



Electric Vehicle Managed Charging in New England

Load Forecast Committee

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Overview

- The purpose of this presentation is to highlight updates to ISO's plan for incorporating EV managed charging of personal light-duty electric vehicles (EVs) into the CELT 2024 transportation electrification forecast
 - An [initial version of this presentation](#) was shared at the December 8, 2023 Load Forecast Committee (LFC) meeting
- Additional analysis and stakeholder feedback have resulted in the following updates:
 - Inclusion of additional details on Burlington Electric Department's EV charging credit program (slide 8)
 - Inclusion of two additional managed charging programs in NH operated by Liberty Utilities and Unitil (slide 9)
 - Updated graphics on slides 12-15, summarizing individual program characteristics
 - Updated regional blended EV managed charging profiles (slides 13, 16, and 17) that:
 - 1) Incorporate the two additional NH programs, and
 - 2) Weight off-peak charging more heavily toward the start of the off-peak period for each program (to capture "timer-peak" effect)

Overview

- Electric vehicle managed charging (EVMC) is expected to impact the timing of electric vehicle (EV) charging to an increasing degree over the next decade and beyond
- Current utility programs largely target personal light-duty EVs, discouraging charging during a static set of on-peak hours
 - Incentives
 - TOU rates
- EVMC programs may likely evolve in the coming years
 - This presentation focuses on incorporating **existing** EVMC program characteristics into ISO's transportation electrification forecast
- Analysis and examples shown in this presentation are based on the CELT 2023 forecast with a focus on winter peak impacts

Electric Vehicle Managed Charging Terms

- **EVMC** – Electric vehicle managed charging
- **Smart charger** – Charger that can communicate and be controlled, not all chargers are smart (also called a “networked charger”)
- **V1G** – Control timing and rate of charging (unidirectional)
- **V2X** – Control direction of energy flow along with timing and rate of charging (bidirectional)
 - Control timing and direction of energy flow (both charging and discharging)
 - Vehicle to home (V2H): discharge to home, or other personal use (controlled by owner)
 - Vehicle to grid (V2G): grid (controlled by electric utility)
- **Behavioral load control** - Customer decides when to charge, and the utility simply observes performance (also called “passive managed charging”)
- **Direct load control** - Utility sends direct load control signals to the EV or EV charger (also called “active managed charging”)

Massachusetts EVMC Programs

Personal Light-Duty Vehicles

- National Grid (NGRID): [Massachusetts EV Off-Peak Charging Program](#):
 - Off-peak hours are 9 pm to 1pm Mon-Fri, excluding national holidays
 - Participants are eligible to earn
 - \$0.05/kWh for EV charging during off-peak hours from June 1 to September 30 (“summer months”)
 - \$0.03/kWh for EV charging during off-peak hours from October 1 through May 31 (“non-summer months”)
 - Earning an average of \$100 annually when you charge your EV during designated off-peak times and get a \$50 enrollment incentive*
- Eversource – nothing at the moment

Connecticut EVMC Programs

Personal Light-Duty Vehicles

- [Connecticut Electric Vehicle Charging Program](#)

“...offers eligible residential EV drivers the opportunity to earn rebates and incentives to charge their EV smarter, avoid costly peak time energy use, and help your utility, either United Illuminating (“UI”) or Eversource, collectively (“utilities”), manage the additional electricity demand from EV’s now and into the future”

Baseline Tier	Advanced Tier
<ul style="list-style-type: none">• Earn up to \$120 a year for charging during off-peak hours<ul style="list-style-type: none">• Off-peak hours are defined as any time other than 3 pm to 9 pm on weekdays• Every month during which 80% of charging time is during off-peak hours: \$10 per month• Earn up to \$80 a year for not opting out of peak demand events<ul style="list-style-type: none">• From June to September: \$20 per month.	<ul style="list-style-type: none">• Earn \$25 per month by allowing Eversource to schedule your charging for you• More sophisticated managed charging tier where participants are rewarded for partnering with the utility to coordinate charging such that EV charging is optimized on the utility system• In this tier, participants will create a charging schedule for themselves, and the utilities will coordinate and optimize the charging schedules of all EVs in the Advanced Tier to drive better outcomes for their grid systems

Rhode Island EVMC Programs

Personal Light-Duty Vehicles

- SmartCharge Rhode Island pilot program
 - 2019 National Grid program with 300 drivers
- Participants garner a cost incentive for charging their vehicles during off-peak times
 - Off-peak hours: 9 pm until 1 pm
 - \$0.06 per kWh from June to August
 - \$0.04 per kWh for the remainder of the year.
- Expired in September 2022

Vermont EVMC Programs

Personal Light-Duty Vehicles

Burlington Electric Department (BED) Electric Vehicle Charging Credit

- The EV Charging Credit is \$0.076 per kWh and will appear as credit on bill
- To receive the monthly EV charging credit, you may **only** charge your vehicle during the allowed times for each option
 - If at any time during your billing month you charge outside these times, you will not receive the credit
- Three participation options
 - Fixed EV Charging Option
 - Charge your vehicle between 10 pm and 12 noon only
 - Flexible Load Option
 - Charge your vehicle outside of event times
 - BED will notify Customers through a mobile phone at least 8 hours of notice prior to the start of an event
 - Flexible Real-Time Option
 - Allow for utility to directly load control of your EV charging in real-time
 - The utility will curtail charging when necessary, based on market and load information
 - Control can be overridden, but will result in a forfeiture of the EV charging credit for the billing month

Green Mountain Power (GMP) EV Rates

Rate 74 - Residential Time-of-Use Electric Vehicle Service

- Peak Hours : 1 pm and 9pm, Mon -Fri
- During Peak Hours: \$0.18989 per kWh
- During Off-Peak Hours: \$0.14452 per kWh

Rate 72 - Residential Off Peak Electric Vehicle Service

- Off Peak Hours are defined as all hours outside of any Peak Event

- Peak Event is defined as a period of time in which GMP will disable the vehicle charger from charging a vehicle, but this can be overridden
- Occur on average of 5 to 10 times per month for an average of 2 to 6 hours at a time.
- Notification sent 4 to 24 hours in advance
- Rewarded for off-peak charging, penalized for peak charging
 - Usage, Off Peak: \$0.15029/kWh
 - Usage, Peak Opt-out: \$0.77270/kWh

New Hampshire EVMC Programs

Personal Light-Duty Vehicles

- [New Hampshire Electric Cooperative \(NHEC\) Electric Vehicle \(EV\) Time-Of-Use \(TOU\) Rate](#)

- On peak: 7 am – 9 pm non-holiday weekdays only
- Incentive for charging off peak
 - Basic res rate: \$0.21274 per kWh
 - Off-peak EV rate: \$0.15432 per kWh
 - On-peak EV rate: \$0.25316 per kWh

- [Unitil Electric Vehicle Time of Use \(TOU\) Rate](#)

- Tiered rate depending on time charging occurs
 - On-peak (most expensive)
 - Mid-peak (less expensive)
 - Off-Peak (cheapest)
- Hours
 - On-Peak kWh: 3 pm – 8 pm non-holiday weekdays
 - Mid-Peak: 6 am – 3 pm non-holiday weekdays
 - Off-Peak: 8 pm – 6 am

- [Liberty Utilities Plug in Electric Vehicle Rate](#)

- Tiered rate depending on time charging occurs
 - Critical-peak (most expensive)
 - Mid peak (less expensive)
 - Off-Peak (cheapest)
- Hours
 - Off peak: 8 pm to 8 am
 - Mid peak:
 - 8AM to 3PM daily Monday through Friday except holidays
 - 8AM to 8PM Saturday, Sunday and holidays
 - Critical peak: 3PM to 8PM daily Monday through Friday, except holidays.
- Rates are revised for each seasonal period:
 - Summer period spans May - November
 - Winter period spans November - April

Summary of Residential EVMC Programs

State	Utility	Program	Type	Pricing	On-Peak Hours *	Adherence
MA	National Grid	Massachusetts EV Off-Peak Charging Program	Incentive	<ul style="list-style-type: none"> Credit for charging outside peak hours: <ul style="list-style-type: none"> \$0.05 /kWh June-Sept \$0.03 /kWh other months 	1 pm – 9 pm non-holiday weekdays	Passive, User Choice
CT	Eversource, United Illuminating	CT Electric Vehicle Charging Program – Baseline Tier	Incentive	<ul style="list-style-type: none"> \$10/month each month where at least 80% of charging is outside of peak times \$20/month June-Sept for not opting out of peak demand events 	3 pm – 9 pm weekdays	Passive, User Choice with constraint
CT	Eversource, United Illuminating	CT Electric Vehicle Charging Program – Advanced Tier	Incentive	<ul style="list-style-type: none"> \$25 per month by allowing Utility to schedule your charging Participants create daily charging schedule and Utilities will optimize among all EVs 	N/A	Passive
RI	National Grid	SmartCharge RI Pilot (expired)	Incentive	<ul style="list-style-type: none"> Credit for charging outside peak hours: <ul style="list-style-type: none"> \$0.06 /kWh June-Aug \$0.04 /kWh other months 	1 pm – 9 pm	Passive, User Choice

* The term “on-peak” here refers to the hours in which the program de-incentivizes charging



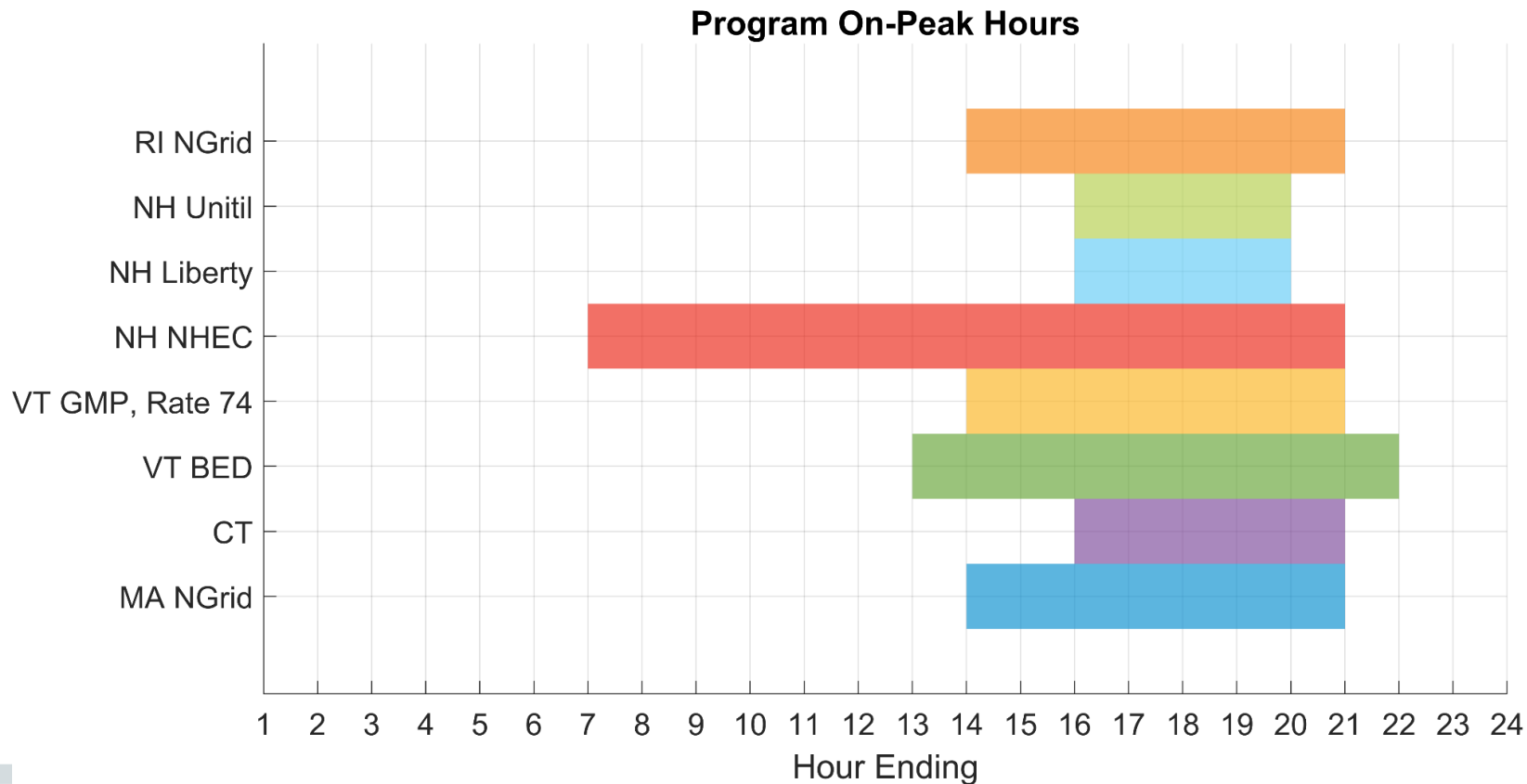
Summary of Residential EVMC Programs

State	Utility	Program	Type	Pricing	On-Peak Hours *	Adherence
NH	New Hampshire Electric Co-op (NHEC)	Electric Vehicle (EV) Time-Of-Use (TOU) Rate	TOU	<ul style="list-style-type: none"> Off-Peak Rate: \$.15432 per kWh On-Peak Rate: \$.25316 per kWh 	7 am – 9 pm non-holiday weekdays	Passive, User Choice
NH	Unitil	Electric Vehicle (EV) Time-Of-Use (TOU) Rate	TOU	<ul style="list-style-type: none"> Off-Peak Rate: \$0.08323 per kWh Mid-Peak Rate: \$0.08480 per kWh On-Peak Rate: \$0.10204 per kWh 	3 pm – 8 pm non-holiday weekdays	Passive, User Choice
NH	Liberty Utilities	Plug in Electric Vehicle Rate	TOU	<ul style="list-style-type: none"> Off-Peak Rate: \$0.20779 per kWh Mid-Peak Rate: \$0.23595 per kWh Critical-Peak Rate: \$0.24487 	3 pm – 8 pm non-holiday weekdays	Passive, User Choice
VT	Burlington Electric Dept. (BED)	Electric Vehicle Charging Credit - Fixed	Incentive	<ul style="list-style-type: none"> Credit of \$0.075691/kWh if you only charge outside peak times within the billing month 	12 pm – 10 pm	Passive, Rigid
VT	Burlington Electric Dept. (BED)	Electric Vehicle Charging Credit – Flexible (2 options)	Incentive	<ul style="list-style-type: none"> Credit of \$0.075691/kWh if you only charge outside events (Flexible Load Option) or do not override direct load controls signals (Flexible Real-Time Option) 	Flexible Load Option: Based on events called with advance notice Flexible Real-Time: charging is controlled by utility	Passive, Direct Load Control, Rigid
VT	Green Mountain Power (GMP)	Rate 72	TOU	<ul style="list-style-type: none"> Off Peak Rate: \$0.15029/kWh Peak Opt-out Rate: \$0.77270/kWh 	Based on events called 4-24 hours in advance	Passive, User Choice
VT	Green Mountain Power (GMP)	Rate 74	TOU	<ul style="list-style-type: none"> Off-Peak Rate: \$0.14452 /kWh Peak Rate: \$0.18989 /kWh. 	1 pm – 9 pm weekdays	Passive, User Choice

* The term “on-peak” here refers to the hours in which the program de-incentivizes charging



EVMC Program Peak Hours



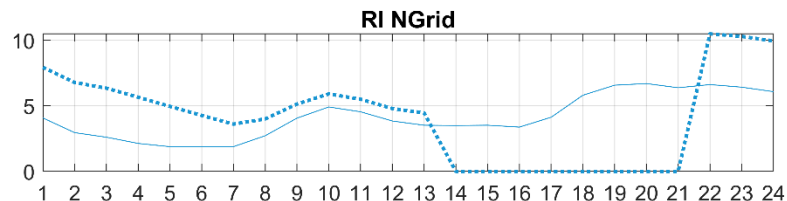
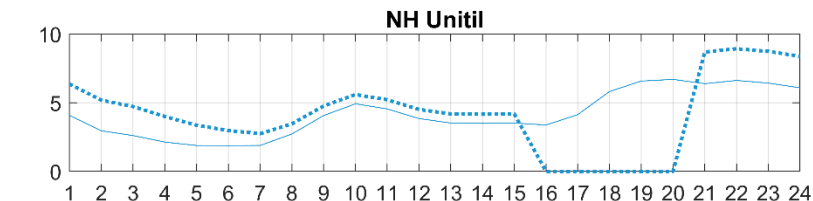
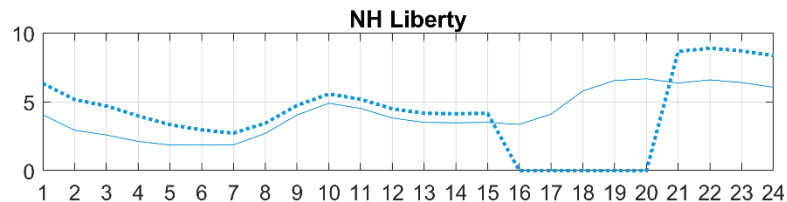
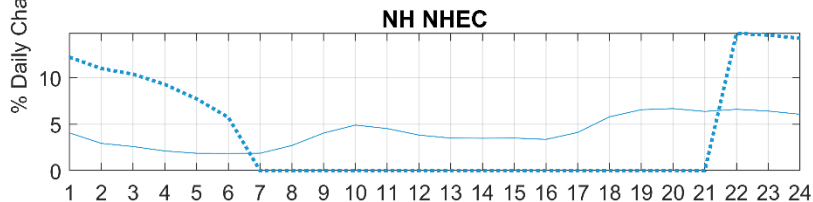
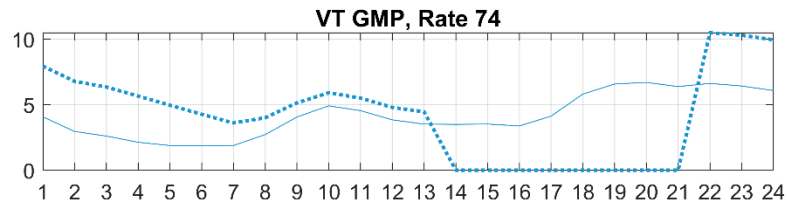
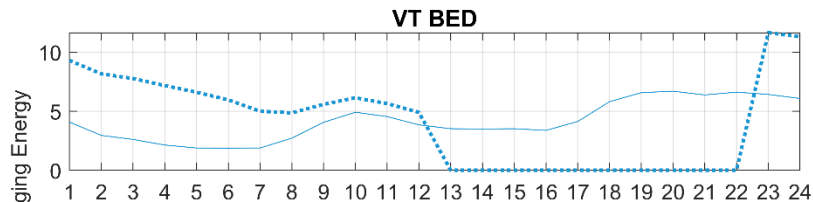
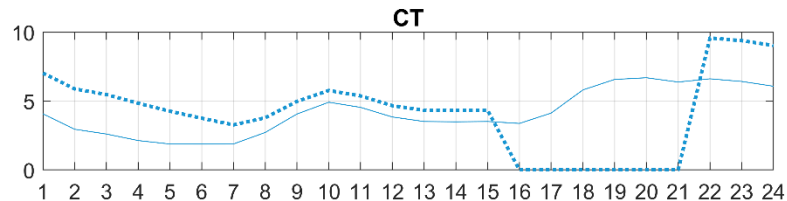
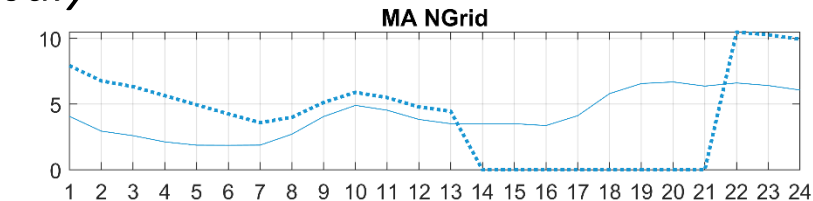
Developing a Regional EVMC Profile

- Existing state and utility EVMC programs represent a sample of different program designs that mainly utilize a static on/off-peak period framework, spanning a variety of hours, and target personal light-duty vehicles
- ISO has developed a blended profile that equally weights all current EVMC programs that utilize the on/off-peak structure (excludes expired RI program)
 - Each component program profile assumes no charging during on-peak hours
 - Energy not consumed during peak hours is distributed throughout all remaining hours of the day, with a heavier weighting in the hours just after the end of the on-peak period
 - Total daily charging energy remains unchanged
 - Blended EVMC profile will only apply to non-holiday weekdays
- A blended profile can be phased-in over the forecast horizon to reflect varying participation levels of the personal light-duty EV population in EVMC

Program Charging Shapes

July

— Base Shape ····· Program Shape

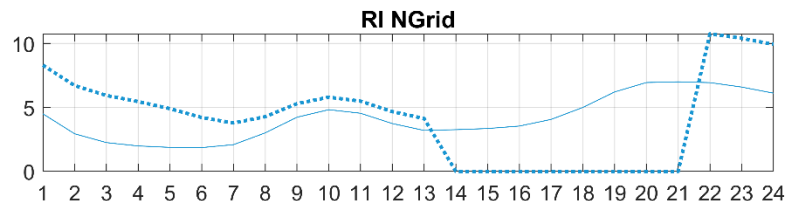
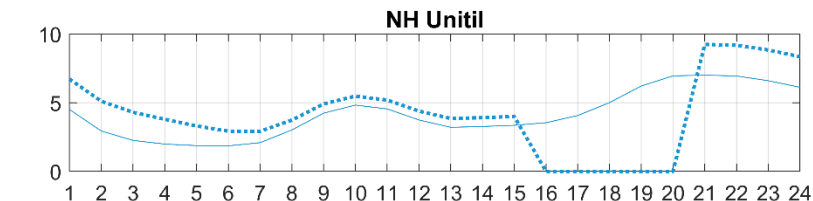
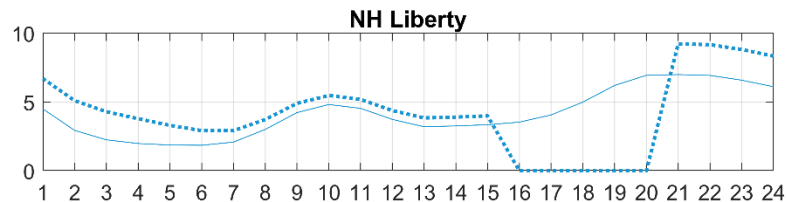
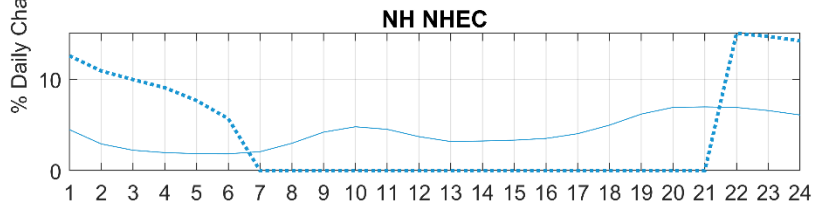
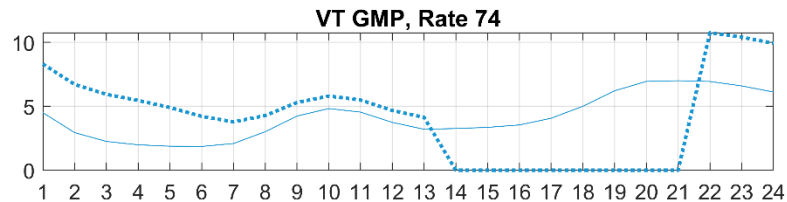
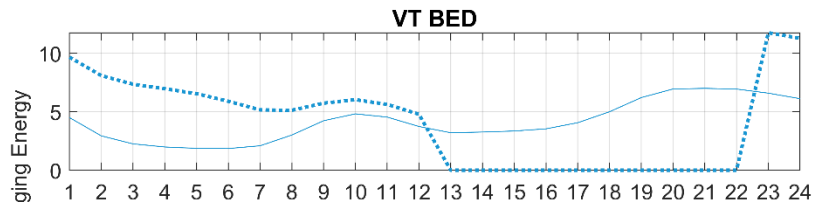
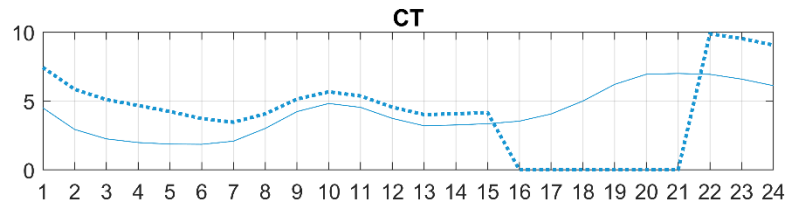
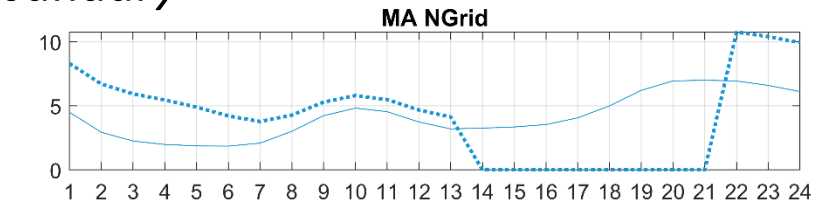


Hour Ending

Program Charging Shapes

January

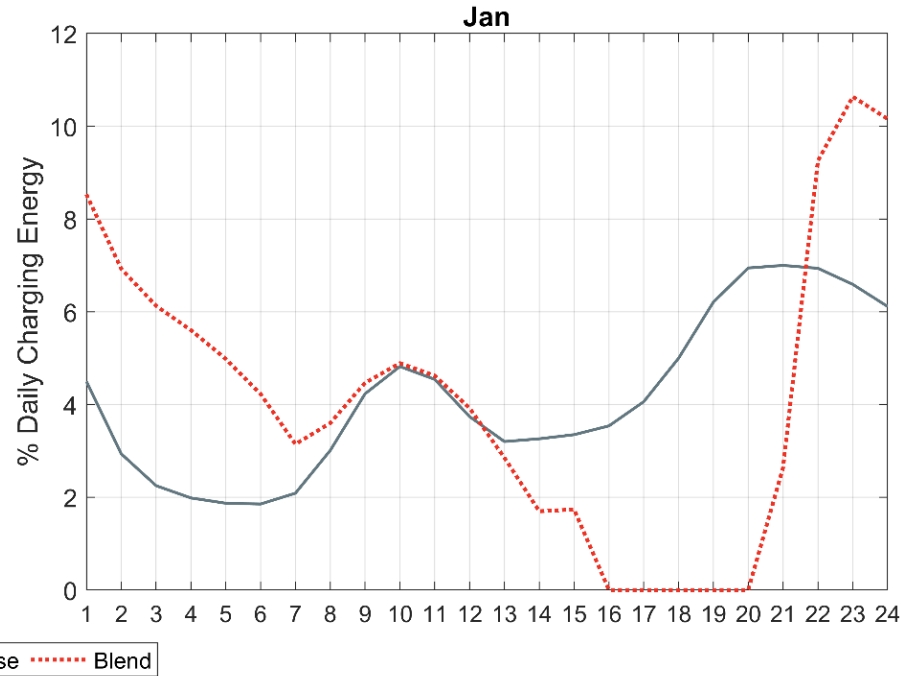
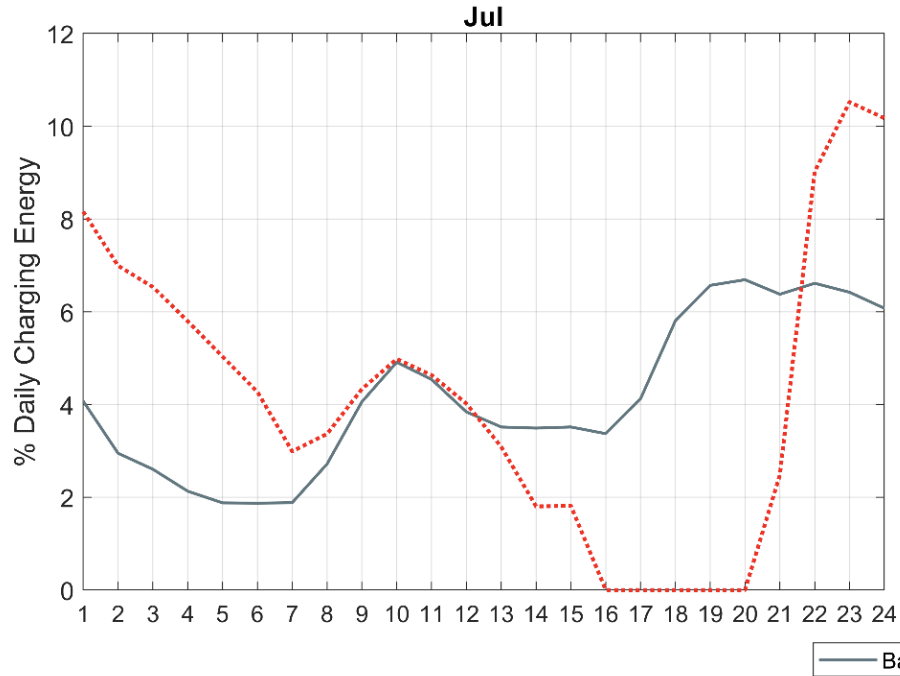
— Base Shape ····· Program Shape



Hour Ending

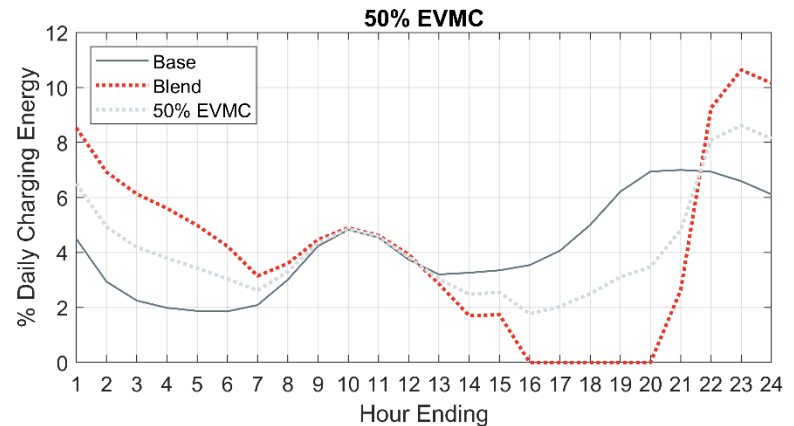
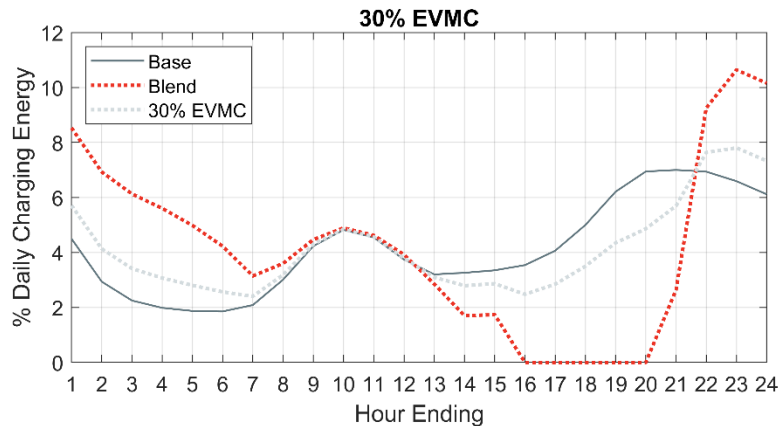
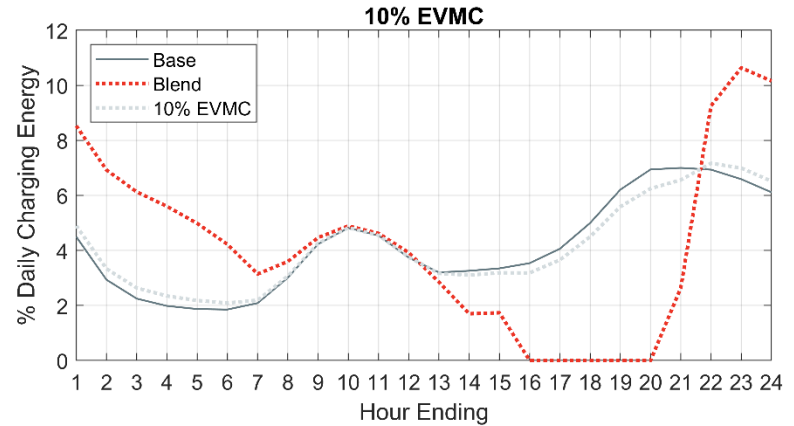
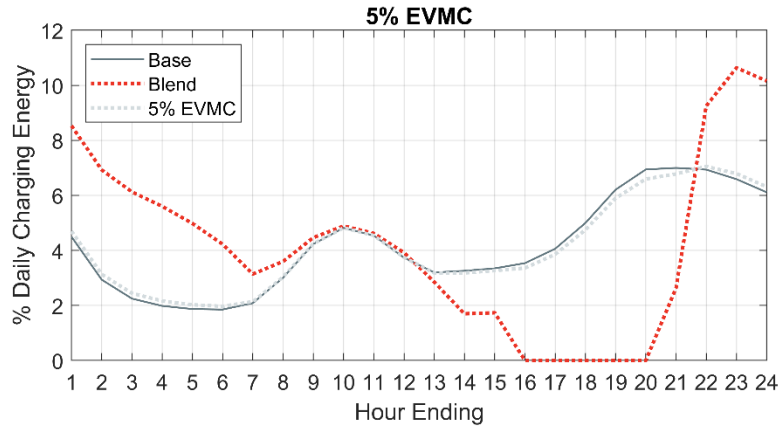
Regional EVMC Profile

Average of Program Shapes



Phasing Regional EVMC Profile into EV Population

January



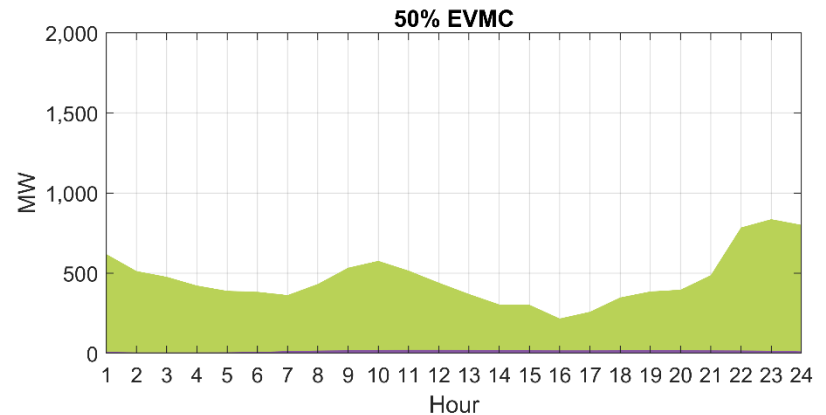
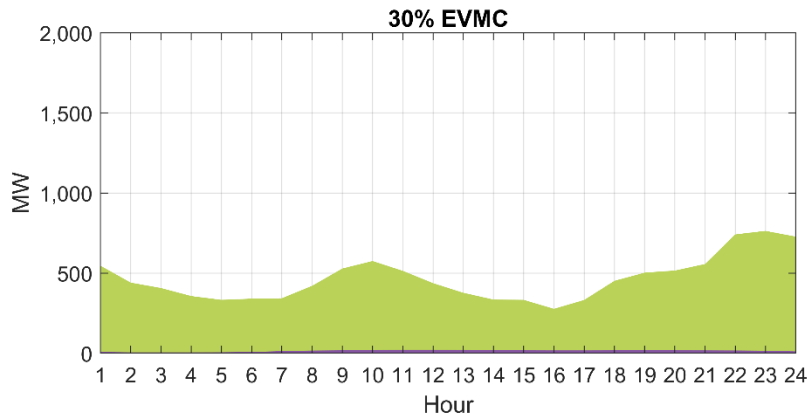
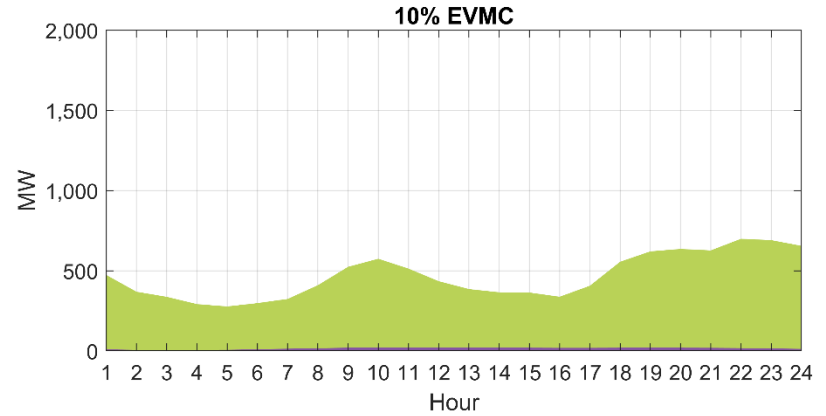
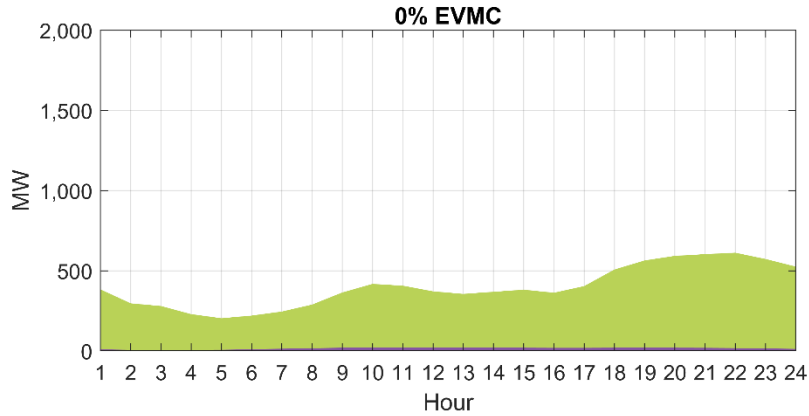
Impacts on Load Shape

- Current EVMC programs focus on moving charging outside of afternoon and evening hours
 - This results in increased charging during the late evening and morning hours
- Growing levels of heating electrification are expected to increase load in the morning hours, possible moving the system to a morning peak in the winter months
 - EVMC programs as they are currently structured largely only consider evening peaks

Example of Electrification Impacts

Approximated July 2027

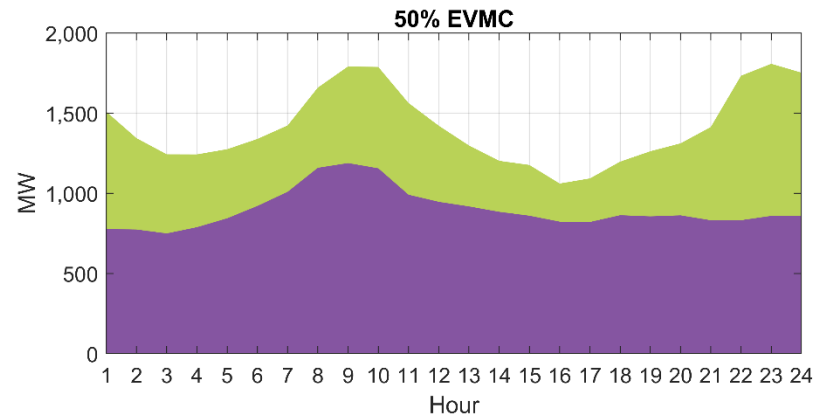
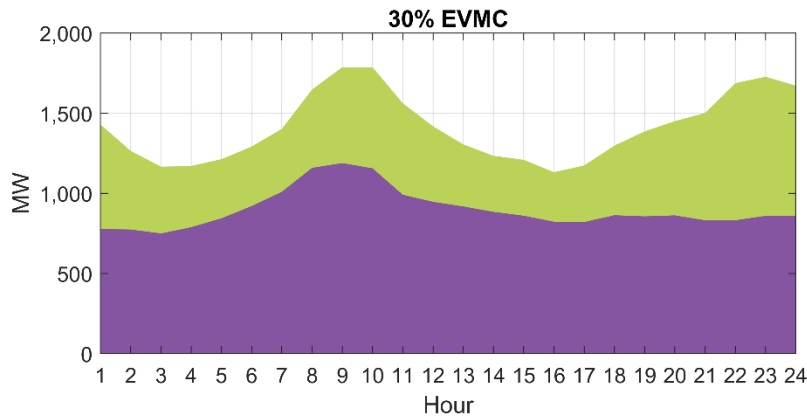
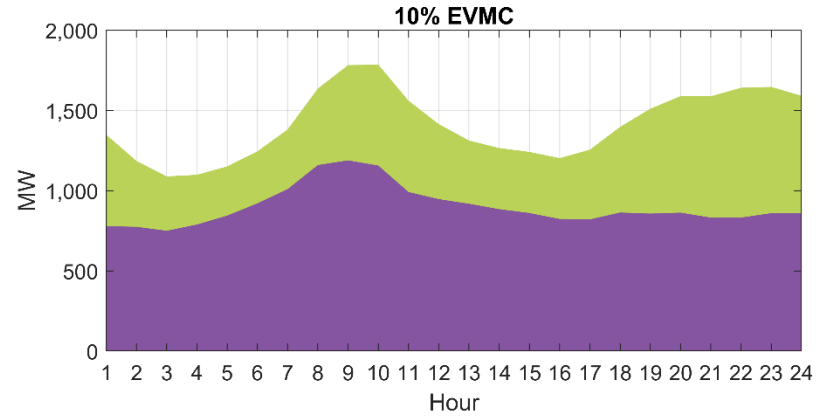
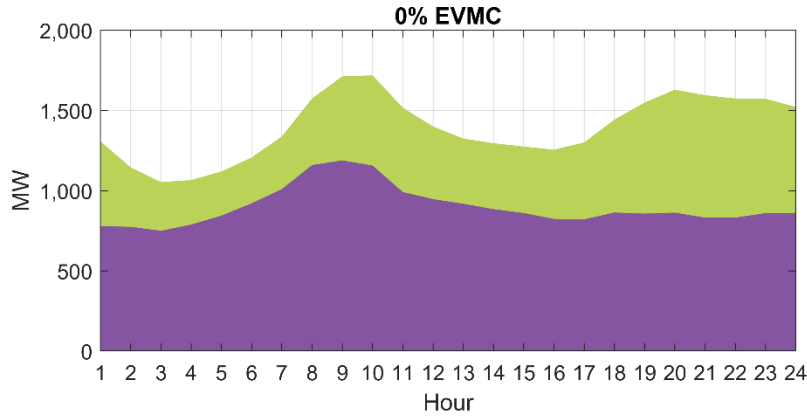
Heating Transportation



Example of Electrification Impacts

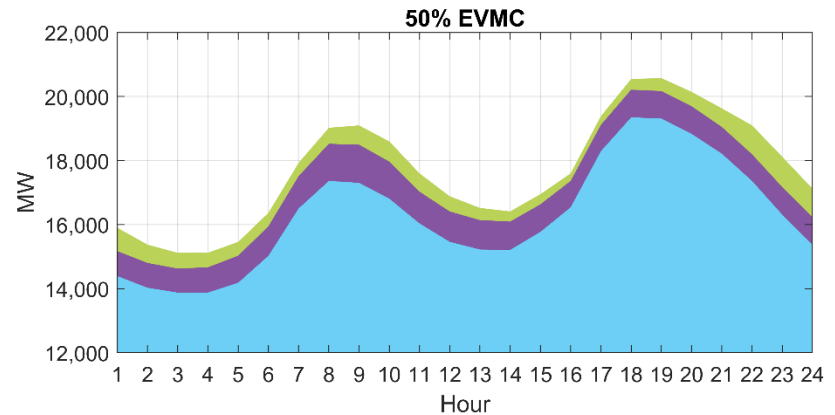
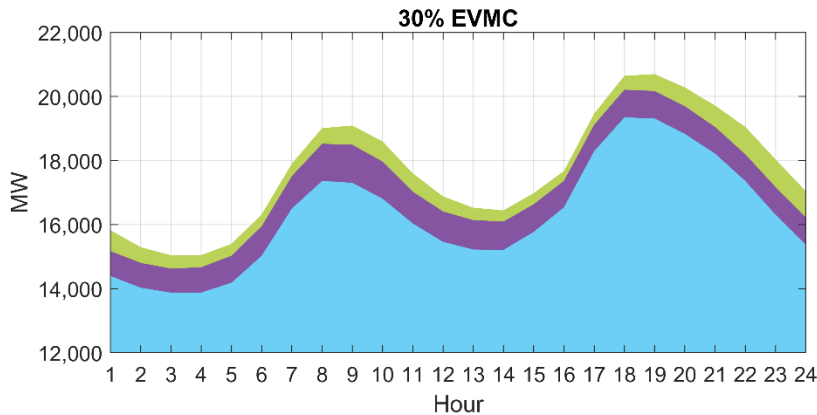
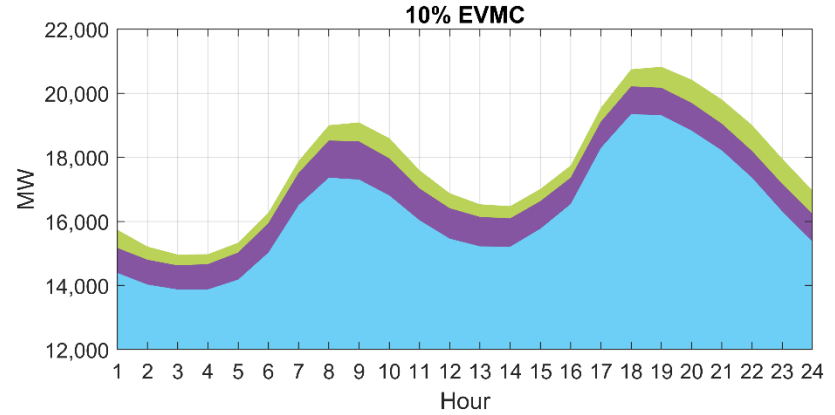
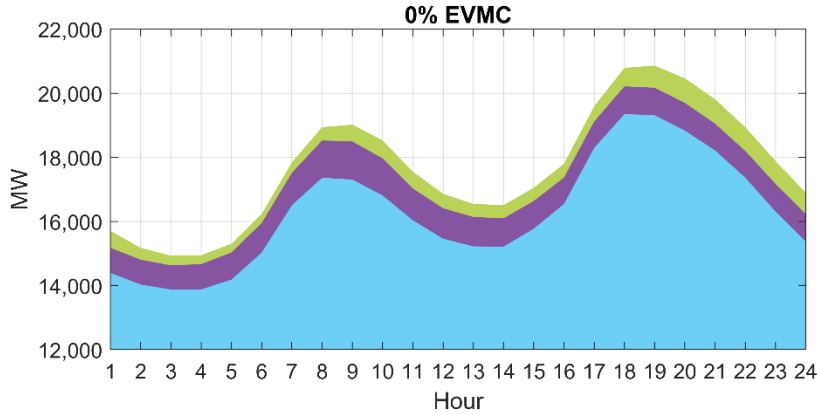
Approximated January 2027

Heating Transportation



Example Winter Net Load Impacts on CELT 2023

Approximated January 2027



Considerations

- Current program design focuses on peak hours but incentive levels and mechanisms vary widely
 - TOU rates
 - Energy-based incentives for off-peak charging
 - Static incentives for monthly participation
 - Event-based incentives or penalties
 - Incentives give greater value to summer participation than winter participation
 - Current programs focus on at-home charging
- Program participation of the larger population remains uncertain
 - Are participation rates at the start of the program indicative of what they will be for a broader and more diverse population of EV owners?
- Current retail policy and rate drivers do not consider key load characteristics, whether already existing or anticipated in the future, that inform system needs as the New England grid evolves
 - Mid-day minimums due to BTM PV impacts
 - A future winter peaking system, with likely timing in the morning

Forecast of Participation in EV Managed Charging

Personal Light-Duty Vehicles

- It is uncertain how EV managed charging will impact EV profiles over the next 10 years
 - How will consumer participation in programs evolve?
 - What will managed charging programs look like as they continue to mature?
- For the CELT 2024 forecast, ISO is incorporating a gradual uptick in managed charging participation of personal light-duty EVs in New England over the next 10 years:
 - 1% participation in 2024
 - 10% participation in 2033
- The regional EVMC profiles shown in red on slide 16 will be phased into the personal light-duty EV population over the forecast horizon at the levels shown in the table to the right

Year	Participation Level (% of EV population)
2024	1%
2025	2%
2026	3%
2027	4%
2028	5%
2029	6%
2030	7%
2031	8%
2032	9%
2033	10%

Summary

- The CELT 2024 transportation electrification forecast will reflect increasing portions of the personal light-duty EV population participating in EVMC each year
 - Blended regional EVMC profile reflects *existing* personal light-duty EVMC program structures

Questions

