Global Warming Solutions Act
10 Year Progress Report

January 23, 2019

Massachusetts Global Warming Solutions

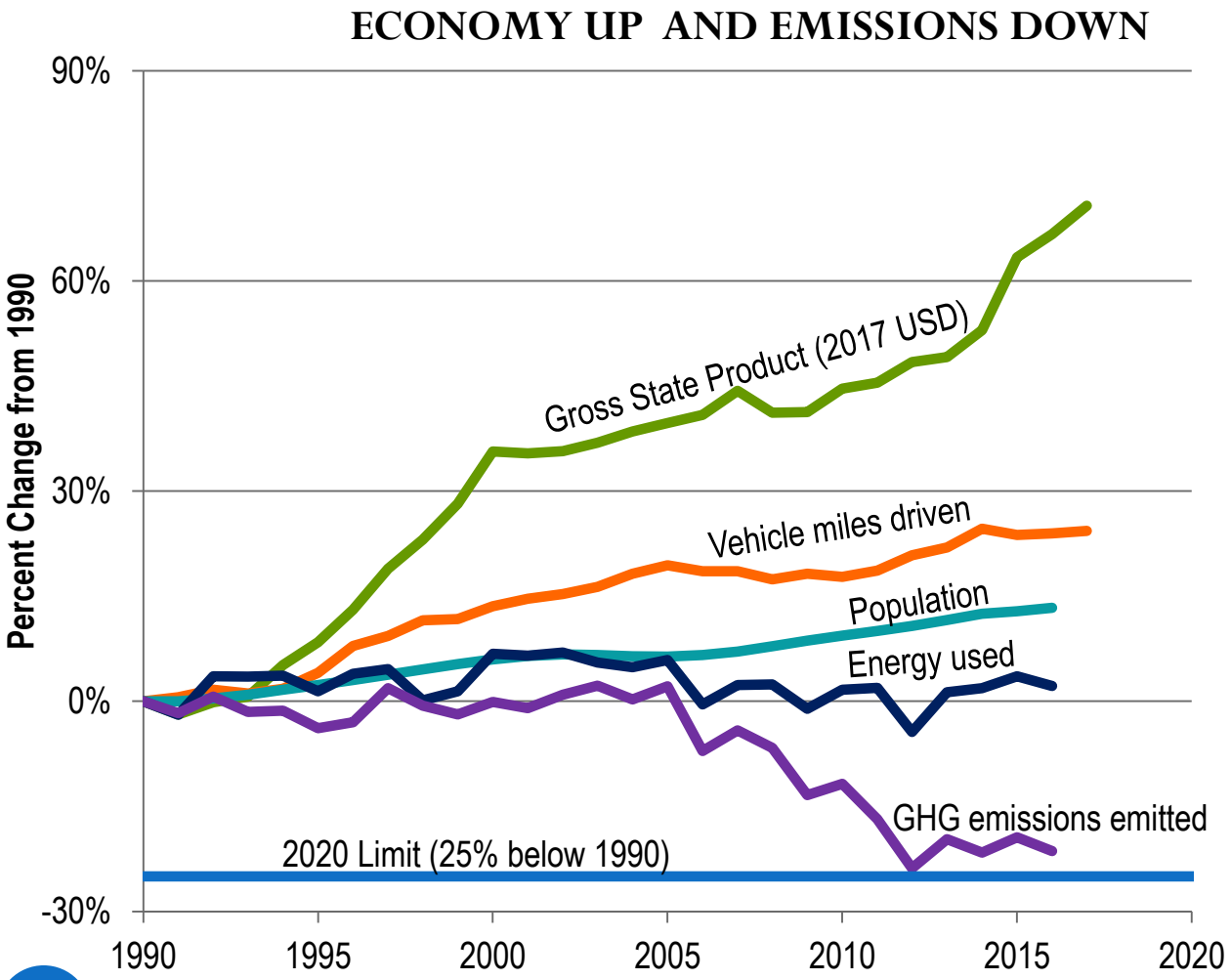
Purpose & Scope

- **MGL, Chapter 21N, Section 5:**

  "The secretary [of Energy and Environmental Affairs] shall monitor the implementation of regulations relative to climate change and shall, every 5 years, publish a report which shall include recommendations regarding such implementation…"

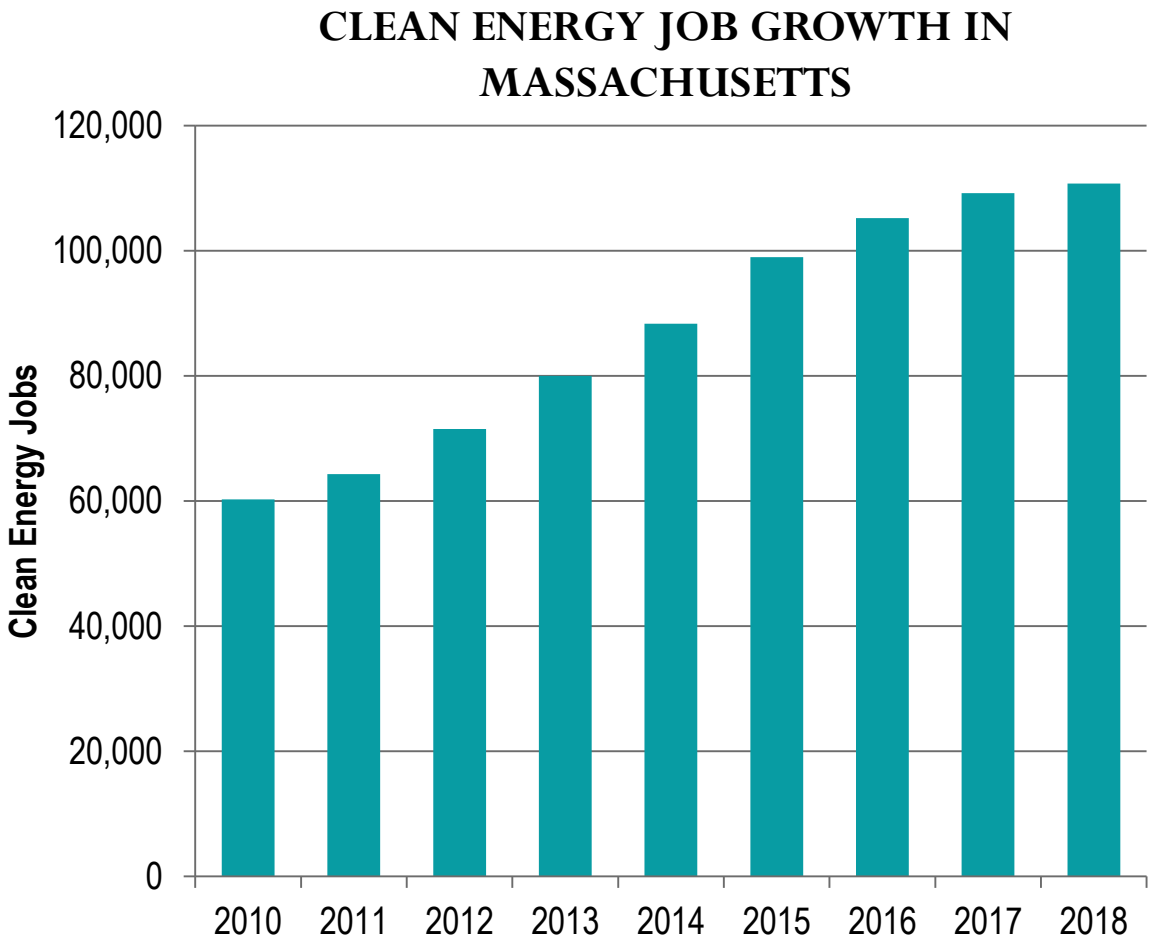
- Evaluate how policies listed in the updated *Massachusetts Clean Energy and Climate Plan for 2020* (Updated CECP) have reduced GHG emissions in the last 5 years and how much more reductions can be expected for 2020.
  - Includes discussion of equity in policy implementation as well as additional benefits of GWSA implementation (i.e. economic, public health, and ecosystem services).

Main Highlights



- Gross GHG emissions in 2016 were 21.4% below the 1990 baseline.
- Gross GHG emissions decreased despite a 13% growth in population and 24% growth in vehicle miles traveled.
- After adjusting for inflation, Massachusetts's Gross State Product increased by more than $91 billion (21%), from $436 billion in 2008 to $527 billion in 2017.

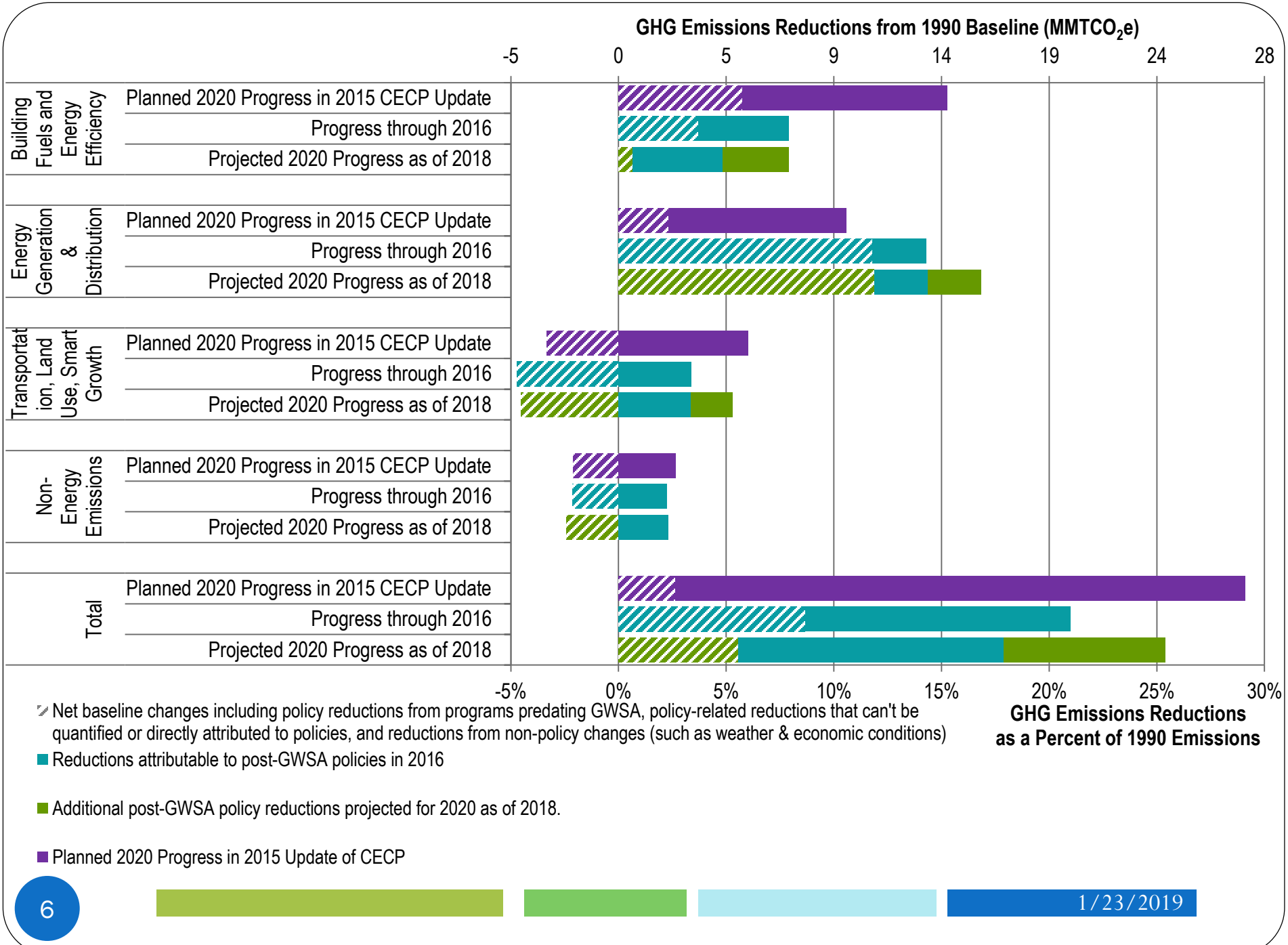
Main Highlights, cont.



- The clean energy industry in 2018:
  - employs more than 110,000 people in Massachusetts;
  - contributes $13.2 billion to the Commonwealth's economy, or about 2.5% of the annual GSP.
- Net economic benefits from ratepayer and state investment in the Mass Save® programs 2010-2020 are projected to exceed $18 billion.

Main Highlights, cont.

- **First 5 years, 2008-2013:** Building institutional capacity, coordination, collaboration, and stakeholder engagements.
- **Second 5 years, 2014-2018:** Continuing capacity-building, coordination, collaboration, and stakeholder engagements.
  - GHG reductions are now estimated for all non-cross cutting policies in the 2015 CECP Update:
    - Approximately 20.2 MMTCO$_2$e were reduced between 1990 and 2016. Approximately 11.6 MMTCO$_2$e of that are attributed directly to the implementation of GHG mitigation policies since 2010.
    - Analyses in 2018 indicate that the Commonwealth is on track to meet the GWSA emissions limit in 2020.


GHG Emissions Reductions from 1990 Baseline (MMTCO2e)
-5
0
5
9
14
19
24
28
Building Fuels and Energy Efficiency
Planned 2020 Progress in 2015 CECP Update
Progress through 2016
Projected 2020 Progress as of 2018
Energy Generation & Distribution
Planned 2020 Progress in 2015 CECP Update
Progress through 2016
Projected 2020 Progress as of 2018
Transportation, Land Use, Smart Growth
Planned 2020 Progress in 2015 CECP Update
Progress through 2016
Projected 2020 Progress as of 2018
Non-Energy Emissions
Planned 2020 Progress in 2015 CECP Update
Progress through 2016
Projected 2020 Progress as of 2018
Total
Planned 2020 Progress in 2015 CECP Update
Progress through 2016
Projected 2020 Progress as of 2018
-5%
0%
5%
10%
15%
20%
25%
30%
GHG Emissions Reductions as a Percent of 1990 Emissions
Net baseline changes including policy reductions from programs predating GWSA, policy-related reductions that can't be quantified or directly attributed to policies, and reductions from non-policy changes (such as weather & economic conditions)
Reductions attributable to post-GWSA policies in 2016
Additional post-GWSA policy reductions projected for 2020 as of 2018.
Planned 2020 Progress in 2015 Update of CECP

	PLANNED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2015)		2016 PROGRESS		PROJECTED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2018)	
	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL
Building Fuels and Energy Efficiency	**9.0**	**9.5%**	**4.0**	**4.2%**	**6.8**	**7.2%**
All Cost-Effective Energy Efficiency	5.4	5.8%	3.2	3.4%	5.1	5.4%
Advanced Building Energy Codes	1.5	1.6%	0.7	0.7%	0.8	0.9%
Building Energy Rating and Labeling	–	–	Cross-cutting policy; reduction reflected elsewhere.			
Expanding Energy Efficiency Programs to Commercial and Industrial Heating Oil	<<0.1	<<0.1%	Reductions to be included in All-Cost Effective Energy Efficiency			
Appliance and Product Standards	1.0	1.1%	0.1	0.1%	0.8	0.8%
Renewable Thermal Technologies	1.0	1.1%	<<0.1	<<0.1%	0.1	0.1%
Tree Retention and Planting to Reduce Heating and Cooling Loads	<<0.1	<<0.1%	<<0.1	<<0.1%	<<0.1	<<0.1%

	PLANNED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2015)		2016 PROGRESS		PROJECTED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2018)	
	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL
Transportation, Land Use, and Smart Growth	**5.7**	**6.1%**	**3.2**	**3.4%**	**5.0**	**5.3%**
Federal and California Vehicle Efficiency and GHG Standards (CAFE/Pavley)	3.7	3.9%	2.6	2.7%	3.7	4.0%
Federal Emissions and Fuel Efficiency Standards for Medium and Heavy Duty Vehicles	0.4	0.4%	<<0.1	<<0.1%	0.5	0.5%
Federal Renewable Fuel Standard (RFS) and Regional Clean Fuel Standard (CFS)	0.1	0.1%	<<0.1	<<0.1%	0.1	0.1%
Clean/Electric Vehicle Incentives	0.1	0.1%	Reductions included in CAFE/Pavley standards.			
State Transportation Regulations (includes policy formerly called GreenDOT)	1.0	1.1%	Transportation reductions included in CAFE/Pavley standards; Buildings reductions included in All Cost-Effective Energy Efficiency.			
Smart Growth	0.4	0.4%	0.6*	0.6%*	0.7*	0.8%*

	PLANNED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2015)		2016 PROGRESS		PROJECTED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2018)	
	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL
Electricity Generation and Distribution	**7.8**	**8.2%**	**2.4**	**2.5%**	**4.7**	**4.0%**
Coal-Fired Power Plant Retirements	2.7	2.9%	1.7	1.7%	2.7	2.9%
Regional Greenhouse Gas Initiative (RGGI)	–	–	Cross-cutting policy; reductions counted elsewhere.			
Renewable Portfolio Standard (RPS)	1.1	1.1%	0.7	0.8%	1.0	1.1%
Clean Energy Standard (CES)	–	–	0.0	0.0%	1.0	1.0%
Clean Energy Procurements	4.0	4.2%	Some reductions to be counted in RPS and CES after 2020.			
Electric Grid Modernization	–	–	Cross-cutting policy; reduction counted elsewhere.			

	PLANNED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2015)		2016 PROGRESS		PROJECTED 2020 GHG EMISSIONS REDUCTION (ESTIMATED IN 2018)	
	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL	$MMTCO_2E$	% OF 1990 LEVEL
Non-Energy Emissions	**2.5**	**2.6%**	**2.1**	**2.2%**	**2.2**	**2.3%**
Reducing GHG Emissions from Plastics Combustion	0.3	0.3%	0.1	0.1%	0.1	0.1%
Reducing SF_6 Emissions from Gas-Insulated Switchgear	0.4	0.4%	0.4	0.4%	0.4	0.4%
Reducing Emissions from the Natural Gas Distribution Network	1.7	1.8%	1.7	1.8%	1.7	1.8%
Stationary Equipment Refrigerant Management	0.1	0.1%	Policy not yet pursued.			
Total Reductions Attributable to Policies post-GWSA	25.0	26.4%	11.6	12.3%	18.7	19.8%
Other Changes Not Attributable to Policies post-GWSA	2.5	2.6%	8.6	9.1%	5.3	5.6%
Total Emissions Reductions	27.5	29.0%	20.2	21.4%	24.0	25.4%

Recommendations for how to focus efforts in the next 5 years, cont.

- **Continue implementation of policies in the Updated CECP and additional GHG mitigation policies:**

Buildings

- Continue aggressive implementation of energy efficiency as proposed in the latest 3-Year Energy Efficiency Plan for 2019-2021 filed with DPU:
  - Achieve more aggressive gas savings goals. Increase weatherization measures to improve existing building shell efficiencies and targeted winter gas savings.
  - Achieve electric energy efficiency goals and peak demand reductions. Expand programs to include new cost-effective active demand management programs such as energy storage, residential direct load control, and commercial and industrial (C&I) load curtailment programs.
  - Expand electric efficiency programs to holistically serve customers and promote fuel switching to more efficient and lower GHG emitting heating and hot water systems.
  - Serve more customers through additional efforts to serve moderate income, non-English speaking residents, renters, and small business customers.
  - Drive market/consumer demand for energy efficiency measures and fuel switching by educating consumers about the benefits of energy efficiency and creating a market incentive for consumers to invest in energy efficiency improvements through a "Home Energy Scorecard".
  - Further reduce energy demand in new buildings through promoting high efficiency building construction (such as meeting Passive House or Zero Net Energy standards).
- Explore possible ways to strengthen building codes that better support renewable energy, electrification, energy storage, and resiliency policy goals.

Recommendations for how to focus efforts in the next 5 years, cont.

Transportation

- Continue electrification of passenger vehicles, and promote electrification/decarbonization of freight and other vehicles.
- Continue to provide incentives for in transit-oriented development areas and other locations with low car travel.
- Continue regional collaboration through the Transportation and Climate Initiative to develop a framework for a regional program that addresses GHG emissions from the transportation sector.

Electric

- Continue to increase cost-effective clean electricity supply to meet RPS and CES compliance obligations.
- Continue policies that support distributed resources, including considering policies that will support solar development in the Commonwealth after the SMART program concludes, especially projects that pair renewables with energy storage to align supply and demand and provide grid flexibility.
- Implement policies and programs, including the Clean Peak Standard, that incentivize energy conservation and renewable energy utilization during peak periods.

Recommendations for how to focus efforts in the next 5 years, cont.

Non-Energy

- Explore potential strategies to limit use and emissions of HFCs.

Cross-Sector

- Leverage and enhance data collection and analyses to help a diverse portfolio of government offices, public university campuses, and other state buildings track energy use and GHG emissions, as well as prioritize opportunities and strategies for future emissions reductions.
- Assist Green Communities to reduce their energy use by 20% within 5 years of their official designation despite growth in demand for municipal services.
- Identify opportunities to engage more municipalities to participate in the Green Community Designation and Grant Program.
- Revise the Massachusetts Environmental Policy Act (MEPA) GHG Emissions Policy and Protocol including incorporation of climate change adaptation and resiliency and land use.
- Look for opportunities to deploy strategies that achieve adaptation and mitigation goals, such as sustainable forestry practices and urban tree planting.

Recommendations for how to focus efforts in the next 5 years

- **Analyze and develop a roadmap for meeting the GWSA emissions limit for 2050, informed by existing analyses.**
  - Continue addressing socio-economic and environmental justice equity in policy design and implementation.
  - Continue to integrate climate change mitigation and adaptation strategies and policies.
  - Explore additional land use strategies and policies and promote nature-based solutions to increase carbon sequestration and avoid GHG emissions from natural and working lands.

Extra Slides

Buildings Sector GHG Emission Reduction Calculations

Policy	Methodological Approach
All Cost-Effective Energy Efficiency	Data from Mass Save® screening calculations aggregated into annual adjusted gross savings by fuel type. Baseline savings pre-2010 subtracted; savings discounted annually to account for measure degradation and depreciation; savings from **new** construction programs omitted to avoid double-counting with building codes. Building codes' impacts on retrofits are captured as Mass Save® weatherization and envelope measures.
Appliance and Product Standards	National projections of appliance standards savings from ASAP & U.S. DOE downscaled to Massachusetts by a variety of factors and annualized. Only standards that have been implemented are counted. Residential lighting standards are omitted to avoid double-counting with Mass Save®.
Advanced Building Energy Codes	Average savings per housing unit built computed from Mass Save® screening data applied to residential building permit data to reach estimate of annual impact across all new building projects. Similar calculation performed for commercial sector, using commercial square footage rather than number of housing units. Note: Non-Mass Save® construction projects likely result in smaller energy use reductions, but since non-Mass Save® retrofit savings are not counted alongside Mass Save® retrofit savings in the EE line item, these two sources of error directionally offset.
Renewable Thermal Technologies	MassCEC's detailed database indicates type and size of new system installed as well as information about previous heating and cooling systems. After making some basic assumptions about average equipment efficiency, emissions from new equipment are subtracted from hypothetical emissions from old equipment. Heat pump space cooling and electric-to-electric heat pump conversions omitted to avoid double-counting with Mass Save®.
	Savings for DOER's solar thermal program directly estimated from installed capacity. Projected savings from biofuel blending estimated according to DOER expectations of how much of APS (5% of retail load in 2020) will be fulfilled by biofuels (capped at 20%, 2020 estimate is 15%).

Buildings Sector GHG Emission Reduction Calculations

Policy	Efficient Equipment	Envelope Retrofits	New Builds	Air-Source Heat Pumps	Renewable Fuels
All Cost-Effective Energy Efficiency	Mass Save® EE screening data	Mass Save® EE screening data; no adjustment to include non-Mass Save® retrofit savings	Excluded here; included under building codes	Counted as efficiency gains from resistance to heat pump	
Appliance and Product Standards	Downscaled national savings estimates; residential lighting excluded.				
Advanced Building Energy Codes		Excluded here; included under Mass Save®	Mass Save® savings scaled up to include "universe" of new construction.		
Renewable Thermal Technologies: MassCEC rebates	Recorded for biomass-to-biomass rebates, but there are no resulting net non-biogenic savings.			Cooling and electric-to-electric ASHP savings excluded.	Biomass and ground-source heat pump savings.
Renewable Thermal Technologies: DOER's programs					Solar thermal and biofuel blending savings.