Technical Potential of Load Management in the Commonwealth

Public Session #2

September 10, 2025

Applied Economics Clinic

Energy+Environmental Economics

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Agenda

- **Reminder of Study Motivation, Tasks, & Goals |** 5 min, State Team
- **Overview of Benefit-Cost Analysis and Feasible Potential Scenarios |** 5 min, E3
- **Key Findings |** 25 min, E3 + AEC
- **Implementation Barriers|** 25 min, State Team
- **Q&A and Breakout Discussions |** 25 min, all
- **Wrap Up |** 5 min, State Team

DOER's Mission

The Department of Energy Resources' (DOER) mission is to create a clean, affordable, resilient, and equitable energy future for all in the Commonwealth.

Who We Are: *As the State Energy Office, DOER is the primary energy policy agency for the Commonwealth. DOER supports the Commonwealth's clean energy goals as part of a comprehensive Administration-wide response to the threat of climate change. DOER focuses on transitioning our energy supply to lower emissions and costs, reducing and shaping energy demand, and improving our energy system infrastructure.*

What We Do: *To meet our objectives, DOER connects and collaborates with energy stakeholders to develop effective policy. DOER implements this policy through planning, regulation, and providing funding. DOER provides tools to individuals, organizations, and communities to support their clean energy goals. DOER is committed to transparency and education, supporting the accessible access to energy information and knowledge.*

Load Management Study Scope

Goals

Quantify the potential for load management to reduce electric system costs

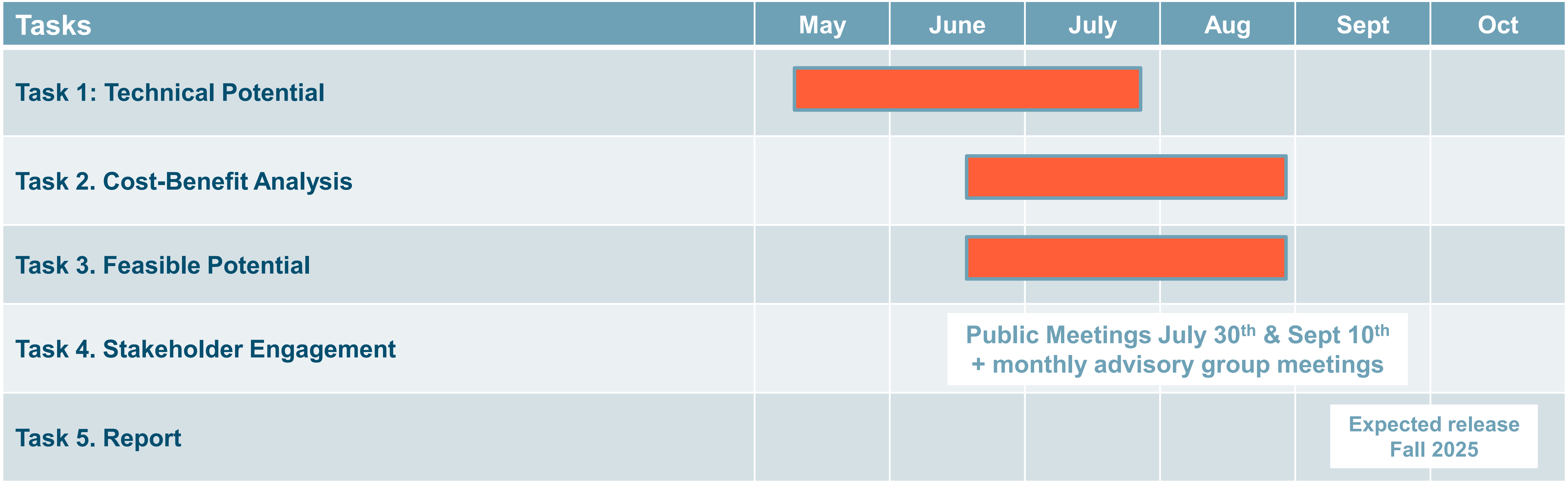
Provide technical assumptions and modeling to support DOER load management strategy, program design, & advocacy

Key Questions

- By how much can different load management strategies reduce peak load in the near- and long-term?
- Which load management strategies are most cost-effective at reducing electric system costs?
- What are feasible levels of adoption and participation that can be achieved in the near- and long-term?
- What are the key implementation barriers to scaling up load management in Massachusetts?

Load Management Study Timeline

Timeline



Overview of Benefit-Cost Analysis and Feasible Potential Scenarios

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Passive measures reduce energy year-round
Active measures target critical hour peak reduction

Passive

- Cold-climate heat pumps
- Ground source heat pumps
- Stretch code for new construction
- Shell retrofits

Active

Shift

- HVAC flexibility
- Water heating
- Appliances
- V1G and V2G
- BTM Storage

Shed

- Grid-enabled hybrid heat pumps*
- Industrial demand response

* Modeled both under passive and active set-ups; Gas or fuel oil back-up heating system

Study is performing total resource cost test to evaluate the benefits and costs of different load management strategies

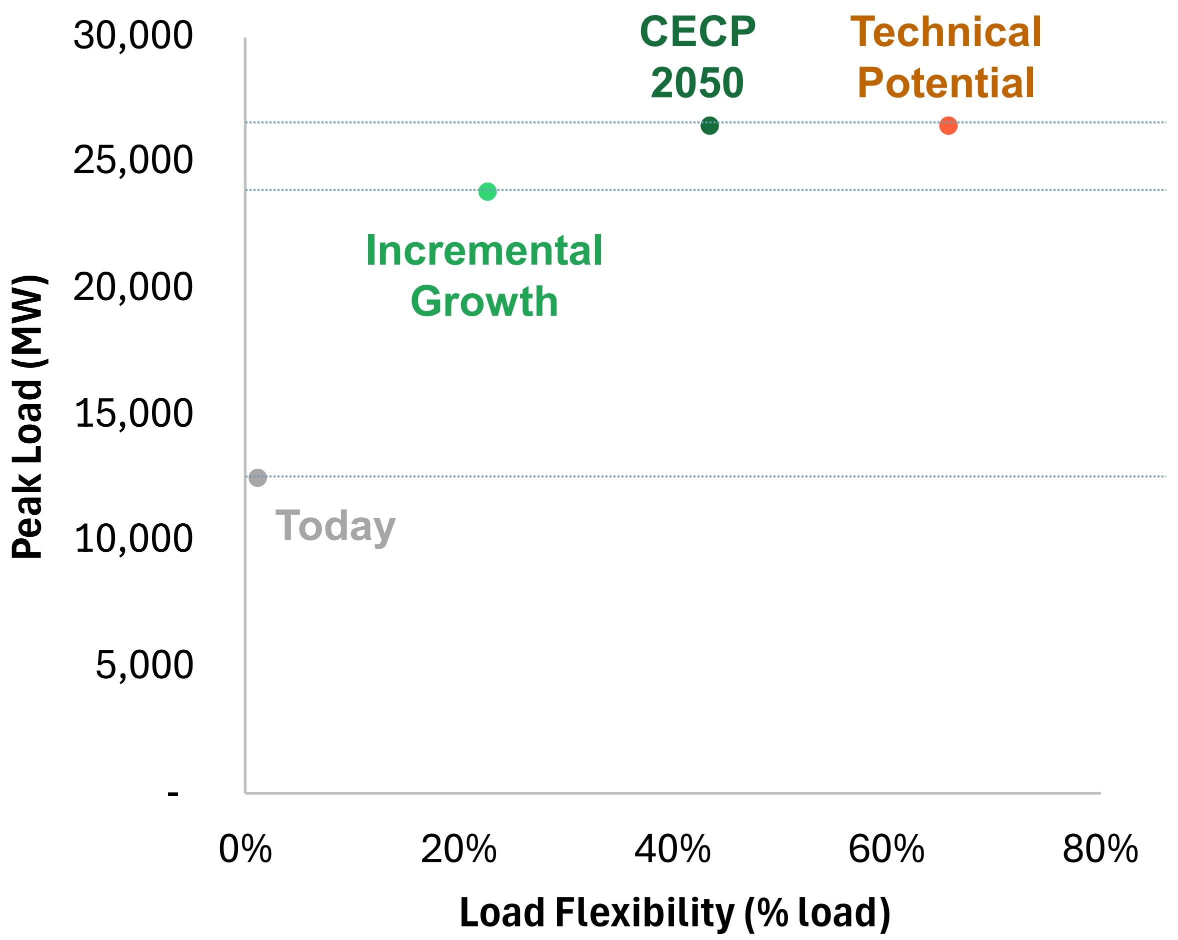
+ **Load management measures are assessed based on Total Resource Cost (TRC) Test**
  - Compares total benefits of a program or measure to the total costs, from the perspective of both the utility system and the participant, excluding any utility incentives or transfers
  - Follows general approach utilized by DPU in evaluating EE plans
+ **Key data sources include:**
  - AESC data on avoided costs
  - LBNL, MassCEC & Mass Save for other key categories, including the costs of enabling grid flexibility & administrative costs
  - DPU 3-Year EE Plans for social cost of carbon

Test	Total Resource Cost	Ratepayer Impact Measure
Avoided utility marginal costs	Benefit	Benefit
Upfront and maintenance costs	Cost	
Environmental benefits (carbon-only)	Benefit*	
Administrative costs	Cost	Cost
Bill Savings		Cost

*MA DPU "Modified TRC" test includes avoided emissions in evaluation of 3-year EE plans

Three scenarios developed to explore potential under different load growth and flexibility worldviews

Scenario Design – Load Growth and Flexibility



	Incremental Growth	CECP 2050 Growth	Technical Potential
Load Growth Scenario	**Based on expected trends**	**CECP 2050 Phased scenario**	**CECP 2050 Phased scenario**
Load Flexibility	**Lower flexibility** • Baseline technology rollout (e.g., AMI) • Individual customer response	**Higher flexibility** • Enabling technology investment (e.g., DERMS and VPPs) • Targeted response to barriers to adoption.	**Maximum resource load flexibility** • Complete participation assumed • Physical resource constraints (e.g., vehicle driving patterns) included

Note: Future projections based on bottom-up assessment. Peak loads are reported with passive measure adoption.

Key Findings

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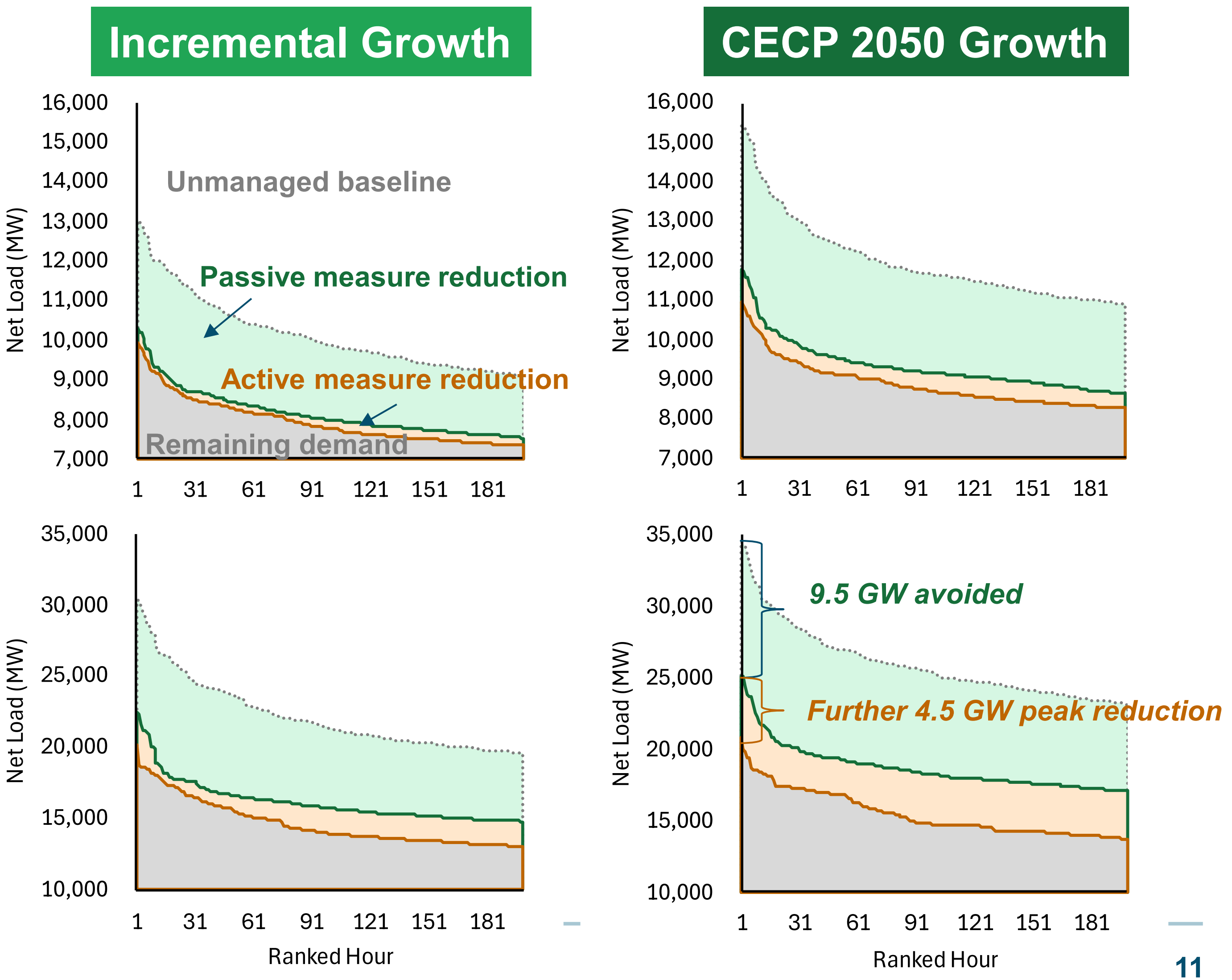
Passive load management can avoid 2.5 to 3.5 GW by 2030, and 8 to 9.5 GW by 2050. Active load management can further flatten peak demand by 300 to 800 MW by 2030, and 2.5 to 4.5 GW by 2050

- **Passive high-efficiency electrification and building shell improvement measures help avoid significant peak demand growth***
- **Active load management measures focus on high net peak hours, shedding and shifting load to periods with lower resource adequacy risk, flattening net peak demand**
- **The active measure peak reductions shown do not reflect "perfect capacity" reductions**
  - Further research is required to understand the reliability of load management strategies

Sorted Net Demand over Top 200 Hours

2030

2050



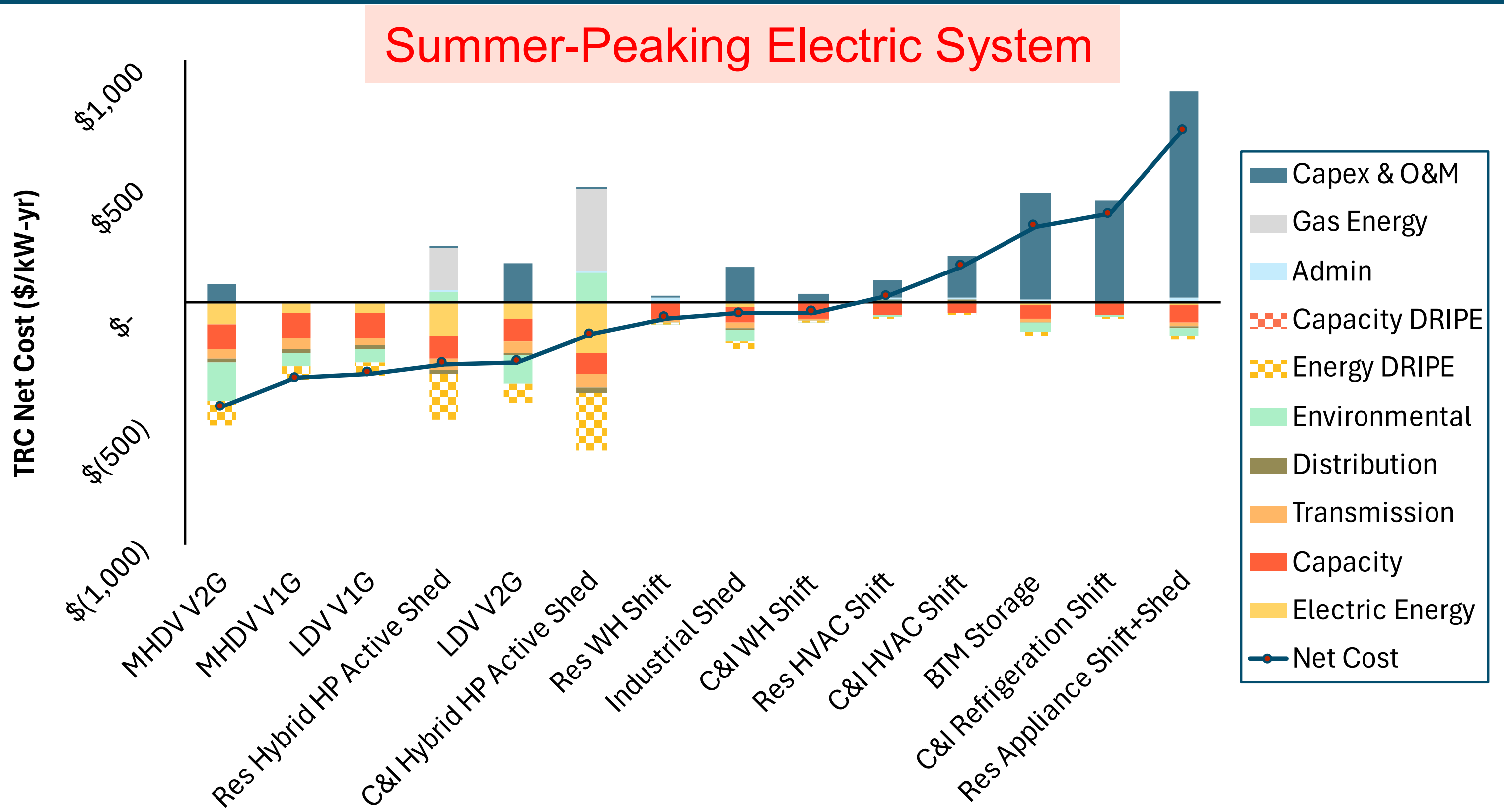
*Relative to electrification with standard heat pumps

Active load management strategies are expected to deliver net benefits.

Feasible avoidable electric system costs through active measures by 2030 are limited (<~$20M); 2050 savings are on the order of $700M to $2B annually across Incremental and CECP 2050 Growth scenarios respectively

- **Flexibility resources help avoid future capacity and transmission costs via <u>critical hour load reduction</u>**
- **Electric vehicle management leads to the highest net benefits, with no-cost smart charging being an early "no-regrets" strategy to pursue**
- **Estimating aggregate avoided costs from load management requires additional research**
  - The estimates presented use marginal avoided costs which would change with peak reduction at scale
  - Estimates above would reduce to $600B to $1.5B without DRIPE

Levelized Lifetime TRC Net Cost* for Active Measures, $/kW-yr, 2030

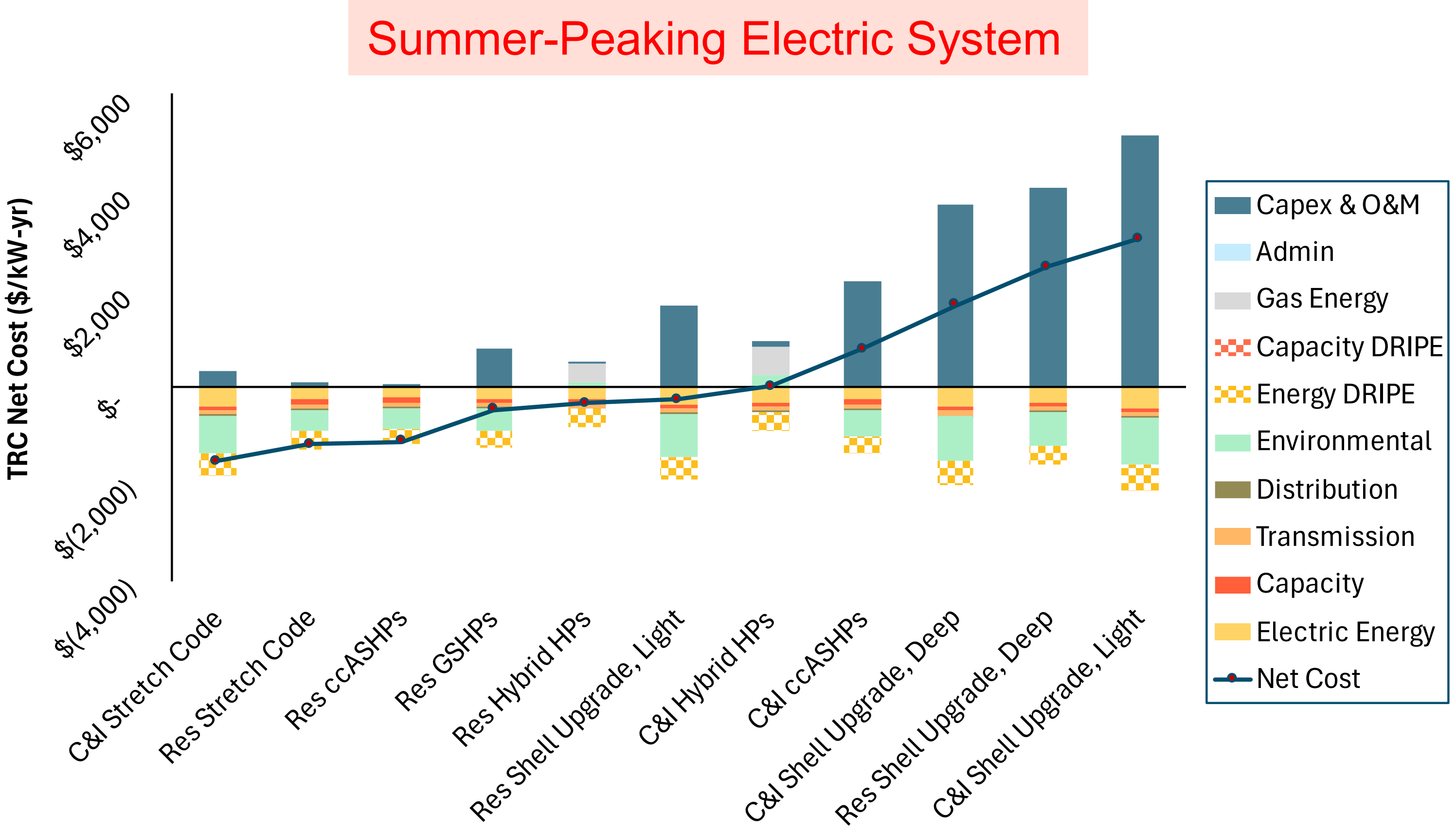


**Lifetime NPV of avoided and incurred costs levelized over device lifetime, normalized "per kW" of critical hour load reduction*

Passive load management strategies deliver important avoided energy and emission benefits, in addition to avoided electric system costs

- Passive load management and/or efficiency measures provided valuable energy and emissions reductions <u>year-round</u>
- Stretch codes and building shell retrofits ensure cost-effective improved building energy performance
- The analysis presented emphasizes the importance of <u>efficient</u> electric load growth in buildings

Levelized Lifetime TRC Net Cost* for Passive Measures, $/kW-yr, 2030



*Lifetime NPV of avoided and incurred costs levelized over device lifetime, normalized “per kW” of critical hour load reduction

Programs to encourage load management that center equity can deliver benefits to disadvantaged communities

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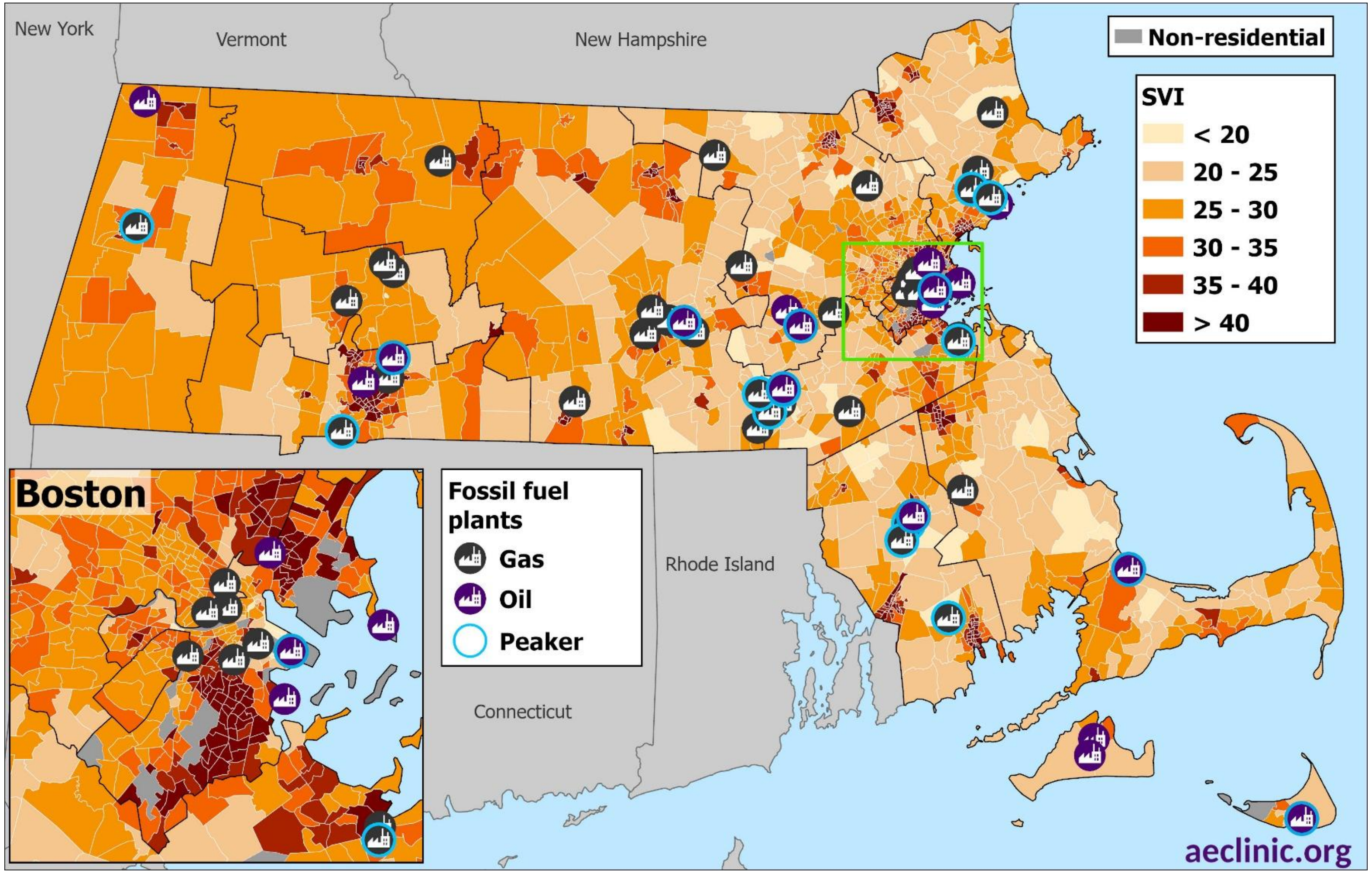
Economic and Policy Analysis of Energy, Environment and Equity

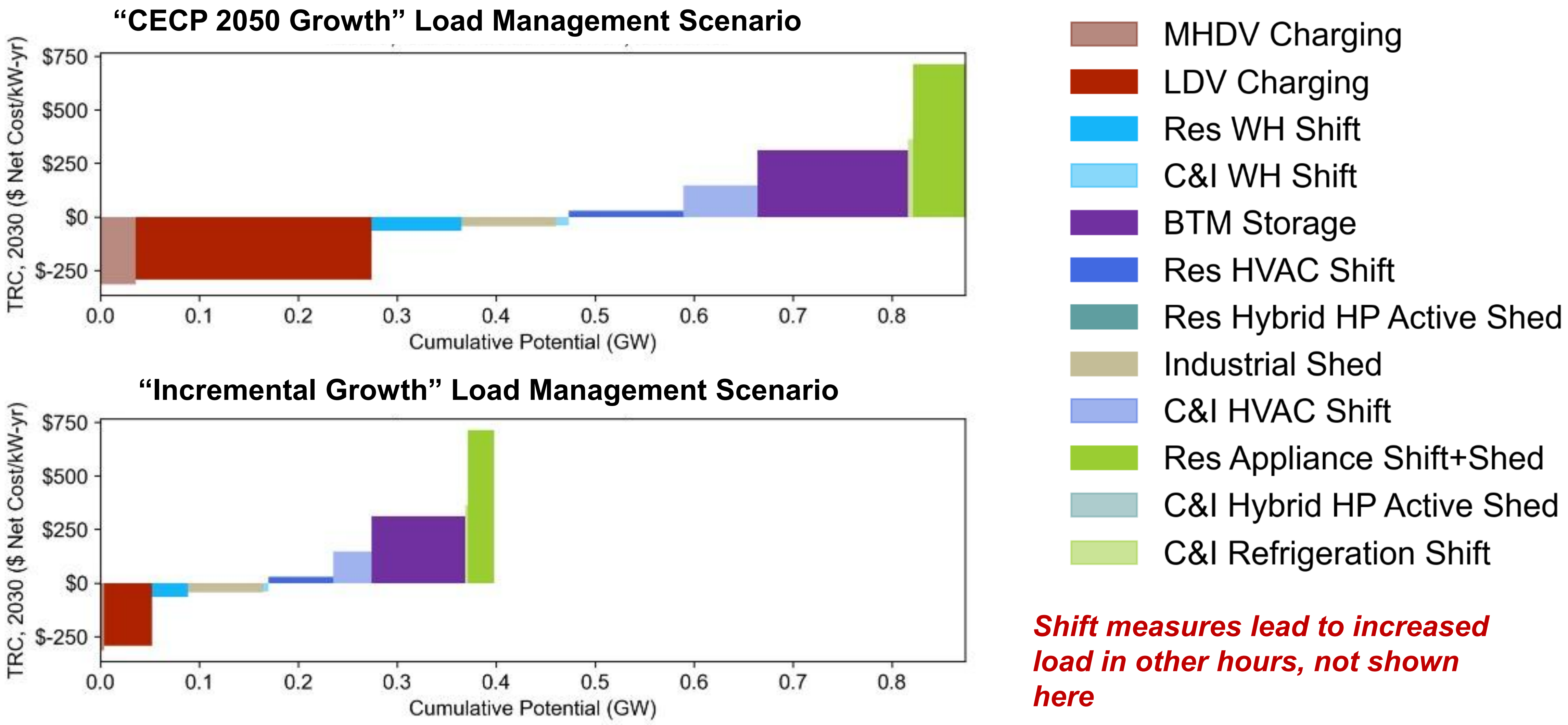


+ **Load management resources improve household and community resiliency and equity only when their benefits are targeted at (and reach!) vulnerable and underserved communities**
  - Resiliency and equity impacts are often **difficult to quantify** and include in conventional cost-effectiveness tests
  - Estimating these resiliency and equity impacts as fully as possible and building them into program design can help ensure **benefits flow to disadvantaged communities**
+ **Vulnerable households face particularly steep barriers to adopting load management resources**

Load management can have a diverse set of resiliency and equity impacts

Load Management Impact	Relevance to Disadvantaged Communities in Massachusetts
Avoided power outages	• Loss of power is most harmful for some groups: elderly, disabled, low-income, those with serious health conditions, or those reliant on electronic medical devices • Low-income households and other vulnerable individuals are less likely to have backup power, transportation for evacuation, or funds for alternative housing
Enhanced building-level resilience	
Avoided disruptions to critical facilities	
Lower energy use and bill impacts	• Low-income and BIPOC households, older adults, and rural residents are more likely to be energy-burdened and to fall behind on their energy bills • Cost shifts could occur through ratepayer-backed programs
Environmental and public health benefits	• Fossil fuel-fired power plants are typically located near low-income and BIPOC areas, putting these areas at higher risk for negative health outcomes
Enhanced indoor health, comfort, and safety	• Low-income households tend to live in lower-quality housing and are more likely to keep their homes at unsafe temperatures to reduce expense
Job creation	• Low-income and BIPOC communities are less likely to have access to well-paid employment opportunities
Increased property values	• Higher property values boost homeowner wealth but also increase property taxes and rents, which can lead to gentrification and displacement

By summer 2030, V1G, storage, and building flexibility could shift 400 MW to 850 MW out of top 200 critical hours across scenarios

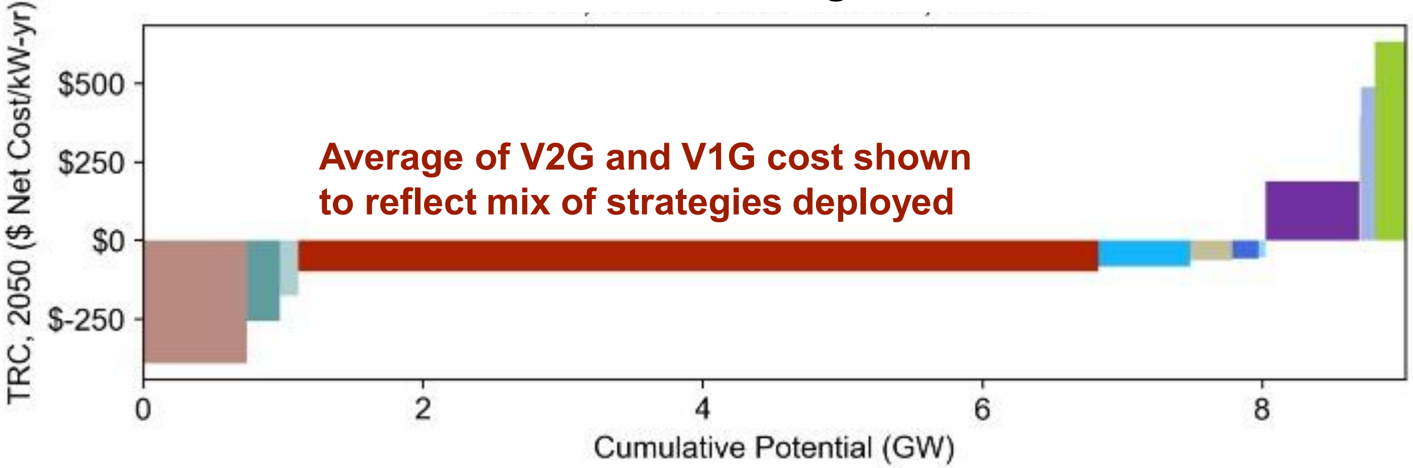


Shift measures lead to increased load in other hours, not shown here

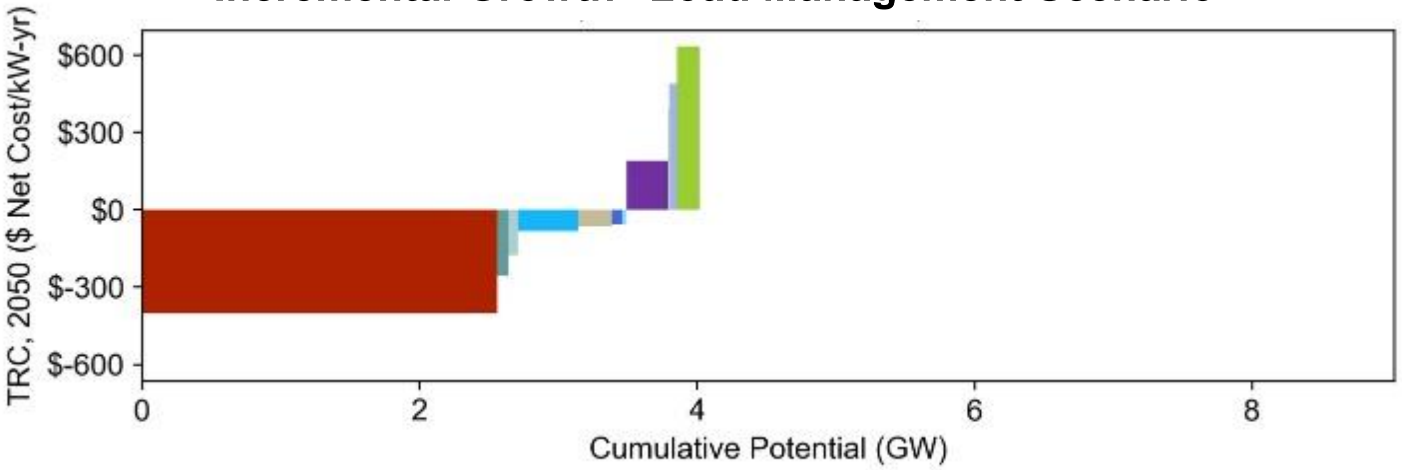
X-axis – weighted average hourly peak reduction in top 200 critical hours

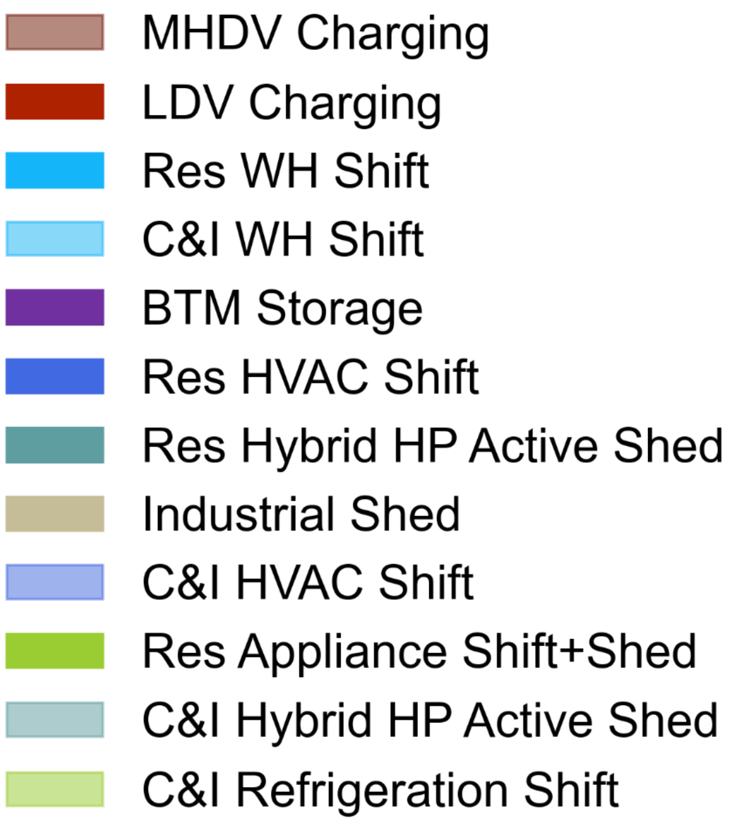
By winter 2050, V2G could significantly increase load management potential, enabling a total shift of over 8.5 GW out of the top 200 net load hours in the CECP 2050 scenario

"CECP 2050 Growth" Load Management Scenario



"Incremental Growth" Load Management Scenario



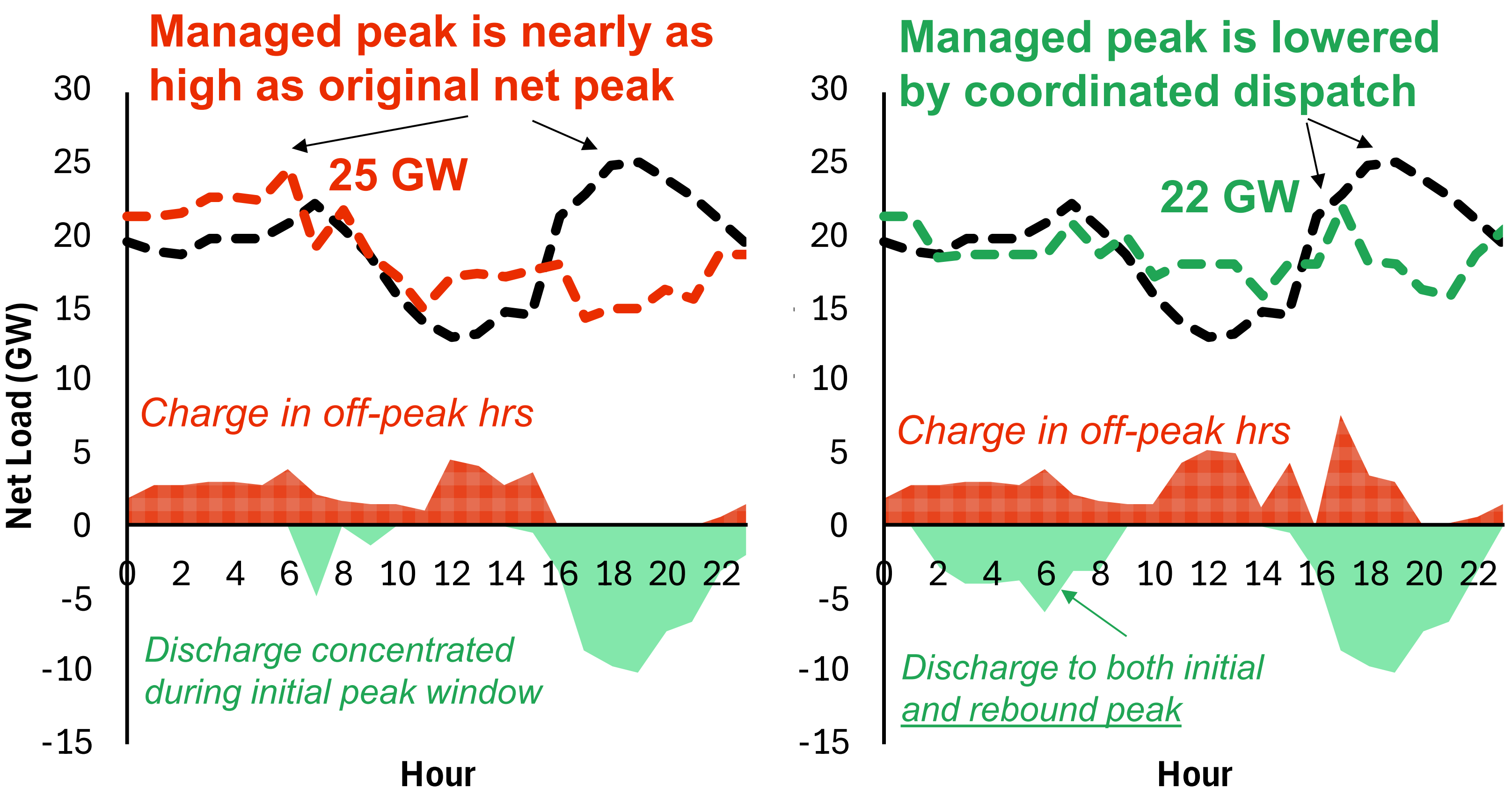


Shift measures lead to increased load in other hours, not shown here

X-axis – weighted average hourly peak reduction in top 200 critical hours

Orchestration of different load management strategies can help avoid rebound peaks and maximize benefits

Simplified Example of Uncoordinated Load Flexibility Creating Rebound Peak Demand – Jan 5, 2050



+ **Uncoordinated price signals run the risk of rebound peaks emerging, and peak reduction potential left unrealized.**
  - Programs and rates must ensure price signals reflect true electric system costs to encourage load management that is aligned with system needs.

- **Since load management strategies will compete to shift the same loads, utility programs that encourage and incentivize the most cost-effective demand-side management strategies can ensure maximum ratepayer benefit.**

Thank You

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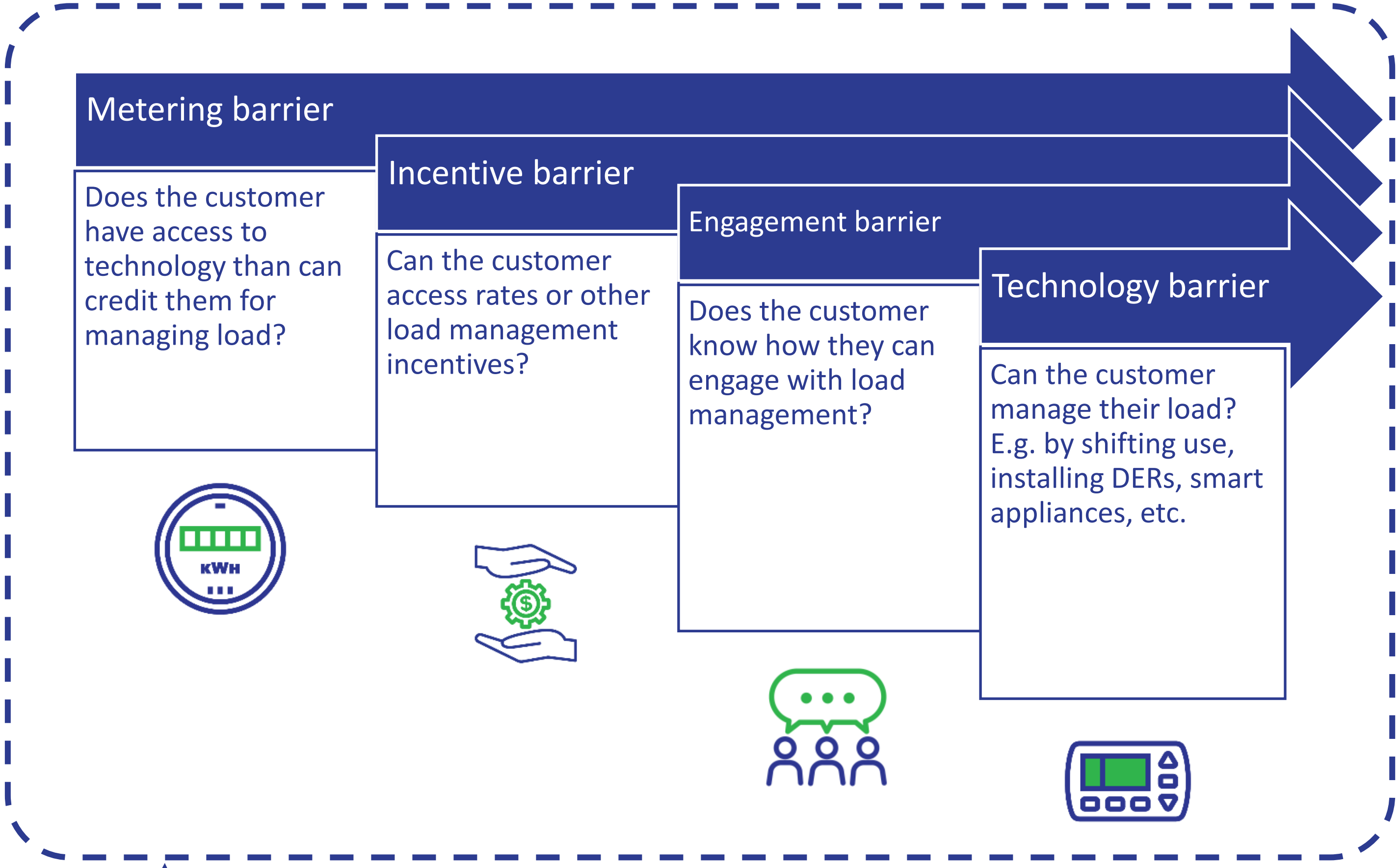
Implementation barriers

How can Massachusetts …

- Scale load management?
- Ensure equitable access and distribution of costs & benefits?
- Support innovation?

Barriers to load management



Clearing these barriers unlocks load management potential

Beyond technical and programmatic barriers, ***structural barriers*** *also prevent equitable access.*

Metering barriers

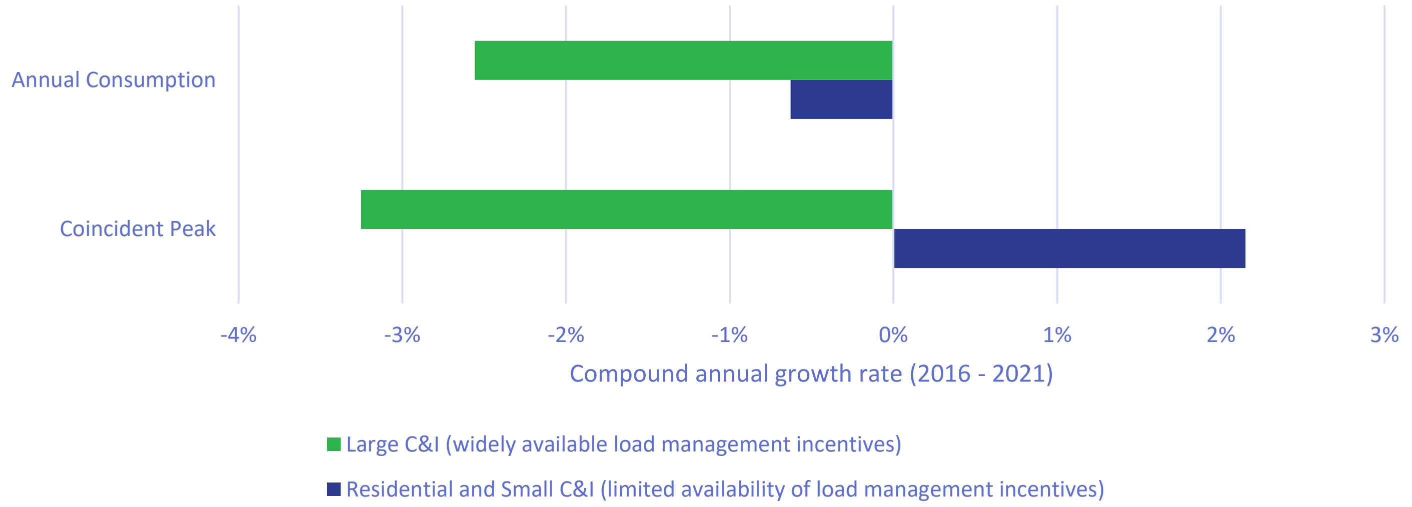
Without smart meters, load management programs are limited to a small list of technologies.

Residential and small commercial customers (no smart meters)

- Flat volumetric rates
- No peak pricing
- Active demand response limited to batteries and central AC
- Limited EV load management

Large commercial customers (with smart meters)

- Time-of-use rates (both delivery and supply)
- Option to reduce costs through peak pricing
- Active demand response based on performance, technology-neutral



Incentive barriers

What are best practices to ensure broad access to load management incentives?

Current state		Challenges
C&I peak-shaving incentives		
• Technology-neutral		
• Pay-for-performance		
• Stack with wholesale & supply incentives	→	• Retail/wholesale coordination
Residential peak-shaving incentives		
• Technology-specific	→	• Limits access
• Some pay-for-performance, some flat	→	• Risk of cost-shift
• Few other incentives to stack with	→	• Leaves load management potential on the table

Engagement barriers

Some customers may want to engage more with load management

- How do we educate those customers and give them options?

Other customers may want load management that “just works”

- How do we meet customers where they are and make it easy to save?
  - Can equipment be flexible by default?
  - Can municipal aggregations help customers navigate programs?

Technology barriers

How do we get flexible loads and DERs onto the grid?

- Market availability of flexible technologies (e.g., smart thermostats, water heaters)
- Interconnection (esp. storage and vehicle-to-grid)
- Up-front costs & financing for storage, vehicle-to-grid, energy efficiency
    - Interactions with structural barriers for renters, low-income, and EJ customers (next slide)

Structural barriers

Building on issue areas identified by stakeholders

- The need to engage communities in designing new programs
- Removing barriers to accessing load management
  - Many barriers are particularly acute for renters, LMI customers, and EJ communities
- Ensuring costs and benefits are equitably distributed
- Supporting wealth creation and DER ownership

Discussion and next steps

Today

- DOER, E3, and AEC will be available for questions, comments, and discussion
- We're happy to answer any clarification questions, but we're also interested in your feedback
  - Are there barriers we haven't listed here?
  - Do you have suggestions for addressing these barriers?

Next few weeks

- DOER will post slides online
  - https://www.mass.gov/info-details/peak-potential-load-management-for-an-affordable-net-zero-grid
- Please share any further feedback with Charles Dawson, charles.dawson@mass.gov

Fall 2025

- DOER will publish technical and policy reports

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Thank You!