Office of Energy Transformation: Decarbonizing the Peak Focus Area Work Group Webinar

October 8, 2024

Agenda

1. Welcome, Introductions, and Agenda Review (5 min)

2. Overview of Office of Energy Transformation, Context, and Focus Area Work Group (FAWG) Process (10 min)

3. Overview of and Background on Peak Energy Demand, How It's Met Today, Facility Characteristics, and Current Policy Drivers (35 min)

4. Review of Decarbonizing the Peak Workplan and Future Convenings (15 min)

5. Response to Questions and Next Steps (15 min)

Massachusetts Policies, Programs, and Focus

Mandates to mitigate greenhouse gas emissions, drive efficiency, and deploy clean energy

Programs and regulations that implement mandates and achieve climate, clean energy, and consumer-focused outcomes

A focus on equity, affordability, economic opportunity, and environmental justice

2050 CECP pathways to accomplishing the Commonwealth's net zero greenhouse gas emissions goals[1]

Transportation

- **97%** of light-duty vehicles (5 million) electrified
- **93%** of medium- and heavy-duty vehicles (over 350,000) electrified or non-emitting

Buildings

- **80%** of homes (over 2.8 million) heated and cooled by electric heat pumps (including those with on-site fuel backups)
- **87%** of commercial space heated by either electricity or alternative fuels

Electric Power

- **2.5-fold** increase in electric load compared to 2020
- **97%** of electricity consumed is from clean and renewable sources

Non-Energy and Industrial

- **52%** of industrial energy use electrified

Office of Energy Transformation

- Established May 1, 2024, this first-in-the-nation Office of Energy Transformation (OET) is charged with:
  - Enabling the hands-on execution of the clean energy transition, including:
    - gas-to-electric transition coordination,
    - electric grid readiness, and
    - a just and equitable transition for workers, businesses, and communities.
  - Establishing an Energy Transformation Advisory Board ("ETAB" or "Advisory Board") to accelerate cooperation, understanding, and action among all stakeholders to transform the energy ecosystem.

Mission and Structure

Energy Transformation Advisory Board

To provide guidance and recommendations on strategic direction to the OET and focus areas work groups to execute the energy transition, including gas-to-electric transition, electric grid readiness, and the just and equitable transition for workers, business, and communities.

Transitioning Away from EMT	Decarbonizing the Peak	Financing the Transition
To develop a coordinated strategy to reduce and ultimately eliminate the local gas distribution companies' reliance on the Everett Marine Terminal (EMT) Liquified Natural Gas (LNG) facility aligned with DPU Order 20-80 and the state's climate and clean energy mandates, including those established in the *Global Warming Solutions Act*.	To demonstrate pathways to reduce reliance on and expeditiously eliminate fossil fuels from peaking power plants and combined heat and power facilities and deploy alternative demand and supply side options to meeting peak load needs in the Commonwealth, in alignment with the electric sector sublimit and clean energy goals established in the *2050 Climate and Clean Energy Plan*.	To identify alternative mechanisms for financing/funding electricity distribution system infrastructure upgrades necessary to achieve the Commonwealth's clean energy and climate mandates that minimizes impacts on consumers' electricity bills, while providing an affordable, sustainable and timely source of revenue to support investments.

Governance, Responsibilities and Expectations of Participants

Governance

Participation is open, with membership affirmed by Advisory Board

Meet at least bi-monthly, or more often, depending on need

FAWGs will conduct work via individual workstreams, which will meet as necessary

FAWG participants can select workstreams

Workstream and full FAWG meetings are Chatham House Rules; all materials provided to the Advisory Board will be made public

Deliver consensus work products and recommendations to the Advisory Board, where consensus is not possible, note participant positions

Responsibilities

Execute workplans approved by the Advisory Board and deliver recommendations for Advisory Board deliberation and approval

Establish workstream teams to advance workplans, establish milestones, and make recommendations

Review and seek consensus on deliverables and recommendations

Align around options to be presented to the Advisory Board, where consensus is not possible, participant positions are to be noted and accurately reflected

Expectations

Commit to a one-year term and actively participating and attending meetings (all meetings will have a virtual option)

Are subject matter experts/have a command of the topic

Have a level of decision-making authority, if participating on behalf of an organization

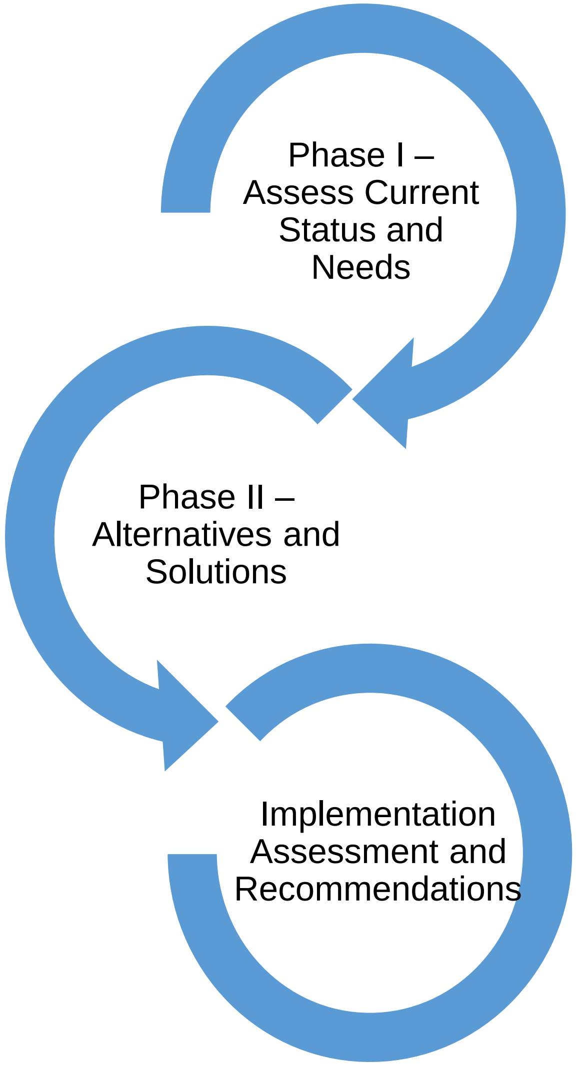
Follow the workplans and process adopted by the Advisory Board

Work in good faith to seek consensus

Adhere to the Ground Rules and Remote Participation policies adopted by the Advisory Board; failure to comply can result in removal

Approach and Process

- Decision-making to follow a methodical approach
  - Each FAWG launches with a webinar and follows same phased approach:
    - Start with understanding the issues and perspectives and assessing current state
    - Identify and assess alternatives and potential solutions
    - Conduct implementation assessment and make recommendations
- Success requires:
  - Commit and align
  - Engage and enable
  - Implement and sustain



Sign Up for the Decarbonizing the Peak FAWG

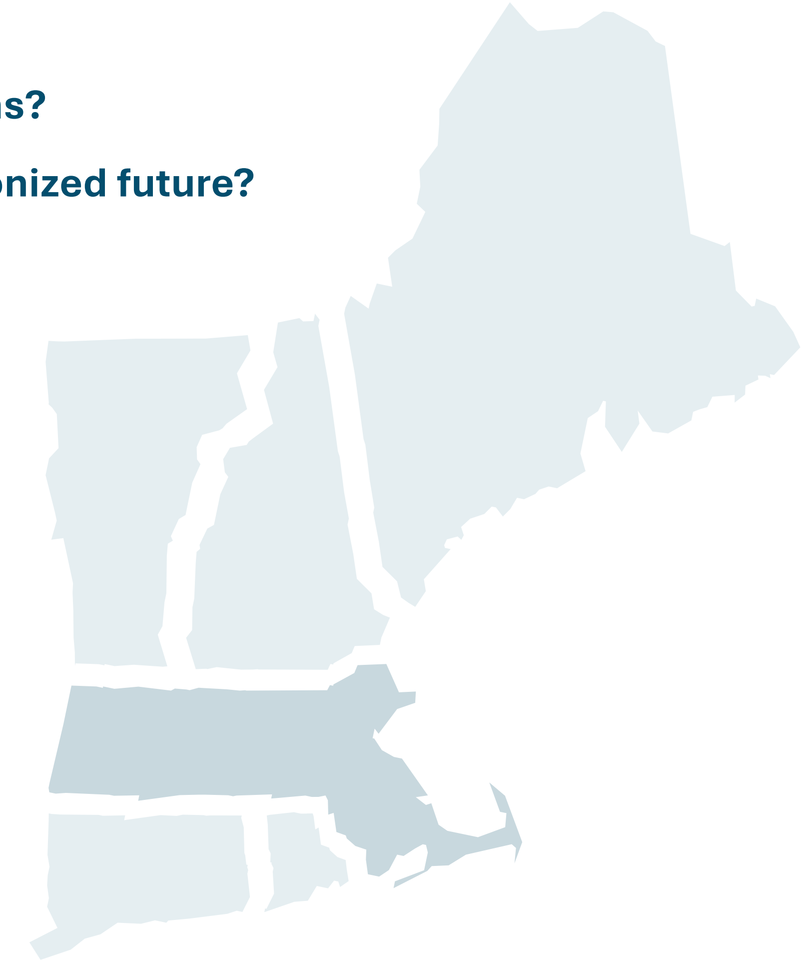
- Bylaws, Ground rules and approved workplans are available on the Office of Energy Transformation website
- A link will be provided in the chat function of this meeting to sign up to participate in the FAWG and will be accessible on the Office of Energy Transformation website
- Registration to participate will close on October 15th
- A participant list will be provided to the Advisory Board
- The first convening of the FAWG will be in November
- Workstream self-selection will occur at the meeting
    - Individuals can participate in a workstream and not the full FAWG

Purpose and Methodology

+ **Mission:** To identify and demonstrate pathways to reduce reliance on and expeditiously transition away from reliance on fossil fuel peaking power plant and combined heat and power facilities by deploying alternative demand-side and supply-side options to meet peak load needs in the Commonwealth, in alignment with the electric sector sublimit and clean energy goals established in the 2050 Climate and Clean Energy Plan.

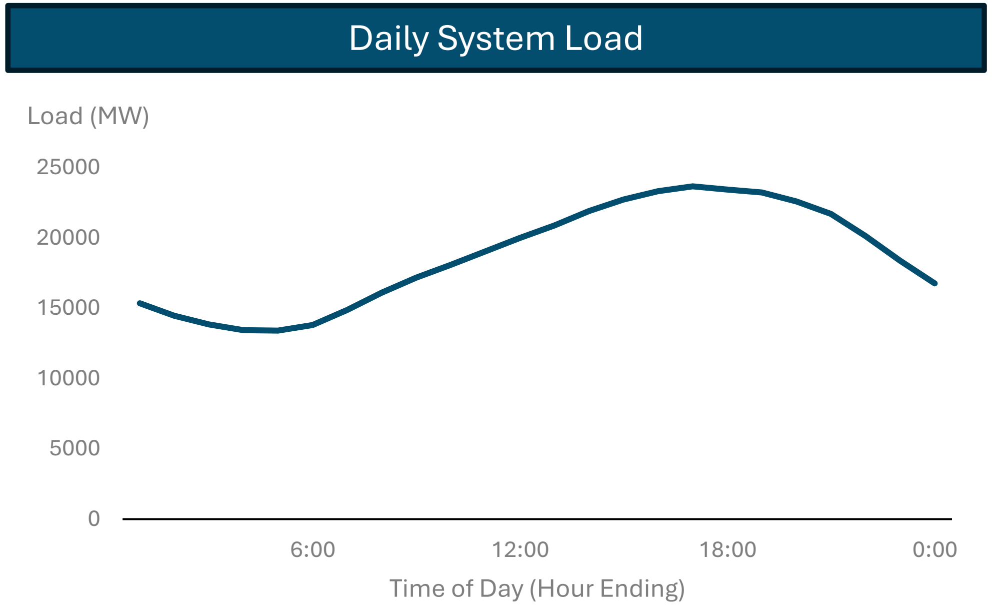
+ **Phase 1 Objectives**
  - Characterize peak load
  - Inventory peak and CHP resources in Massachusetts
  - Assess economic, environmental, and health impacts of peaker plants
  - Understand system costs, benefits, constraints, and incentives
  - Correlate relevant policies influencing peaker plant and CHP operations

Contents



What is “the peak?”

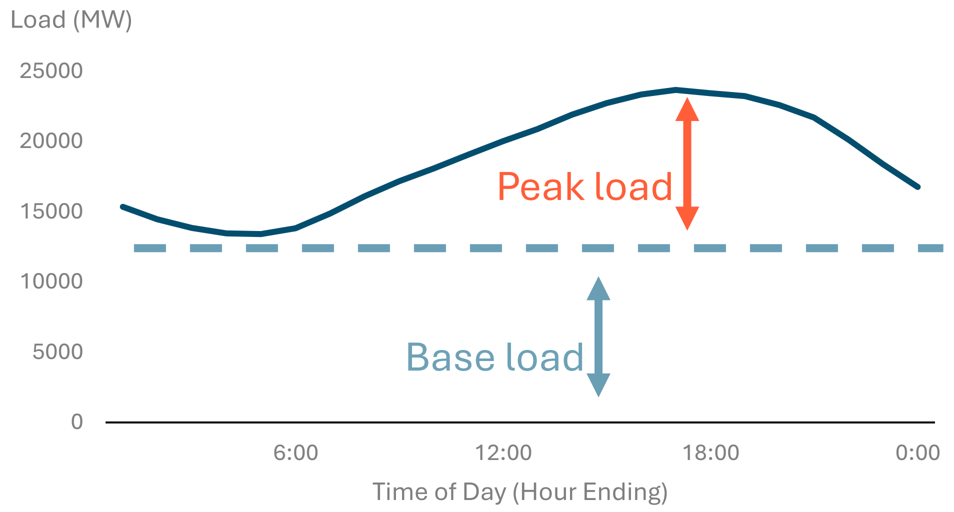
- **Peak power refers to the interval of greatest demand on the electric system for a given period**
- **The regional electric grid reflects the aggregate effect of consumer usage patterns, with periods of higher and lower consumption throughout the day and year**
  - Typically, power consumption increases throughout the day and is at its highest in the evening hours
  - The highest demand for power generally coincides with the hottest and coldest days of the year



How does generation supply meet power demand?

- **Historically, large power plants used nuclear fission or combustion of coal, oil, or natural gas to create thermal energy (i.e., heat) which can be converted into electricity**
  - These plants are designed to operate with high, steady output around the clock
  - Designed to satisfy the system's minimum (i.e., "base load") requirements
- **Smaller, flexible generators are added to the system, when needed, to supplement base load generators and provide power to serve the maximum (i.e., "peak load") requirements**
- **Increasing renewable generation on the system will make flexibility an increasingly valuable characteristic**

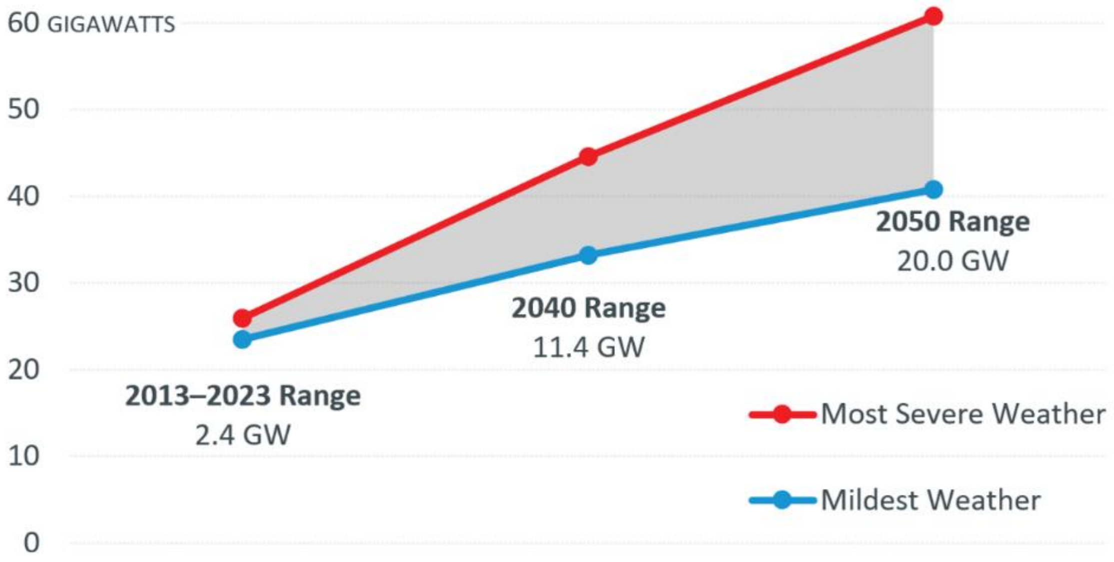
Daily System Load

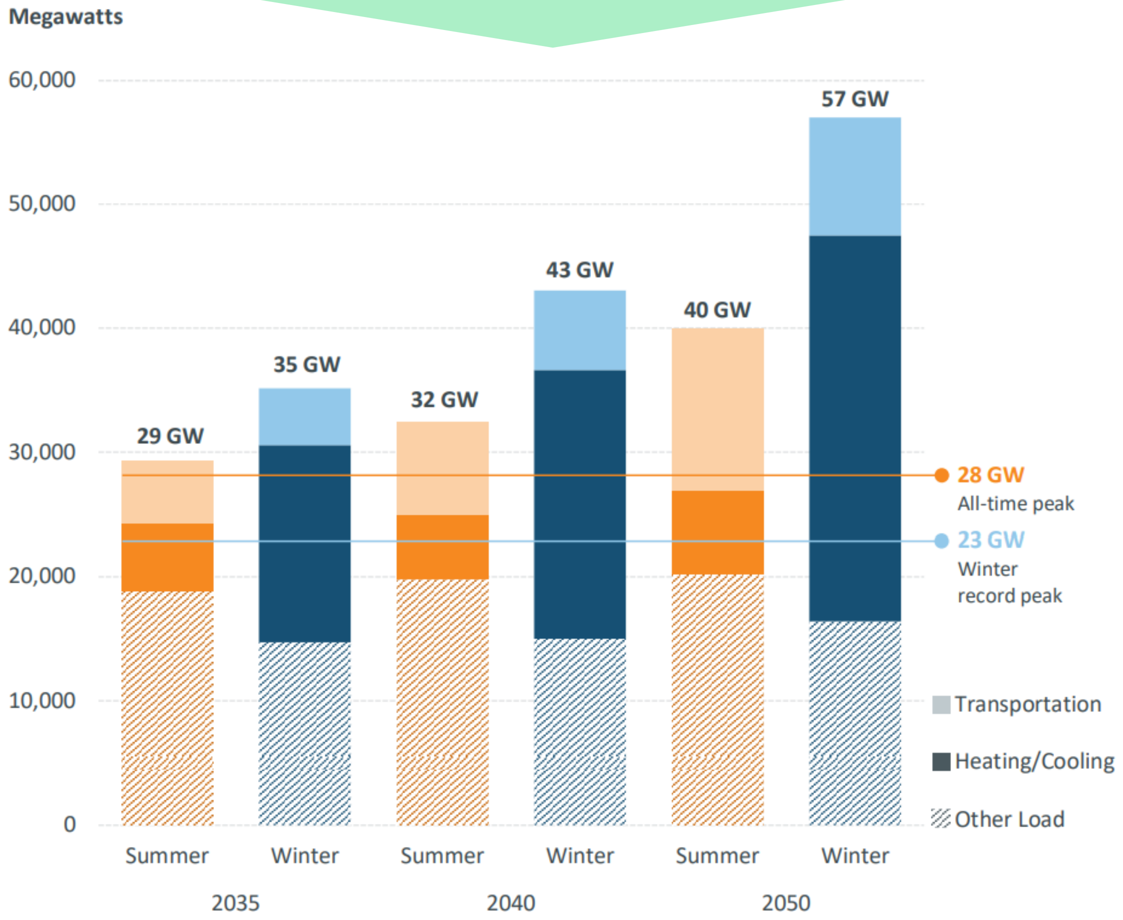


Changes in consumer demand, driven primarily by electrification, are expected to result in significant changes to system peaks

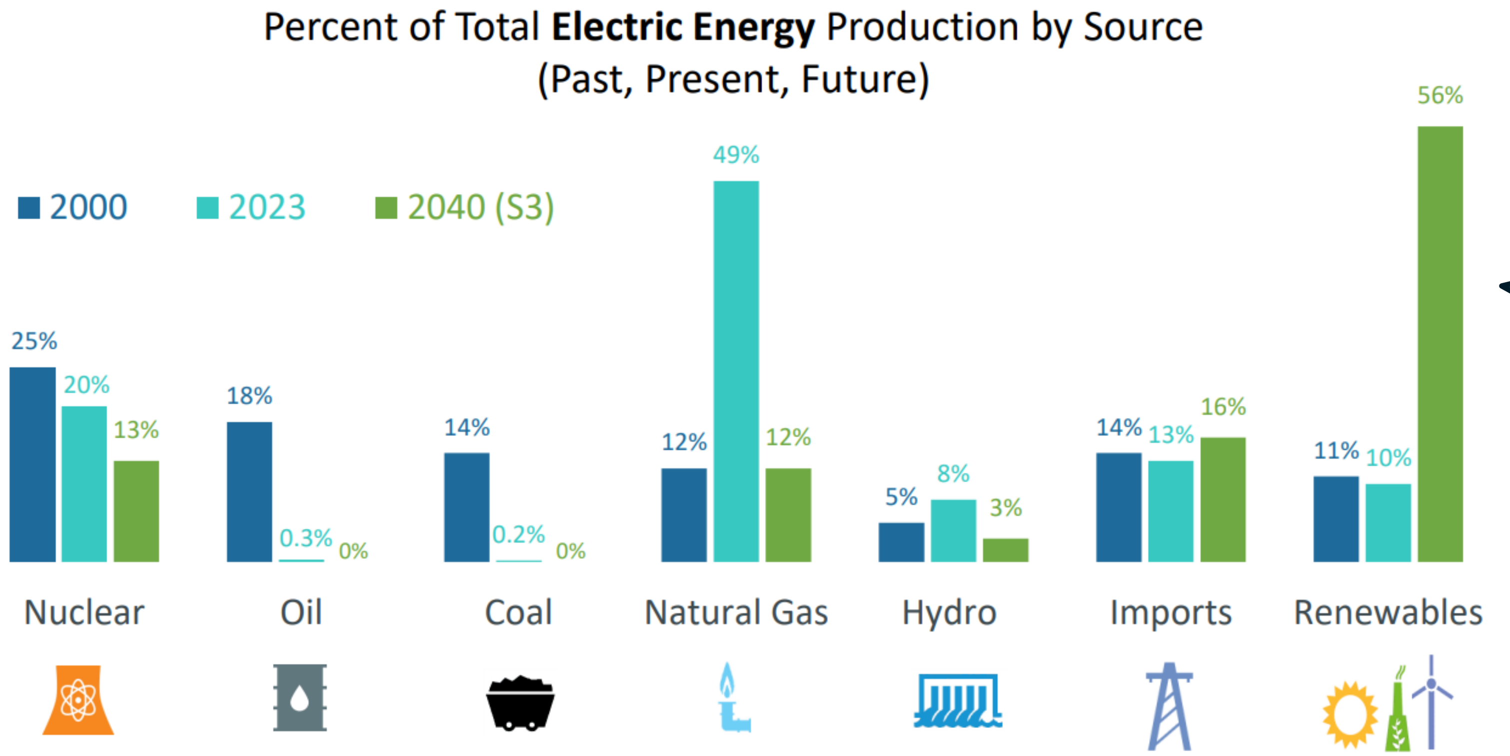
ISO-NE projects peak demand will shift from summer to winter in the mid-2030's and double in magnitude by 2050

Annual peak demand is expected to vary significantly year to year, depending on severity of weather





Flexibility will become an increasingly valuable characteristic as the region's resource supply mix evolves



Variable resources, like solar and wind, are expected to be the dominant source of generation

Source: ISO New England Net Energy and Peak Load by Source; data for 2023 is preliminary and subject to resettlement; data for 2040 is based on Scenario 3 of the ISO New England 2021 Economic Study: Future Grid Reliability Study Phase 1.
Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, behind-the-meter solar, municipal solid waste, and miscellaneous fuels.

Peaker plants have special attributes that allow them to provide power at key times and locations

Dispatchable

Rapidly start up and increase power production when needed

Low capacity factor

Operating hours make up a low percentage of available hours to meet highest power needs

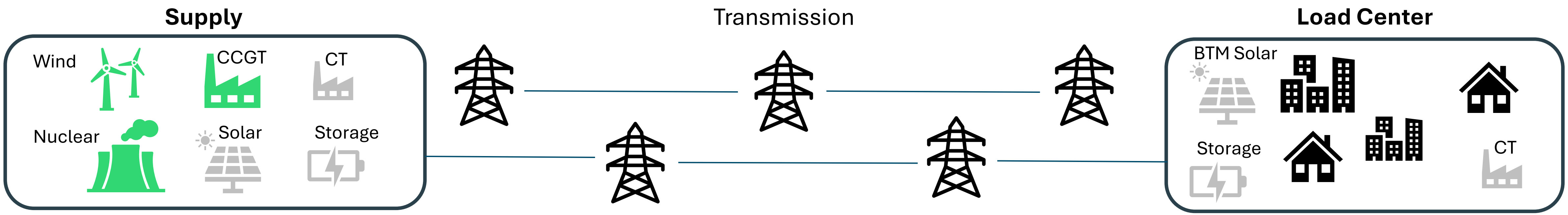
Thermal

Producing electricity by converting heat into mechanical energy, typically via combustion of fossil fuels like natural gas, diesel, or kerosene

Small footprint

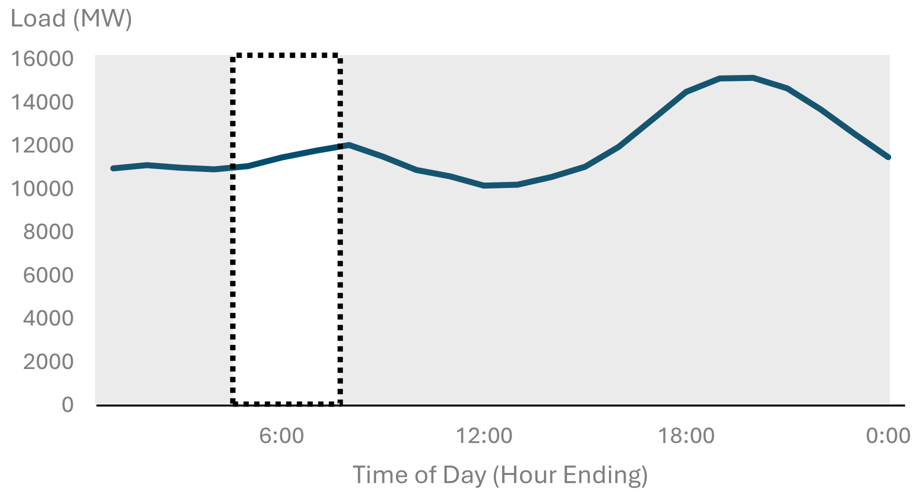
Peaker plants are often smaller in size allowing them to be located closer to load centers

Peaker plants are important because they provide power in places and at times where additional supply is needed

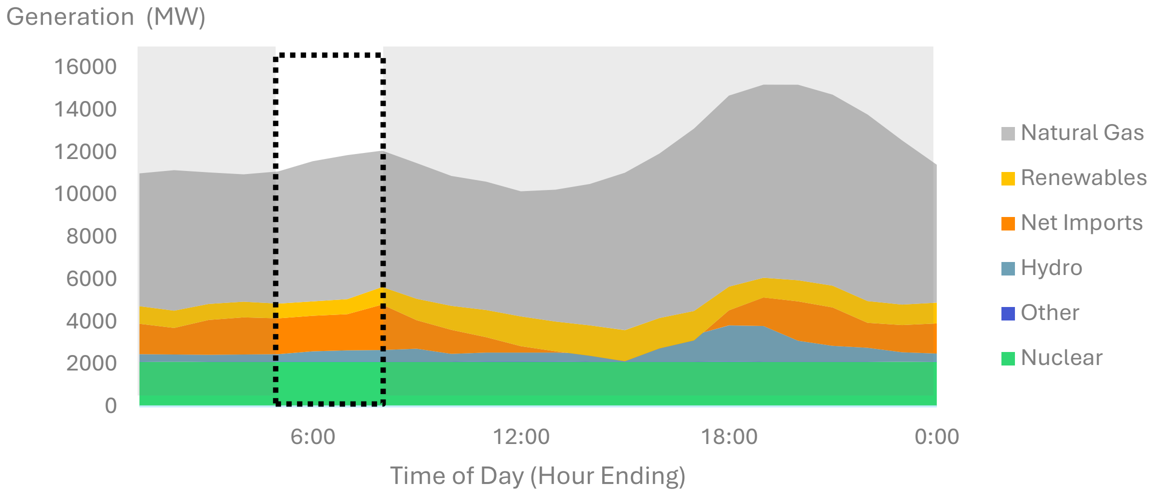


Illustrative Scenario: In the morning, loads begin to ramp up, but remain managed by resources without dispatching peaker plants

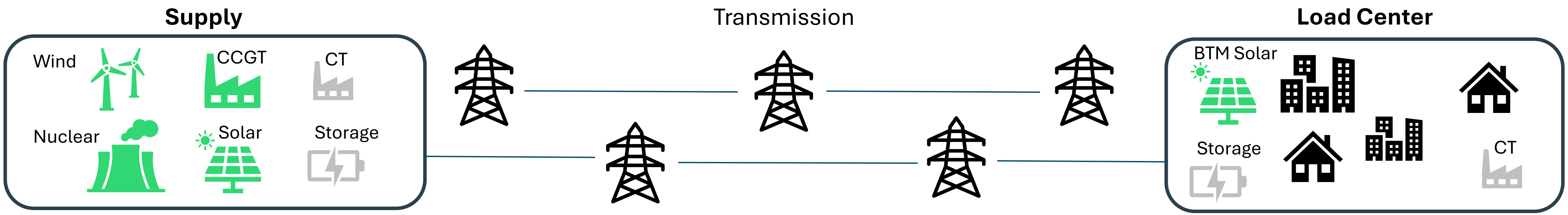
Illustrative System Load



Illustrative System Supply

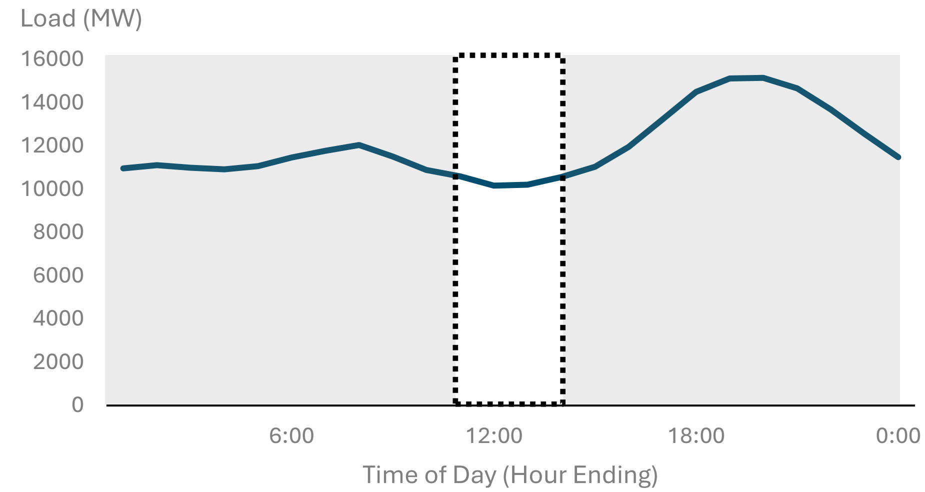


During normal conditions, baseload generators satisfy the necessary supply and peaker plants do not operate

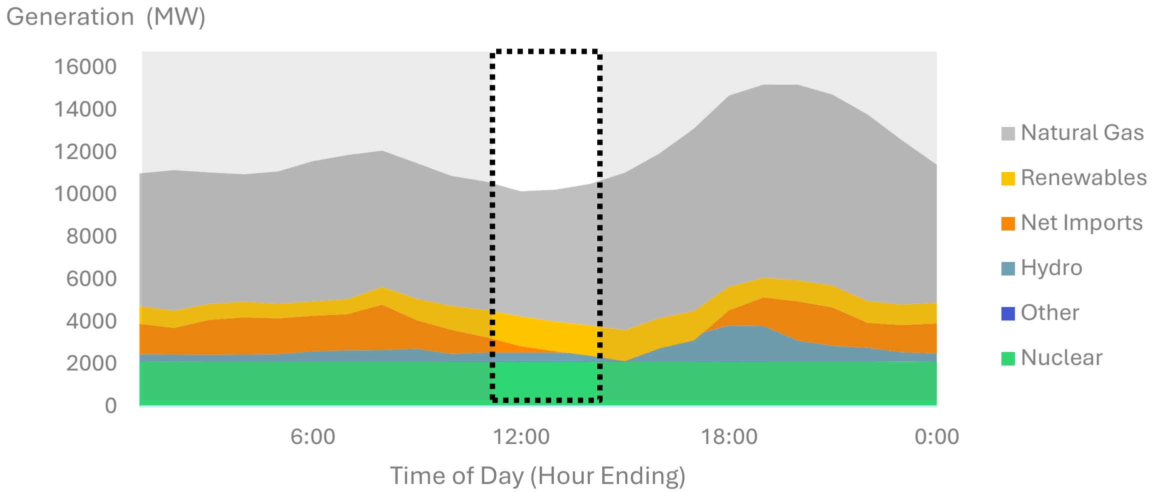


Illustrative Scenario: At midday, loads climb toward peak, but generation from solar resources mitigates the need for dispatching peaker plants

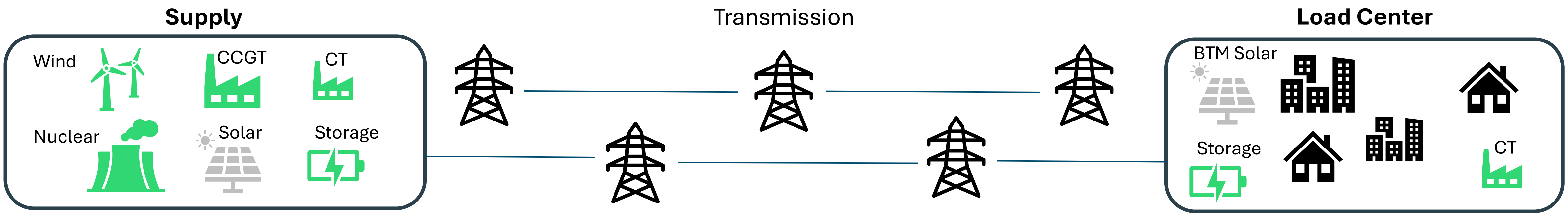
Illustrative System Load



Illustrative System Supply

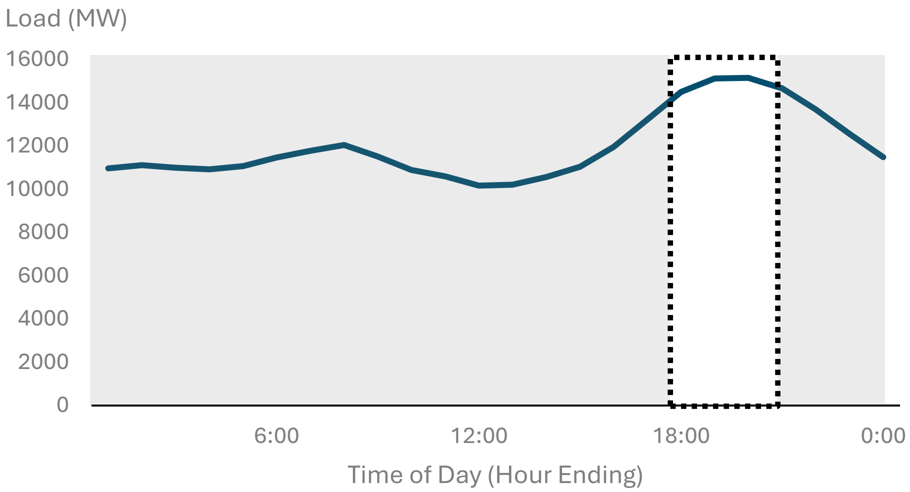


During periods of high demand, peaker plants augment baseload generators to deliver the necessary supply

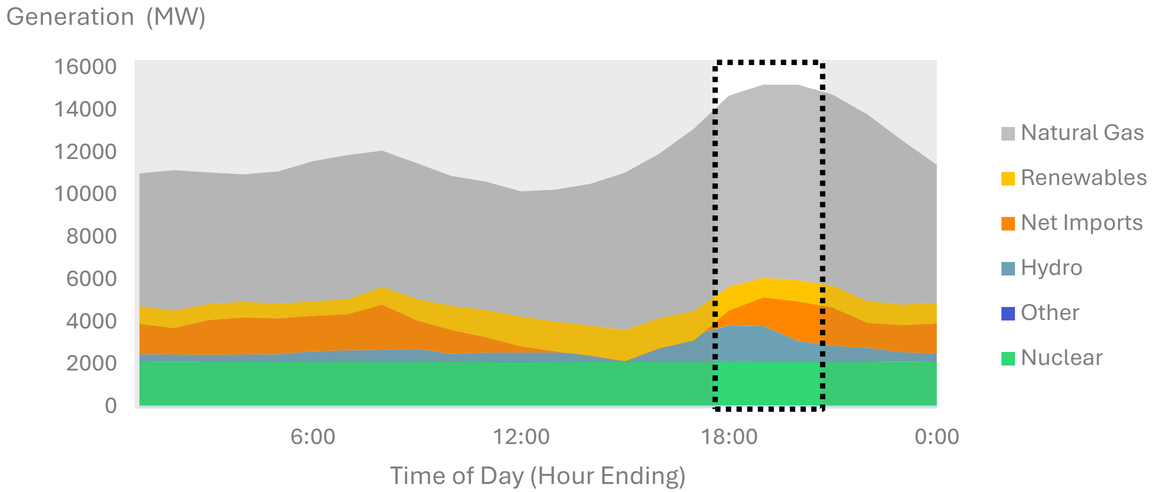


Illustrative Scenario: In the evening, solar production wanes and the elevated demand must be satisfied by peaker plants until loads subside

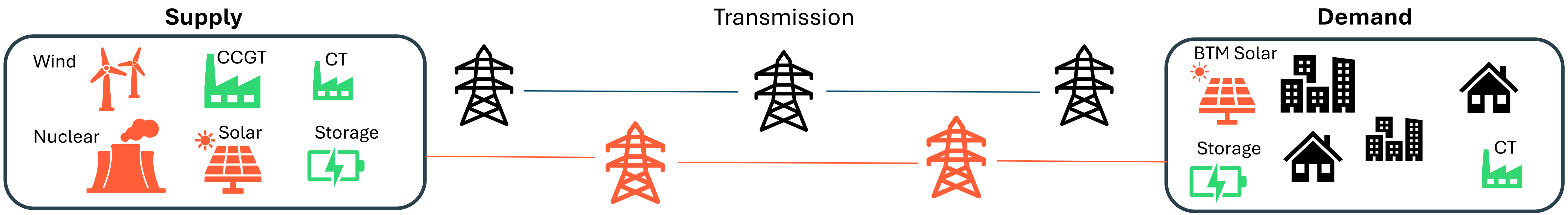
Illustrative System Load



Illustrative System Supply



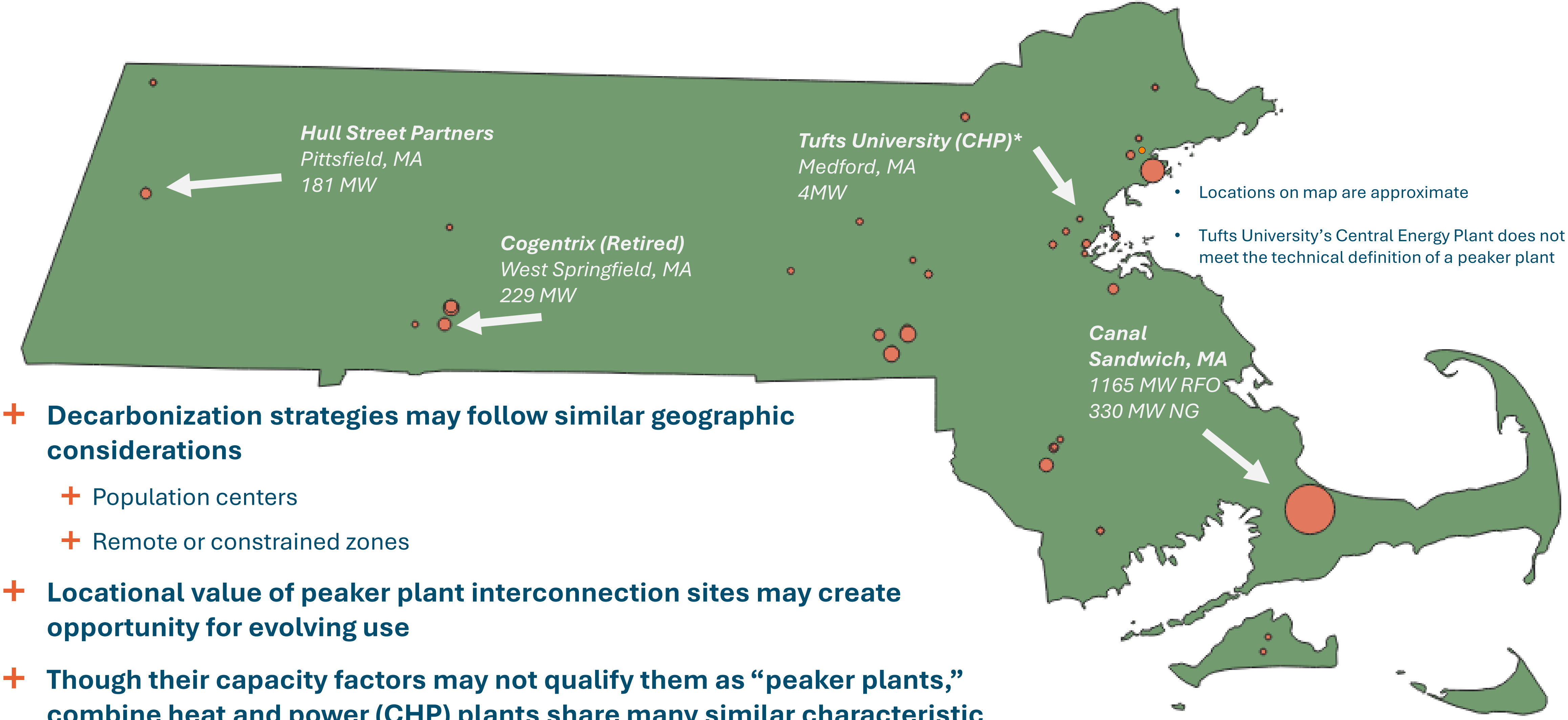
Peaker plants also provide backup supply and locational value when supply or transmission of other resources is constrained



Illustrative Scenario: Peaker plants may also provide necessary support under specific system conditions, including:

- Transmission congestion
- Lack of wind or solar resources
- Preferred resources are unavailable due to maintenance or resource conditions

Most of the Commonwealth's peaker plants are strategically positioned to provide specific locational value



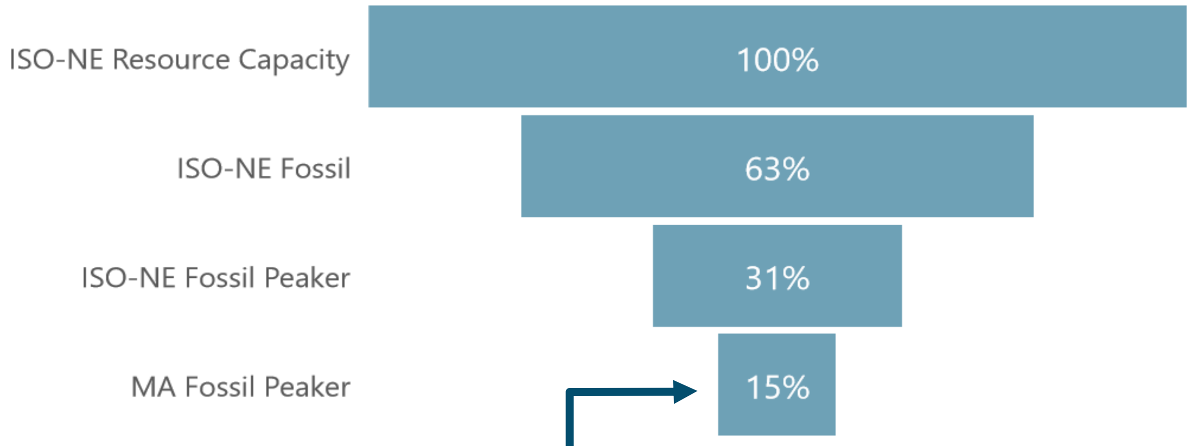
- Locations on map are approximate
- Tufts University's Central Energy Plant does not meet the technical definition of a peaker plant

+ **Decarbonization strategies may follow similar geographic considerations**
  + Population centers
  + Remote or constrained zones
+ **Locational value of peaker plant interconnection sites may create opportunity for evolving use**
+ **Though their capacity factors may not qualify them as "peaker plants," combine heat and power (CHP) plants share many similar characteristic**

https://www.psehealthyenergy.org/wp-content/uploads/2019/12/Massachusetts.pdf
https://www.sandia.gov/app/uploads/sites/163/2022/04/Issue-Brief-2020-11-Peaker-Plants.pdf

Massachusetts peaker plants comprise 15% of region's total resource capacity

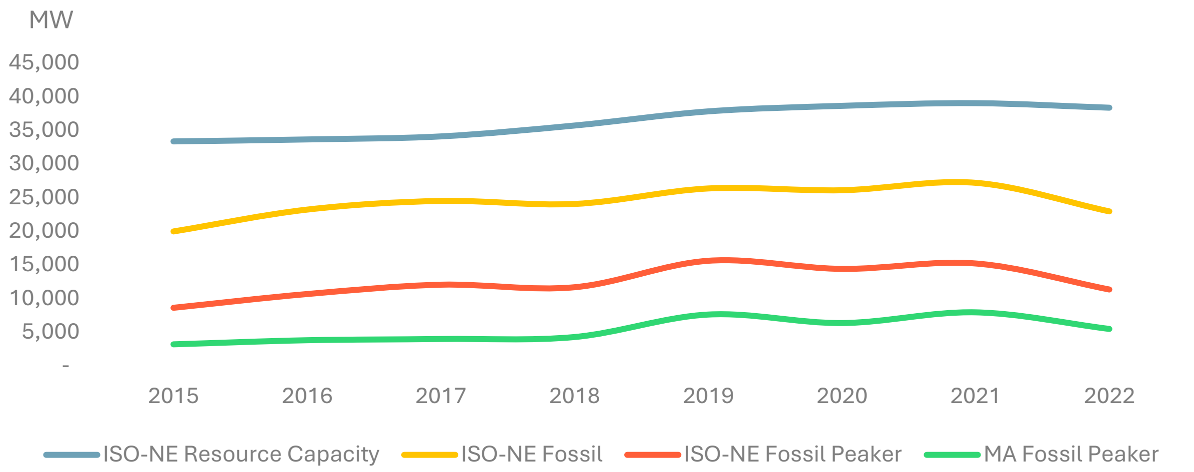
MA Peaker Share of Total ISO-NE Capacity (2022)



- **Consistent contribution of Massachusetts peaker plants to total New England resource capacity**
- **Retirement of baseload units may have increased reliance on peakers to meet energy needs**

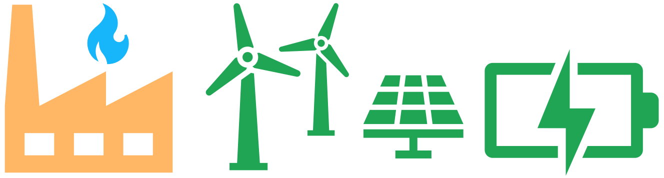
Massachusetts has the opportunity to decarbonize 15% of the New England region's capacity

Regional Capacity and Trends

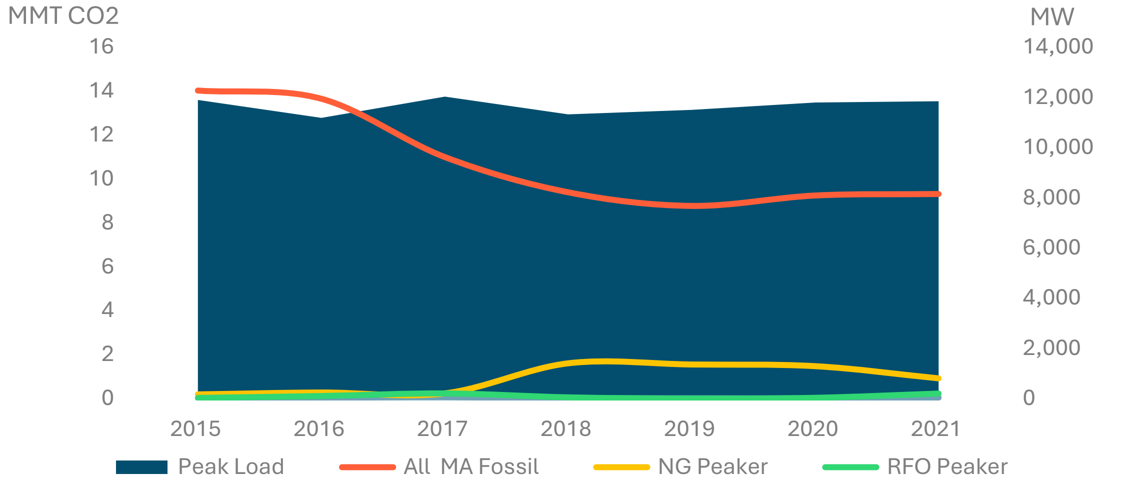


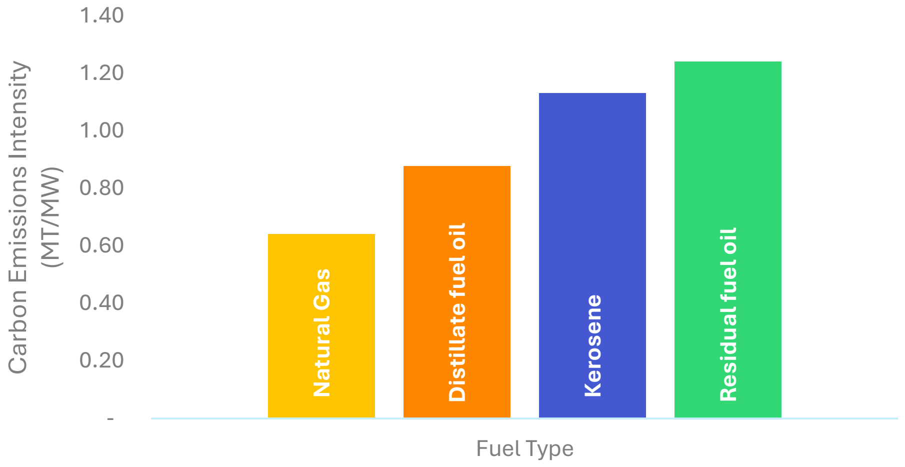
Total emissions have declined, despite steady peak demand and an increase in peaker plant operations

+ **As the grid evolves away from large, centralized, base load generation toward a more diverse and complimentary resource portfolio, peaker plants continue to play an important role**
+ **Peaker plants augment the power supply as fossil fuel baseload is displaced by renewable generation**
+ **Emissions fall as higher polluting fuels and resources are replaced with cleaner options**
+ **Gross contributions of peaker plants to emissions will likely increase commensurate with increased operations**
+ **Local air pollution (e.g., SOx, NOx) follows similar trends as carbon emissions**



MA Emissions Profile





Air Pollutant Emissions Trends Data | US EPA

Several distinct revenue streams exist within New England's wholesale electricity market

Resource Adequacy

The Forward Capacity Market provides fixed revenues, subject to accredited resource capacity and forward market clearing price.

Energy

Sales into the energy market provide variable revenues subject to production and real-time market pricing.

Ancillary Services

Services like (frequency) regulation, operating reserves, blackstart, and voltage support provide real-time support to balance grid operations.

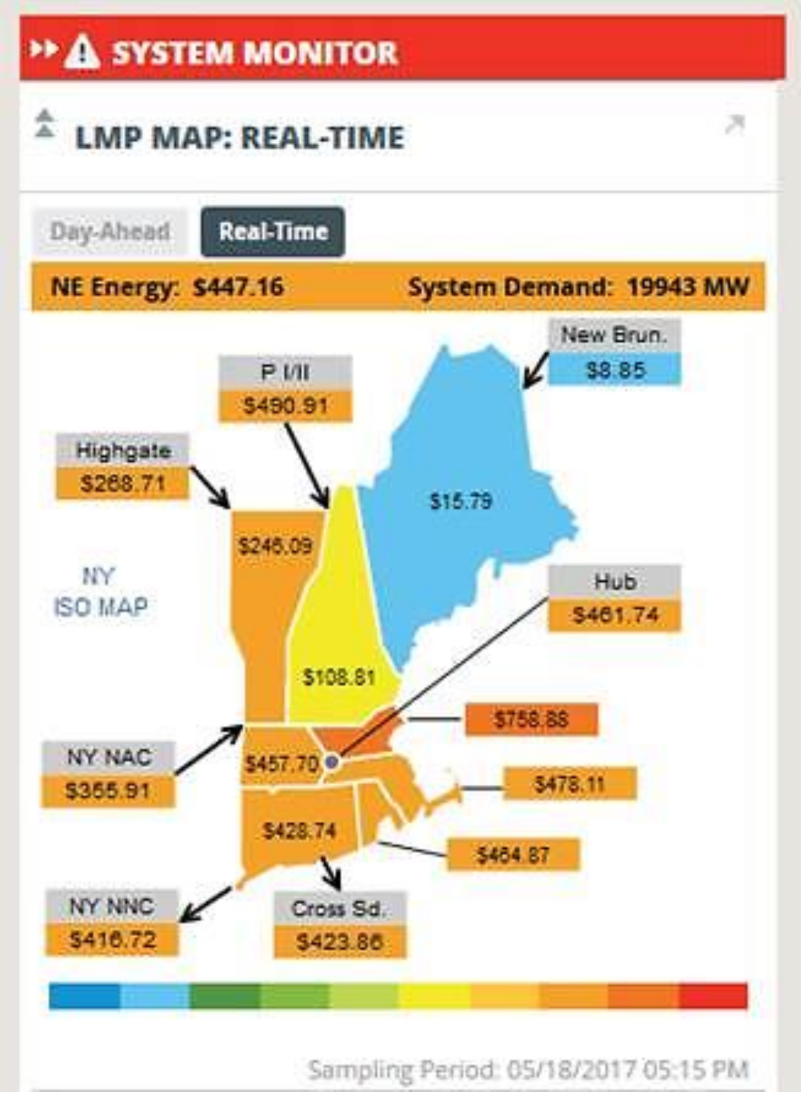
Environmental Attributes

Massachusetts awards Class I Renewable Energy Certificates (RECs) to various generators like solar and wind resources.

The location of electricity supply, relative to demand has measurable value

+ Marginal electricity pricing sends a direct cost signal to generators and loads to support efficient market outcomes
+ Locational marginal prices (LMPs) reflect the marginal value of energy for a specific location at a given time
+ Transmission congestion (analogous to traffic on a highway) between regions can lead to large spreads in LMPs, leading to generators in constrained regions receiving higher revenue

Example: In May of 2017, unseasonably warm weather coincided with planned generator and transmission outages, resulting in significantly divergent real-time LMPs. Imports into northern New England moderated prices, whereas more expensive generation was dispatched to supply loads in constrained zones in southern New England.



Policy is a major influence in how the electric sector operates

Rules & Restrictions

Mandates such as emissions limits compel action and can put additional pressure on fossil resources

Incentives

New programs and tax incentives may create opportunities for new resources, including flexible resources like battery storage

Guidance

Guidance can provide improved frameworks for consideration, such as siting and permitting

+ Influences come from many sources, at various jurisdictional levels

- National – Orders from Federal Energy Regulatory Commission (FERC), Environmental Protection Agency (EPA), etc.
- Regional – Policy and planning initiatives, including ISO-NE's Capacity, Energy, Loads, and Transmission (CELT) Report
- State – Legislated standards; reviews by Energy Facilities Siting Board (EFSB) and Department of Public Utilities (DPU)
- Local – Community needs, capabilities, and interests

Policy at the national, regional, state, and local levels are influencing how peaker plants may operate in the future

+ Federal

- 2011 FERC Order 745
- 2018 FERC Order 845
- 2020 FERC Order 2222
- 2022 Inflation Reduction Act
- 2024 EPA fossil fuel power plant emissions standards

+ Regional

- Reliability Agreement, formerly known as "Reliability Must Run" (RMR)
- Minimum Offer Price Rule (MOPR)
- Competitive Auctions with Sponsored Policy Resources (CASPR)
- Pay for performance (PfP)

+ State

- 2015 Energy Storage Initiative
- 2017 Clean Energy Standard (CES)
- 2020 Clean Peak Energy Standard (CPS)
- 2021 An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy
- 2022 An Act Driving Clean Energy and Offshore Wind
- Ongoing siting reform

+ Local

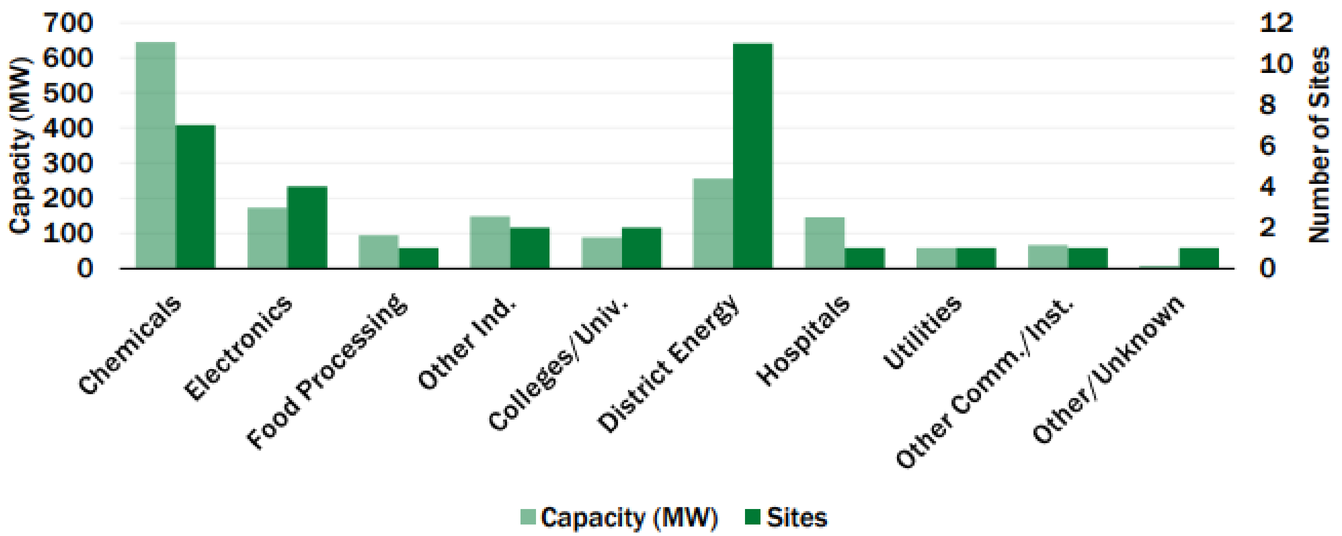
- Reuse opportunities
- Interconnection agreements
- Infrastructure considerations
- Real estate
- Zoning, building/fire codes, and permitting requirements
- Cumulative impacts for environmental justice communities

Greenhouse Gas Standards and Guidelines for Fossil Fuel-Fired Power Plants | US EPA
Order-845.pdf (ferc.gov)
https://commonwealthbeacon.org/energy/a-new-way-to-connect-offshore-wind-power-to-the-grid/

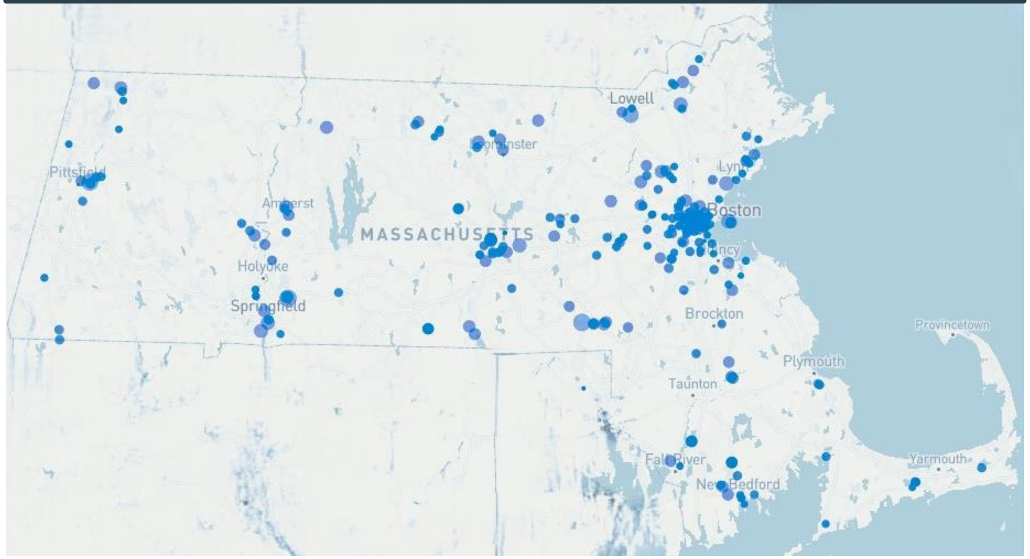
Combined heat and power (CHP) plants offer a unique way to address multiple needs, including peak power, with one resource

- Combined heat and power (CHP) plants, which are also referred to as cogeneration facilities, provide an efficient solution to providing on-site electric and thermal (i.e., heat) energy from a single fuel source.
- This approach can reduce fuel consumption and greenhouse gas emissions, relatively to addressing heat and power needs separately
- CHPs provide effective, reliable, and efficient heat and power for customers with predictable, consistent needs

Massachusetts CHP by Application



Massachusetts CHP Locations

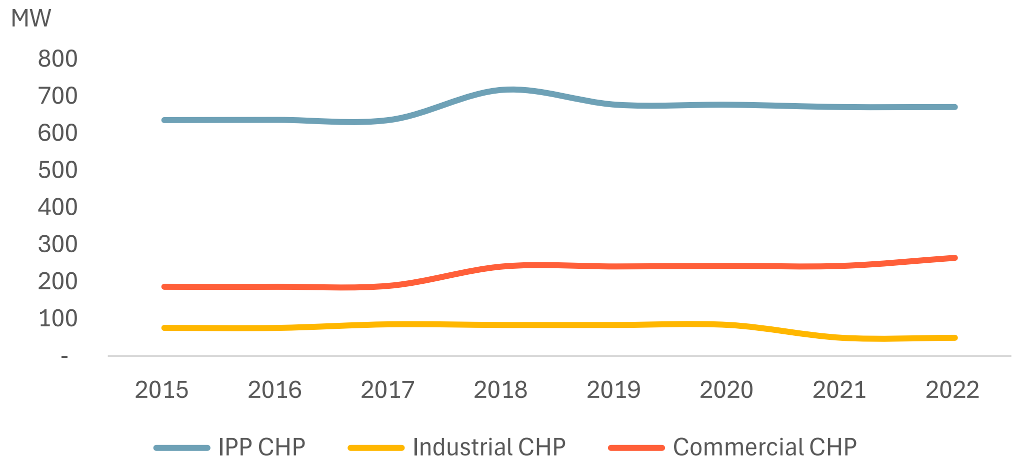


https://betterbuildingssolutioncenter.energy.gov/sites/default/files/files/tools/Massachusetts.pdf
Combined Heat and Power | Mass.gov
U.S. Department of Energy Combined Heat & Power and Microgrid Installation Databases (icfwebservices.com)

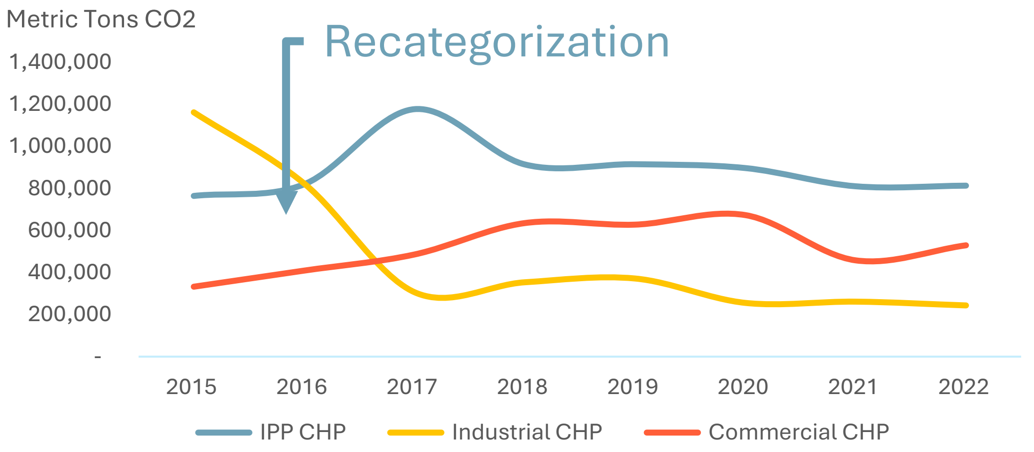
Massachusetts CHP capacity provides meaningful and consistent capacity to power supply

>250	~10%	1.6GW	>25%
Registered facilities	Massachusetts' electric supply in 2022	Installed capacity	Capacity factor

Capacity



Emissions



Combined heat and power generators face challenges as source of carbon emissions in Massachusetts

- Most CHPs in the Commonwealth are powered by natural gas
- With the generation mix changing and decarbonizing over time, CHP facilities will become sources of higher emitting generation on the system

Tufts University CHP

MIT's Central Utilities Plant

The Heartbeat of Campus: MIT's Central Utilities Plant (CUP) (youtube.com)

Key Takeaways

+ Peak power represents a specific challenges and opportunities for decarbonization
+ Peaker plants currently provide significant contributions to maintaining system reliability
+ Despite their infrequent operations, peaker plants contribute disproportionately to climate and air pollution due to their low efficiency and use of higher-emitting fuels
+ A combination of market forces and policy drivers will lead to significant transformations in both electricity supply and demand in the coming decades, requiring more flexible capacity on the system
  - Increased electric demand due to transportation and building sector electrification
  - Shifts in the timing and season of peak demand
  - Increased reliance on intermittent renewable energy sources like solar and wind
+ Combined heat and power plants are also important resources in the Massachusetts energy ecosystem and their role in a decarbonized future warrants specific consideration
+ Massachusetts has an important opportunity to examine both demand-side and supply-side alternatives that can partially or fully replace the system flexibility and reliability contributions of peakers

DTP: Issue Overview and FAWG Mission

- Despite their infrequent operations, peaker plants are higher emitters for the power they provide because they are less efficient than other plants, with some burning fuels like oil.
- Increased reliance on intermittent renewable energy sources like solar and wind, coupled with shifts in the timing and season of peak demand and increased electricity demand due to transportation and building sector electrification, could require more peaking capacity on the system in the coming decades.
- Most CHP systems operate continuously to reduce regional electricity demand. CHP systems currently play an important role in helping to meet peak demand. As generation in the regional system becomes more decarbonized, CHP systems will need to also decarbonize and/or customers reliant on CHP will need to find other decarbonized means of supporting energy needs. If this shift includes greater utilization of grid power, this could increase peak demand and the need for peaking resources.
- Supply and demand side alternatives are available to reduce and decarbonize the peak.

Mission

To identify and demonstrate pathways to reduce reliance on and expeditiously transition away from fossil fuel peaking power plants and combined heat and power facilities by deploying alternative demand and supply side options to meet peak load needs in the Commonwealth, aligned with the electric sector sublimit and clean energy goals established in the *2050 Clean Energy and Climate Plan.*

DTP FAWG Workstream – Overview

Phase 1

Phase 2

Phase 3

Current Role of Peakers and CHP

(system & facility-specific)

- Peak demand
- System Needs/Uses
- Attributes
- Emissions/Impact

Revenue Streams for Peakers and CHP

- Compensation
- Cost
- Market Design

Alternatives for Peakers and CHP

- Supply
- Demand
- Interconnection
- Cost
- Emissions

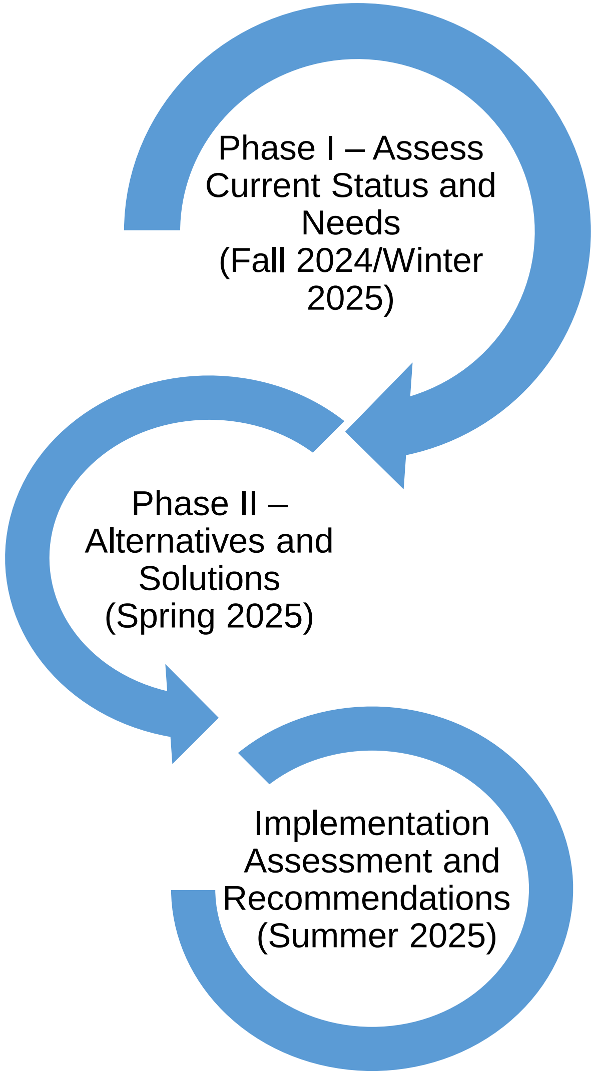
Implementation Assessment

- Policy
- Financing
- Cost
- Timing
- Feasibility
- Customer

Land use, equity and environmental impacts, community, and workforce

Federal, Regional, State, Local Policy

DTP FAWG Workstream – Phase 1 Focus and Proposed Timelines

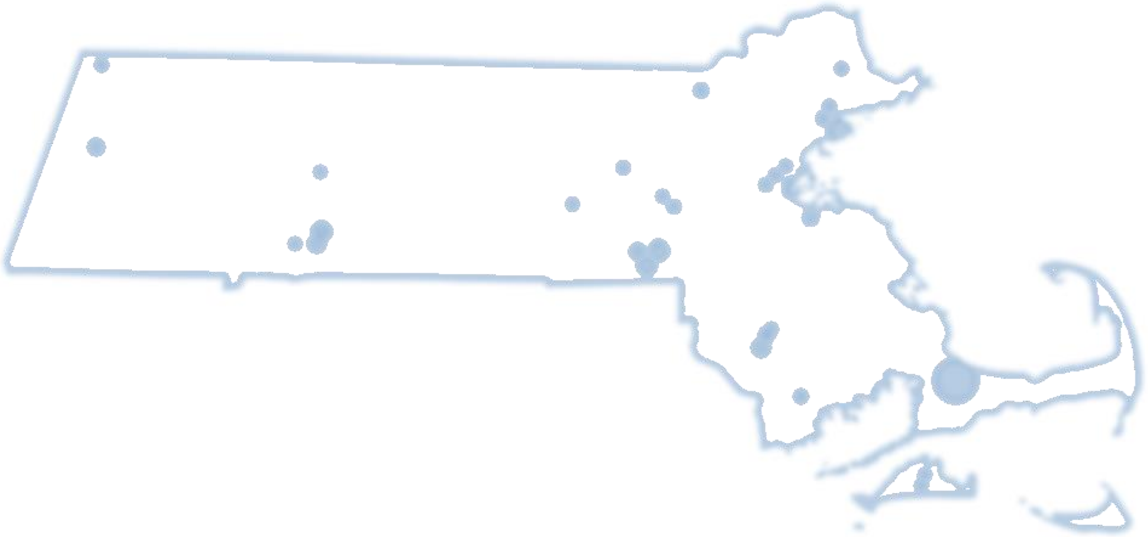


<u>Regional/Statewide Overview Analysis</u>

- Inventory
- Peak demand
- Market and compensation
- Cost considerations
- Emissions (air quality, toxics and CO_2)
- Existing policies and incentives

<u>Analysis of Four Facilities</u>

- Plants' characteristics and overview (e.g., emissions, workforce, community)
- Market and uses
- Cost considerations
- Policies and incentives affecting and utilized by each facility



Phase I - Planned Meetings

- **October 8** – FAWG Launch Webinar (today)

- **November** – FAWG zoom to discuss foundational knowledge concepts including: future load projections and systemic interventions (e.g., demand response, storage), land use, equity and environmental impacts, community, and workforce and current state, regional, and federal policies

- **December** – FAWG meets in Boston to discuss attributes of eastern Massachusetts plants: Canal General Plant and Tufts University Central Power Plant (CHP)

- **January** – FAWG meets in western Massachusetts to discuss attributes of: Cogentrix West Springfield Plant and Pittsfield Generating Plant

- **February** – FAWG zoom:
    - evaluate considerations for system-wide and demand-side interventions, options for each plant, and application of concepts to other peakers and CHP plants in Massachusetts
    - explore potential alternatives to be evaluated in Phase II, including new policies needs (Alternatives Discussion)

- **March – Energy Transformation Advisory Board Meeting**

PHASE I CONCLUDES

Next Steps

- Sign up if you would like to participate in the Decarbonizing the Peak Work Group
  - A link is provided in the chat and will be on the Office of Energy Transformation website
- Review the Bylaws, Ground Rules, and approved workplans available on the Office of Energy Transformation website
- Registration to participate will close on October 15th
- Confirmation will be sent by November 1st
- The first convening of the FAWG will be in mid-November

Adjourn

Thank you!