a draft procedure for handling after-hours load control customer issues. We met with Customer Service, Metering, and Engineering/Operations staff to discuss and get feedback.

Customer Service / Metering

- Carole and Donna have conducted 8 interviews for the Customer Service Specialist position. They hope to schedule second-round interviews soon. There were over 145 applicants for the position.
- NISC's annual user conference is in Kentucky this year. Customer Service will probably send 2 employees, and planning has begun for coverage and accommodations.
- The team has been working on the Time-of-Use bill tools (like the calculator) and other bill requirements.
- We will be updating the progress on individual goals later this month. Staff reviewed current progress and made plans to achieve goals by the end of the Town's fiscal year.
- The Public Works department is spinning up a stormwater utility and has approached CMLP about supporting the billing and customer service needs of that and the curbside pickup operations. Conversations are ongoing, but this will likely happen later this summer (2025).

- The team is working on moving around resources on the website to make information easier to find. We plan rolling out a whole new website in early 2026.

TOWN OF CONCORD
MUNICIPAL UTILITIES
ELECTRIC | WATER | SEWER | TELECOMMUNICATIONS

March 2025 – Broadband Updates

Concord Broadband is pleased to share the following updates and information from the past month. Please do not hesitate to contact us at broadband@concordma.gov should you have any questions, concerns, or feedback.

Operations

The Broadband team is interviewing candidates for the Network Engineer position. With over 150 applicants to date, we hope to have finalists identified by mid-April.

The XGS-PON bid has been advertised. At this time, we have begun receiving responses and will vet them and award the bid shortly after the deadline for submissions.

The Technicians have spent some recent days assisting with the relocation of equipment from poles that are moving as well as supporting the Town's 250th efforts. Most or all Broadband staff will be working on April 19th to support and be available in case of any unexpected events.

Wi-Fi Performance

A frequent trouble call we receive at Concord Broadband is a customer struggling with achieving advertised speeds on a wireless device. They feel that if they pay for a certain speed of internet service, they should be able to receive that speed on all of their devices.

In reality, there are a number of factors that contribute to the speeds customers get on their devices. First, as a general rule, wired devices are generally capable of faster speeds than wireless devices. New wireless devices (utilizing Wi-Fi 6, 6E or 7) are likely capable of faster speeds than older devices that might only support 802.11n, or 802.11ac (obviously depending on whether or not your router is capable of newer protocols). Wireless devices that are closer to the router/access point will generally outperform those that are farther away or those that have barriers between the source and the destination.

We want all customers to receive advertised speeds, but some devices may never be able to achieve them. Testing with a newer device hard-wired into an Ethernet port on the ONT or router itself will always yield the most accurate test results when measuring speed.

For more details, review the article that follows on router placement and settings.

Upcoming Maintenance

There are no maintenance windows currently scheduled.

Concord Broadband typically schedules maintenance windows from 1-4am on Saturday or Sunday to minimize the impact to customers.

Learn more on our maintenance page here:

https://concordma.gov/3144/Broadband-Maintenance

Maximizing Your Wi-Fi Performance: Router Placement and Settings

A strong and reliable Wi-Fi connection starts with the right setup. Whether you're streaming, gaming, or working from home, optimizing your router's placement and settings can significantly improve your internet experience.

Optimal Router Placement

1. **Central Location** – Place your router in a central area of your home to ensure even signal distribution. Avoid placing it in a corner, basement, or near thick walls.

2. **Elevated Position** – Keep the router off the floor and position it on a shelf or mounted on a wall to reduce interference.

3. **Away from Interference** – Keep your router away from large appliances, metal objects, and electronic devices like microwaves and cordless phones, which can disrupt the signal.

Best Router Settings

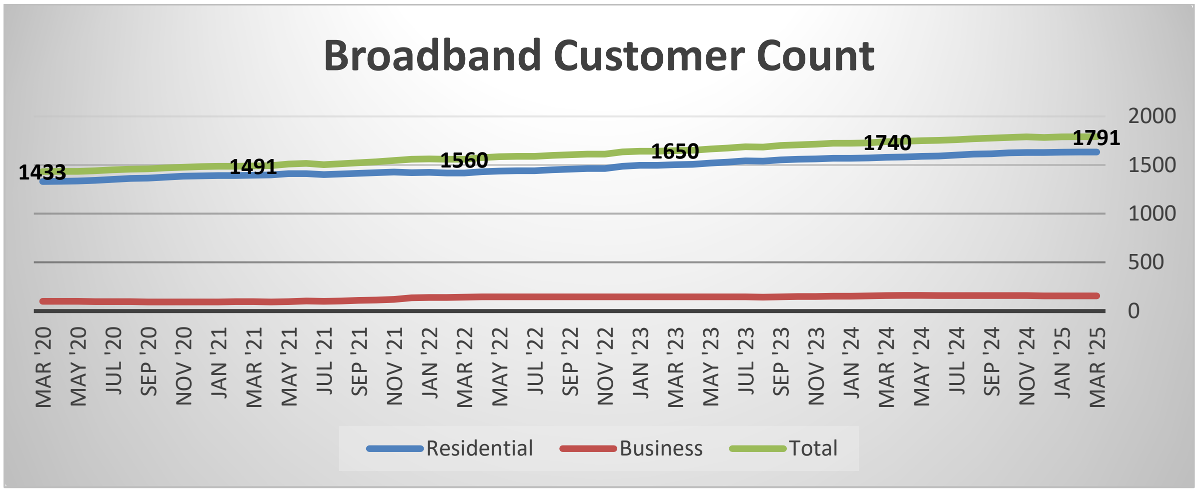
1. **Choose the Right Frequency Band** – Use the 5GHz band for faster speeds and less interference, and the 2.4GHz band for better range.

2. **Update Your Firmware** – Regularly updating your router's firmware can improve security and performance.

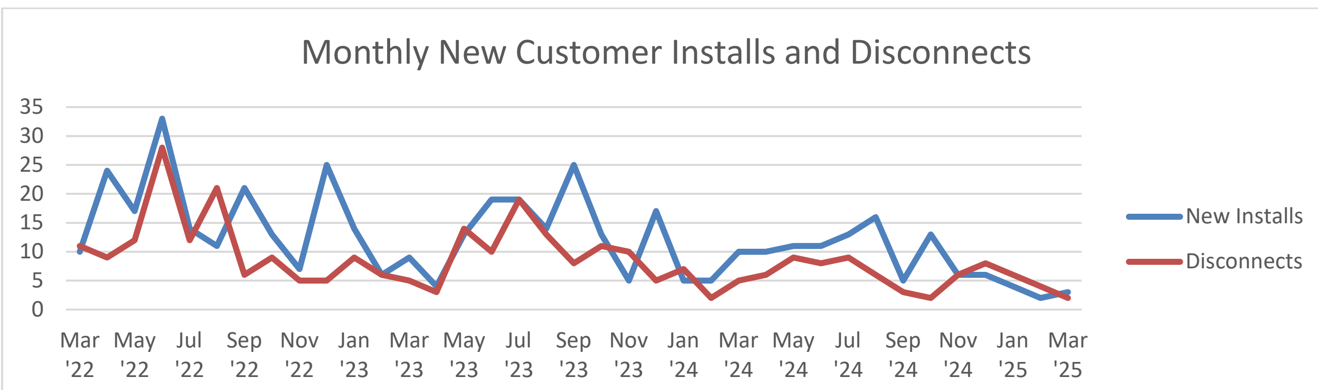
3. **Adjust Channel Settings** – If your Wi-Fi feels slow, switch to a less crowded channel using your router's settings.

By following these simple steps, you can enhance your home Wi-Fi performance and enjoy a more reliable connection.

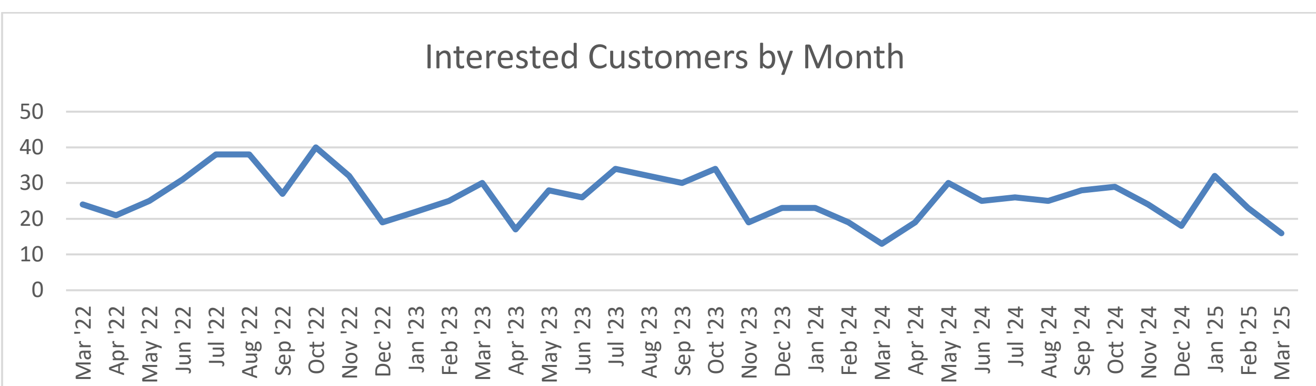
Monthly Metrics and Business Data



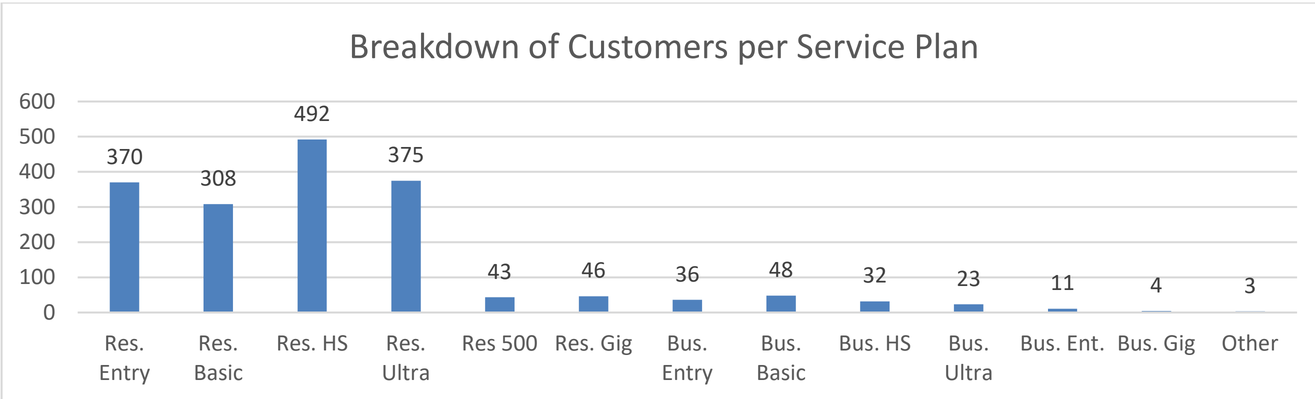
(*Customer count: March 2020 – March 2025*)



(*The number of new installations and disconnects completed each month.*)

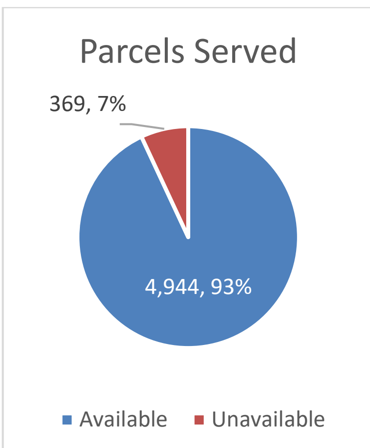


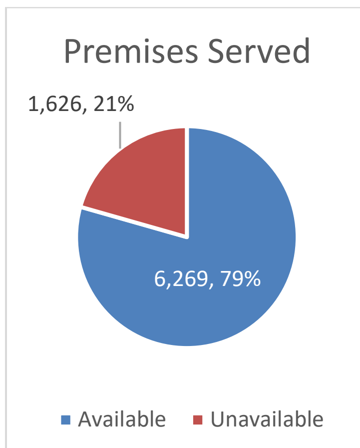
(*This is the number of individuals who submit the Broadband interest form, whether they are in the current service area or not.*)

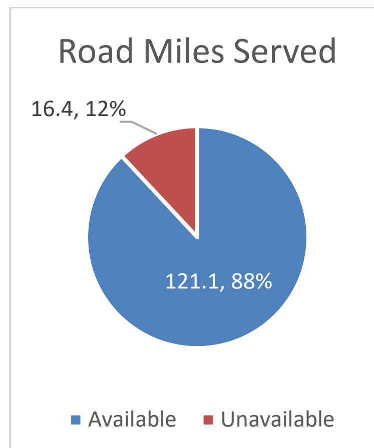


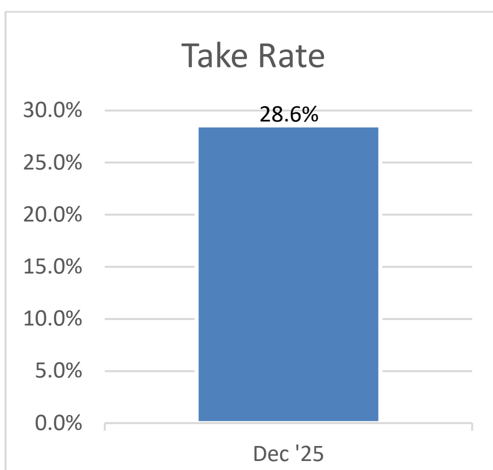
(This is the number of each customer on our different service plans as of 3/31/2025.)

Other Metrics









(As of 2/15/2025)

Appendix

Fiber Broadband Completion Task Force's Report Goals

Goal	Type	Priority	Responsible Party	Additional Info.
Policies (p.39)				
• Universal Access	Policy	Highest	Select Board/Town Meeting	
• Expansion outside current territory	Policy	Low	Select Board/Town Meeting	Conversations happening
• Support Economic Vitality, Sustainability, Equity & Inclusion	Policy	High	Select Board/Light Board/TM Economic Development	Rate subsidy planned
• Affordable Housing	Policy	Medium	Select Board/Housing Groups	Rate subsidy planned; working on Concord Housing Authority properties
• Public Safety	Policy	Medium	Select Board/Town Manager	
• Education	Policy	Medium	Select Board/School Dept.	
• Government Access (PEG)	Policy	Medium	Select Board/PAAC	
Recommended metrics for tracking (p.41)				
• Parcels served	Metric	Medium	Town Staff/Light Board	Complete; will report quarterly
• Premises served	Metric	Medium	Town Staff/Light Board	Complete; will report quarterly
• Road miles served	Metric	Medium	Town Staff/Light Board	Complete; will report quarterly
• Subscribers	Metric	High	Town Staff/Light Board	Complete; will report monthly
• Take rate	Metric	Medium	Town Staff/Light Board	Complete; will report quarterly
• Churn	Metric	High	Town Staff/Light Board	Complete; included in monthly report
• Installations	Metric	Highest	Town Staff/Light Board	Complete; will report monthly
Governance (p.39)				
• Track progress against completion	Metric	Highest	Light Board/Town Staff	Working on this
• Rate of return policy	Policy	High	Light Board/Town Staff	Working on this
• Financial goals with regular reporting	Policy	High	Light Board/FinCom	Working on this
• Retained earnings and reserve policy	Policy	High	Light Board/FinCom	Working on this

Goal	Type	Priority	Responsible Party	Additional Info.
Strategic Planning Goals (p.43)				
• Marketing and growth	Metric	High	Light Board/Town Staff	Working on this
• Business return	Policy	High	Light Board/Town Staff	Working on this
Budgeting Process for Fiber Expansion (p.41)				
• Expand to fill existing opportunities	Planning	High	Light Board/Town Staff	
• External funding sources	Research	Medium	Light Board/Town Staff	Working on this
• ARPA Relief Funds Allocation, incl. Lost Revenue	Finance	Highest	Select Board/Town Manager	Complete
• Review/Confirm Internal Loan Findings	Finance	Highest	Financial Audit Comm/Staff	Complete
• Review and Rescind PILOF to MMN	Finance	High	Select Board/Town Manager	Complete
Capital Planning Process (p.42)				
• Review/Revise Debt financing schedule	Policy	Highest	Light Board/Town Staff	In progress; due to positive financial situation, anticipating being able to repay faster.
• Quantifying cost of expansion	Planning	Medium	Town Staff	Working on this
• How to fund expansion	Planning	Medium	Light Board/Town Staff	Working on this
• Revise/refine methods for computing ROI	Planning	Medium	Light Board/Town Staff	Working on this
Construction and Logistics (p.42)				
• Vibratory plow – direct buried fiber cables	Operations	Medium	Town Staff	Working on this
• Revise/Refine Communication conduit construction standards and guidance	Policy	Medium	Town Staff	Working on this
• Integrate Fiber construction with the Roads Program – focus on Streets without fiber that already have underground electric	Planning	High	Town Staff	Working on this

CONCORD MUNICIPAL LIGHT PLANT
ELECTRIC | BROADBAND | ENERGY MANAGEMENT

Commercial Solar PV Net Metering Policy Acknowledgement

Definition
"Net metering" means a system of metering electricity in which the Concord Municipal Light Plant (CMLP) provides credits on the Customer's bill for electricity generated on the Customer's property that migrates to (i.e. is received by) the CMLP distribution system when generation is greater than consumption at the Customer location.

Applicability
This policy is for customers with commercial electric accounts installing solar arrays. CMLP offers net metering to customers generating electricity on the Customer's side of the meter provided that the Customer's generating capacity does not exceed 167 kW (AC).

CMLP calculates the solar PV capacity in kW (AC) as follows:

((# of panels) * (PTC per CA Energy Commission)) / (1,000 W / kW) = ____ kW (AC)
Source data for California Energy Commission's PTC number is here:
https://solarequipment.energy.ca.gov/Home/PVModuleList

Engineering Review
Before net metering will be permitted, installations are subject to review by CMLP's engineering division to ensure that the amount of electricity projected to migrate to the distribution system does not exceed the capacity of the transformer serving the Customer or adversely impact CMLP's distribution system in any other way.

Energy Storage System Requirements

CMLP Paired Equipment Requirements		
For NEW solar installations bringing site's TOTAL solar capacity in kW (AC) to:		
0	25	50
←------→ **Export Limiter and/or Batteries Not Required**	**←------→** **Export Limiter and/or Batteries May be Required** **Decisions made on case-by-case basis per CMLP Engineering review**	**←------→** **Export Limiter and/or Batteries Required**

As shown in the graphic above, if solar is added to a site whose prior solar capacity is under 50 kW(AC), an export limiter and/or battery **must** be paired with any solar capacity beyond 50 kW. The battery must be capable of storing 4 hours of peak electric production for the portion of the solar array over 50 kW. If solar is added at a site with prior solar capacity over 50 kW(AC), an export limiter and/or storage **must** be paired with any additional solar capacity. The battery must be sized to store 4 hours of peak production potential (AC) from the new solar capacity. If a site's prior solar capacity is less than 25 kW(AC) and solar capacity is added, an export limiter and/or battery capacity ***may*** be required to pair with any solar capacity exceeding 25 kW. The battery capacity must be capable of storing 4 hours of electricity produced by any solar capacity that exceeds 25 kW, at its peak solar production potential (AC). In all scenarios, CMLP must be able to control battery charge and discharge times on predicted peak demand days. Export limiters must be set for no export beyond 50 kW(AC).

Metering

CMLP's advanced meters record the amount of electricity delivered to the customer by CMLP as well as any solar electricity that migrates to CMLP's distribution system because it is not needed on the property at a given moment.

Net Metering Credits

Meter, Distribution and Demand Charges

The Meter Charge, Distribution Charge and Demand Charge paid by the Customer are the same as the charges paid by the Customer under their regular General Service rate tariff. Net metering credits do not apply to these charges.

Capacity and Transmission Charge

Customers pay for Capacity and Transmission on only the net amount of electricity delivered (energy delivered by CMLP less energy migrating to CMLP's system). If the Customer sends more energy to the distribution system than CMLP delivers to them, the Capacity and Transmission charge is zero. No credits are accrued for Capacity and Transmission charges for any energy migrating to CMLP's system that exceeds the purchases from CMLP during the billing period.

Energy Charge

Customers pay for Energy on only the net amount of electricity delivered (energy delivered to the Customer by CMLP less energy migrating to CMLP's system). If the Customer sends more energy to the distribution system than CMLP delivers to them, they are credited for the excess at the price CMLP pays New England's Independent System Operator for electricity on the Spot Market. The "9-4 Spot Market" price is defined as the average Real Time locational marginal price set by the Independent System Operator-New England (ISO-NE) for all hours between 9am and 4pm in the month the migration occurs.

The 9-4 Spot Market price fluctuates based on market conditions. From the start of 2024 through early 2025, it ranged between $0.02 and $0.12 per kilowatt-hour (kWh).

Customer Acknowledgment

Customers receive lower compensation for solar production that exceeds consumption in that month. At the end of each billing cycle CMLP tallies the total solar kWhs sent by the Customer to the grid that month. The solar kWhs are subtracted from the total grid kWhs delivered by CMLP to the Customer that month. Therefore, the financial value of those solar kWhs is equivalent to the Customer's G1, G2, or G3 commercial rate. Any excess solar kWhs that remain are credited at that month's 9-4 Spot Market price. Therefore, the financial value of those solar kWhs is less than the Customer's G1, G2, or G3 rate.

The Customer acknowledges that if the solar PV system is sized so that more electricity migrates to CMLP's distribution system than the Customer purchases from CMLP during a given month, the excess electricity will be credited at the generally lower 9-4 Spot Market price rather than subtracted from the billing units to which the higher Energy, Capacity, and Transmission Charges apply.

This Solar PV Net Metering Policy Acknowledgement references CMLP's Rate G-1, G-2, G-3 NET MTR: General Service Net Metering Rate, available on CMLP's website at https://concordma.gov/DocumentCenter/View/13235/General-Service-Net-Metering-PDF. The Net Metering Rate is subject to change.

___________________________ ________________________________

Customer Signature Customer Address

___________________________ ________________________________

Customer Name Date

CONCORD MUNICIPAL LIGHT PLANT
ELECTRIC | BROADBAND | ENERGY MANAGEMENT

Residential Solar PV Net Metering Policy Acknowledgement

Definition
"Net metering" means a system of metering electricity in which the Concord Municipal Light Plant (CMLP) provides credits on the Customer's bill for electricity generated on the Customer's property which migrates to (i.e. is received by) the CMLP distribution system when generation is greater than consumption at the Customer location.

Applicability
This policy is for customers with residential electric accounts installing solar arrays. CMLP offers net metering to customers generating electricity on the Customer's side of the meter provided that the Customer's generating capacity does not exceed 167 kW (AC).

CMLP calculates the solar PV capacity in kW (AC) as follows:

((# of panels) * (PTC per CA Energy Commission)) / (1,000 W / kW) = ____ kW (AC)
Source data for California Energy Commission's PTC number is here:
https://solarequipment.energy.ca.gov/Home/PVModuleList

Engineering Review
Before net metering will be permitted, installations are subject to review by CMLP's engineering division to ensure that the amount of electricity projected to migrate to the distribution system does not exceed the capacity of the transformer serving the Customer or adversely impact CMLP's distribution system in any other way.

Energy Storage System Requirements

CMLP Paired Equipment Requirements		
For NEW solar installations bringing site's TOTAL solar capacity in kW (AC) to:		
0	25	50
← - - - - - - → Export Limiter and/or Batteries Not Required	← - - - - - - → Export Limiter and/or Batteries May be Required Decisions made on case-by-case basis per CMLP Engineering review	← - - - - - - → Export Limiter and/or Batteries Required

As shown in the graphic above, if solar is added to a site whose prior solar capacity is under 50 kW(AC), an export limiter and/or battery **must** be paired with any solar capacity beyond 50 kW. The battery must be capable of storing 4 hours of peak electric production for the portion of the solar array over 50 kW. If solar is added at a site with prior solar capacity over 50 kW(AC), an export limiter and/or storage **must** be paired with any additional solar capacity. The battery must be sized to store 4 hours of peak production potential (AC) from the new solar capacity. If a site's prior solar capacity is less than 25 kW(AC) and solar capacity is added, an export limiter and/or battery capacity ***may*** be required to pair with any solar capacity exceeding 25 kW. The battery capacity must be capable of storing 4 hours of electricity produced by any solar capacity that exceeds 25 kW, at its peak solar production potential (AC). In all scenarios, CMLP must be able to control battery charge and discharge times on predicted peak demand days. Export limiters must be set for no export beyond 50 kW(AC).

Metering

CMLP's advanced meters record the amount of electricity delivered to the customer by CMLP as well as any solar electricity that migrates to CMLP's distribution system because it is not needed on the property at a given moment.

Net Metering Credits

Each month, any solar electricity (in kilowatt-hours) that migrates through the Customer's meter to CMLP's distribution system is subtracted from the electricity (in kilowatt-hours) that the Customer purchases from CMLP at the Residential Service Rate. The Customer is billed for the net amount of electricity at the applicable rate for Residential Service, to the extent that the solar electricity that migrates to CMLP's distribution system does not exceed the Customer's purchases from CMLP.

Any solar electricity migrating through the Customer's advanced utility meter to CMLP's distribution system that exceeds electricity purchases from CMLP that month are credited at the price CMLP pays New England's Independent System Operator for electricity on the Spot Market. The "9-4 Spot Market" price is defined as the average Real Time locational marginal price for all hours between 9am and 4pm in the month the migration occurs.

The 9-4 Spot Market price fluctuates based on market conditions. From the start of 2024 through early 2025, it ranged between $0.02 and $0.12 per kilowatt-hour (kWh). On average, kWhs of solar electricity credited at the 9-4 Spot Market price will provide less financial benefit to the customer than kWhs of solar electricity that are subtracted from the billing units to which the Residential Service Rate is applied. The 2025 R-1 Residential Service Rate has 3 tiers that range from $0.20173 to $0.23999 per kWh, depending on the net amount of electricity delivered to the Customer by CMLP in that billing cycle.

Customers receive lower compensation for solar production that exceeds consumption in that month. At the end of each billing cycle CMLP tallies the total solar kWhs sent by the Customer to the grid that month. The solar kWhs are subtracted from the total grid kWhs delivered by CMLP to the Customer that month. Therefore, the financial value of those solar kWhs is equivalent to the Customer's R-1 Residential Service Rate. Any excess solar kWhs that remain are credited at that month's 9-4 Spot Market price. Therefore, the financial value of those solar kWhs is less than the Customer's R-1 Residential Service Rate.

If the Customer has controlled electric water heating and low overall electricity consumption, the financial benefit due to solar electricity production may be diminished.

Distribution Charges

All residential net metering customers will also be assessed a monthly Distribution Charge on their electric bill, based on the size of their solar PV system:

Installed Generation Capacity:		Price per month
Equal or Greater Than	and Less Than	
2 kW (AC)	4 kW (AC)	$4.18 / month
4 kW (AC)	7 kW (AC)	$7.70 / month
7 kW (AC)	10 kW (AC)	$11.88 / month
10 kW (AC)	13 kW (AC)	$16.06 / month
13 kW (AC)	16 kW (AC)	$20.24 / month
16 kW (AC)	19 kW (AC)	$24.42 / month
19 kW (AC)	22 kW (AC)	$28.71 / month
22 kW (AC)	25 kW (AC)	$32.89 / month
25 kW (AC)	28 kW (AC)	$37.07 / month
28 kW (AC)	31 kW (AC)	$41.25 / month
31 kW (AC)	34 kW (AC)	$45.43 / month
34 kW (AC)	37 kW (AC)	$49.17 / month
37 kW (AC)	40 kW (AC)	$53.79 / month
40 kW (AC)	46 kW (AC)	$62.26 / month
46 kW (AC)	58 kW (AC)	$78.98 / month
58 kW (AC)	82 kW (AC)	$112.53 / month
82 kW (AC)	130 kW (AC)	$179.74 / month
130 kW (AC)	167 kW (AC)	$231.44 / month

The Distribution Charge ensures that the costs of maintaining the local electrical distribution system and running CMLP are shared fairly among all CMLP customers, including those who have reduced their financial contribution towards maintaining these services by replacing some of the electricity they had purchased from CMLP with electricity generated by their solar PV system. Customers with solar PV systems continue to receive all the services provided by the electricity distribution system in Town and by CMLP. Customers' adoption of solar does not reduce CMLP's costs for maintaining local infrastructure and providing services.

Customer Acknowledgment

The Customer acknowledges that if the solar PV system is sized so that more electricity migrates to CMLP's distribution system than the Customer purchases from CMLP in a month, the excess electricity will be credited at the substantially lower 9-4 Spot Market price, rather than subtracted from the billing units to which the higher R-1 Residential Service Rate applies.

The Customer also acknowledges that the Distribution Charge is a condition of receiving net metering credits from CMLP. This Solar PV Net Metering Policy Acknowledgement references CMLP's Residential Service Rider - Net Metering with Banking Rate, available on CMLP's website at https://concordma.gov/DocumentCenter/View/1205/Net-Metering-with-Banking-Rate-PDF. The Net Metering Rate, including the Distribution Charges, is subject to change.

______________________________	______________________________
Customer Signature	Customer Address
______________________________	______________________________
Customer Name	Date

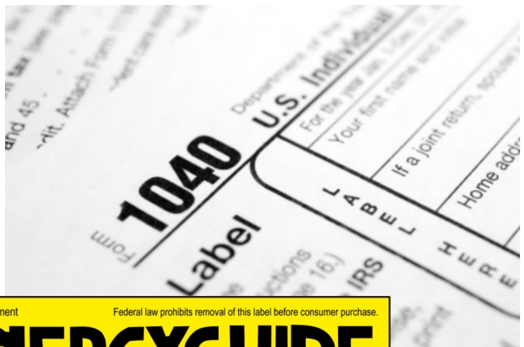
Using a Nudge to Shave Peak Electricity Demand

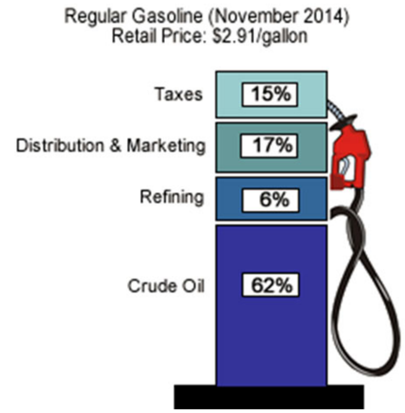
Gib Metcalf
Tufts University and MIT Sloan School

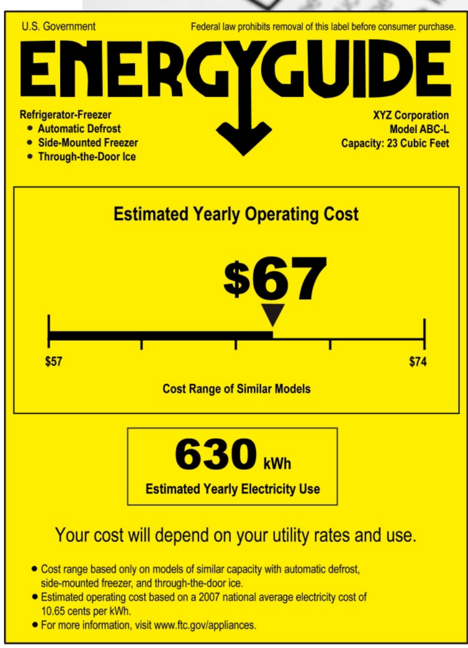
CMLP Board Presentation
April 2025

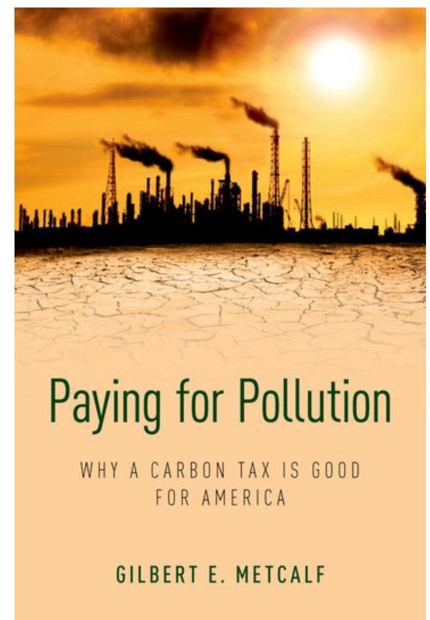
A Bit About Me

A Bit About Me









The Issue

- ISO-NE charges utilities an annual capacity charge based on each utility's share of load in the peak hour of the year
- Concord Municipal Light Plant (CMLP) sends out occasional email blasts during the summer alerting customers to a possible ISO-NE peak demand day the following day.
- Recipients of the email are encouraged to reduce demand during the peak window to lower CMLP share of load during that hour

- Roughly 5 alerts sent each summer
  - Each alert covers multiple hours

ISO-NE Cost of Capacity

"CMLPs annual cost of capacity is equal to the product of the regional clearing price resulting from ISO-NE's annual capacity auction and the ratio of CMLP's use (as measured by the import meter) to the total New England load during the single highest use hour of the year."

Laura Scott

CMLP Power Supply & Rates Administrator

- Transmission costs based on monthly peak demands
- Other CMLP initiatives in place to tamp down transmission costs

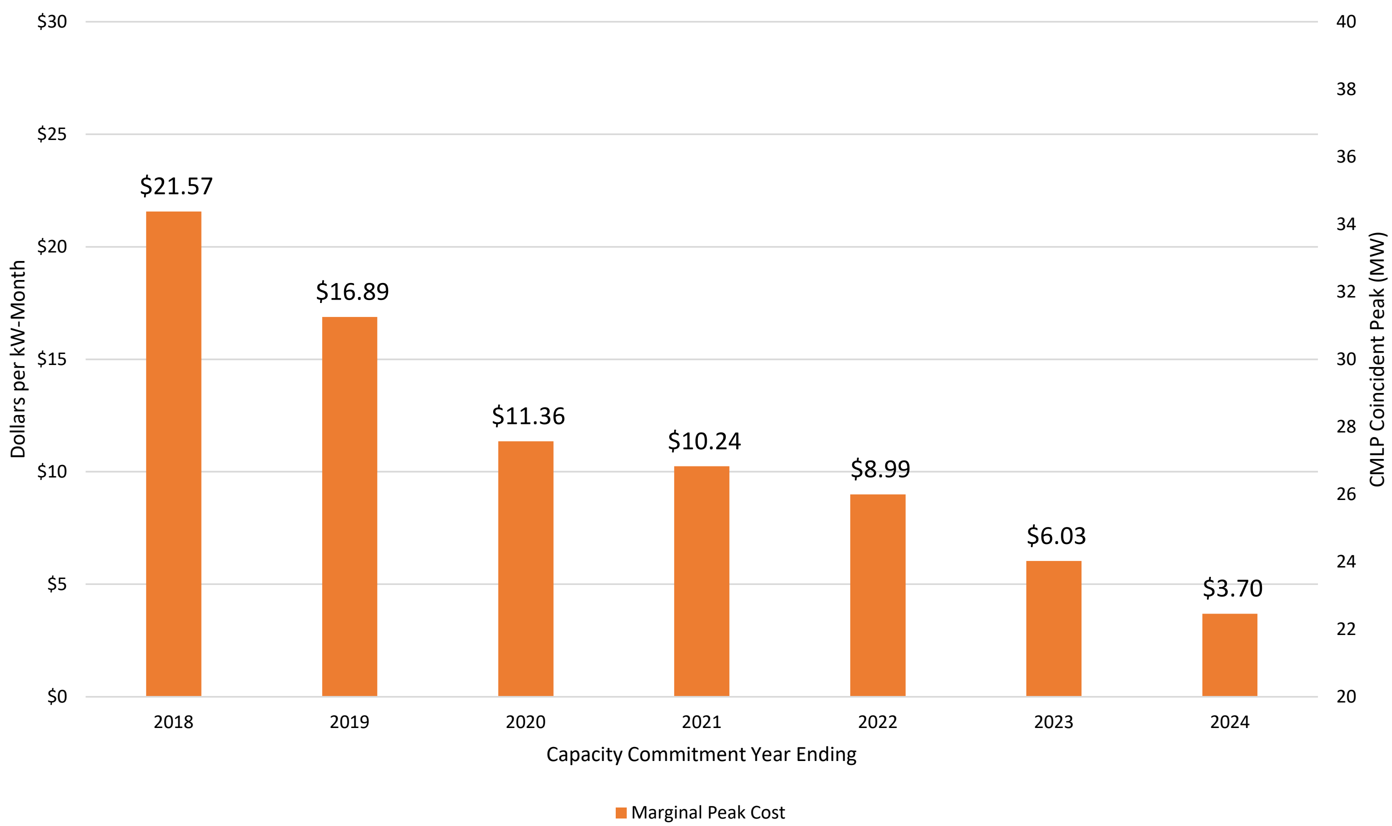
CMLP Shares of ISO System Peak Load

Capability Year & Capacity Commitment Period (CCP)	Begin Date	End Date	Peak Date	Peak Hour		System Peak Load	CMLP Coincident Peak	CMLP coincident peak as a % of ISO peak
Date Range	Date	Date	Date	Hour Begin	Hour End	MW	MW	
6/1/2021 - 5/31/2022	1/1/2020	12/31/2020	7/27/2020	17:00	18:00	24,726.74	37.077	0.150%
6/1/2022 - 5/31/2023	1/1/2021	12/31/2021	6/29/2021	16:00	17:00	25,279.65	38.146	0.151%
6/1/2023 - 5/31/2024	**1/1/2022**	**12/31/2022**	**8/8/2022**	**15:00**	**16:00**	**24,395.52**	**37.000**	**0.152%**
6/1/2024 - 05/31/2025	1/1/2023	12/31/2023	9/7/2023	17:00	18:00	23,623.02	38.102	0.161%
6/1/2025 - 05/31/2026	1/1/2024	12/31/2024	7/16/2024	18:00	19:00	24,254.65	38.218	0.158%

Charges are actually based on CMLP peak as percentage of Zonal Peak

Source: CMLP

Value of Reducing Coincident Peak



Research Questions

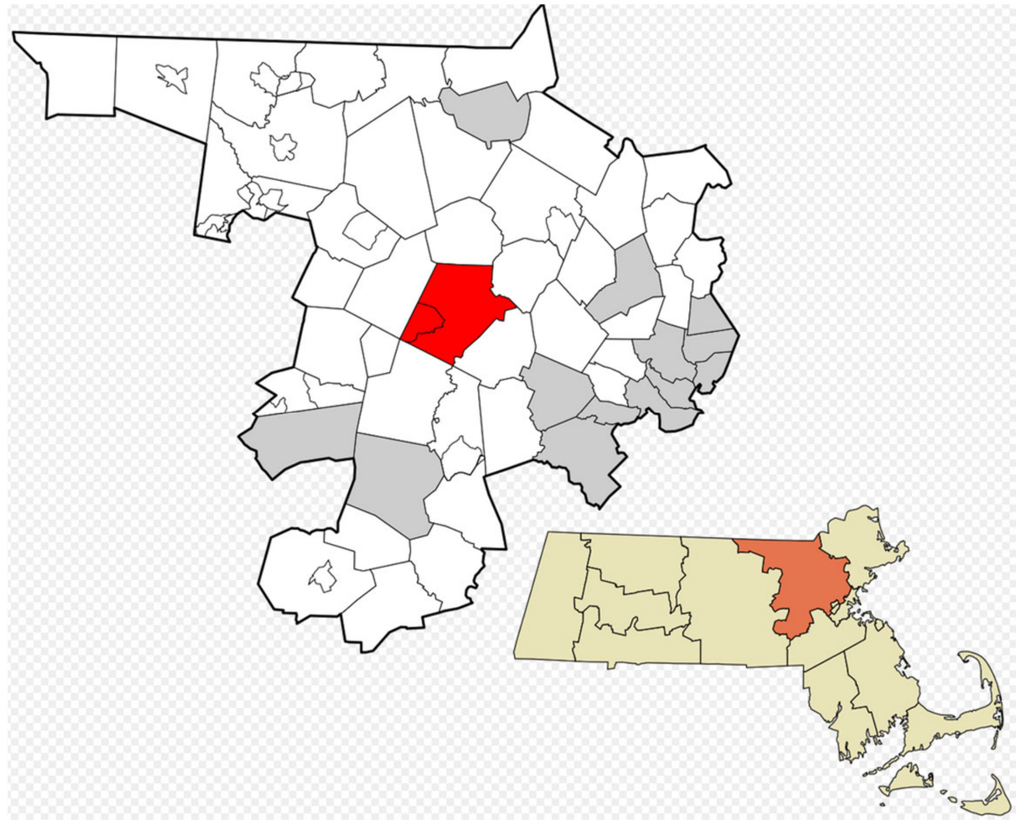
- Does the peak alert program lower Concord's load?
  - A private benefit
- Does the program lower demand?
  - A private and social benefit

- Demand and load differ due to solar production within Concord

- Quantifying the benefits of the peak alert program?

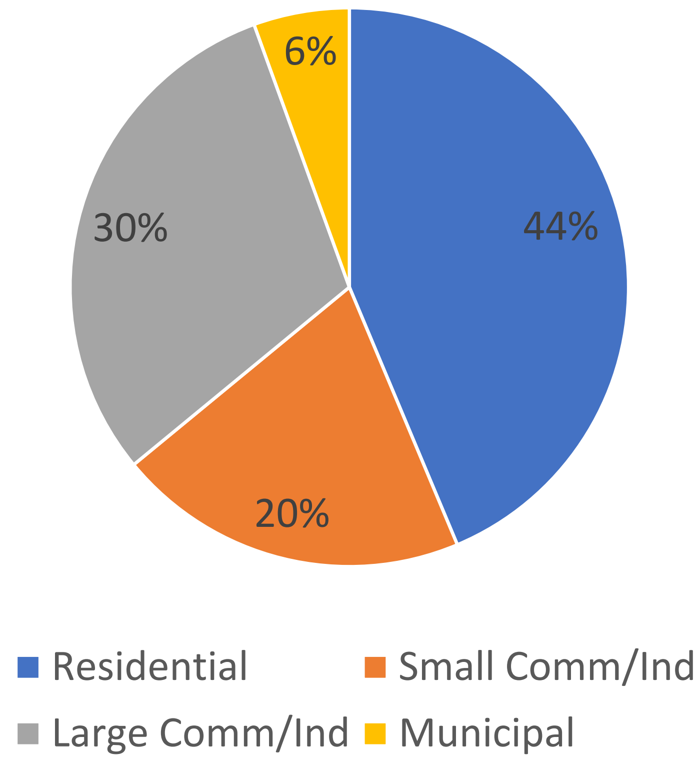
CMLP Background

- A municipally owned utility serving all Concord MA customers
  - 8,306 customer meters in Concord
  - 15 meters in Lincoln and Acton (adjacent communities)
- Concord – suburban community with population of 18,491
- Largest employer is Emerson Hospital (1700 employees)



CMLP Background

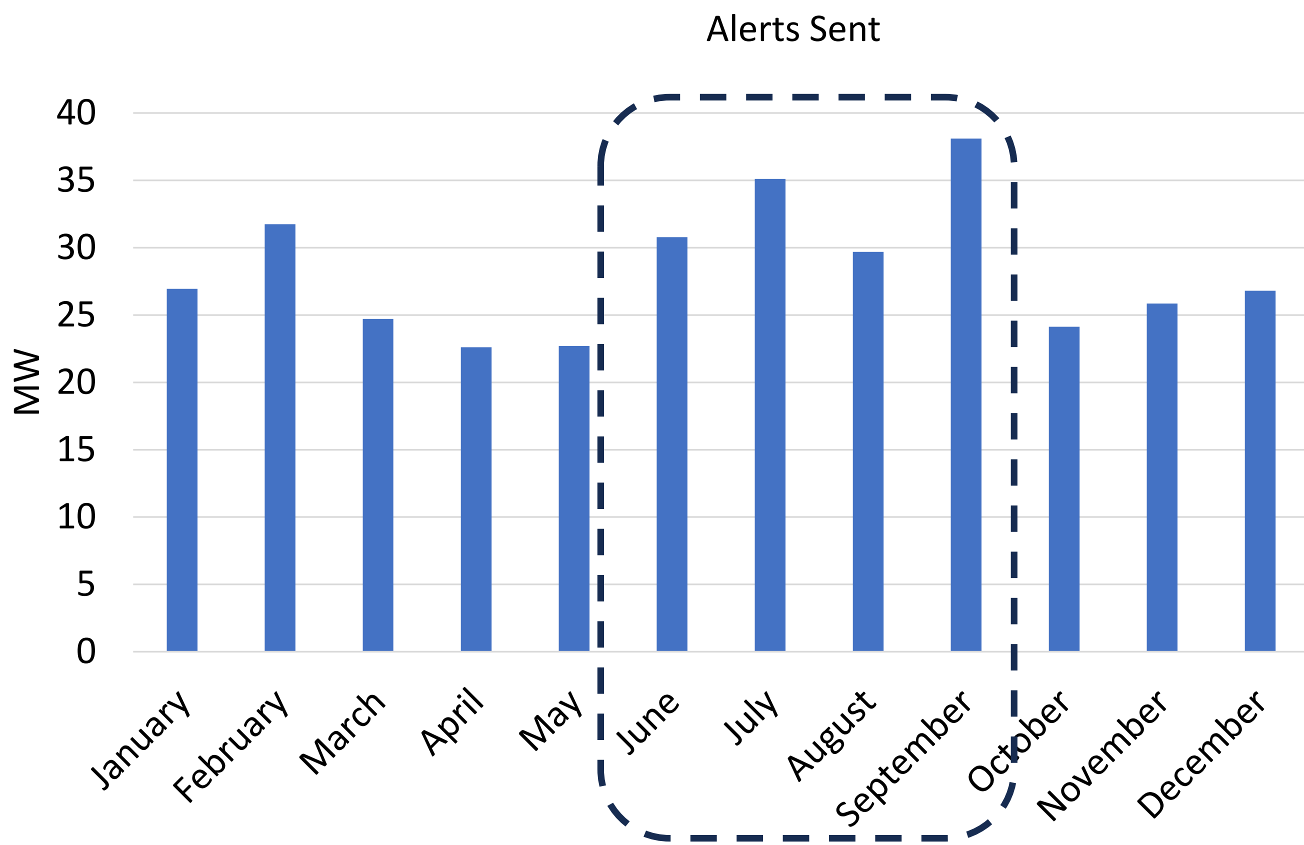
- Total Load in 2022: 175,229 MWh
- Distribution Losses: 3.16% of load
- 3 Solar Arrays in town
  - 6.355 MW capacity
- Rooftop solar growing
  - 4.457 MW capacity currently



Data

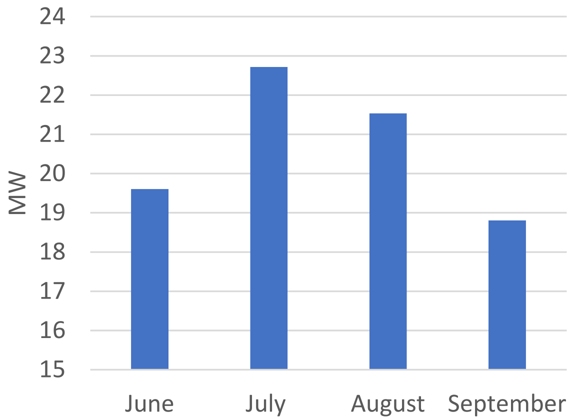
- CMLP Data
  - Hourly load data for summer months (June – September) for 2009 – 2024
  - Peak alert data
  - Central solar array capacity in Concord
  - Hourly solar array production data for central arrays for 2015 – 2023
  - Monthly behind the meter solar capacity (2008 – 2023)
- NOAA Data
  - Hourly weather data for Hanscom Field (in Concord and Lexington)
- ISO-NE Data
  - Hourly load data for all of ISO-NE for 2017 – 2024
  - One-day ahead capacity peak forecasts (and hour of predicted peak) for 2009 – 2024

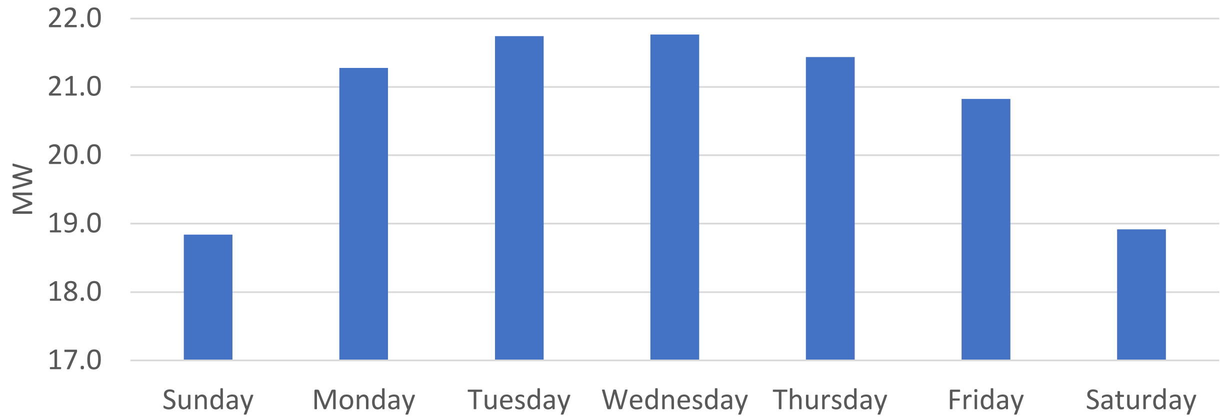
Peak Load: 2023

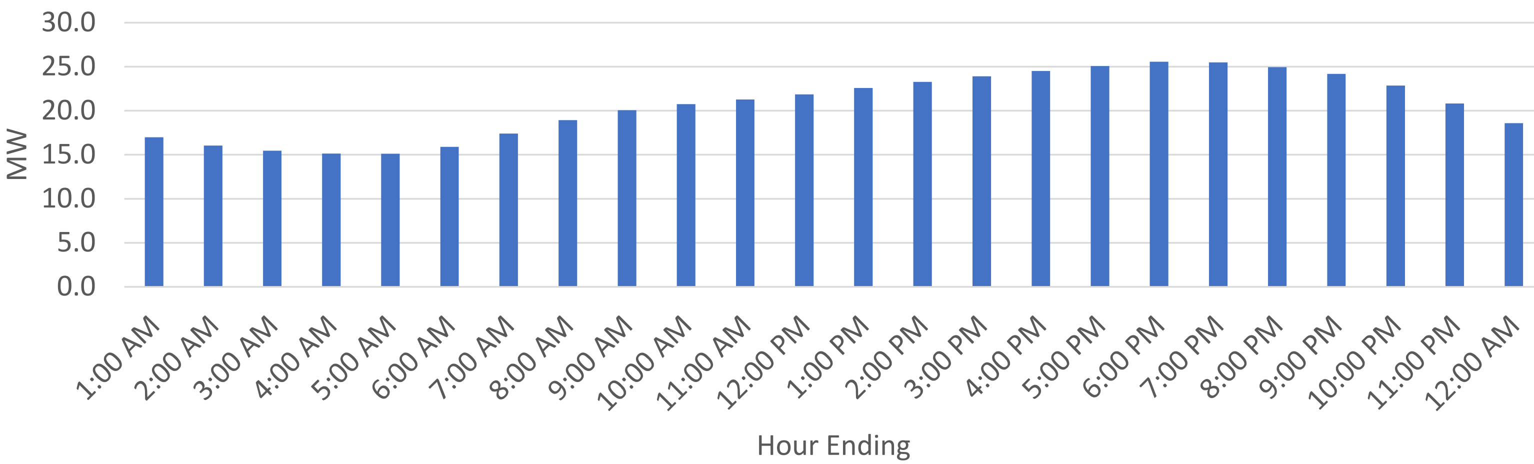


CMLP (2024)

Average Summer Hourly Load: 2009 - 2024







Peak Alerts

CMLP
to CMLP CAP

Sep 6, 2023, 10:33:48 AM

Thank you for participating in Concord Light's CAP Google Group and helping to **reduce the summer peak demand for electricity** on New England's electrical grid (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and most of Maine.)

The current weather forecast confirms a peak electricity day is possible for Thursday September 7th 2023 from 4PM to 7PM.

Forecast for 2023-09-07 (as of 09/06/2023 09:31 AM EDT)

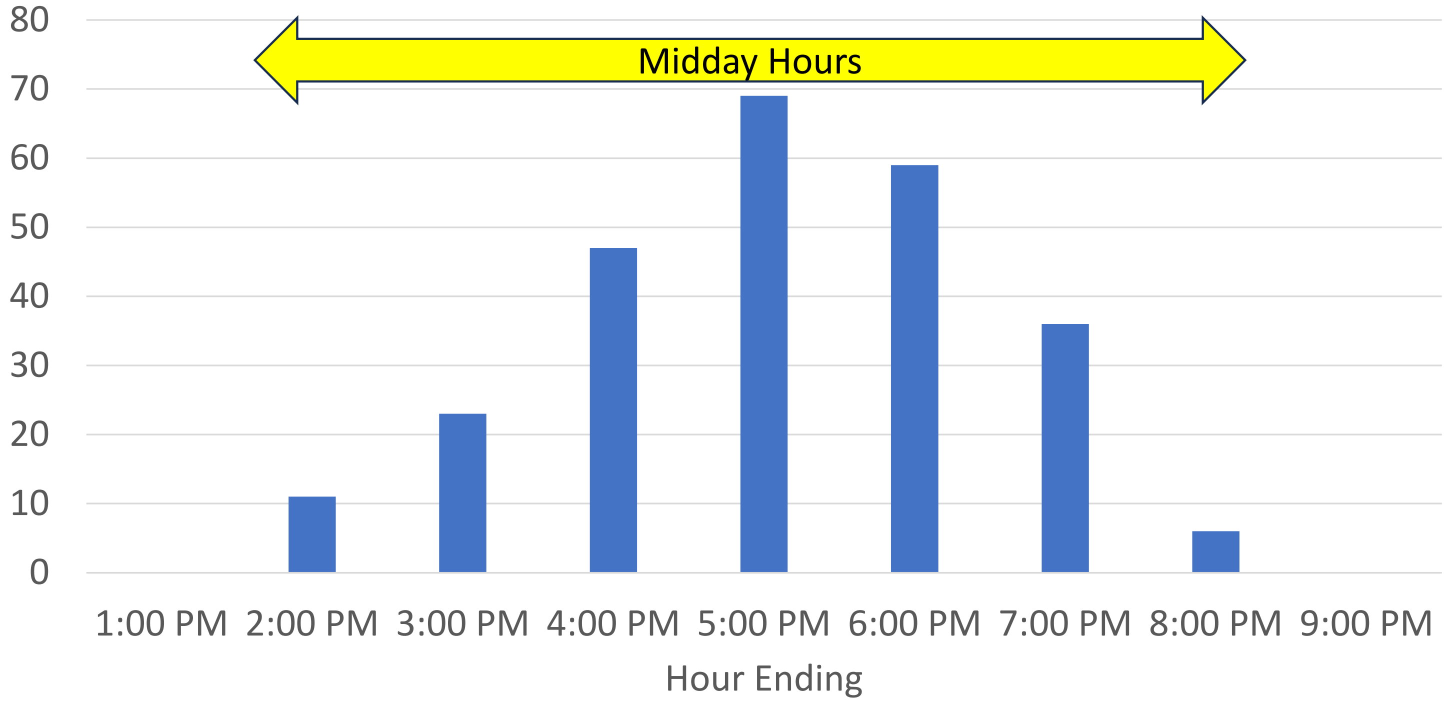
Weather	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Wed	Thu	Fri	Sat	Sun	Mon
	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep	11-Sep
High Temperature - Boston	81	86	86	82	78	76
Dew Point - Boston	68	70	71	70	70	68
High Temperature - Hartford	93	94	88	83	79	77
Dew Point - Hartford	68	69	72	71	71	69
Projected Peak Load	22,800	23,500	21,250	18,750	17,500	17,500
Peak Forecast Hour	6PM	5PM	5PM			
Peak Occurrence Probability	POSSIBLE	POSSIBLE	UNLIKELY	UNLIKELY	UNLIKELY	UNLIKELY

Peak Alerts

If you are able to reduce your electricity use during these hours, you can help reduce electricity costs for all CMLP customers. During these hours, you might consider doing any of the following:

- turn your A/C up a few degrees
  - turn off lights anywhere they are not needed and dim others if they are dimmable
- postpone use of pool pumps, dryers, washing machines, and other appliances
- reduce plug load by turning off computers, televisions, etc.
- Cook dinner on the grill or have a picnic supper
- Do not charge an electric vehicle during a peak demand event
  - Pre-cool your home and then let it coast without A/C until after the peak demand event
  - Use fans instead of or in addition to A/C as fans use much less electricity than air conditioning
- Close blinds on windows facing the sun
- Use smart power strips to turn off multiple devices with one touch
- Get an energy assessment for your home or business to see if there are more electricity-saving opportunities. Find out more information here: http://www.concordma.gov/1751/Energy-Management-Renewable-Energy-Effic

Peak Alerts



Frequency Over 16 Years

Empirical Analysis

- Do peak alerts affect:
  - Load (electricity transmitted to CMLP by ISO-NE)?
    - Subject to capacity charge
  - Demand?
- Load is observed; demand is not
  - No information on production behind the meter (rooftop solar)
  - Limited information on production from three solar arrays
    - I can use this to estimate capacity factors and so estimate in-town solar production for all years and months (subject to noise!)
- Hourly load regressions for summer months (June – September) between 2009 and 2024, peak hours only

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CMLP Real Time Load (MW)	13664	24.7	5.6	8.7	45.0
CMLP Peak Alert Hour	13664	0.018	0.134	0	1
ISO-NE Day Ahead Peak Forecast (MW)	13664	18,080	2,991	12,450	27,700
Dry Bulb Temperature	13637	74	9	42	101
Dew Point Temperature	13614	59	9	26	79
ISO-NE Hourly Load less CMLP Load (MW)	10248	16,953	3,147	8,698	27,334

Sample limited to June-September for years 2009 – 2024 and to midday hours when peak alerts may be called
ISO-NE load data available for years 2013 - 2024

Statistical Framework

$$CMLP\ Load_t = \beta Peak_t + \gamma X_t + \alpha_H H_t + \alpha_D DOW_t + \alpha_M M_t + \alpha_Y Y_t + \varepsilon_t$$

$$t \in \{midday\ hours, June - Sept, 2009 - 2024\}$$

- Peak = 1 if CMLP alert indicates peak possibility during that hour; otherwise 0
- Other regressors (X_t) include:
  - Local temperature
  - Local dewpoint
  - ISO-NE load (less CMLP)

CMLP Load Regressions

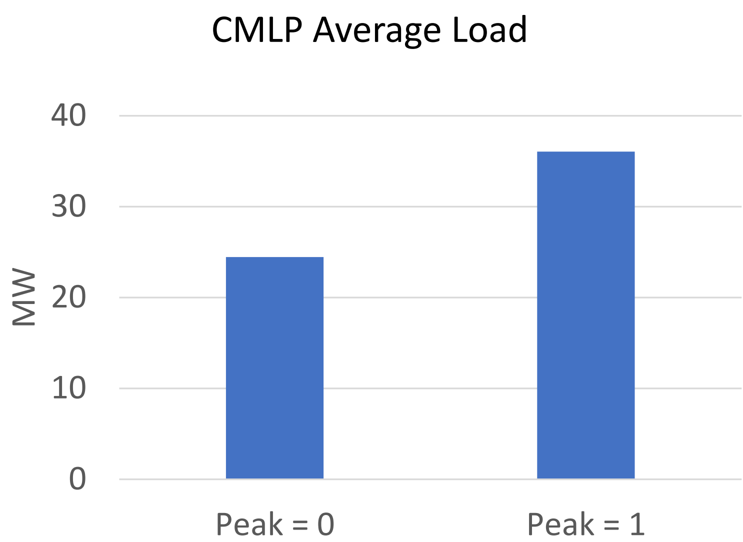
VARIABLES	CMLP Load			
	(1)	(2)	(3)	(4)
Peak Alert	11.60***	9.023***	0.826***	0.810***
	(0.340)	(0.274)	(0.0869)	(0.0864)
ISO-NE Load			1.771***	1.716***
			(0.00493)	(0.00841)
Observations	13,664	13,664	10,248	10,018
R-squared	0.079	0.421	0.955	0.956
Fixed Effects	No	Yes	Yes	Yes
ISO Load	No	No	Yes	Yes
Weather Variable	No	No	No	Yes

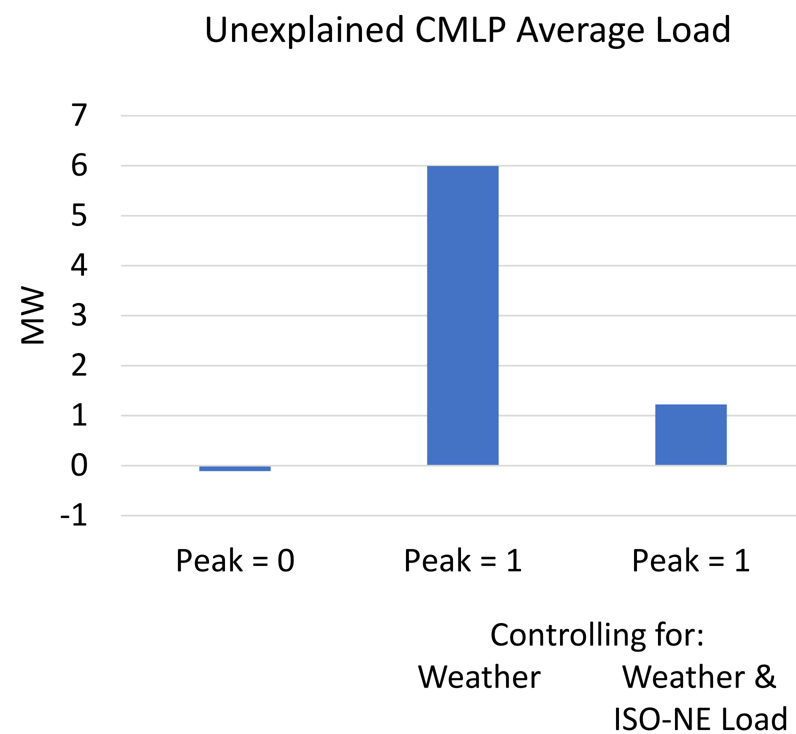
Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Fixed effects control for hour of day, day of week, month, and year included. ISO Load excludes CMLP load. Midday hours only in regressions

Statistical Problem: Peak Alerts are Endogenous





Endogenous Alerts

- CMLP sends peak alerts out when it believes ISO-NE might hit an annual load peak
  - This occurs on especially hot and/or muggy days, potentially after a several-day heat wave
- These are days when CMLP is likely to have high demand

When Does CMLP Send Out Peak Alerts?

Seven-Day Capacity Forecast

IN THIS SECTION

- Power System Forecast and Status
- Morning Report
- Current Power System Status
- Seven-Day Capacity Forecast
- Three-Day System Demand Forecast
- 21-Day Energy Assessment Forecast and Report

RELATED LINKS

- Download Previous Seven-Day Forecasts

Every day, ISO New England publishes this summary of factors affecting the power system for the next seven days, including weather, generating capacity, and peak demand. The forecast is used to identify capacity deficiencies several days in advance and triggers the commitment of generators with start times greater than 24 hours. For today's forecast, see the Morning Report

View the forecast below, or download a CSV file. Hover over items for an explanation.

WEATHER	DAY 2 SAT 11/02	DAY 3 SUN 11/03	DAY 4 MON 11/04	DAY 5 TUE 11/05	DAY 6 WED 11/06	DAY 7 THU 11/07
High Temperature - Boston	55	50	51	68	72	62
Dew Point - Boston	40	24	33	54	54	39
High Temperature - Hartford	58	56	54	73	75	66
Dew Point - Hartford	33	25	32	54	54	39

GENERATING CAPACITY POSITION						
Total Capacity Supply Obligation (CSO)	27,887	27,887	27,887	27,887	27,887	27,887
Anticipated Cold Weather Outages	0	0	0	0	0	0
Other Generation Outages	10,544	10,218	11,404	11,546	10,083	10,439
Anticipated De-List MW Offered	1,161	1,161	1,161	1,161	1,161	1,161
Total Generation Available	18,504	18,830	17,644	17,502	18,965	18,609
Import at Time of Peak	2,895	2,895	3,095	3,095	3,095	3,095
Total Available Generation and Imports	21,399	21,725	20,739	20,597	22,060	21,704
Projected Peak Load	13,000	14,010	15,110	14,440	14,590	14,190

Instrumental Variable Approach

$$Load = \alpha + \beta Peak + \gamma X + \varepsilon$$

ε − unexplained factors affecting CMLP Load

$$Cov(\varepsilon, Peak|X) > 0$$

Solution:

1. Identify variables Z that are correlated with $Peak$ but not with ε
2. Predict $Peak$ using Z: $\widehat{Peak} = f(Z)$
3. Replace Peak with $\widehat{Peak}$ in $Load$ regression

Z is an instrumental variable

Instrumental Variable Approach

- Instrumental variables are correlated with decision to issue a peak alert but not correlated with unexplained variation in CMLP houlrly load

- Possible instruments include
  - Day ahead forecasts of ISO system-wide peak load (1 through 4 day leads possible)
  - Day ahead forecast of temperature and dewpoint in Hartford CT.
    - Note – these do not vary by hour

  - Interactions of day ahead forecasts with hour of day fixed effects

Instrumental Variable Approach

VARIABLES	CMLP Load				
	(1)	(2)	(3)	(4)	(5)
Peak Alert	-0.444	-0.714*	-0.586	-0.379	-0.576
	(-1.50, 0.10)	(-1.86, -0.25)	(-2.57, -0.36)	(-1.48, 0.38)	(-2.38, 1.23)
Peak Alert (2020-2024)					-0.318
					(-4.04, 3.40)
Observations	10,248	10,018	8,464	8,464	10,018
R^2	0.954	0.955	0.952	0.952	0.955
Notes:					
Weather Variables	No	Yes	Yes	Yes	Yes
Instrumental Variables	IV1	IV1	IV2	IV1	IV1

Standard errors in parentheses unadjusted for possible weak instruments
*** p<0.01, ** p<0.05, * p<0.1
Confidence intervals in parentheses adjusted for possible weak instruments. In column (5), refined projection methods used
Controls for hour of day, day of week, month, and year included
ISO Load excluding CMLP Load included as a variable
Midday hours only in regression

IV1 uses one-day ahead ISO peak forecast interacted with hour of day indicator variables
IV2 adds one-day ahead Boston temperature forecast interacted with hour of day indicator variables

IV Estimate Plausible?

- Consider the estimate: -0.714
- Average summer peak in 2023 was 33.4

- Percentage reduction: $\frac{-0.714}{0.714+33.4} = -2.1\%$

- July peak in 2023 was 35.1
- Percentage reduction equals -2.0%
- Percentage reduction as share of demand is lower.
  - *How much lower? Not much*

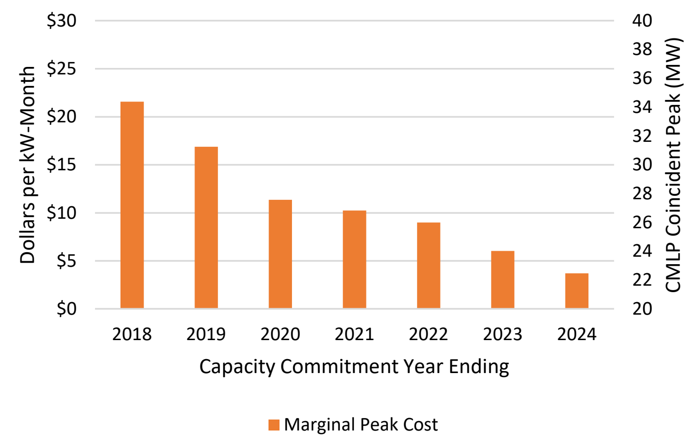
- *Note: Residential load is roughly 40 percent of total CMLP Load. Suggests a reduction in residential load on the order of 4 to 5 percent (but this ignores any other incentives to reduce load at peak)*

Benefit of the Peak Alert Program

- Reduced capacity payments (private CMLP benefit)
- Avoided power purchases (private CMLP benefit)
- Reduced pollution (social benefit)

Reduced Capacity Payments

CCP	Marginal Peak Cost (kW-Mo)	Marginal Peak Cost (MW-Yr)	Value of Peak Alert	E(Value of Peak Alert)
2018	$21.57	$258,890	$184,847	$132,034
2019	$16.89	$202,628	$144,676	$103,340
2020	$11.36	$136,279	$97,303	$69,502
2021	$10.24	$122,928	$87,771	$62,693
2022	$8.99	$107,921	$77,056	$55,040
2023	$6.03	$72,366	$51,669	$36,906
2024	$3.70	$44,340	$31,659	$22,614



Assumptions:

- Peak alert program reduces load during alert by 0.714 MW
- Coincident peak occurs during peak alert hour with probability 5/7.

Note – Capacity costs expected to rise in future years

Additional Savings

- Average on-peak locational marginal price for SENE was $108.63 per MW in 2022 (a high-cost year)
- Average number of peak alert hours over the sample is 15.7 hours

$$Savings = \$108.63 \ x \ 15.7 \ x \ 0.714 = \$1{,}218$$

- Annual power savings on the order of $1,200 per year

- In 2023, marginal emissions on high demand days:
  - 903 pounds of carbon dioxide per MWh
  - 0.5 pounds of NO_x per MWh
  - Using 2023 EPA estimates of the social cost of CO_2 and NO_x, annual value of pollution reduction is $1,004.

Demand versus Load

- CMLP has several solar arrays totaling 6.355 MW and 4.4 MW of rooftop solar (BTM) as of September, 2023
- Is demand significantly higher than load?
- Not much.
    - I predict capacity factors using rooftop CMLP arrays for which we have production data. Average midday, summertime capacity factor is 26% (23% for hours in which an alert is called).
    - Load underestimates demand by about 7 percent in hours when an alert is called.

Summing Up

- Small number of Peak Alert days makes it difficult to estimate the load impact precisely
- Best estimate is a load reduction of 0.7 MW during hours of alert saving CMLP customers over $20,000 to $45,000 annually in recent years
  - But ISO-NE expects those costs to rise in coming years
- Capacity savings is the bulk of savings
- Cost of peak alert program is very low. Very high benefit-to-cost ratio!

- Comments and Questions?

MIT Center for Energy and Environmental Policy Research

Tufts University

Additional Slides

(Not covered in presentation)

Valuing Savings

- Capacity charge to Load Serving Entity (LSE) equals Net Regional Clearing Price (NCRP) times Capacity Load Obligation (CLO).
- NRCP set at the capacity zone level:

$$NRCP_{CZ} = \frac{Gross\ Credit_{CZ}}{CSO_{CZ} - Self\ Supply_{CZ}}$$

- CLO set for each LSE:

$$CLO_{CMLP} = CapReq_{CMLP} - SelfSupply_{CMLP}$$

where

$$CapReq_{CMLP} = \left(\frac{Peak_{CMLP}}{Peak_{SENE}}\right)(CapReq_{SENE})$$

Valuing Savings

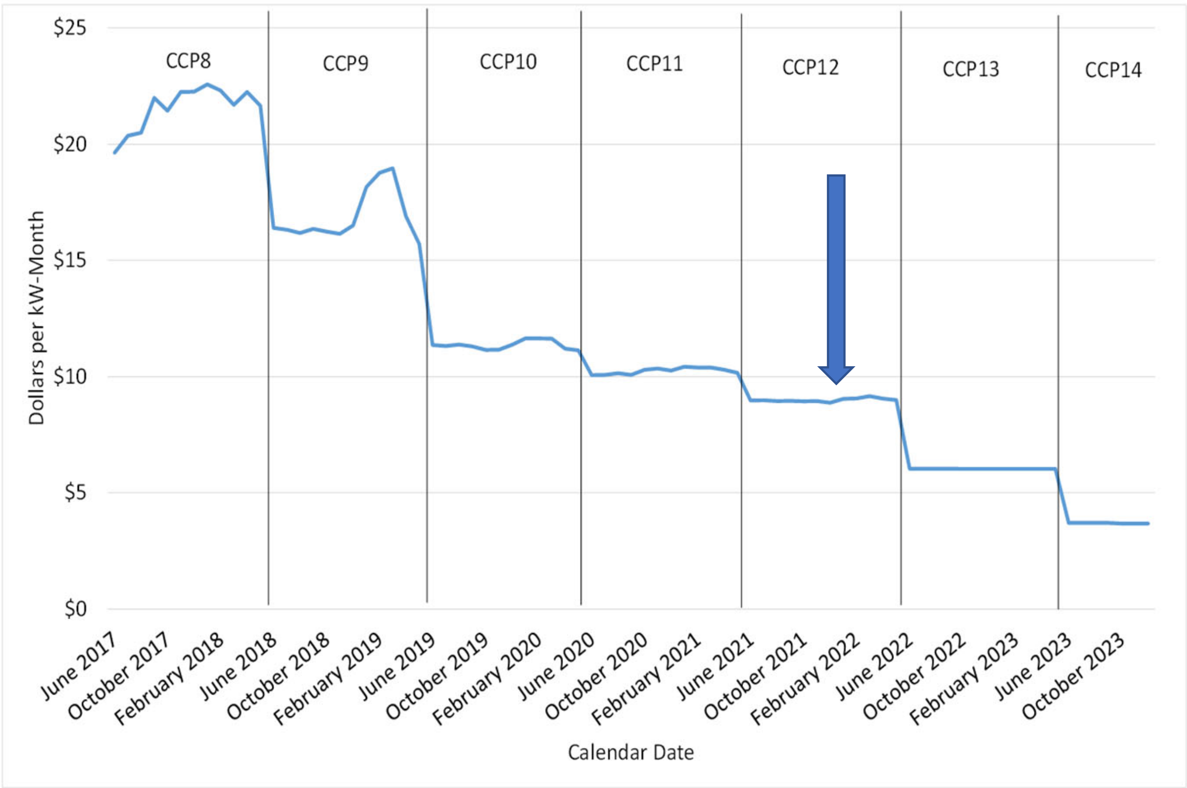
$$CLO\ Charge_{CMLP} = \kappa(Peak_{CMLP}) - NCRP\ x\ SelfSupply_{CMLP}$$

$$\kappa = \left(\frac{NCRP\ x\ CapReq_{SENE}}{Peak_{SENE}}\right)$$

Example for January 2022:

$$\kappa = \left(\frac{\$6.136033\ \ x\ 14{,}880.414}{10{,}093.38}\right) = \$9.046198$$

Incremental Value of Reducing Coincident Peak



An Informational Nudge to Shave Peak Demand

Gilbert E. Metcalf[1]

April 2, 2025

Abstract: Informational nudges to encourage energy conservation or load shifting have been tried in various contexts. This paper studies a program run by a small municipally owned electric utility to reduce demand on certain peak demand days. An email alert is sent out to residential customers who sign up for the alerts. Some recipients of those alerts forward the alerts on to other customers or community groups, making it difficult to determine how broadly the alerts are disseminated. The alerts encourage load shifting and energy saving during specific hours on the following day.

Using hourly load data for the utility, I estimate the reduction in electricity load caused by the alert emails. Using an instrumental variables approach, estimates suggest that load is reduced by roughly 0.7 MWs per hour during the hours covered by the alert. This works out to a reduction in load on the order of 2 percent. I calculate the cost savings to the municipal utility and discuss social and private benefits of the program. The private benefits of the peak alert program swamp the social benefits.

[1] Department of Economics, Tufts University; Visiting Professor, MIT Sloan School; and NBER. gmetcalf@tufts.edu.
I am grateful for helpful insights and data assistance from Laura Scott at Concord Municipal Light Plant and Scott Bertrand at ISO-NE. All errors are my own.

An Informational Nudge to Shave Peak Demand

I. Introduction

Coordinating electricity markets is a critical and complex operation, given the need to balance supply and demand at all times. To facilitate that co-ordination, the Federal Energy Regulatory Commission (FERC) encouraged the development of regional transmission and independent system operators (RTO/ISOs) to operate over larger geographic regions. Currently, RTOs and ISOs cover roughly two-thirds of the electricity load in the United States (Federal Energy Regulatory Commission, 2023). In New England, ISO New England (ISO-NE) is responsible for operating wholesale power markets and ensuring adequate capacity to serve load throughout the year. Theory suggests that competitive power markets should incentivize adequate capacity to serve load in all scenarios. In practice, however, a variety of real-world market impediments preclude that theoretic outcome. As a result, RTOs and ISOs have fallen back on other approaches to ensuring adequate capacity, including the introduction of capacity markets.

ISO-NE holds annual capacity auctions to lock in capacity for future years and charges load serving entities (LSEs) for that capacity. Charges to LSEs are based on their share of load in the single highest peak hour during the summer each year. This creates incentives for LSEs to predict the peak hour and undertake measures to reduce load during that hour. The Concord Municipal Light Plant (CMLP), a small municipally owned utility in Concord, MA, has implemented an alert program to encourage residential consumers to reduce demand during a potential peak alert hour in the months of June through September.

This paper measures whether and how much these informational alerts lower the utility's load during those hours. Using hourly data in the summer months when alerts are sent, I carry out an econometric analysis of hourly load over the years 2013 to 2024. I estimate that the alerts reduce load demand on the order of two percent. Depending on ISO-NE's cost of purchasing capacity in a given year, the benefits of a small reduction in load at peak can be substantial for a peak alert program that has almost zero cost. I estimate expected savings to CMLP in 2018, a high cost year, on the order of $132,000. The expected savings have declined over time but are anticipated to begin rising again, given ISO-NE's projections of rising clearing prices in the forward capacity auction over the next few years (ISO New England Internal Market Monitor, 2024). The private benefits to CMLP from this program are substantial but come at the cost of shifting capacity costs on to other LSEs in ISO-NE. There are social benefits from the program, however. But I find that those social benefits are swamped by the private benefits.

Section II provides some background on CMLP's program and relate it to other informational programs studied in the literature. Section III describes the data and the statistical analysis of hourly load data over a twelve-year period. A final section draws some implications and concludes.

II. Background

ISO-NE, the grid operator for New England charges load consumers an annual capacity charge based on each load's share of system load in the single highest peak demand hour for the system in a year. To reduce its charge, the Concord Municipal Light Plant (CMLP), a municipally owned utility located in Concord Massachusetts, takes various actions to encourage customers to reduce their load when it believes ISO-NE load will hit an annual peak. Among other actions, it sends an alert out, typically one-day ahead, encouraging residential customers to reduce load during the hours when the utility predicts system load might peak. Those alerts are sent to anyone who signs up to receive the emails. The total number of email recipients is not known as some recipients forward them to other individuals or groups in the community.

CMLP's informational alert is a type of nudge that is increasingly used by utilities to manage demand. Carlsson et al. (2021) define a pure nudge as a "behavioral intervention that aims to make it easier for the individual to 'do the right thing'" (p. 217). The peak alert program takes the burden off of consumers to determine when a seasonal peak might occur. There is a "moral nudge" element to the program as well since the messaging makes clear that an individual's effort to reduce energy load at peak benefits all CMLP customers.[1] Carlsson et al. survey the large and growing literature on green nudges. They argue that moral nudges can be welfare improving even when put in place in the presence of an optimal tax system. In the absence of tax optimality, nudges can be efficiency improving. While energy and pollution savings may be quite modest, most nudge type programs have a high benefit-cost ratio given the low cost of the programs.

Reiss and White (2008) provide early evidence of the impact of public exhortations to reduce electricity consumption. Like most other electricity consumers in California, households in San Diego experienced a sharp and unexpected increase in electricity prices in 2000. Over a three-month period,

[1] Carlsson, et al. (2021) define a *moral nudge* as a nudge that rewards people for "doing the right thing through psychological utility" (p. 218).

prices more than doubled.[2] Following state intervention in electricity markets, prices eventually stabilized. The city of San Diego instituted a large-scale public relations campaign to encourage households to reduce electricity use. They find that electricity use declined by 7 percent over the six-month period of the publicity campaign.

The Reiss and White analysis is instructive regarding the possibilities of public information campaigns to encourage energy saving, but it is difficult to prove causality. Ito et al. (2018) describe a field experiment carried out in Japan to reduce energy consumption during peak demand periods that is better suited to identifying causality. One of the treatment arms is a "moral suasion" treatment where households received text messages asking them to reduce electricity consumption during summer or winter peak hours. Households in this group would receive a messages on their phone, computer, and an in-home display that they were given at 4 pm on the day previous to the peak. Peak alerts were based on a specific trigger (that the next-day temperature would exceed 88 degrees F in the summer or fall below 57 degrees F in the winter) and would request reductions in electricity consumption for fixed time periods (1 to 4 pm in the summer and 6 to 9 pm in the winter). Households in the study had advanced meters installed and the researchers tracked household consumption at 30-minute intervals. The researchers find that the moral suasion treatment leads to an 8 percent reduction in consumption initially, but that the effect wears off over time with repeated messaging (what the researchers call dishabituation). They do find that after a "rest period" of three months, a repeated application of the moral suasion treatment leads to a response similar to the original response, though once again the effect wears off over time. This will be relevant when considering the design of CMLP's program.

Brandon et al. (2019) also employ a nudge to encourage energy conservation during peak demand periods. Their nudge consisted of a personal contact (automated telephone call or email) announcing a possible peak demand on the following day. Their nudge also included information about the performance of their house in saving energy relative to other similar homes in the last peak alert. They found a 3.8 percent reduction during a peak event as a result of this intervention.[3]

The Concord Municipal Light Plant (CMLP) is a municipally owned electric utility (one of 41 in Massachusetts) in Concord, MA. Concord is a wealthy, suburban community with a population of over

[2] Borenstein (2002) documents the causes and consequences of this state-wide electricity market crisis.

[3] Burkhardt et al. (2023) also does a field experiment with an alert message to warn of a peak event similar to the messaging in Ito et al. and this study. They find no impact of messaging by itself on consumption. They do find that critical peak pricing does reduce consumption at peaks, primarily by reducing air conditioner use during the peak period.

18,000 and CMLP serves over 8,300 customers in Concord (and a handful of customers in adjacent communities). The utility's total load in 2023 was 164,474 MWh, nearly 45 percent of which was load of residential customers. Another 20 percent of load serves small commercial and industrial customers while 30 percent serves large commercial and industrial customers. Municipal load makes up the balance (Concord Municipal Light Plant, 2023).

Beginning in 2009, CMLP initiated an email alert program to encourage energy saving during hours of projected ISO-NE peak load. Reducing demand during potential system-wide peaks has two benefits. First, it reduces the utility's need to purchase expensive peak power. Second, ISO-NE charges load consumers an annual capacity charge for an entire year based on each load consumer's share of system peak load in that single peak hour. That charge is applied for a year-long capacity commitment period (CCP). For example, the annual capacity commitment period for June 1, 2024 through May 31, 2025 is based on a system peak occurring in calendar year 2023. In that year, the system peak load occurred in the hour between 5:00 and 6:00 pm on Sept. 7, 2023. CMLP's peak during that hour equaled 0.161 percent of the system-wide peak. CMLP's share of the forward capacity charge for the CCP ending May 31, 2025, therefore, is 0.161 percent of the total ISO-NE capacity charge that is assessed to load.[4,5]

Alerts are sent out typically 4 to 6 times a year. Figure 1 illustrates a typical alert sent to members of the CMLP *Concordians Addressing the Peak* (CMLP CAP) google group. Currently the CMLP CAP group contains roughly 600 email addresses.[6] The overall reach of the emails, however, is a bit hard to determine since email recipients often forward the emails to friends and neighbors as well as to local community groups.[7] To put this in context, there are just over 7,000 residential customers in the CMLP system.

---

[4] Data on CMLP's CCP share from Laura Scott, CMLP employee in charge of the peak alert program, contained in an email dated June 24, 2024.

[5] ISO-NE's approach to allocating capacity charges is very similar to NYISO's approach. Both transmission organizations base the allocation off the single highest peak hour in the year (with some exceptions, in NYISO's case). ERCOT focuses on the highest load 15 minutes in each of four summer months (June through September) and averages the results. Like ERCOT, PJM constructs an average but it is over the five highest hours from the five highest peak days in the year (Energy by 5 (2022)).

[6] Number from Laura Scott (email sent on Aug. 13, 2020). According to Scott, "Some of those [email] addresses are list serves. Other folks automatically forward the alerts on to their neighbors or others. So we don't really have a precise idea of how many people we are reaching."

[7] One prominent local group is the Concord Climate Action Network (Concord CAN).

For my analysis below, I code the peak alert in Figure 1 as occurring on Sept. 7, 2023 for the hours ending 5 pm, 6 pm, and 7 pm. Figure 2 shows that most peak alerts cover the hours between 3 and 6 pm.

III. Analysis

A. Data

For my analysis, I have CMLP hourly load data for summer months (June through September) when peak alerts might be sent out covering the years 2009 – 2024.[8] I also have all of the peak alert messages sent out by CMLP since the alert program's inception in 2009. The analysis below primarily focuses on hourly load for the years 2013 through 2024, given lack of other data required in the analysis. My analysis focuses on the load data, but it is important to distinguish load from demand. Knowing demand is useful for estimating how large a percentage reduction in demand results from the peak alert program.

The town of Concord has several solar arrays in town with aggregate capacity of 6.355 megawatts and behind the meter solar capacity that, as of September 2024, totaled 4.684 megawatts. Given a summer monthly peak load between 30 and 40 megawatts (see Figure 3 data for 2023[9]), there could potentially be a significant discrepancy between load and demand in a peak hour.

In order to estimate hourly solar electricity production in Concord, I have capacity data for the three central solar arrays in town for various years. In addition, I have monthly behind-the-meter (BTM) solar capacity. Finally, I have some hourly solar production data for the three town owned arrays. Two of the arrays are ground-mounted solar arrays. The third array is a set of three roof-top solar panels on buildings in an industrial park in Concord. For the three roof-top systems, I have hourly production data for the summer months for 2018 – 2024.[10] I do not have any measure of production for the BTM panels.

Below, I will use the electricity production data from the three buildings with roof-top systems to estimate hourly capacity factors as functions of hourly weather conditions. I then use those coefficient estimates to estimate BTM solar electricity production. Estimated BTM production along with actual production for the town-owned arrays allows me to report total demand in various years.

---

[8] CMLP is only now beginning to roll out the installation of smart meters. Thus, I am forced to use aggregate CMLP data for my analysis.
[9] CMLP's monthly peak load in 2023 is similar to peak load profiles for other years. Those data are reported in CMLP's annual report to the Commonwealth of Massachusetts Department of Public Utilities.
[10] Two of the three rooftop systems have data from 2018 forward. The third one has data starting in 2021.

From NOAA's National Center for Environmental Information (NCEI), I have hourly weather data for Hanscom Air Field, located in Bedford, MA, just adjacent to Concord. Weather data include temperature, relative humidity, precipitation, and cloud cover, among other data.

From ISO-NE, I have one- through four-day ahead capacity peak forecasts (and hour of predicted peak) for 2008 through 2023 along with predicted high temperatures and dew points for Boston MA and Hartford, CT (as illustrated in Figure 1). It is these day-ahead forecasts that CMLP relies on, for the most part, for issuing a peak alert. From ISO-NE, I also have real-time hourly load data for the ISO-NE system for the years 2017 through 2023.

Table 1 provides descriptive statistics for the dataset. CMLP load during midday hours (when a peak might occur) varies between 8.7 and 45 MW with a mean of 25.[11] As Figure 3 illustrates, peak loads can be above 30 and approaching 40 MW. Peak alerts are infrequent with less than 2 percent of hours during the midday (between 1 and 8 pm) covered by a peak alert. Concord is a small load in ISO-NE with its load accounting for less than 0.2 percent of total load in the region.

B. Results

1. Regression Results

The purpose of this paper is to measure the reduction in CMLP hourly load due to the informational peak alert messages sent out. To do that, I run regressions of the following form:

$$(1) \qquad Load_{hdmy} = \beta \cdot Alert_{hdmy} + \gamma X_{hdmy} + \alpha_h + \alpha_d + \alpha_m + \alpha_y + \varepsilon_{hdmy}$$

where $Load_{hdmy}$ is the CMLP aggregate load in hour of day (h), day of week (d), month of year (m), and year (y). The variable *Alert* is an indicator variable equal to 1 in hours covered by an alert and zero otherwise. Weather regressors are included in X as well as load in the rest of the ISO-NE region. Between the various fixed effects and Concord area weather conditions, I should control for much of the variation in electrical load in Concord. Including load in the rest of the ISO-NE region captures unexplained variation in load demand not captured by my fixed effects and weather variables.

A major concern with running OLS regressions is that peak alerts are endogenous. CMLP issues a peak alert when the expected load in ISO-NE for the next day is predicted to be high. A high demand day in ISO-NE is very likely associated with a high demand day in ISO-NE. Despite my inclusion of a rich

[11] The interquartile range is 21.1 to 28.2 MW. Low values typically occur in late September and indicates the importance of electricity for cooling in the summer months.

set of weather-related variables, we can expect a positive correlation between load and the alert. To address this, I run instrumental variable regressions where I include instruments correlated with the decision to issue a peak alert but not correlated with unexplained load variation. The alerts sent to households (figure 1) suggest that the day-ahead ISO-NE projected peak load should serve as a valid instrument.[12] To allow for the possibility that the day-ahead ISO-NE projected peak load forecast may affect the decision to issue a peak alert differently depending on the hour of the day, I interact the forecasted peak load (a single number per day) with hour dummy variables.

Ordinary least square regressions of Equation (1) confirm the endogeneity issue (Table 2). If we simply split the data between hours with a peak alert and hours without, the mean hourly load is 11.6 MW higher during hours when an alert is called relative to a non-alert hour. Controlling for fixed effects lowers the mean difference from 11.6 MW to 9.0 MW. Controlling for load in the rest of ISO-NE does appear to soak up a great deal of unexplained variation in CMLP load demand. However, there is still a positive and statistically significant correlation between a peak alert hour and CMLP load (column 3). Adding weather variables does not appreciably change the coefficient. Taking the OLS regressions at face value, it would appear that issuing a peak alert is associated with higher load in the order of 0.8 MW during the peak alert hour. This, of course, is simply a correlation that does not account for any causal impact of the alerts on load.

Table 3 reports results from instrumental variable regressions. The first regression includes fixed effects for hour of day, day of week, month, and year as well as the ISO-NE hourly load (excluding CMLP's load). In this and all regressions, the ISO-NE hourly load coefficient is strongly significant; an increase in regional load of 1 MW is associated with an increase in CMLP load of roughly 1.7 MWs. The peak alert coefficient is now negative, but not statistically significant. Adding weather variables to the regression (column 2) leads to a larger and now statistically significant coefficient (at the 10 percent level) on the peak alert variable. The coefficient suggests an alert lowers load by 0.7 MWs during the alert hour. Given that less than two percent of midday hours are subject to a peak alert, it is not surprising that the regressions struggle to pick up a strong signal of the alert's impact on load.

Column 3 adds one-day ahead Boston high temperature forecasts (interacted with hour of day dummies) to the instrument set. Because of incomplete data on this day ahead forecast, I lose roughly

[12] CMLP staff member Laura Scott, who decides when to issue peak alerts, confirms that this is an important determinant of her decision to issue an alert. She also looks at day-ahead Boston temperature and relative humidity as well as forecasts of cloud cover. I do not have access to historical cloud cover forecasts and the data series on day-ahead Boston weather is incomplete. I report some runs where I include the data that I do have below.

15 percent of my observations. The coefficient on the peak alert variable continues to be negative (albeit a bit smaller) but is now not statistically significant.[13] In the final column, I consider the possibility that the peak alert program effect has changed over time. Again, given the small number of peak alerts issued, it is challenging to allow for much flexibility in how this variable impacts load. The regression shown in column 4 allows for the impact to differ for years prior to 2020 and for the years 2020 – 2024. The results suggest that the effect of the peak alert program is stronger in recent years, but neither estimated coefficient is statistically significant.[14]

Are these estimates plausible? Consider the coefficient estimate of -0.714 from column 2 in Table 3. The average July and August peak in 2022 was 38.7 MW. This suggests that the peak in the absence of the alert would have been 39.4 MW and that the alert reduced load by 1.8 percent. Given that this is a voluntary program with limited participation by CMLP customers, this strikes me as a large response. Consider this thought experiment. Residential load accounts for 45 percent of total CMLP load on average. Assuming only residential customers respond to the informational nudges, this suggests that residential load has responded by 4 percent. Depending on whether the alerts are shared with other households, the total number of households exposed to the alerts could be anywhere from 600 to 1,400 (or more). This range represents 8.5 to 20 percent of residential customers, suggesting the load reduction could be substantially higher.

To understand the impact of the program on actual electricity demand, we need an estimate of CMLP demand. That requires adding local solar production to load. As of 2023, solar capacity in the CMLP area equaled 10.76 MWs.[15] Average production from the three solar arrays in Concord in 2023 during the summertime midday hours was 1.96 MWs and during hours when a peak alert was called it was 1.51 MWs. To estimate behind the meter (BTM) solar production, I run a fractional probit regression of the capacity factors for the three roof-top installations for which CMLP collects production data as a function of weather conditions. Regression output is in appendix table A3. I then predict BTM production by multiplying the monthly BTM capacity values by the predicted capacity factor from the regression. The average predicted capacity factor for summertime midday hours is 26.3 percent.

[13] In regressions not reported here, I ran the regression using the ISO-NE peak load forecast only as an instrument (interacted with hour dummies) on the same observations included in the column 3 regression. The estimated coefficient is smaller than in column 2 and not statistically significant. It appears that the smaller number of observations is the driving factor for the change in the estimated coefficient between columns 2 and 3 rather than the expanded instrument set.

[14] I have explored various alternative specifications (different year cut-offs, interactions with a time trend, etc. In all cases, estimated coefficients are not statistically significant once I allow for more flexible formulations.

[15] I report values for 2023 because solar production data for some of the arrays are corrupted in part for 2024. No corrupted data are used in capacity factor regressions or estimated solar production.

Conditional on a peak alert being called, the average predicted capacity factor is 23.2 percent. Behind the meter solar production during summertime midday hours averages 1.16 MWs and, conditional on a peak alert being called, 0.98 MWs. Total summertime midday solar production averages 3.10 MWs and, conditional on a peak alert, 2.52 MWs. It appears load underestimates demand by roughly 13 percent on average and 7 percent conditional on a peak alert occurring.

2. Welfare Analysis

I next turn to the question of the benefits of the peak alert program. There are private benefits to CMLP customers if the program leads to a reduction in CMLP's share of the system peak used to allocate capacity charges. There may also be social benefits to the extent the program reduces load and system peaks. Focusing first on the private benefits, Figure 4 shows CMLP's coincident peak load (blue line) for the capacity commitment periods (CCPs) 2018 through 2024. CMLP's peak load varies some, ranging from a low of 36.31 MWs in CCP 2018 to a high of 39.62 MW in CCP 2019, but has fluctuated less in recent years. The bar chart reports the value of reducing CMLP's peak by one kilowatt. The average value for CCP12 was $8.99 per kW-Month. In terms of the annual savings per megawatt of peak reduction, this equates to $107,921.[16]

ISO-NE capacity costs peaked in 2018 and have significantly declined since then. Forward capacity market payments to cleared capacity actually peaked in FCA 9 (CCP 2018 – 2019) with payments totaling $4 billion. This reflected a deficit in FCA 8 arising, in large part, from the retirement of the four coal-fired Brayton Point units (totaling 1.5 MW of nameplate capacity) in 2017. The clearing price for new and existing capacity in the forward capacity market peaked in FCA 9 and then began a steady decline as new capacity entered in response to the high auction clearing price (ISO New England Internal Market Monitor, 2016).[17] Forward capacity auction clearing prices have declined from a peak of $9.55 per kW-month in FCA 9 to $2.00 per kW-month in FCA 14 (for capacity charge year 2023 – 2024). These declines are reflected in the incremental savings to CMLP from shaving peak. The most recent ISO-NE Annual Markets Report (2024) predicts they will start rising over the next four years to $3.58 per kW-month, an increase of nearly 80 percent.

Capacity costs are non-trivial for CMLP. It's annual payments in CCP 2022 came to over $3.3 million a year. Reducing CMLP's peak can bring about substantial savings. The value of reducing CMLP's

[16] In Appendix A, I describe how these values are computed. I also report monthly values of peak load reduction.
[17] CMLP's annual capacity cost and average per kW of coincident peak actually peaked the previous year.

coincident peak per kilowatt in CCP 2022 was $8.993. On a megawatt basis, this is $8,993 per month or $107,921 annually.[18]

My preferred estimate of the impact of the peak alert program is to reduce the coincident peak by 0.714 MWs. Conditional on a peak alert being called for the hour that CMLP's coincident peak occurs, the value of the program, on average, is 0.714 x $107,921 or $77,056 in CCP 2022. This assumes CMLP correctly identifies the ISO-NE peak hour each year. In actuality, CMLP calls an alert for an hour that turns out to be the ISO-NE peak hour for that year in five out of the seven years for which I have ISO-NE peak dates and hours (2018 – 2024). The expected value of the peak alert program then is

$$E(Savings) = \left(\frac{5}{7}\right)(\$77{,}056) = \$55{,}040.$$

Table 4 reports the yearly expected savings to CMLP from its peak alert program. Expected savings have declined from over $130,000 to a little more than $20,000 in the last full year (ending May 2024).

CMLP also saves the cost of purchased power, to the extent that the program leads to reduced as opposed to shifted demand. An upper bound estimate on purchased power savings assumes the peak alert leads to reduced demand only and no shift in demand.[19] Savings in private power purchase from the peak alert program are dwarfed by the savings in capacity charge. Consider 2022 when wholesale electricity prices were at a local peak over the last decade. In July of that year, the average on-peak locational marginal price for Southeast Massachusetts region was $108.63 per MW.[20] The average number of peak alert hours in a year is 15.7. Using the peak power price from July 2022, average power purchase savings were no more than $\$108.63\ x\ 15.7\ \text{hours}\ x\ 0.714$ equals $1,218.

Estimating the social value of the program is complicated. In addition to needing to know the actual change in consumption, we need to know the marginal generator. In 2023, the most recent year for which data are available, marginal emissions on high-demand days averaged 903 pounds per MWh.[21]

---

[18] I ignore the effect of a reduction in CMLP's coincident peak on ISO-NE's peak load given that CMLP's peak is about 0.15 percent of the system peak.

[19] If all load is simply shifted, the private savings is simply the difference in the locational marginal price (LMP) of electricity between the two hours. Note that It is possible that the load reduction could be negative if, for example, households use more electricity to cool their homes prior to a peak alert period in anticipation of the alert's call to reduce load. In that case, there would not be a savings unless a reduction in the LMP for the hours of shifted demand more than offset the increased electricity consumption.

[20] Monthly ISO-NE average locational marginal prices are available at https://www.iso-ne.com/isoexpress/web/reports/pricing/-/tree/monthly-lmp-indices, accessed on March 18, 2025.

[21] Averages are load-weighted, reflecting the fact that generation of renewables is more likely to occur in export constrained areas. Data are from ISO New England (2024). The 2023 high-demand days match closely with days on which CMLP issued peak alerts. Note however that true marginal emissions can differ from ISO-NE specific measured emissions given the ability to import or export electricity from other regions. See Holland et al. (2024)

Marginal emission rates for nitrous oxides (NO_x) and sulfur dioxide (SO_2) were 0.5 and 0.1 pounds per MWh, respectively. The U.S. EPA's National Center for Environmental Economics (2023) reports a social cost of carbon dioxide (CO_2) for 2025 (in 2020 dollars) of $212 per metric ton and a social cost of nitrous oxide (N_20) is $60,267 per metric ton.[22] This translates to a social cost of carbon per MWh on high demand days of $86.83 for carbon dioxide and $2.73 for nitrous oxide. Using these numbers, the annual reduction in environmental costs due to CMLP's peak alert program is $15.7 \cdot (86.83 + 2.73)(0.714) = \$1,004$.

IV. Conclusion

The Concord municipal peak alert program is an interesting example of an informational nudge program to reduce peak demand. It is but one of a large number of programs that have been carried out across the country. Despite the fact that there is limited information dispersion through the email group and no individual financial incentive to reduce or shift demand, the program appears to reduce load during peak hours when an alert is called. Annual social benefits are modest, but the costs of the program are trivial. Private benefits, however, are significant for this small, municipal utility as any reduction in its capacity share shifts aggregate ISO-NE capacity charges onto other utilities and load customers in the region. This, of course, suggests a unproductive competition where ISO-NE utilities implement similar programs to reduce peak demand during the hour that ISO-NE is predicted to hit its annual peak. A focus on reducing this singular hour of demand is unlikely to reduce overall peak demands and the need to have capacity available for high-demand summer hours. Such a competition would suggest that it would be fruitful for ISO-NE to consider alternative ways to allocate capacity charges across its customers that don't focus on a single peak hour of the year to allocate annual charges.

---

who discuss possible biases when ignoring the impact of load in one region on marginal generation in other regions.

[22] These are the vues assuming a near-term discount rate of 2 percent. No values for sulfur dioxide are reported.

Figure 1. A Typical Peak Alert Message

CMLP

to CMLP CAP

Sep 6, 2023, 10:33:48 AM

Thank you for participating in Concord Light's CAP Google Group and helping to **reduce the summer peak demand for electricity** on New England's electrical grid (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and most of Maine.)

The current weather forecast confirms a peak electricity day is possible for Thursday September 7th 2023 from 4PM to 7PM.

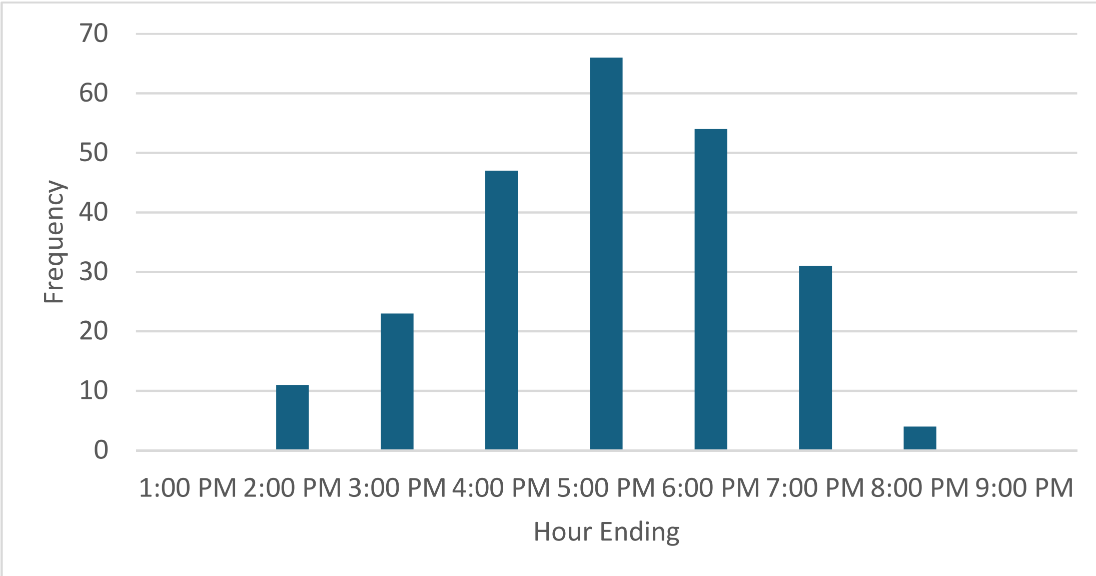
Forecast for 2023-09-07 (as of 09/06/2023 09:31 AM EDT)

Weather	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Wed	Thu	Fri	Sat	Sun	Mon
	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep	11-Sep
High Temperature - Boston	81	86	86	82	78	76
Dew Point - Boston	68	70	71	70	70	68
High Temperature - Hartford	93	94	88	83	79	77
Dew Point - Hartford	68	69	72	71	71	69
Projected Peak Load	22,800	23,500	21,250	18,750	17,500	17,500
Peak Forecast Hour	6PM	5PM	5PM			
Peak Occurrence Probability	POSSIBLE	POSSIBLE	UNLIKELY	UNLIKELY	UNLIKELY	UNLIKELY

If you are able to reduce your electricity use during these hours, you can help reduce electricity costs for all CMLP customers. During these hours, you might consider doing any of the following:

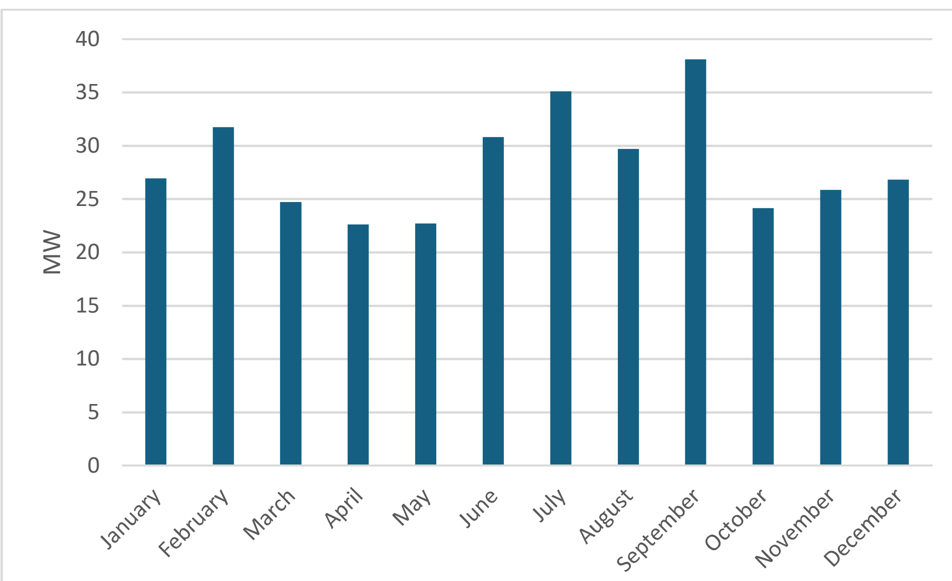
- turn your A/C up a few degrees
  - turn off lights anywhere they are not needed and dim others if they are dimmable
- postpone use of pool pumps, dryers, washing machines, and other appliances
- reduce plug load by turning off computers, televisions, etc.
- Cook dinner on the grill or have a picnic supper
- Do not charge an electric vehicle during a peak demand event
  - Pre-cool your home and then let it coast without A/C until after the peak demand event
  - Use fans instead of or in addition to A/C as fans use much less electricity than air conditioning
- Close blinds on windows facing the sun
- Use smart power strips to turn off multiple devices with one touch
- Get an energy assessment for your home or business to see if there are more electricity-saving opportunities. Find out more information here: http://www.concordma.gov/1751/Energy-Management-Renewable-Energy-Effic

Figure 2. Frequency of Peak Alert Messages by Hour Ending



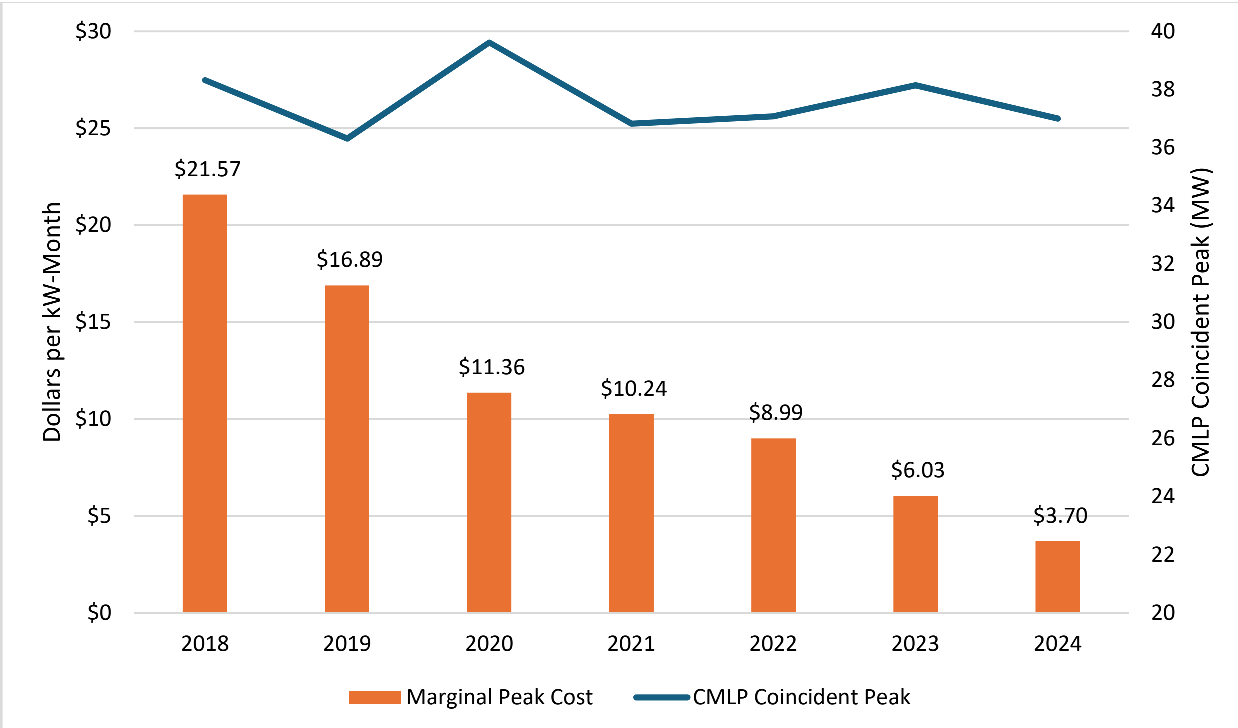
Source: CMLP Peak Alert Data on peak alerts for years 2009 – 2023
from the CAP Google Group

Figure 3. Monthly Peak Load in 2023



Source: Concord Municipal Light Plant (2023)

Figure 4. CMLP Capacity Charges



Source: CMLP and ISO-NE Data. Year labels indicate the ending year for a Capacity Commitment Period.

Table 1. Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Max
CMLP Real Time Load (MWh)	13664	24.674	5.56	8.657	45.019
Peak Alert Hour	13664	.018	.134	0	1
Day Ahead ISO-NE Peak Forecast (GW)	13664	18.08	2.991	12.45	27.7
ISO-NE Load (GWh)	10248	16.953	3.147	8.698	27.334
Dry Bulb Temperature	13637	74.323	9.168	42	101
Wet Bulb Temperature	13562	64.832	6.801	39	82
Dew Point Temperature	13614	58.571	8.748	26	79
Relative Humidity	13614	61.071	19.075	16	100
Interaction of Dry Bulb Temp and Relative Humidity	13614	44.463	12.01	13.12	76
Barometer Reading	13602	29.798	.174	28.87	30.46
Hourly Precipitation (inches)	13482	.006	.043	0	2.23
Visibility in Miles	13636	9.547	1.628	.5	10

Summary statistics for years 2009 - 2024, summer months and midday hours only when peak alerts might be called. ISO-NE load excludes CMLP load.

Table 2. OLS Regressions on CMLP Load

VARIABLES	CMLP Load			
	(1)	(2)	(3)	(4)
Peak Alert	11.60***	9.023***	0.826***	0.810***
	(0.340)	(0.274)	(0.0869)	(0.0864)
ISO-NE Load			1.771***	1.716***
			(0.00493)	(0.00841)
Observations	13,664	13,664	10,248	10,018
R-squared	0.079	0.421	0.955	0.956
Fixed Effects	No	Yes	Yes	Yes
ISO Load	No	No	Yes	Yes
Weather Variable	No	No	No	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Fixed effects control for hour of day, day of week, month, and year included. ISO Load excludes CMLP load. Midday hours only in regressions

Table 3. Instrumental Variable Regressions on CMLP Load

VARIABLES	CMLP Load			
	(1)	(2)	(3)	(5)
Peak Alert	-0.444	-0.714*	-0.586	-0.576
	(0.373)	(0.370)	(0.438)	(0.877)
Peak Alert (2020 – 2024)				-0.318
				(1.830)
ISO-NE Load	1.789***	1.742***	1.731***	1.742***
	(0.00709)	(0.0105)	(0.0121)	(0.0105)
Observations	10,248	10,018	8,464	10,018
R-squared	0.954	0.955	0.952	0.955
Weather Variables	No	Yes	Yes	Yes
Instrumental Variables	IV1	IV1	IV2	IV1

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Controls for hour of day, day of week, month, and year included in all regressions. ISO Load excludes CMLP Load. Midday hours only in regression. IV1 is a set of instrumental variables comprising the one-day ahead ISO-NE peak forecast interacted with hour of day dummies. IV2 adds the one-day ahead temperature forecast for Boston interacted with hour of day dummies to IV1.

Table 4. Expected Private Value Of Peak Alert Program

CCP	Marginal Peak Cost (kW-Mo)	Annual per MW	Value of Peak Alert	E(Value of Peak Alert)
2018	$21.57	$258,890	$184,847	$132,034
2019	$16.89	$202,628	$144,676	$103,340
2020	$11.36	$136,279	$97,303	$69,502
2021	$10.24	$122,928	$87,771	$62,693
2022	$8.99	$107,921	$77,056	$55,040
2023	$6.03	$72,366	$51,669	$36,906
2024	$3.70	$44,340	$31,659	$22,614

Source: Author's Calculations

References

Borenstein, Severin. 2002. "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster." *Journal of Economic Perspectives*, 16(1), 191–211.

Brandon, Alec; John A List; Robert D Metcalfe; Michael K Price and Florian Rundhammer. 2019. "Testing for Crowd out in Social Nudges: Evidence from a Natural Field Experiment in the Market for Electricity." *Proceedings of the National Academy of Sciences*, 116(12), 5293-5298.

Burkhardt, Jesse; Kenneth T. Gillingham and Praveen K. Kopalle. 2023. "Field Experimental Evidence on the Effect of Pricing on Residential Electricity Conservation." *Management Science*, 69(12), 7784-7798.

Carlsson, Fredrik; Christina Gravert; Olof Johansson-Stenman and Verena Kurz. 2021. "The Use of Green Nudges as an Environmental Policy Instrument." *Review of Environmental Economics and Policy*, 15(2), 216-237.

Concord Municipal Light Plant. 2022. "Return of the Municipal Light Department of the Town of Concord," Commonwealth of Massachusetts Department of Public Utilities: Boston, MA,

Concord Municipal Light Plant. 2023. "Return of the Municipal Light Department of the Town of Concord," Commonwealth of Massachusetts Department of Public Utilities: Boston, MA,

Energy by 5. 2022. "Coincidental Peaks Should Peak Your Interest," https://www.energyby5.com/coincidental-peaks-should-peak-your-interest#. Accessed on March 4, 2025.

Federal Energy Regulatory Commission. 2023. "Electric Power Markets," https://www.ferc.gov/electric-power-markets, Accessed on March 19, 2025.

Holland, Stephen P.; Erin T. Mansur; Valentin Verdier and Andrew J. Yates. 2024. "Regularization from Economic Constraints: A New Estimator for Marginal Emissions." *National Bureau of Economic Research Working Paper Series*, No. 32065.

ISO New England. 2022. "Monthly Market Operations Report January 2022," ISO-NE, Holyoke, MA.

ISO New England. 2024. "2023 ISO New England Electric Generator Air Emissions Report," ISO-NE, Holyoke, MA.

ISO New England Internal Market Monitor. 2016. "2015 Annual Market Report," ISO New England, Holyoke, MA.

ISO New England Internal Market Monitor. 2024. "2023 Annual Markets Report," ISO New England, Holyoke, MA.

Ito, Koichiro; Takanori Ida and Makoto Tanaka. 2018. "Moral Suasion and Economic Incentives: Field Experimental Evidence from Energy Demand." *American Economic Journal: Economic Policy*, 10(1), 240-267.

National Center for Environmental Economics. 2023. "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," Climate Change Division: Washington, DC,

NOAA National Centers for Environmental Information. 2025. "Local Climatological Data (LCD)," NOAA NCEI: Washington, DC, https://www.ncdc.noaa.gov/cdo-web/datatools/lcd.

Reiss, Peter C. and Matthew W. White. 2008. "What Changes Energy Consumption? Prices and Public Pressures." *The RAND Journal of Economics*, 39(3), 636-663.

Appendix I: Capacity Charging in ISO-NE

ISO-NE runs an annual forward capacity auction (FCA) to ensure adequate supply for the New England region. The auction sets an initial price for firm capacity for a Capacity Commitment Period (CCP). As an example, CCP12 was a period running from June 2021 through May 2022 and the initial auction was held in February 2018. That annual auction is supplemented by subsequent annual and monthly reconfiguration auctions that occur up to and during the CCP.

Each month, payments are made to Capacity Supply Obligations (CSO) that indicate megawatts of capacity that are obligated for that month. In CCP12, CSOs and obligated payments were allocated among three capacity zones: Northern New England (NNE), SouthEast New England (SENE), and the Rest of the Pool (ROP). As an example, CSOs and the projected payment (gross credit) in January 2022 was as follows:

Table A1. January 2022 Capacity Market Information

Zone	CSO (MW)	Gross Credit	Self-Supply (MW)	NCRP ($ per kW-Mo)
ROP	15,829	$77,068,447	602	$5.089647
NNE	8,448	$35,565,942	736	$4.611848
SENE	10,722	$64,338,251	307	$6.136033
TOTAL	34,999	$176,972,640	1,644	

Source: ISO New England (2022)

The first step in assigning costs to load serving entities is to determine the net regional clearing price (NRCP), the price applied to load. The NRCP is determined for each zone and equals

A1 $$NRCP_{CZ} = \frac{Gross\ Credit_{CZ}}{CSO_{CZ} - Self\ Supply_{CZ}}.$$

The last column of Table A1 reports the NCRP for January 2022.[24]

A load serving entity (LSE) will pay a monthly charge equal to the zonal NCRP times its capacity load obligation (CLO). The CLO for LSE i in capacity zone j equals

A2 $$CLO_{ij} = Capacity\ Requirement_{ij} - HQICC_{ij} - SelfSupply_{ij} + Bilaterals_{ij}$$

where $HQICC_{ij}$ is the LSE's Hydro Quebec Installed Capacity Credits and $Bilaterals_{ij}$ are any bilateral contracts the LSE has, and

A3 $$Capacity\ Requirement_{ij} = \left(\frac{Peak_i}{Peak_j}\right)\left(Capacity\ Requirement_j\right).$$

The monthly capacity load obligation charge then is

[24] The reported NCRP differs slightly from the calculated number using the entries in the table above due to rounding in the table for both the CSO and self-supply to integer values.

A4 $$CLO\ Charge_{ij} = NRCP\ x\ CLO_{ij}$$

Consider CMLP in January 2022. It's capacity requirement for that month is

$$Capacity\ Requirement_{CMLP} = \left(\frac{37.088}{10{,}093.38}\right)(14{,}880.414) = 54.662\ MW.$$

CMLP has no *HQICC* or *Bilaterals* and it's self-supply is 9.205 MW so Its capacity load obligation for the month is

$$CLO_{CMLP} = 54.662 - 9.205 = \ 45.457.$$

It's CLO charge for January then would be $45.457\ x\ 1000\ x\ \$6.136033\ = \$278{,}926.$[25]

While the NCRP is a charge per kW-month, it is not the incremental price on a megawatt of CMLP's peak. To see that, combine formulas A2, A3, and A4:

A5 $$CLO\ Charge = \ NCRP\ x\ \left(\left(\frac{Peak_{CMLP}}{Peak_{SENE}}\right)(Capacity\ Requirement_{SENE}) - SelfSupply_{CMLP}\right)$$

or

A6 $$CLO\ Charge_{CMLP} = \ \kappa(Peak_{CMLP}) - \ NCRP\ x\ SelfSupply_{CMLP}$$

where

A7 $$\kappa = \left(\frac{NCRP\ x\ Capacity\ Requirement_{SENE}}{Peak_{SENE}}\right).$$

The parameter, κ , is the incremental value to CMLP of reducing its peak by 1 kW.[26] For January, 2022, The *SENE* capacity requirement was 14,880.414 MW and the zonal peak was 10,093.38 MW. The value of κ in this month was

$$\kappa = \left(\frac{\$6.136033\ \ x\ 14{,}880.414}{10{,}093.38}\right) = \$9.046198\ .$$

[25] The actual charge was $278,923.70. The difference is due to rounding. To this CLO charge is added assorted other charges, all of smaller orders of magnitude, so that the final monthly bill was $272,234.63.

[26] This is an approximation as it does not account for the fact that any change in CMLP's peak affects the zonal peak which, in turn, affects CLO charge sharing across the three ISO-NE zones. CMLP's load is sufficiently small relative to system load that we can ignore this.

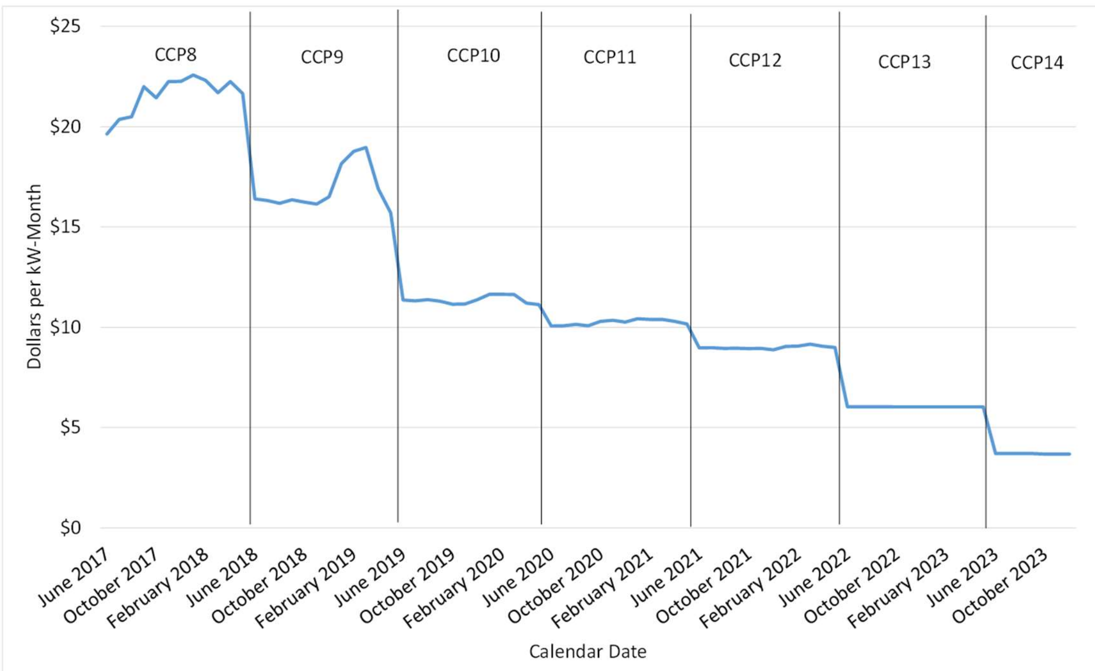
Note that rather than gross up the NRCP by the ratio of the regional capacity requirement to the regional coincident peak, ISO-NE grosses up the customer peak contribution (CMLP's coincident peak) to a "customer capacity requirement" by that ratio. Using the values from January 2022:

$$54.66 = \frac{14{,}880.414}{10{,}093.38}\ x\ 37.08.$$

It then multiplies this number by the NRCP (after subtracting off any CMLP self-supply).

Figure A1 below graphs the monthly incremental savings from a 1 kW reduction in CMLP's peak load for CCP8 through CCP14 (partial year). The monthly incremental value of a peak reduction is generally relatively constant within CCP years.

Figure A1. Monthly Incremental value of 1 kW Peak Load Reduction



Appendix II: Regressions Reporting Weather Variables

Table A1. OLS Regressions

VARIABLES	CMLP Load			
	(1)	(2)	(3)	(4)
Peak	11.60***	9.023***	0.826***	0.810***
	(0.340)	(0.274)	(0.0869)	(0.0864)
ISO-NE Load			1.771***	1.716***
			(0.00493)	(0.00841)
Dry Bulb Temperature				-0.0798***
				(0.0185)
Wet Bulb Temperature				0.0380
				(0.0385)
Dew Point Temperature				0.131***
				(0.0132)
Relative Humidity				-0.00647
				(0.00722)
Interaction of Dry Bulb Temp and Relative Humidity				-0.0914***
				(0.0164)
Barometer				0.0126
				(0.0768)
Precipitation				1.138***
				(0.275)
Visibility				-0.0617***
				(0.00964)
Observations	13,664	13,664	10,248	10,018
R-squared	0.079	0.421	0.955	0.956
Fixed Effects	No	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed effects and weather variables included in regression
Controls for hour of day, day of week, month, and year included. ISO Load excludes CMLP Load.
Midday hours only in regression

Table A2. Instrumental Regressions

VARIABLES	CMLP Load			
	(1)	(2)	(3)	(4)
Peak Alert	-0.444	-0.714*	-0.586	-0.576
	(0.373)	(0.370)	(0.438)	(0.877)
Peak Alert (2020 – 2024)				-0.318
				(1.830)
ISO-NE Load	1.789***	1.742***	1.731***	1.742***
	(0.00709)	(0.0105)	(0.0121)	(0.0105)
Dry Bulb Temperature		-0.0869***	-0.114***	-0.0870***
		(0.0188)	(0.0214)	(0.0188)
Wet Bulb Temperature		0.0469	0.0555	0.0468
		(0.0391)	(0.0441)	(0.0391)
Dew Point Temperature		0.133***	0.149***	0.133***
		(0.0134)	(0.0151)	(0.0136)
Relative Humidity		-0.00498	-0.0206**	-0.00539
		(0.00732)	(0.00839)	(0.00770)
Interaction of Dry Bulb Temp and Relative Humidity		-0.0990***	-0.0880***	-0.0982***
		(0.0168)	(0.0188)	(0.0174)
Barometer		-0.0166	0.156*	-0.0164
		(0.0782)	(0.0884)	(0.0782)
Precipitation		1.035***	1.047***	1.030***
		(0.280)	(0.300)	(0.281)
Visibility		-0.0645***	-0.0730***	-0.0648***
		(0.00980)	(0.0108)	(0.00996)
Constant	-4.734***	-2.717	-6.634**	-2.695
	(0.113)	(2.424)	(2.740)	(2.428)
Observations	10,248	10,018	8,464	10,018
R-squared	0.954	0.955	0.952	0.955
Instrumental Variables	IV1	IV1	IV2	IV1

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed effects and weather variables included in regression
Controls for hour of day, day of week, month, and year included. ISO Load excludes CMLP Load. Midday hours only in regression. IV1 is a set of instrumental variables comprising the one-day ahead ISO-NE peak forecast interacted with hour of day dummies. IV2 adds the one-day ahead temperature forecast for Boston interacted with hour of day dummies to IV1.

Table A3. Solar Capacity Regression

VARIABLES	Capacity Factor
Ln(Temperature)	1.077***
	(0.111)
Ln(Relative Humidity)	-0.978***
	(0.0454)
Visibility (miles)	0.00660
	(0.00737)
Indictor for 10 Mile Visibility	0.143***
	(0.0415)
Indicator for Broken Sky Clouds	-0.0876***
	(0.0160)
Indicator for Overcast Clouds	-0.339***
	(0.0190)
Constant	-0.662
	(0.577)
Observations	8,678
Pseudo R^2	0.216

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Hour of day fixed effects included along with hour of day interactions with ln(Temperature) and ln(Relative Humidity)

Table A4. Summary Statistics on Solar Capacity and Production in 2023

Variable	N	Mean	Std. Dev.	Min	Max
Predicted capacity factor from fractional probit regression	841	.263	.213	.006	.842
Predicted BTM solar production	841	1.157	.936	.026	3.689
Total Solar production (MWs)	791	3.1	2.611	.033	9.12
CMLP Real Time Demand (MWs)	791	25.583	5.058	16.763	41.663
CMLP Real Time Load (MWs)	854	22.498	5.057	10.57	38.102
Summary Statistics Conditional on a Peak Alert					
Predicted capacity factor from fractional probit regression	33	.232	.151	.02	.538
Predicted BTM solar production	33	.976	.622	.087	2.196
Total Solar production (MWs)	33	2.518	1.691	.087	5.557
CMLP Real Time Demand (MWs)	33	38.219	3.087	32.631	43.642
CMLP Real Time Load (MWs)	34	35.684	2.425	30.552	39.304

Summary statistics for summer months and midday hours only in 2023