Massachusetts Comprehensive Energy Plan

Stakeholder meetings

July 17, July 18, and July 19

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Goals of Today's Meeting

- Introduce the Comprehensive Energy Plan (CEP)
- Discuss the scope and anticipated content of the CEP
- Inform about current and future energy challenges in the Commonwealth
- Share drivers and assumptions of various possible energy futures
  - Results have not been finalized and analysis is ongoing
- Spur written comments to the DOER

Introduction and Background

The Comprehensive Energy Plan

- Governor Baker established the requirement for this, our first Comprehensive Energy Plan, in his Executive Order No. 569, *Establishing an Integrated Climate Change Strategy for the Commonwealth*, in September 2016
- Comprehensive Energy Plan (CEP) takes a look at the Commonwealth's energy use and energy supply in a regional context from now until 2030
  - Examines portfolio of energy pathways that seek to balance the three main energy policy goals of clean, affordable, and reliable energy
  - Investigating the impacts of policies over a long-term planning horizon
- The CEP is informed by, and will inform, all of the ongoing energy planning within the Commonwealth
  - This includes the ongoing Clean Energy and Climate Plan (CECP) process that establishes the policies which will allow MA to meet its greenhouse gas emission reduction commitments under the Global Warming Solutions Act (GWSA)

Goals of Massachusetts Energy Policy

- The state's energy policy strives to achieve three goals: clean, affordable, and reliable energy
  - **Clean**: Meet the targets set by the Global Warming Solutions Act by reducing GHG emissions
  - **Affordable**: Reduce the cost of energy and reduce the amount of energy customers need to buy
  - **Reliable and resilient**: Ensure a reliable system and reduce impact of service outages, storms, and emergencies
- Our CEP analysis
  - Projects different possibilities for Massachusetts' energy future through modeling,
  - Interprets the results within the context of these goals,
  - Highlights priorities for policy development and identifies possible strategies to meet demand

Study Scope

- The Comprehensive Energy Plan will include results on:
  - **Supply**: Today, we will review different assumptions that build different supply and demand scenarios
  - **Reliability**: Ongoing work is investigating the impact of policies on winter peak
  - **Cost**: Final report will also contain cost estimates for different scenarios, focusing on impact to residential customers' energy bills
- The Comprehensive Energy Plan will project the energy supply and demand for three sectors:
  1. **Power**
  2. **Transportation**
  3. **Thermal Conditioning**
  - Interaction between the sectors including the impact of increased electrification in Transportation and Thermal Conditioning

Timeline of CEP

- Early 2018 – CEP kickoff
- March to July 2018 – CEP modeling
- July 2018 – CEP stakeholder meetings
- July 31, 2018 – Written comments due
- September 2018 – Report release

Overview of Assumptions and Drivers in Report

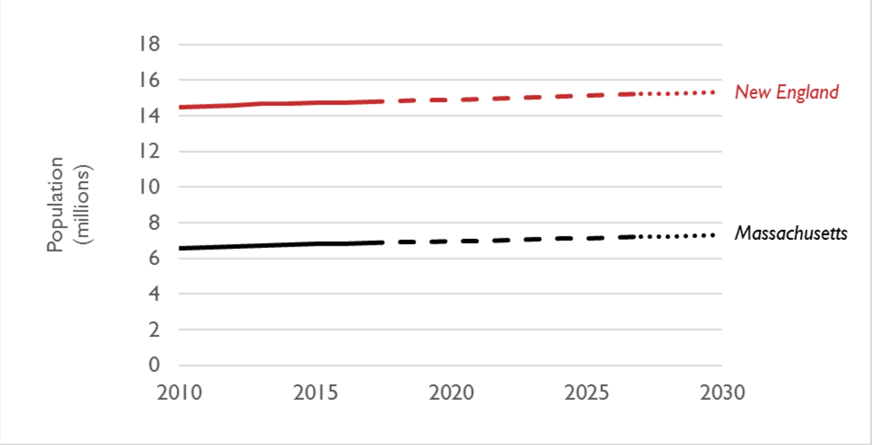
Synapse Energy Economics

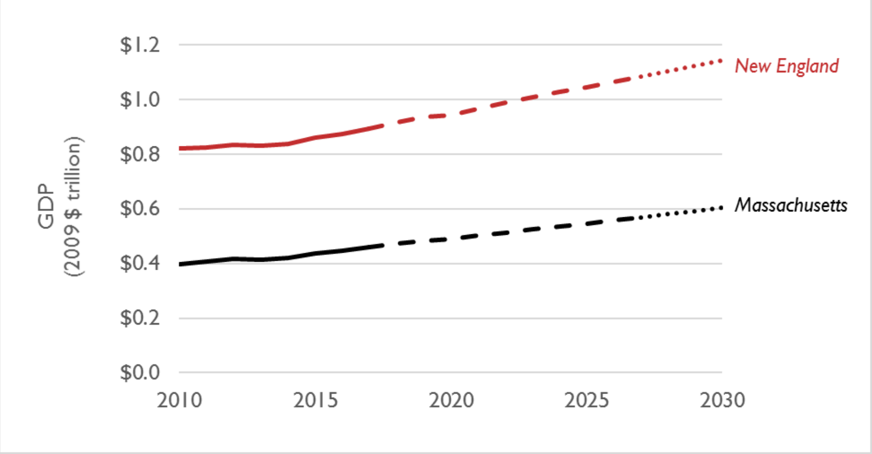
- Founded in 1996 by CEO Bruce Biewald
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector
- Staff of 30 includes experts in energy and environmental economics and environmental compliance
- Based in Cambridge

Demand Drivers

Fundamental Drivers

- Primary drivers for energy demand are population and economic activity
- New England drivers matter as well as MA, because we share a regional electric grid.
- Projections shown here are based on ISO-NE analysis, extrapolated to 2030





Transportation Demand

- Most transportation is measured in terms of vehicle miles traveled or “VMT”
- Most VMT in MA is attributable to light-duty vehicles (LDVs)—personal vehicles which primarily consume gasoline
- Other key parts of the transportation sector include freight, buses, airplanes, and trains, which primarily consume diesel or jet fuel
- Today, virtually all of the VMT in Massachusetts are powered using fossil fuels, but an increasing amount of VMT will be powered by electricity in the future

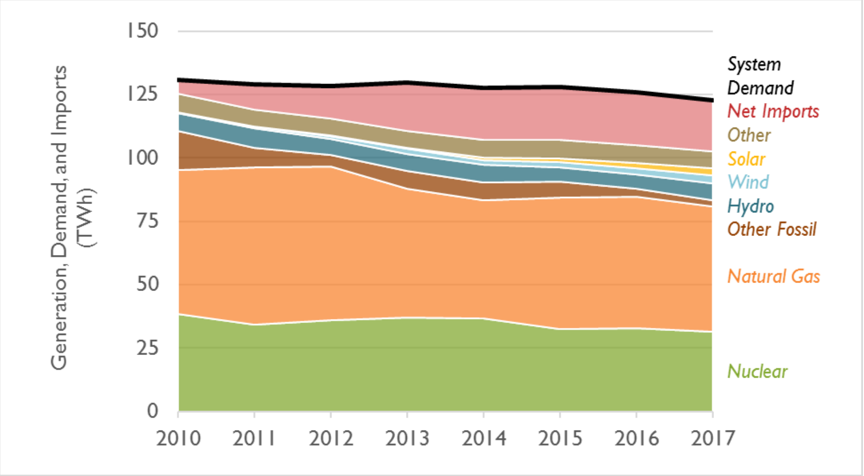
Thermal Demand

- Thermal demand can be divided into three subsectors
  - Residential
  - Commercial
  - Industrial
- Heating and cooling is highly variable year-to-year, based on weather
- Since the early 1990s, residential heating and water heating has decreased by about one-quarter
- Since the mid-2000s, commercial demand for thermal energy has increased by about 40 percent
  - In large part due to increased construction of commercial buildings
- Energy demand in the industrial sector has dropped significantly since the 1990s.

Power Sector Demand

- MA is part of the regional New England electricity grid
  - MA's demand for electricity is about 45 percent of regional demand
- Since 2010, demand for electricity has fallen by about 5 percent
- Electricity is increasingly provided by imports and renewables
- Total fossil generation has decreased by about 30 percent
- Nuclear generation has declined by about 15 percent (retirement of VT Yankee)

Historical – New England



Modeling Future Energy Demand

Scenarios of Future Energy Use

- Energy future depends on:
  - Growth: growing economy and increased population increased vehicle miles traveled and housing square footage
  - Changes to energy supply (fuel switching, increasing renewables from RPS, SMART, 83C and 83D, etc.)
  - Other drivers including fuel costs and appliance efficiencies
- We examine the impact of making adjustments to “key levers”, including: efficiency, renewables, electrification (electric vehicles, heat pumps)
- By analyzing multiple scenarios, we can understand how different policies drive differences in costs, reliability, and emissions

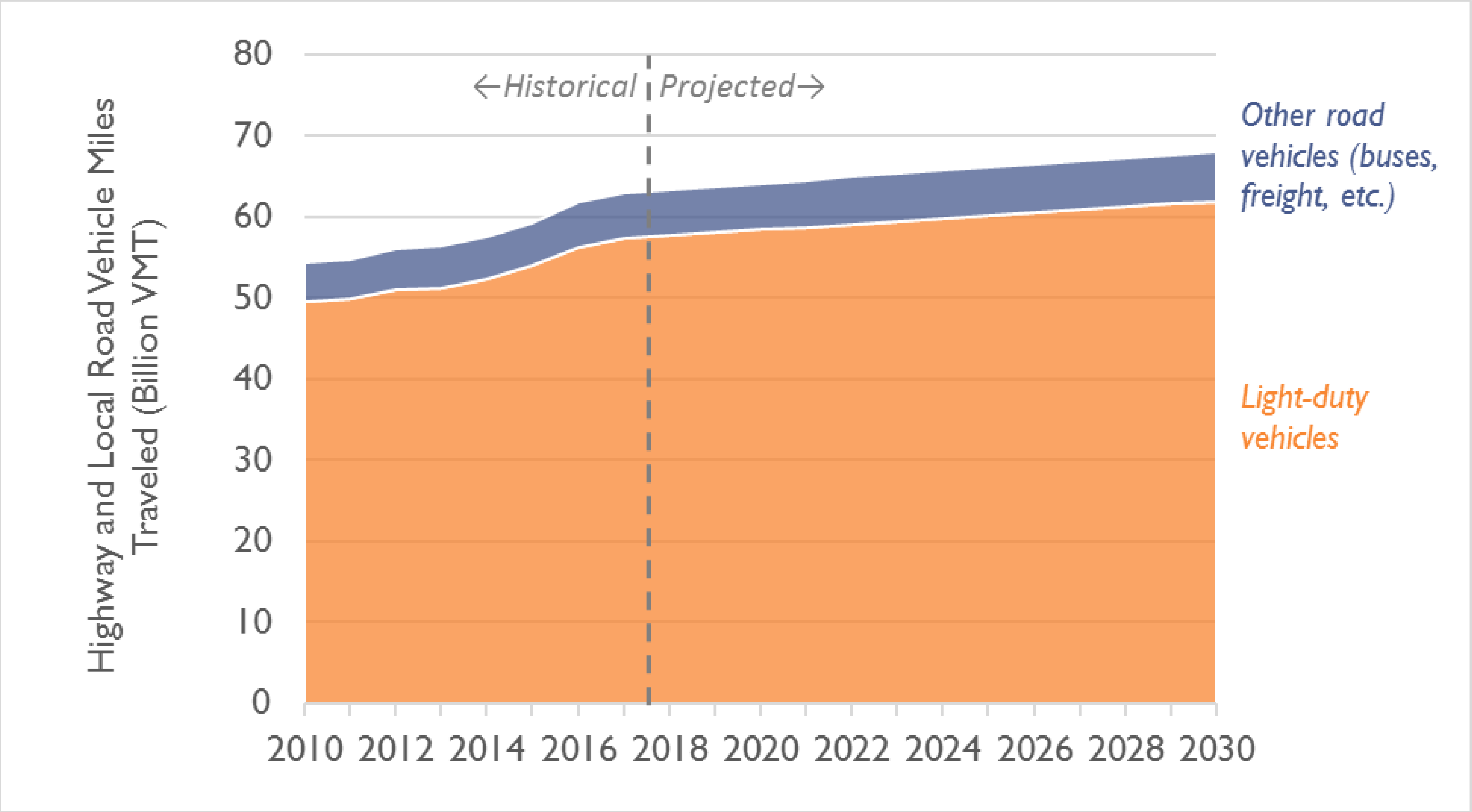
Scenarios
Sustained Policies (SP)
1. Sustained Policies
Increased Policies (IP)
2. High electrification (HE)
3. High renewables (HR)
4. High electrification and high renewables
5. High electrification and high renewables, with Clean Peak (CP)
Aggressive Policies
6. Aggressive Polices

Assumptions for Sustained Policies

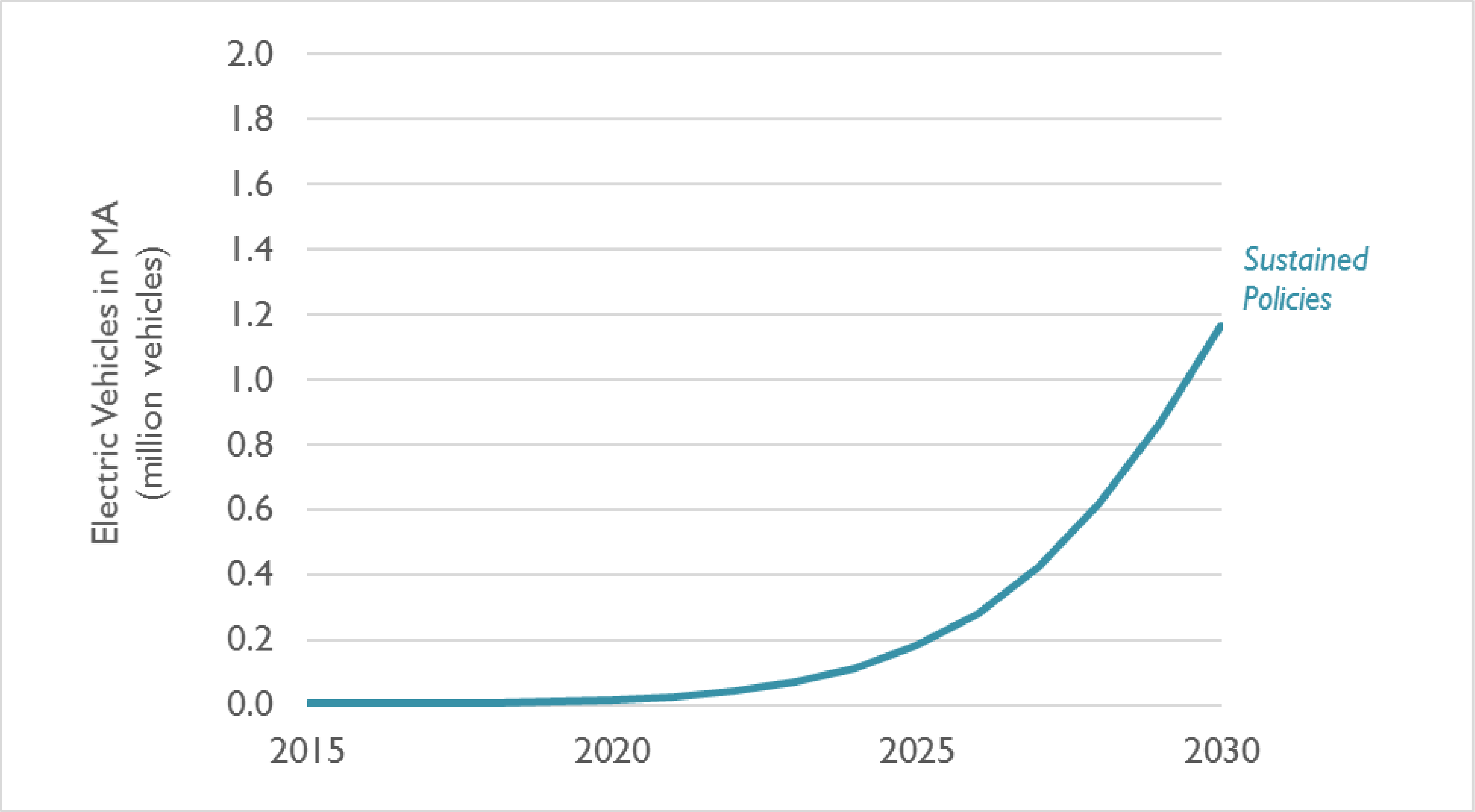
Sustained Policies Scenario

- As a first step in our analysis of Massachusetts' energy future, we've developed a "sustained policies future":
  - A future in which all policies that are in effect today remain in effect into the future
  - This includes future policies which are known and have already been enacted, but are not yet impacting Massachusetts' energy system
  - This scenario does not assume or require results to meet any goals or targets, including any GWSA emissions targets
- Key Assumptions are:
  - Electric vehicles hit 160,000 in 2025
  - VMT continues to grow
  - Current deployment rates of heat pumps
  - No increase in building shell efficiency beyond current trends
  - RPS increases 1% percent per year with current 83C (offshore wind) and 83D (clean energy) procurements

Transportation Energy Demand

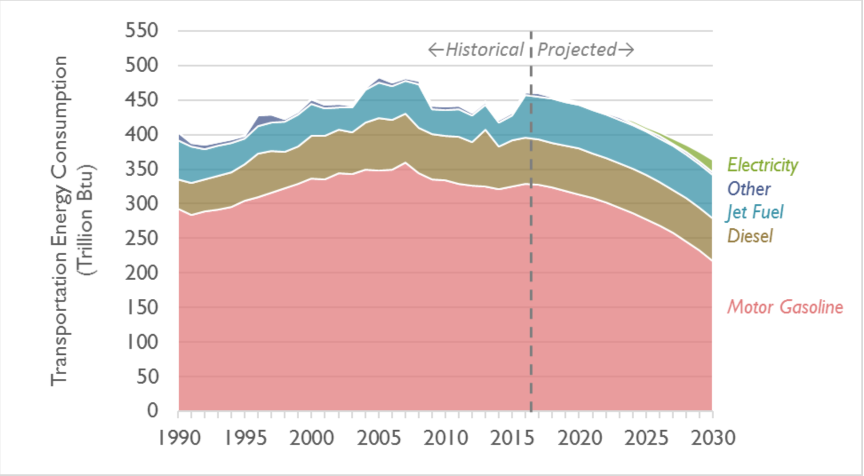


Transportation Energy Demand



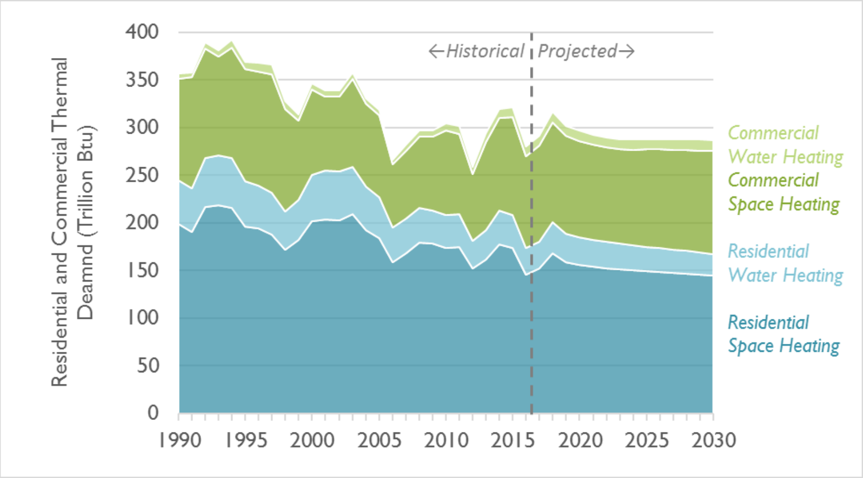
Transportation Energy Use

- While VMT is projected to continue to rise, improved efficiency is expected to reduce fuel consumption
- By 2030, CAFE standards are projected to reduce gasoline consumption by 20 percent
- Under a Sustained Policies future, 1.2 million EVs on the road in 2030 reduces gasoline consumption by another 13 percent
  - 2 out of 3 vehicles purchased in 2030 are EVs



Thermal Sector: Energy Demand

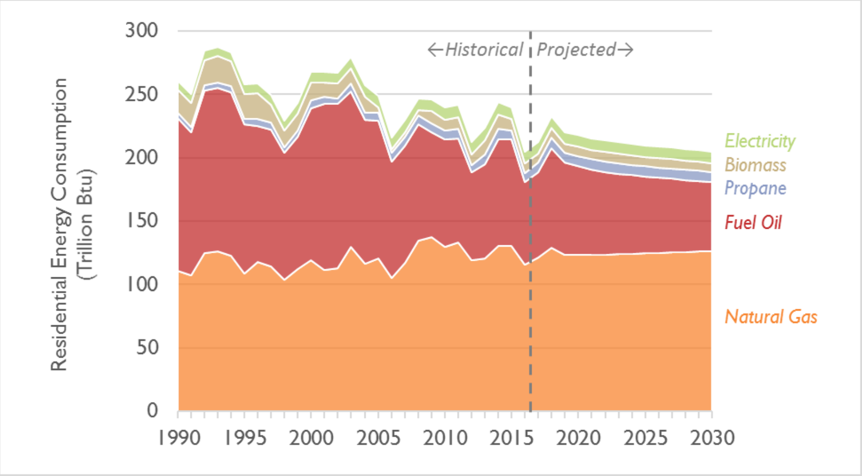
- Demand in the thermal sector includes the demand for heating, including both:
  - Space heating
  - Water heating
- Heating and cooling is highly variable year-to-year, based on weather
- Since the early 1990s, residential heating and water heating has decreased by about one-quarter
  - Under a Sustained Policies future, energy efficiency measures and fuel switching are expected to continue to reduce residential demand for thermal energy



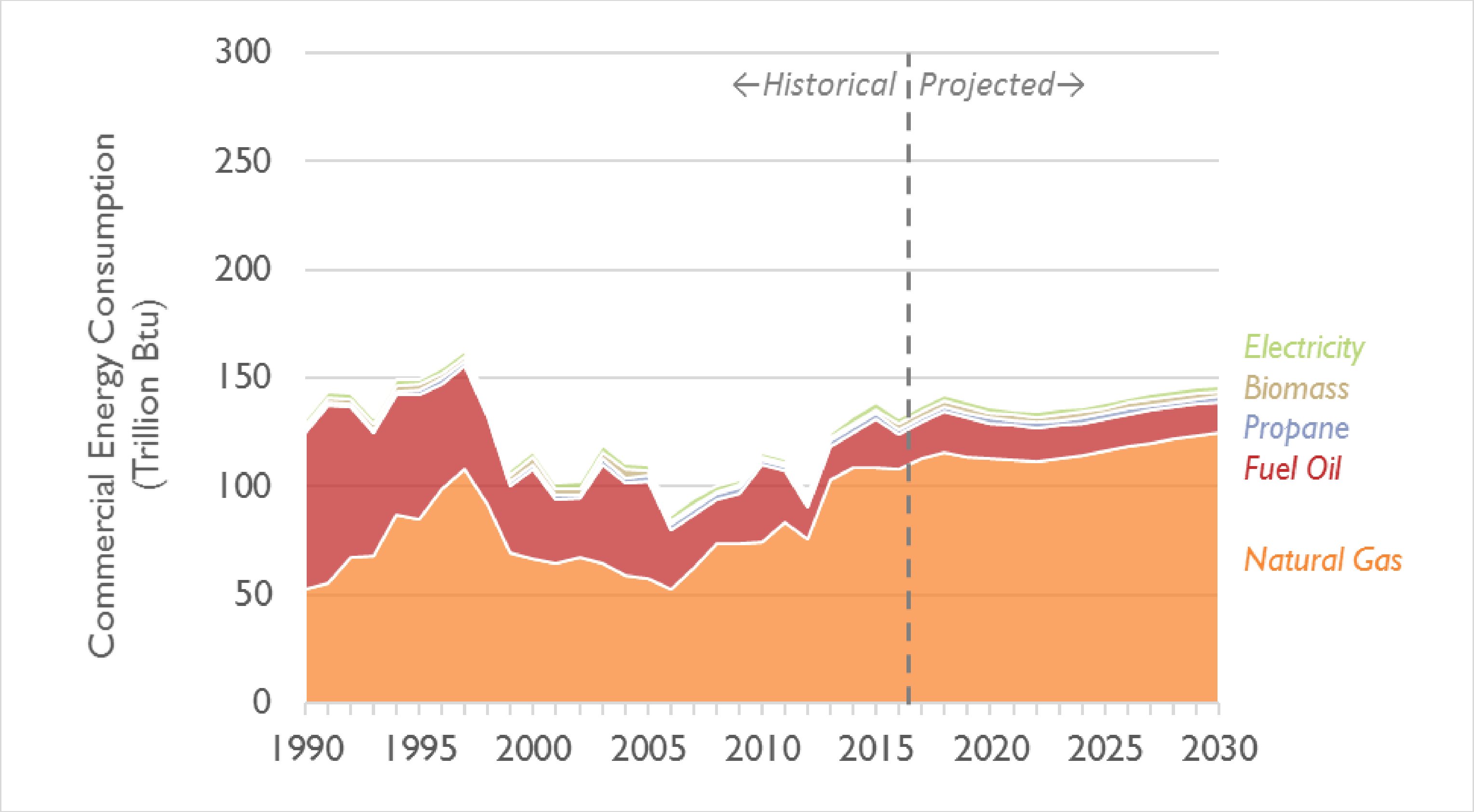
- Since the mid-2000s, commercial demand for thermal energy has increased by about 40 percent
  - In large part due to increased construction of commercial buildings
  - Under a Sustained Policies future, energy efficiency measures and fuel switching are expected to partially offset continued increased in demand

Residential Thermal Energy Use

- Continuing energy efficiency under sustained policies is expected to reduce total residential thermal demand by 15 percent by 2030
- New build and retrofit shells are projected to continue to improve at 0.5 percent per year
- Multifamily buildings are projected to be about 6 percent more efficient than they are today



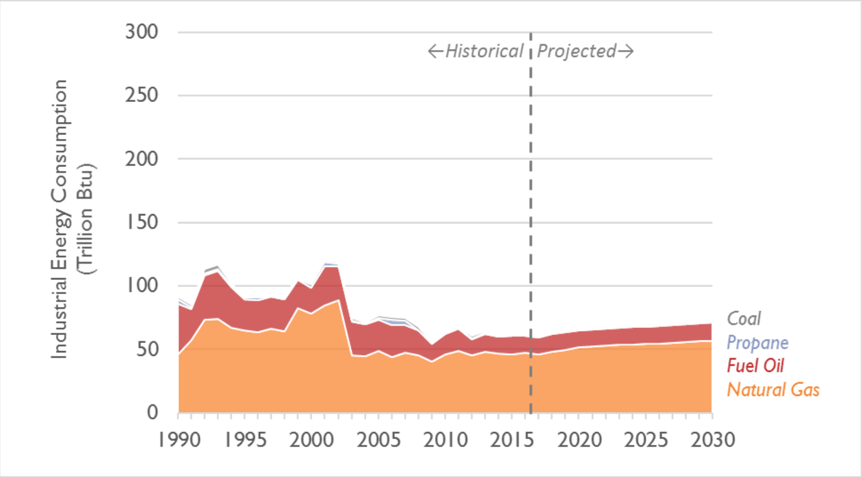
Commercial Thermal Energy Use



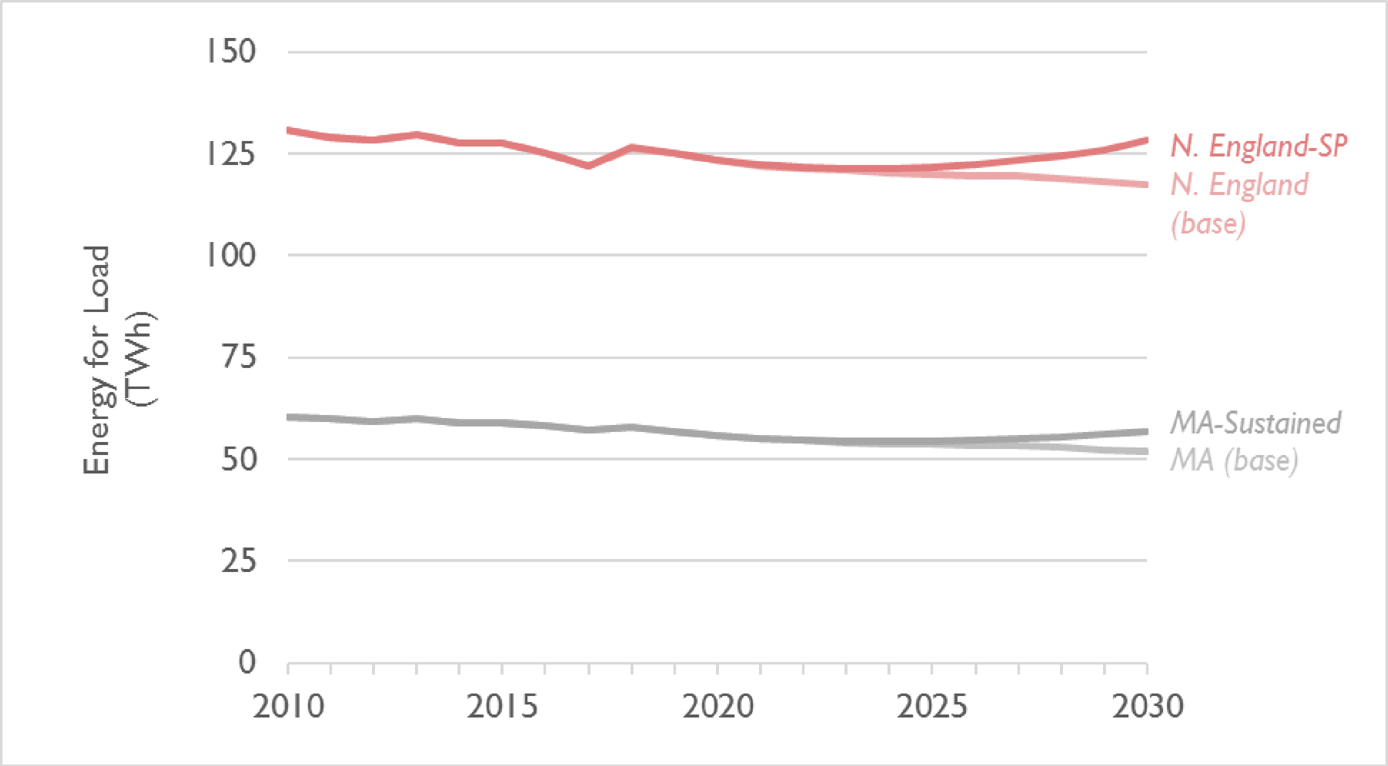
- Despite improved energy efficiency, continued new construction is expected to increase total commercial thermal demand by 6 percent by 2030
- New build and retrofit shells are projected to continue to improve at 0.5 percent per year

Industrial Thermal Energy Use

- Unlike the residential and commercial sectors, only a small part of the industrial sector is "thermal"
  - Exact values are difficult to determine, but most industrial thermal demand is attributable to industrial processes
  - "Thermal" energy (as is thought of in the other two sectors) is often produced as a byproduct of these processes
  - Energy demand is projected to continue to gradually increase
  - Increased manufacturing is expected to more-than-offset improved EE



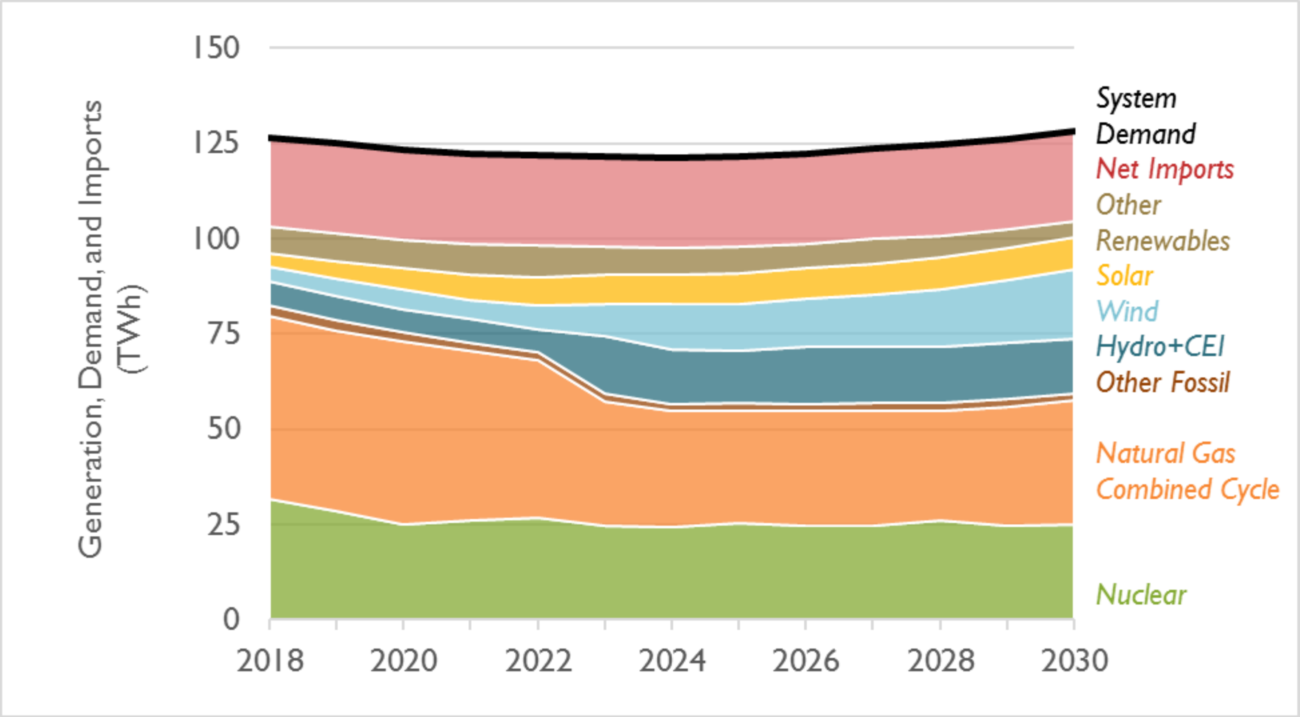
Power Sector: Energy Demand



- Over time, efficiency is expected to decrease demand by about 10 percent
- 1.2 million EVs return the 2030 level of electricity demand to be par with what is observed today
  - Increased levels of EVs will necessitate good planning for charging infrastructure and charging periods

Power Sector: Energy Use

Sustained Policies – New England



- In a Sustained Policies future:
  - Demand is projected to remain relatively flat
  - State policies (RPS, 83C, 83D, SMART, and others) drive increases in renewables, which increase by 120 percent by 2030
  - Fossil generation decreases by one-third

Assumptions for Increased Policies

Levers for Increased Policies Scenario

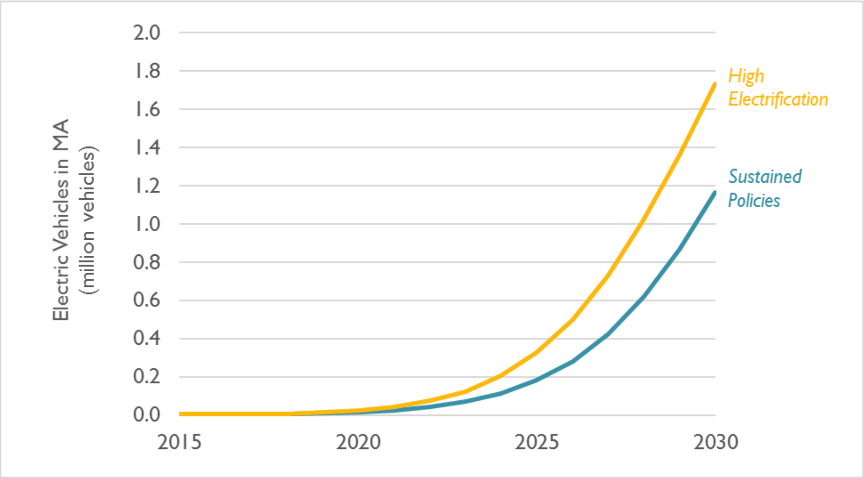
- These scenarios test multiple demand levers including
  - Increasing electrification, including electric heating and vehicles
  - Increasing renewables
  - Combined electrification and renewables,
  - Other possible policies including increasing energy storage capacity
- These levers represent the areas of greatest impact and control for state policy makers

Understanding electrification: What is a heat pump?

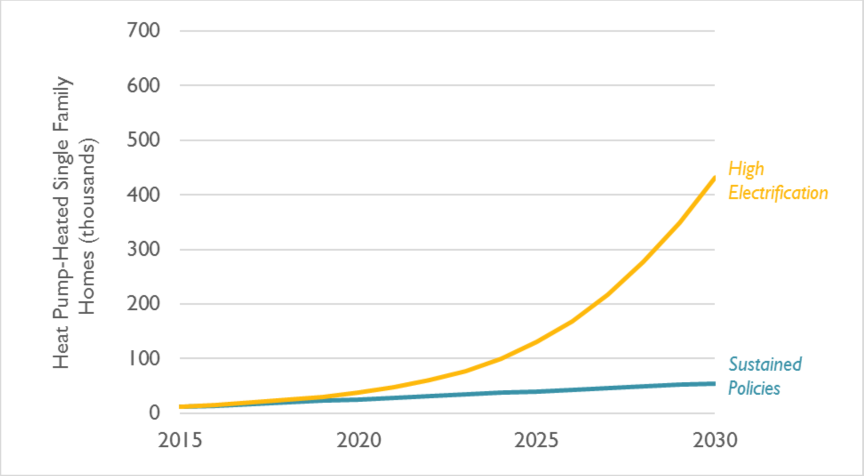
- A heat pump moves heat from outside to inside using the same processes as air conditioners or refrigerators
- Efficiency >100 percent because they move heat, rather than generating it
- Heat pumps for space heat also provide air conditioning (running “backwards”)
- Can replace or supplement existing space heating systems
- Heat pump water heaters are also available

Defining "High Electrification" Assumptions

- Cars and light trucks
  - Meet the ZEV MOU target of 300,000 EVs on our roads in 2025
  - 1.7 million EVs by 2030
  - 6 out of 7 vehicle sales in 2030 are EVs

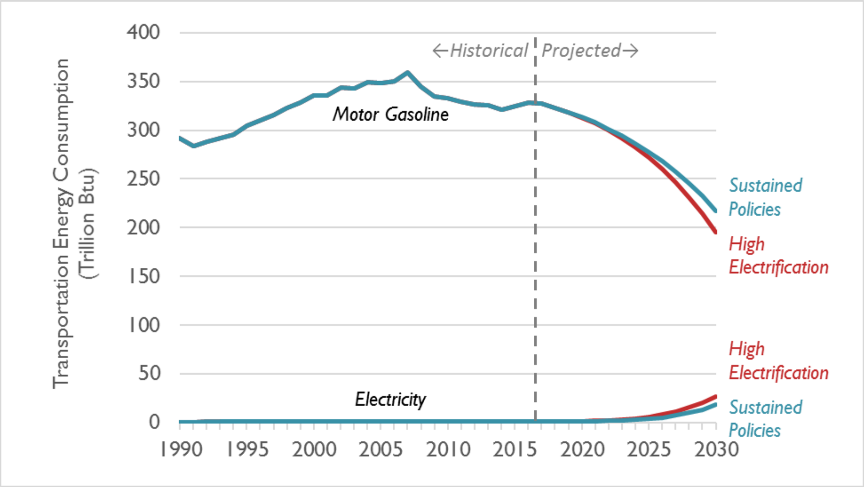


- Residential and commercial heat pumps
  - By 2030, 25 percent of oil- and propane-heated buildings add heat pumps, and 10 percent of natural gas-heated buildings
  - Between half and two thirds of homes getting a heating system in 2030 choose a heat pump



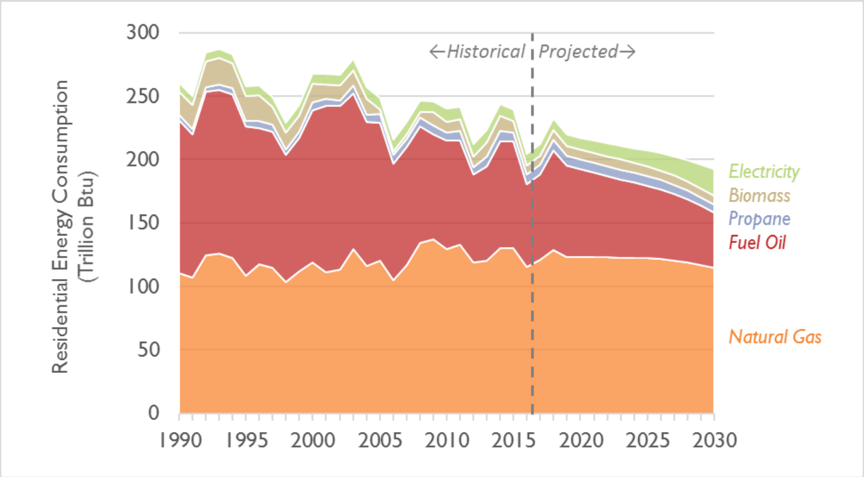
Demand Impacts of "High Electrification" Assumptions

- Transportation
  - Gasoline use falls almost 40 percent by 2030
  - 2030 electric use in transportation 45 percent higher than in Sustained Policies



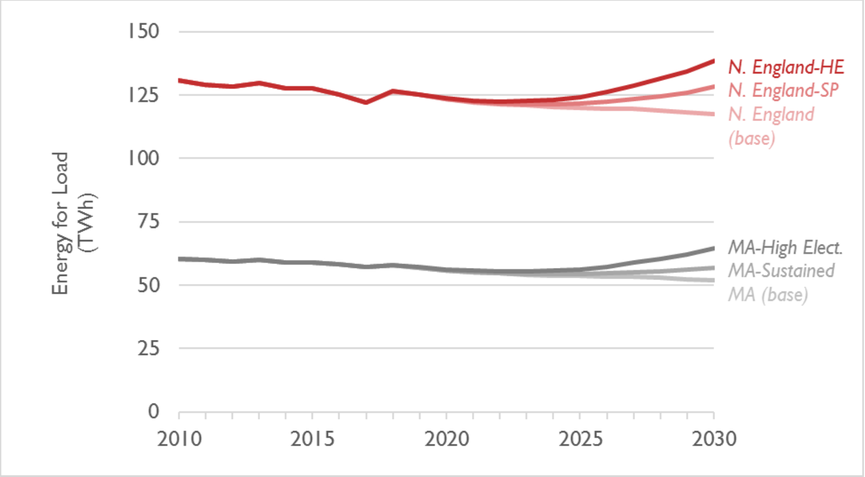
- Thermal
  - Oil and propane use falls 34 percent by 2030
  - Natural gas use falls 1 percent
  - Electric use for heat pumps in MA rises to about 5 TWh per year by 2030 (4 percent of regional load)

Residential



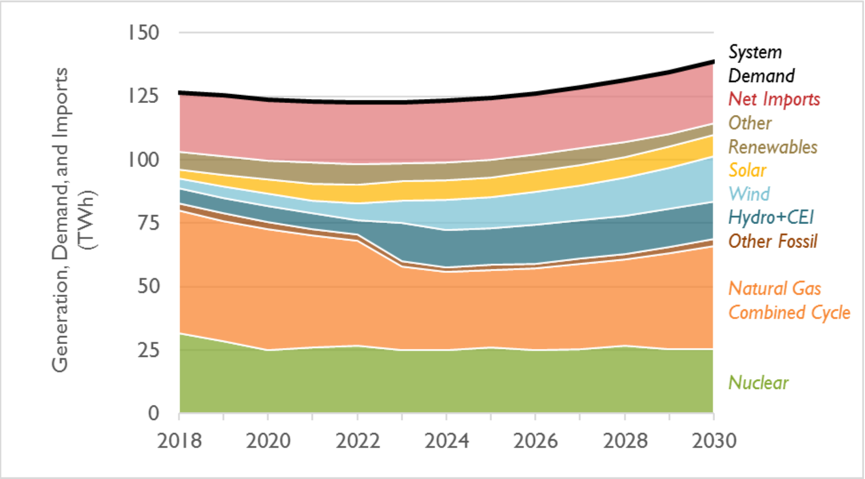
Demand Impacts of "High Electrification" Assumptions

- Power demand
  - 2030 electric consumption 11 percent above 2018



- Meeting the increased demand
  - Energy from natural gas falls relative to 2018, but by less than in Sustained Policies case, while renewables and imports are relatively unaffected

High Electrification – New England



Defining “High Renewables” Assumptions

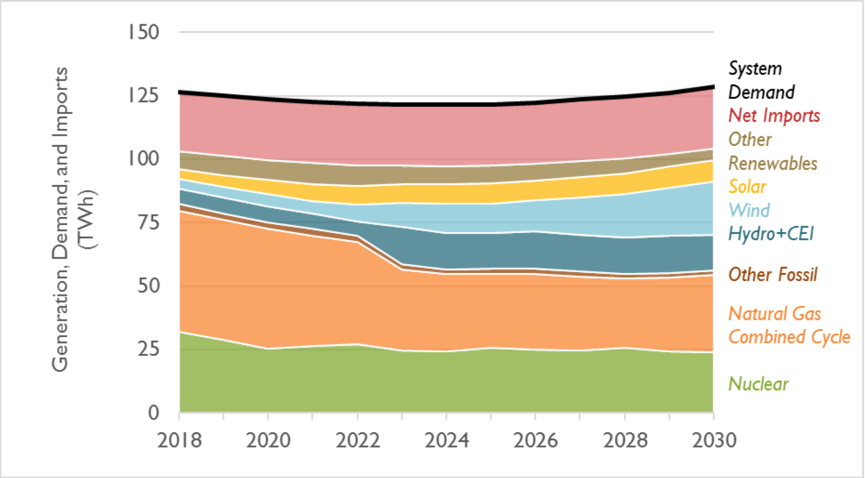
- In Sustained Policies, renewables (including hydro/imports) supply 45.5 TWh in 2030, about 35 percent of electricity in the region, with Massachusetts hitting its 25 percent RPS target
- “High renewables” case increases this to 38 percent (49 TWh), with all of the increment serving Massachusetts, which gets about half its electricity from Class I renewables in 2030
    - This could be achieved through either an increase to the RPS, additional procurements, or a combination of both increased policies
- No changes to thermal or transportation demand or supply from the Sustained Policies case

Demand Impacts of “High Renewables” Assumptions

- Power demand
  - Same as Sustained Policies

- Changes in the supply mix
  - Clean Energy Imports and offshore wind are unchanged
  - Wind and solar grow to 29.5 TWh in 2030
  - Fossil generation falls 39 percent from 2018 levels

High Renewables – New England

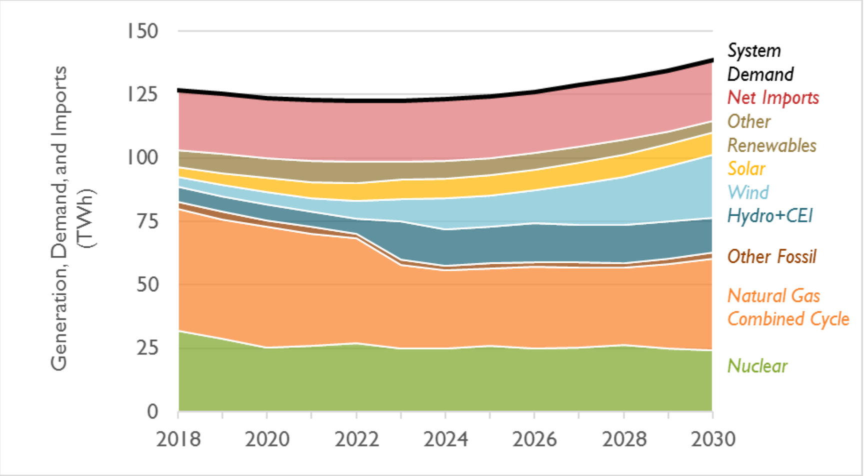


Combining Electrification and Renewables

- Power demand
  - Same as High Electrification

- Changes in the supply mix
  - Instead of meeting the increased demand with natural gas, the increased renewables are sufficient to meet the increased demand
  - Wind and solar grow to 33.7 TWh in 2030
  - Natural gas in 2030 is 29 percent lower than today

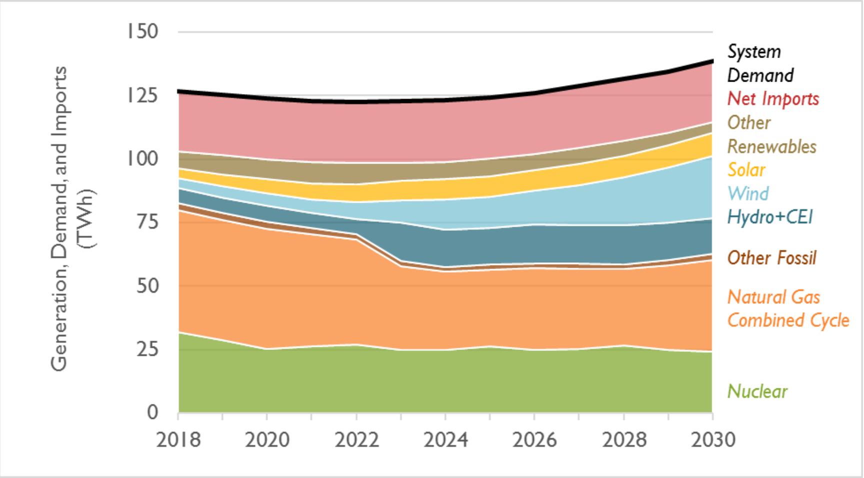
High Electrification + Renewables – New England



Adding Storage Capacity

- Possible “Clean Peak” Policy would incentivize generation or energy dispatch available to meet winter and summer peaks without emissions, although those resources would be available throughout the year
- Modeled as increasing availability of battery storage
- Examining winter peak reliability impacts, too.
- EV and battery charging/discharging load shapes have a real impact

High Electrification + Renewables + Clean Peak – New England



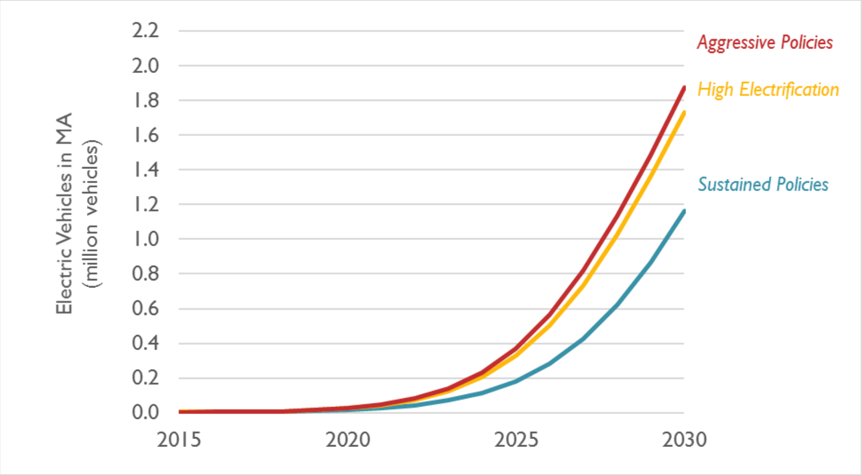
Aggressive Policies Assumptions

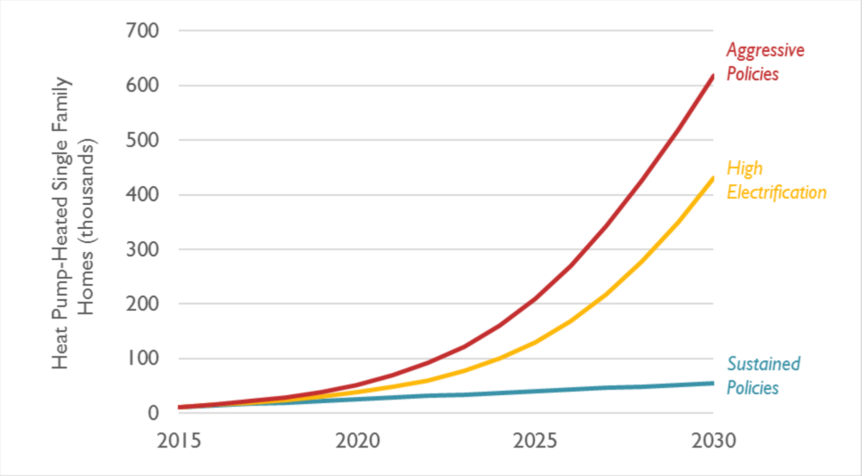
Going further/faster: Efficiency and Renewables

- Scenario for increased efficiency, electrification, and renewables
- Efficiency
  - Pace of building shell improvements increases 2.5-3x relative to today
    - E.g., avg. commercial building in 2030 uses less than 75 percent as much heat energy as a average building today
  - Industrial efficiency lowers thermal demand by 5 percent from today's levels
- Renewables
  - Almost 50 percent of MA electricity from renewables by 2030
  - 20 percent of heating oil from bioheat in 2030
  - 5 percent of freight from blended biodiesel
- Includes the same increased storage resources as the Increased Policies case

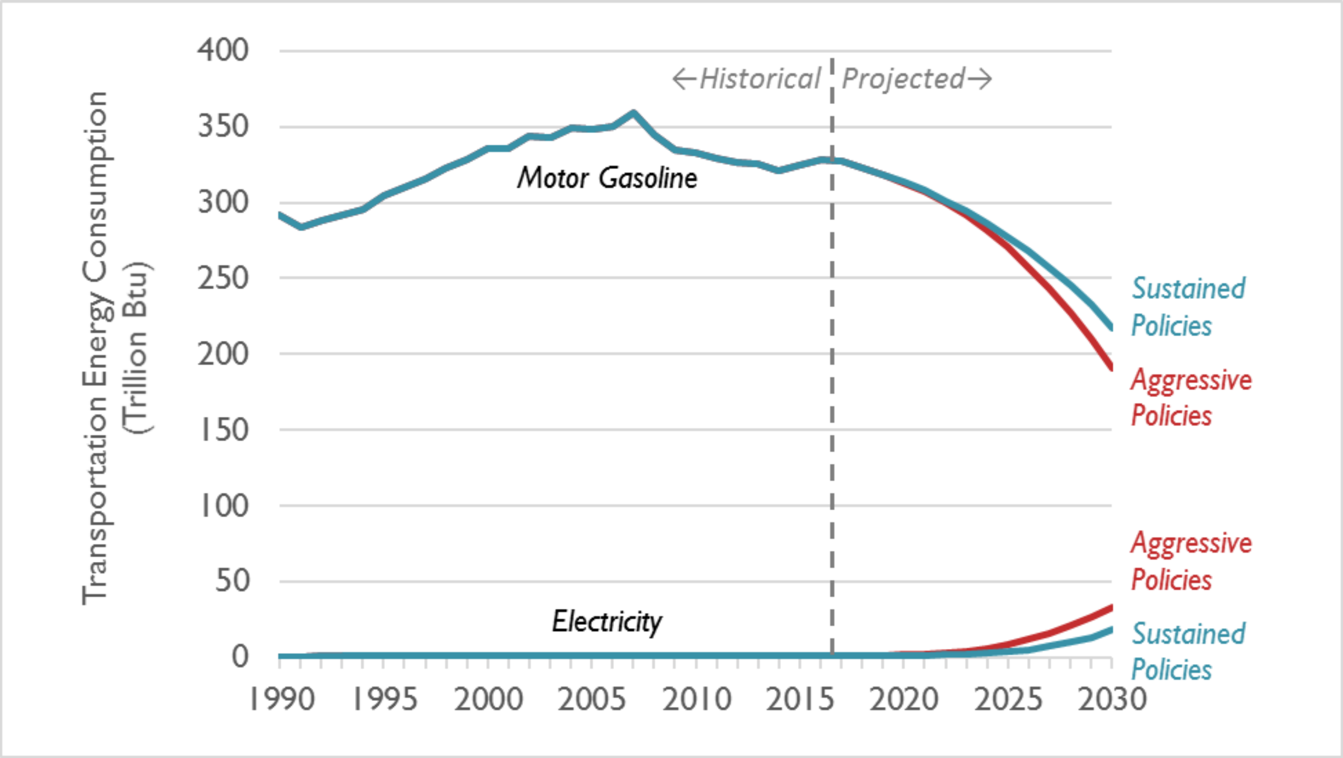
Going further/faster: Electrification

- Transportation
  - Exceed the ZEV MOU goal (370,000 EVs by 2025, and 1.9 million in 2030)
  - 8 of 9 car and light truck sales in 2030 are EVs
  - 5 percent of freight powered by electricity (~1/4 of trips under 100 miles) by 2030
- Thermal
  - Heat pumps used in 25 percent of homes and 20 percent of commercial buildings by 2030
  - 3/4 or more of buildings getting heating systems in 2030 choose heat pumps





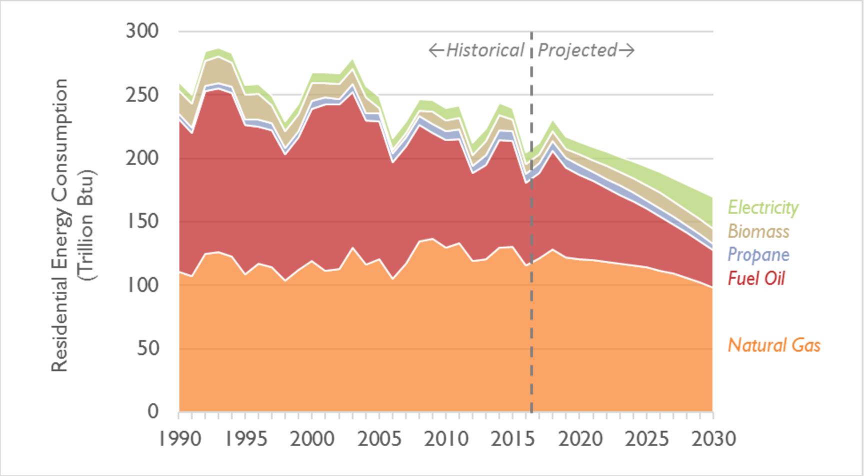
Transportation

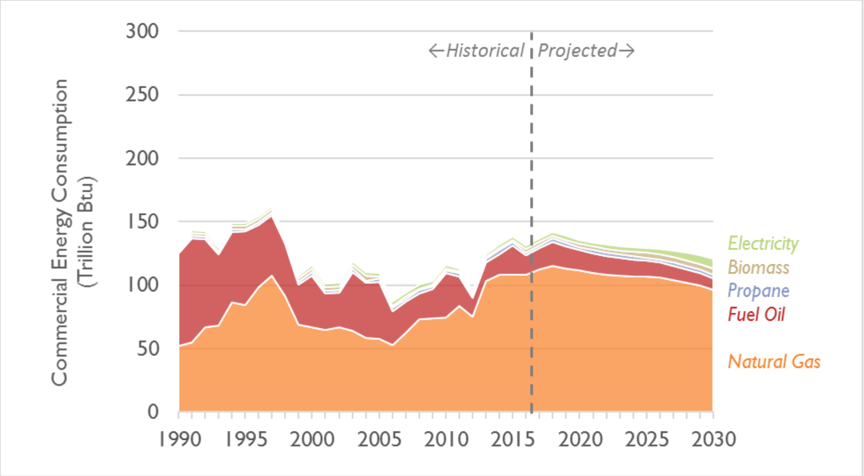


- Advanced deployment of EVs in the Aggressive Policies case (1.9 million by 2030) could decrease gasoline consumption by 12 percent below Sustained Policies, and 40 percent below 2018

Thermal

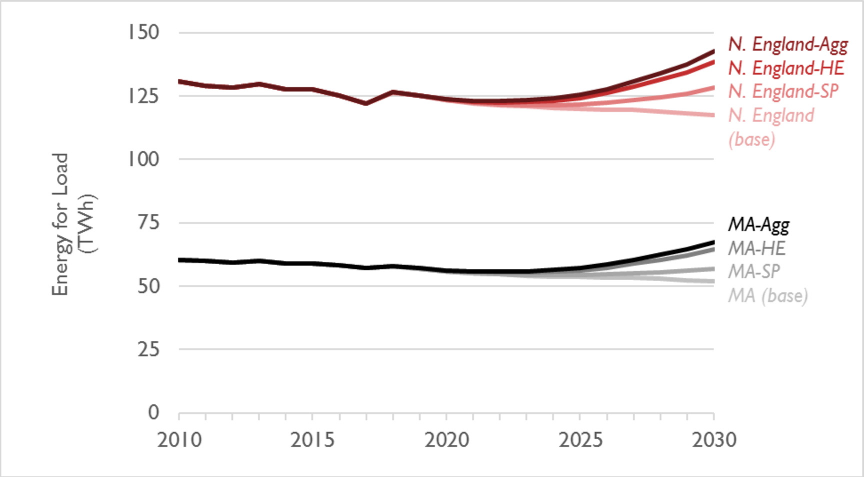
- In an Aggressive Policies future, improved building shells and deployment of heat pumps reduce thermal energy use in residential and commercial buildings to 23 percent below today's levels
- As stated above, industrial efficiency lowers fuel consumption by 5 percent from today's levels (instead of rising 15 percent as in Sustained Policies)

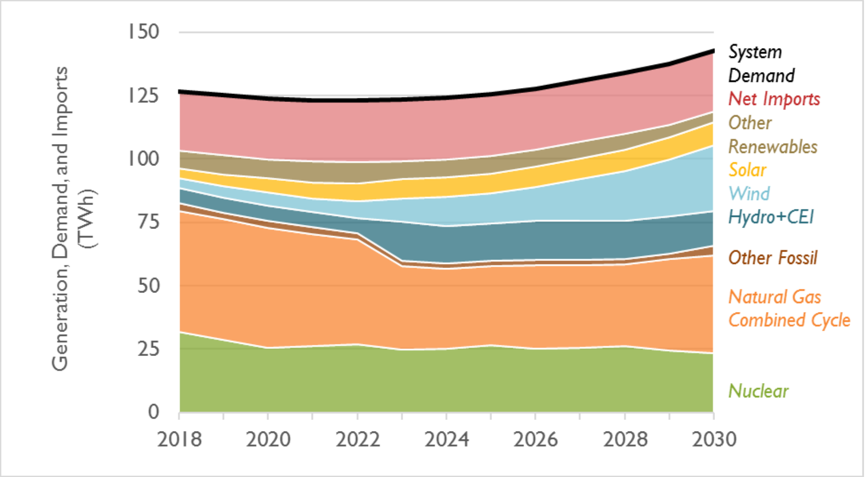




Power

- While regional demand increases by 13 percent, most of that increase is powered by an expansion of renewables
- Gas generation is 25 percent lower than today, while renewables (together) increase by 165 percent from today.





Next Steps

Completion of the Energy Plan

- Finalize Results of Different Scenarios
  - Supply Mix and Associated Emissions
  - Reliability – Winter Peak
  - Costs
    - Wholesale costs and impact on residential energy expenditures
- Stakeholder Input
  - Initial thoughts on:
    - Baseline
    - Assumptions for sustained and policy futures
    - Important drivers to consider
    - Policy pathways and priorities
  - Written Survey
    - To be summarized in final report

Discussion

Summary

Sectors	Sustained Policies	Increased Policies	Aggressive Policies
Transportation	160,000 EVs in 2025; Rapid growth after	300,000 EVs in 2025; Rapid growth after	370,000 EVs in 2025; Rapid growth after Heavy Duty: Small penetration of EVs and biofuels by 2030
Thermal	Current pace of heat pump deployment No increase in building shell efficiency beyond existing programs	By 2030, 25 percent of oil- and propane-heated buildings add heat pumps, and 10 percent of natural gas-heated buildings	Building shell improvements increases 2.5-3x relative to today Increased bioheat Increased heat pumps
Power	Current RPS and CES increases SMART Solar Program Current Procurements	Additional Renewables Additional Storage	

Questions?

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