The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Charles D. Baker
GOVERNOR

Karyn E. Polito
LIEUTENANT GOVERNOR

Kathleen A. Theoharides
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1081
http://www.mass.gov/eea

December 30, 2020

REQUEST FOR COMMENT ON CLEAN ENERGY AND CLIMATE PLAN FOR 2030

Dear Residents and Businesses in our Commonwealth of Massachusetts,

I am pleased to present the Clean Energy and Climate Plan for 2030 for your review and input. Based on the Commonwealth's nation-leading 2050 Decarbonization Roadmap study effort, also published today,[1] Massachusetts has set its Greenhouse Gas (GHG) emissions reduction target for the next decade at a 45% reduction below the 1990 level in 2030. The 2030 Clean Energy and Climate Plan establishes a blueprint for achieving this limit equitably and affordably, with major new initiatives advancing decarbonization of the Commonwealth's buildings, transportation, and electricity sectors.

Stakeholder engagement with the Global Warming Solutions Act (GWSA) Implementation Advisory Committee (IAC) and its work groups, including one focused on Environmental Justice, has been integral to the development of this Plan. The IAC's involvement and recommendations over the past two years have been particularly helpful in helping to ensure that the policies and programs in this Plan reflect the Baker-Polito Administration's commitment to a people-centered approach to reducing GHG emissions in ways that help close the health and economic disparities experienced in Environmental Justice communities.

The Executive Office of Energy and Environmental Affairs (EEA) is now seeking broader public feedback on this interim Plan. EEA invites you to participate and submit public comment between January 7 and February 22, 2021, particularly on the specific "strategy actions" identified in the Plan for each major sector of our economy. The www.mass.gov/2030CECP webpage has further information on the public comment process, public engagement events, and different ways for you to submit your comments.

I look forward to your continued engagement and input to inform and help direct our final updates to the Plan, expected in March 2021.

Sincerely,

K. Theoharides

Kathleen Theoharides
Secretary of Energy and Environmental Affairs

[1] The series of reports documenting the approach, methodologies, assumptions, results, and synthesis of the findings of the 2050 Decarbonization Roadmap Study are posted on www.mass.gov/2050Roadmap. Information regarding public engagements around the Study and associated reports is also posted on that website.

Abbreviations

CECP – Clean Energy and Climate Plan
CES – Clean Energy Standard
CES-E – Clean Energy Standard (Existing)
DCFC – direct current fast charging
DOER – Massachusetts Department of Energy Resources
DER – distributed energy resource
DPU – Massachusetts Department of Public Utilities
EDC – electric distribution company
EEA – Massachusetts Executive Office of Energy and Environmental Affairs
EJ – environmental justice
EV – electric vehicle
EVSE – electric vehicle supply equipment
GHG – greenhouse gas
GW – gigawatt
GWSA – Global Warming Solutions Act of 2008
HFC – hydrofluorocarbon (a greenhouse gas)
IAC – GWSA Implementation Advisory Committee
ICEV – internal combustion engine vehicle (i.e., gasoline or diesel powered)
LDV – light-duty vehicle
MassCEC – Massachusetts Clean Energy Center
MassDEP – Massachusetts Department of Environmental Protection
MDHDV – medium-duty and heavy-duty vehicles
MEPA – Massachusetts Environmental Policy Act
MLP – municipal light plant
MMTCO2e – million metric tons of carbon dioxide equivalent
MW – megawatt
MWC – municipal waste combustor
RPS – Renewable Energy Portfolio Standard
SF6 – sulfur hexafluoride (a greenhouse gas)
SMART – Solar Massachusetts Renewable Target
TWh – terawatt hour
VMT – vehicle-miles traveled
ZEV – zero emission vehicle

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Chapter 1. Overview

1.1 Background

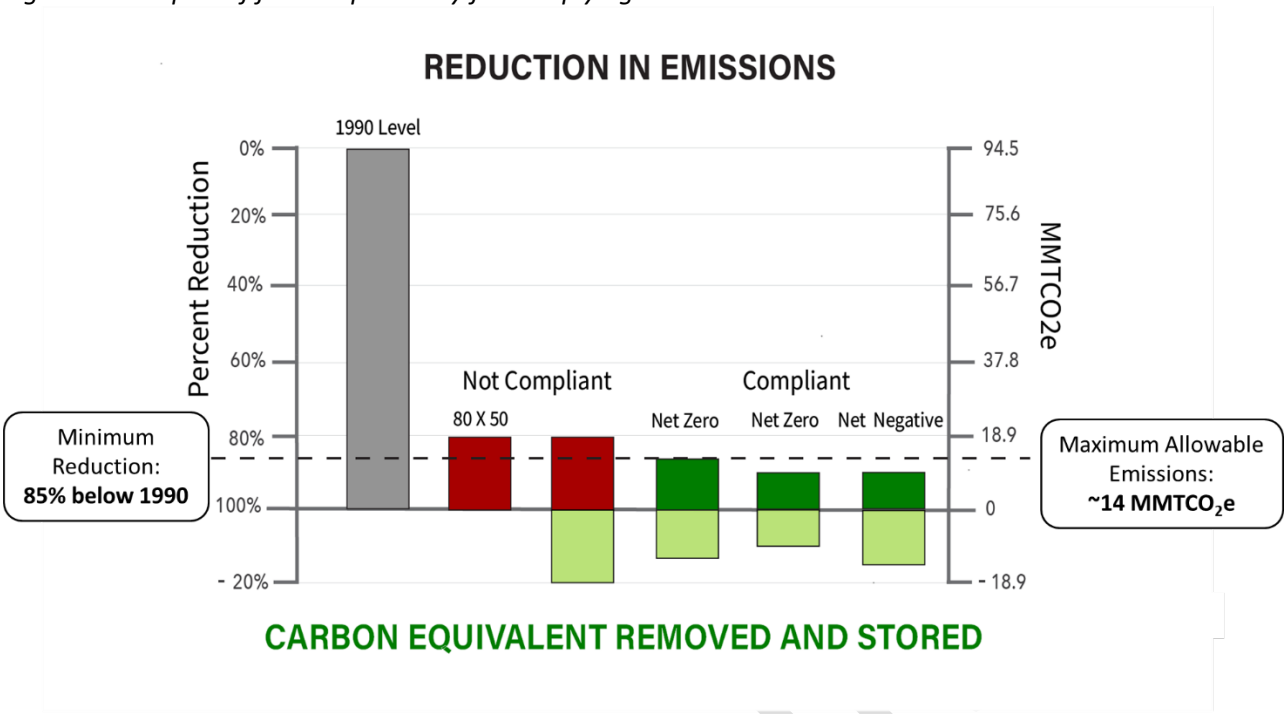
With the passage of the Global Warming Solutions Act (GWSA) in 2008, the Commonwealth of Massachusetts became one of the first states in the nation to adopt ambitious greenhouse gas (GHG) reduction limits consistent with the mid-century goals established by the Intergovernmental Panel on Climate Change (IPCC). The GWSA sets out a series of requirements and authorities regarding the Commonwealth's achievement of required GHG emissions reductions and includes the stipulation that the Secretary of the Executive Office of Energy and Environmental Affairs (EEA) set interim emissions limits for 2020, 2030, and 2040, as well as a final limit for 2050, after considering the feasibility and cost-effectiveness of GHG reduction measures, together with their co-benefits, for achieving such limits. Additionally, in setting the 2030 and 2040 limits, the Secretary is to ensure that the limit maximizes the Commonwealth's ability to meet its 2050 limit. Since 2008, EEA—with support from agencies across the Executive Branch and from stakeholders across the Commonwealth—has implemented policies and programs that advance the objectives of the GWSA.

In October 2018, following commitments made by the signatories of the 2016 Paris Agreement, the IPCC issued updated guidance: to avoid the damaging and extreme impacts of climate change, global warming must stabilize below 1.5 degrees Celsius, requiring global emissions to be net-zero by mid-century. In recognition of that update in best available climate science and the need to take bold actions to reduce GHG emissions, Governor Charles Baker committed Massachusetts to achieving net-zero emissions by 2050 during his January 2020 State of the Commonwealth Address. Following Governor Baker's announcement, EEA Secretary Kathleen Theoharides established a 2050 statewide emissions limit of Net Zero greenhouse gas emissions defined as:

> A level of statewide greenhouse gas emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is 85 percent below the 1990 level.

Informed by more than a thousand public comments received during statewide listening sessions across the Commonwealth and a public comment period, this limit requires Massachusetts to reduce its annual gross emissions to 14.2 $MMTCO_2e$ or less by 2050 while ensuring that an equal amount of CO_2e is removed from the atmosphere each year by natural and working lands or other forms of carbon capture and storage owned by, or accredited to, the state (see Figure 1).

Figure 1.Examples of future optionality for complying with the Net Zero in 2050 limit.

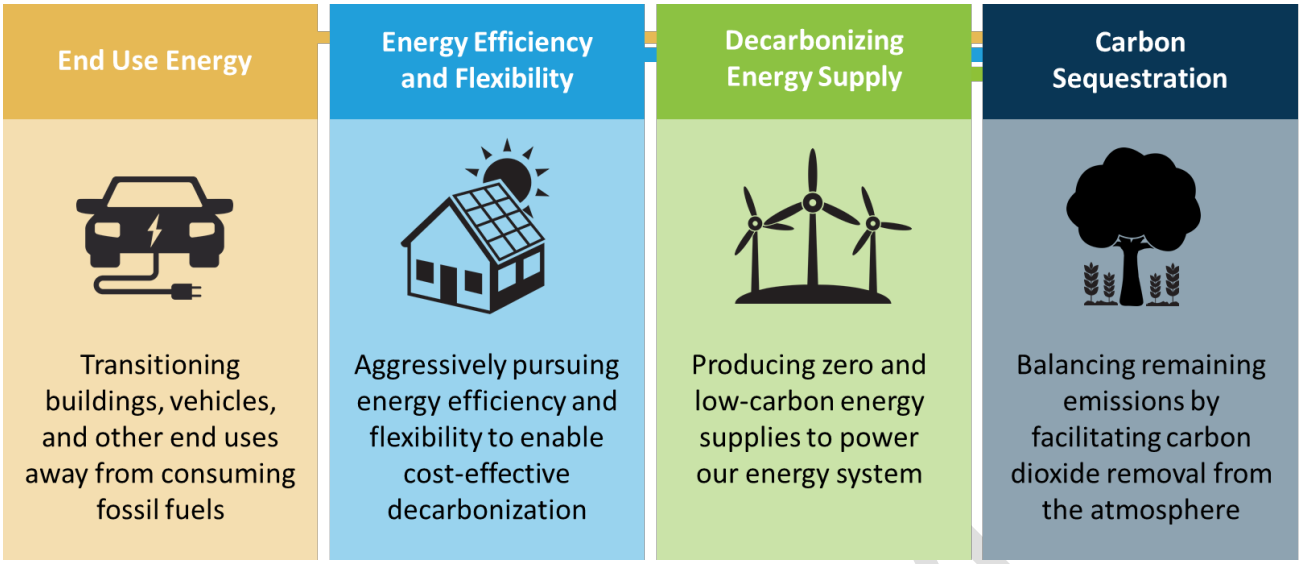


This report is the second update of the Clean Energy and Climate Plan (CECP), building upon the 2010 publication of the Clean Energy and Climate Plan for 2020 (2020 CECP), as well as the 2015 Update to the 2020 CECP (Updated 2020 CECP). In order to both determine pathways to reach Net Zero in 2050, as well as to inform EEA's determination of the interim 2030 emissions limit and the development of this Clean Energy and Climate Plan for 2030, the Commonwealth engaged in a 2050 Roadmap process beginning in 2019. This nation-leading quantitative and qualitative planning effort (henceforth referred to as the "2050 Roadmap") developed multiple technical and policy pathways by which the Commonwealth can equitably and cost-effectively achieve Net Zero in 2050.

The 2050 Roadmap described eight pathways, each of which analyzes potential annual energy supplies that will be needed to serve projected demand in all sectors of the economy while meeting our 2050 target. Based on this analysis, the 2050 Roadmap finds that the Commonwealth can achieve net-zero emissions by 2050 affordably. The strategies we choose in pursuit of Net Zero will likely impact costs, but our lowest cost, lowest risk pathways share core elements, based upon the four pillars of decarbonization (*Figure* 2). The core elements common across pathways and most critical for consideration in the 2020s include a balanced clean energy portfolio anchored by significant offshore wind resources, more interstate transmission, widespread electrification of transportation and building heat, and reducing costs by taking action at the point of replacement for equipment, infrastructure, and systems that use fossil fuels.

The 2050 Roadmap also found significant benefits of reaching Net Zero, including: a precipitous drop in air pollution, including in Environmental Justice (EJ) communities currently over-burdened with poor air quality; significant savings in health costs, up to $100 million per year by 2030; and the creation of thousands of quality local jobs in Massachusetts and across New England.

Figure 2. Four key "pillars of decarbonization" to achieve Net Zero in 2050.



To ensure that the policies and actions pursued in the 2020s would meet an "on pace" 2030 emissions limit and maximize Massachusetts' ability to achieve Net Zero in 2050 and do so equitably,[1] the Commonwealth analyzed these pathways to better understand the transitions required in the near- and long-term, as well as the trade-offs across different decarbonization strategies, while leaving a sufficient amount of flexibility to adjust future policies in response to potentially significant changes in the cost and availability of new technologies. As such, the analyses conducted for the 2050 Roadmap study were completed ahead of the 2030 CECP policy selection and development process.

Building on the 2050 Roadmap and the Commonwealth's previous GWSA implementation plans,[2] this 2030 CECP details the Administration's plan for continuing to equitably and cost-effectively reduce GHG emissions through 2030. Specifically, it describes an ambitious but workable strategy to achieve 2030 statewide emissions that are 45% below the 1990 level while maximizing the ability of the Commonwealth to achieve Net Zero emissions in 2050.

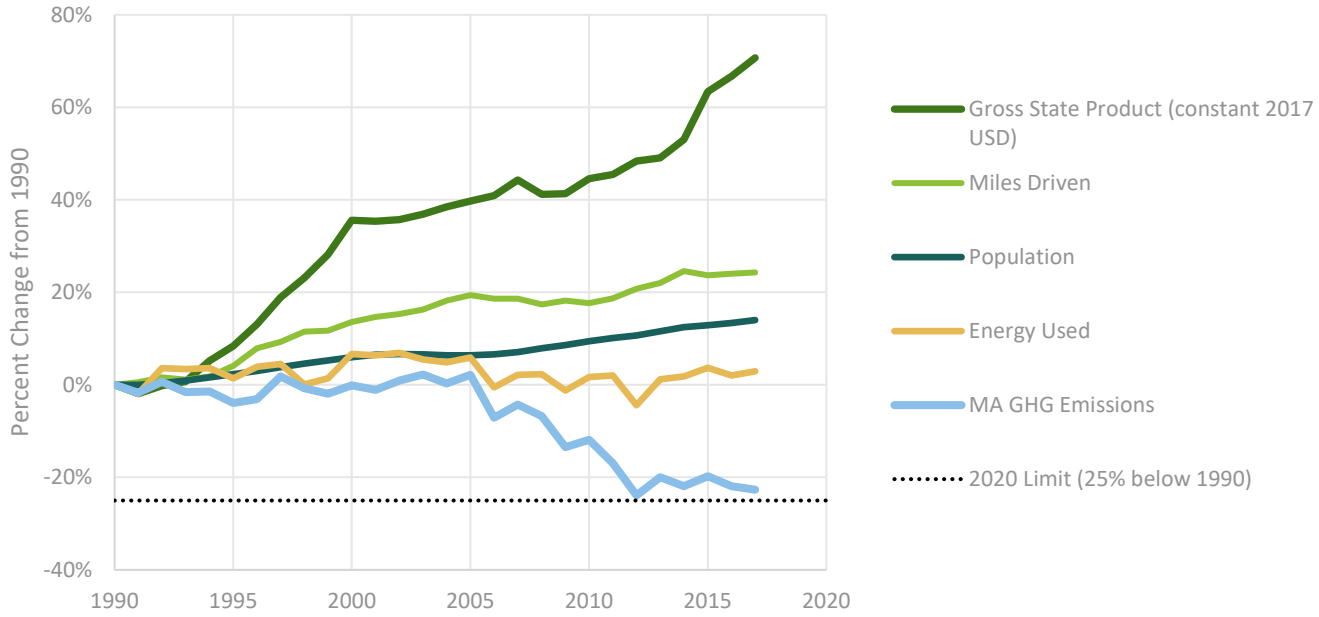
1.2 A Decade of Transformation

Massachusetts is on pace to achieve the GWSA emissions limit of a 25% emissions reduction below the 1990 level in 2020.[3] Climate policies, including those discussed in depth in the 2020 CECP and the Updated 2020 CECP, have achieved emissions 22.7% below the 1990 level even as the Massachusetts economy and

[1] Although the 2050 Roadmap Study was originally designed to explore pathways to achieve emissions reductions of at least 80% below the 1990 baseline level, in support of Governor Baker's commitment, its analysis shifted to explore deeper reductions capable of achieving Net Zero by 2050.
[2] The Commonwealth's initial GWSA implementation plan, the 2020 CECP, was published in 2010 and detailed the state's plan to achieve emissions reductions 25% below the 1990 level by 2020. That plan was updated, as required by the GWSA, in 2015 with publication of the 2015 Updated 2020 CECP.
[3] Based on pre-COVID-19 analysis conducted in support of the 2018 GWSA 10-Year Progress Report.

population have grown 71%[4] and 14%, respectively, (Figure 3) from 1990 to 2017 (the most recent full data year available). Furthermore, as detailed in the GWSA 10-Year Progress Report in 2018, the Commonwealth has thrived while reducing emissions. Massachusetts' Gross State Product (GSP) increased by more than $91 billion (21%) from 2008 to 2017, and the Commonwealth's clean energy industry employs more than 100,000 people while contributing over $13 billion (or about 2.5% of the annual GSP) to the Commonwealth's economy.

Figure 3: Percentage changes in Gross State Product, vehicle-miles traveled, population, energy usage, and statewide GHG emissions since 1990. Dotted line represents the GWSA 2020 emissions limit of 25% below the 1990 level.



Climate policies over the past 10 years have driven emissions reductions. These policies primarily have targeted emissions from electricity supply, but have also promoted end-use fuel switching, clean electricity deployment, energy efficiency and flexibility, and protection of natural lands. They also have created jobs and opportunities for residents throughout Massachusetts' cities and towns. The Commonwealth has advanced several critical climate policies, programs, and actions since the release of the last update to the clean energy and climate plan,[5] including:

***2016*:**

- Governor Baker signed **Executive Order 569** establishing an integrated climate strategy for the Commonwealth and directing the Massachusetts Department of Environmental Protection (MassDEP) to promulgate final regulations that satisfied the mandate of Section 3(d) of the GWSA. Over the next year, MassDEP issued six regulations to establish declining GHG emission limits on many sources of emissions and require the purchase of additional clean energy.
- Governor Baker also signed into law **An Act to Promote Energy Diversity** authorizing large procurements of offshore wind and hydroelectric resources.

[4] Percentage growth in Gross State Product from 1990, adjusted for inflation.
[5] Some of these policies are discussed in more detail in the GWSA 10-Year Progress Report.

2017:

- Massachusetts joined other jurisdictions in the **Transportation and Climate Initiative** to help lead the development of a regional program to reduce transportation sector emissions through investment in low-carbon transportation solutions.

2018:

- Governor Baker signed into law **An Act to Advance Clean Energy**, setting new targets for offshore wind, solar, and storage technologies. MassDEP began the process of distributing funds from the Volkswagen Settlement Trust to electrify the transportation sector in Massachusetts and reduce air pollution.[6]
- The Commonwealth selected and awarded contracts for 9.45 terawatt-hours (TWh) of clean hydropower via a new high-voltage transmission line.

2018-2019*:*

- The **Massachusetts Offers Rebates for Electric Vehicles (MOR-EV)** program, started in 2014 and administered by the Department of Energy Resources (DOER), began providing consumer incentives for the purchase or lease of zero-emission vehicles (ZEV), including battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). In 2018, the incentive program was extended with additional funding through 2019, and again in 2019 the program was extended with an annual fund of $27 million for 2020 and 2021.
- The Commonwealth selected and awarded contracts for the construction of over 1,600 megawatts (MW) of offshore wind generation, the first large-scale offshore wind projects in the nation.

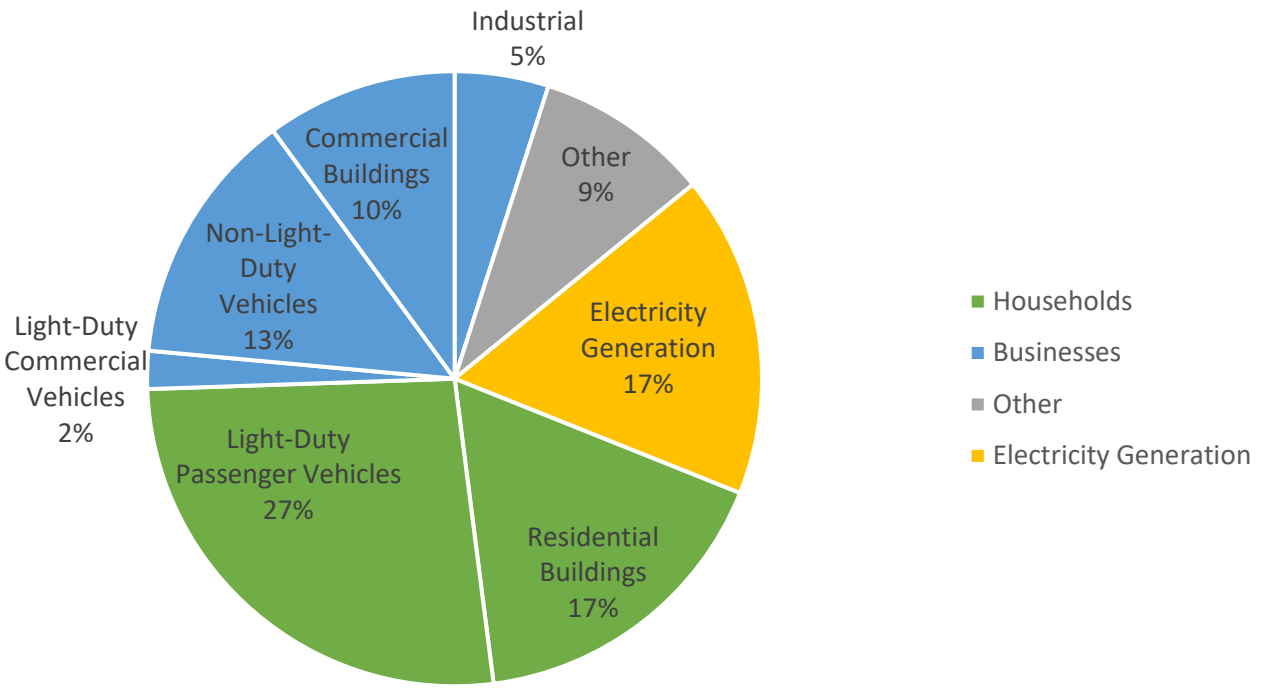
The implementation of climate policies since the passage of the GWSA has made the Commonwealth a leader in climate change mitigation. While progress to date has built a strong foundation for Massachusetts' continued emissions reduction efforts, particularly in the electricity sector, the 2050 Roadmap Study shows that a substantial acceleration of change is needed across all emitting sectors in the next decade. Major transformations must begin now for Massachusetts to remain on course to meet the GWSA emissions limit in 2050, achieve equitable outcomes, and reduce the costs associated with decarbonization in the future.

One of the major differences between the past decade of emissions reductions and the next decade is the number of market actors that need to transition away from the use of fossil fuels. The Commonwealth has been very successful in reducing emissions in the electricity sector, but those emissions were from a relatively small number of market actors, each of whom had very large emissions. From today to 2030, efforts to reduce emissions from a larger pool of market actors is needed.

About 75% of current GHG emissions in the Commonwealth are emitted from much smaller, distributed sources (e.g. vehicles, heating systems) owned by businesses, institutions, households, and individual residents (Figure 4), all of whom play a critical role in the adoption, utilization, and maintenance of technologies best suited to decarbonize Massachusetts' economy. More specifically, at the household level, roughly 5 million light-duty passenger cars and trucks generate about 60% of transportation emissions, and approximately 3 million residential households generate 60% of emissions from buildings.

[6] More information on the Commonwealth's participation in the nationwide settlement of diesel emissions fraud complaints against Volkswagen Group of America is available from MassDEP on Mass.gov: https://www.masscec.com/2019-massachusetts-clean-energy-industry-report

Figure 4: Distribution of 2017 GHG emission across households, businesses, and other categories.



The strategies to achieve emissions reductions in the 2020s necessitate influencing millions of smaller transitions over the next 10 years. It will take action at all levels of government and in all sectors of the economy. With a long track record of passing significant climate legislation, the Massachusetts Legislature has and will continue to play a critical role in the Commonwealth's ability to achieve GWSA-mandated emissions reductions. Similarly, continued action by local government across the Commonwealth is required. Many cities and towns have already implemented clean energy and energy efficiency initiatives that reduce GHG emissions while saving money for those municipalities. Over the course of the next decade, local communities will play an increasingly important role in a range of issues, including the siting of new renewable energy and transmission resources; implementation of zoning and building ordinances that support the development of high-performance, low-carbon emitting buildings and smart growth; expansion of the electric vehicle charging network; increasing climate adaptation and resilience; and equitable implementation of policies that impact residents and businesses in their jurisdictions.

As Massachusetts continues to lead and take actions to achieve its climate goals, continued engagement with, and action by, the federal government is also critical. Federal policies can mobilize markets outside of the direct influence of any one state, as well as advance regulations where the Commonwealth may be pre-empted. Federal actions also can signal a more universal sea change across technologies as well as supporting and spurring research and development at a scale unable to be matched by state actors, which would accelerate and reduce the cost of state and regional policy efforts.

Federal policies that would support Massachusetts' decarbonization efforts include:

- **Upholding international climate agreements:** International climate agreements, such as the Paris Agreement and the Kigali Amendment to the Montreal Protocol, can have a major influence on global markets. The federal government upholding of such agreements could unleash a range of policies that could help Massachusetts tackle challenging areas of decarbonization.
- **Streamlining energy infrastructure siting and permitting**: Siting of large-scale renewables, in particular offshore wind, has been a challenge. Streamlining future processes for leasing new areas for offshore wind by the Bureau of Ocean Energy Management (BOEM) is necessary for deployment of offshore wind generation at scale.
- **Maintaining and extending tax policies that support clean energy deployment**: Federal tax credits like the investment tax credit (ITC) and the production tax credit (PTC) can be a powerful mechanism to help incentivize private investment in new decarbonization equipment. New tax credits for offshore wind will help advance the development of U.S. offshore wind industry.
- **Setting vehicle emissions standards that drive technology transition:** Federal vehicle emissions standards are the single largest driver of technological innovation and transformation in the transportation sector. Strong, increasingly stringent Corporate Average Fuel Economy (CAFE) standards are critical to achieving cost-effective decarbonization particularly of the light-duty passenger fleet.
- **Setting national policies that cap fossil fuel emissions:** Federally imposed caps on GHG emissions could help advance the state-level policies around efficient use of fuels by creating national markets for clean transportation fuels, clean heating solutions, and clean electricity generation.
- **Expanding DOE, DOT, and EPA standard-setting programs:** Several programs through federal agencies support the market for decarbonization. Investments in SolSmart, ENERGY STAR, Portfolio Manager, and Green Power Partnership, and more will help ensure a high quality and healthy market for the decarbonization technologies Massachusetts will be looking to deploy.
- **Expand national lab research and technical assistance programs that support decarbonization:** Federal research efforts can pilot and pre-commercialize decarbonization technologies. Federal investment in research could help Massachusetts tackle challenging areas of decarbonization, such as high global-warming potential refrigerants and the development of low-cost "green" hydrogen production and distribution technologies.

1.3 Commitment to Equity

Deep decarbonization will significantly improve air quality in overburdened communities, and bring new economic opportunities that can revitalize cities and towns across the Commonwealth. Without thoughtful intervention, though, the ability of Massachusetts residents to participate in the transition to a low-carbon economy—such as owning an electric vehicle or retrofitting their homes to be more energy efficient—will differ according to income-level, ability to access and benefit from available resources, location in urban and rural settings, proficiency in English, and previous marginalization.

The Baker-Polito Administration is committed to ensuring that the policies guiding the transition to a new low-carbon economy do not exacerbate but instead assist in closing the health and economic disparities experienced in Environmental Justice communities and communities of color. EEA's Environmental Justice

Policy[7] further codifies the obligation of agencies under EEA's purview to include EJ as an "integral consideration" across programs; this consideration is reflected in the strategies proposed in this plan.

To better achieve these important goals of equity and access related to the Commonwealth's decarbonization transition, EEA staff will be able to draw on the work of an EJ Task Force that is conducting a comprehensive assessment of the Secretariat's programs and policies through an equity and justice lens. As described in the EJ policy, the EJ Task Force is comprised of staff representatives from every agency and office within EEA. Their work will help ensure that decarbonization efforts advance the Administration's complementary core principles of mitigating the impact of climate change while expanding equitable opportunity across the Commonwealth.

Participation by residents of EJ communities in both the decision-making process and the implementation of programs is both beneficial and necessary to meet the 2030 and 2050 emissions limits, while fulfilling the commitments of EEA's EJ Policy. EEA is committed to working in a manner consistent with the EJ Policy to enhance dialogue, stakeholder trust, and governmental transparency. In light of the current public health crisis, EEA is working to adopt new and effective methods of public engagement when and where necessary. Such engagement is not only a way to avoid inequitable outcomes, but also a key step in achieving a net-zero emissions future.

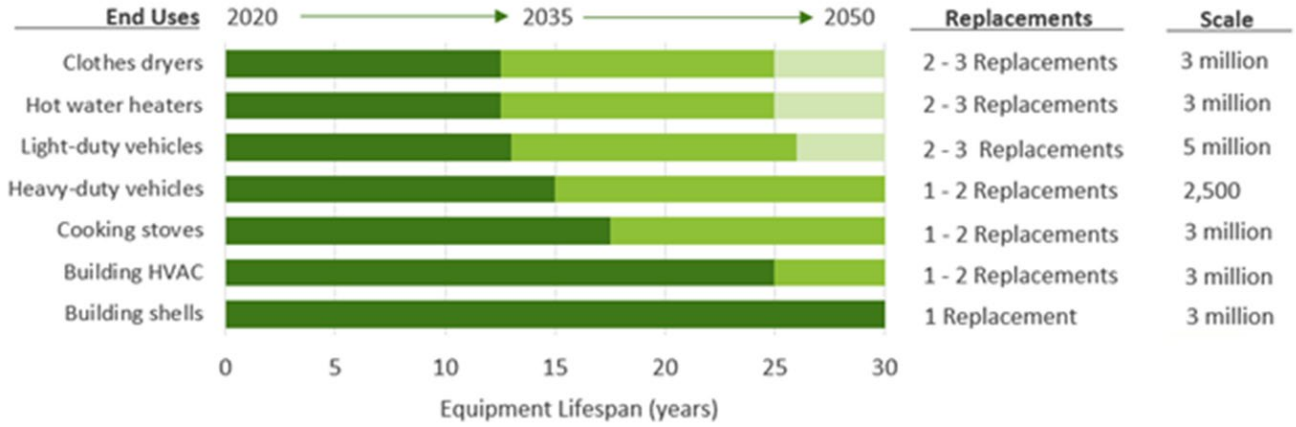
1.4 A New Goal: 45% in 2030

As introduced above in Section 1.1, EEA commissioned the 2050 Roadmap Study to directly inform its determination of an interim 2030 emissions limit. EEA used the 2050 Roadmap to explore the technical feasibility and cost effectiveness of a potential emissions limit between 40% and 50% below the 1990 baseline level. The key technologies needed to cost-effectively decarbonize our economy—zero-emission vehicles; non-fossil fuel heating, ventilation, and air conditioning (HVAC) equipment; clean and renewable electric generators—are largely available today. However, a range of factors limit the pace of their deployment, including replacement economics, equipment production, availability of workforce, and market demand.

The timing of when legacy fossil fuel equipment reaches the end of its service life determines the demand to buy replacements as well as when capital will be available to purchase them. This, in turn, drives the market supply of new equipment and workforce availability to install it. While there are some up-front and lifetime cost differences among GHG-emitting and zero-emission technologies., the point of replacement will almost always be the most cost-effective time for any consumer to switch from one type of equipment to another Thus, EEA undertook technical feasibility and cost effectiveness assessments of potential 2030 emissions limits that centered on taking advantage of stock turnover cycles of key systems and the technologies that drive GHG emissions (Figure 5).

[7] https://www.mass.gov/files/documents/2017/11/29/2017-environmental-justice-policy_0.pdf

Figure 5: Stock turnover cycles across several technologies.



It should be noted that the Commonwealth faces dual challenges in the coming decade related to stock turnover.

- **Equipment with longer lifespans:** Any system or piece of infrastructure that has a useful life that extends to or beyond 2050 and is being installed or replaced in the next decade either needs to align with the Commonwealth's decarbonization pathways or will need to be replaced before the end of its useful life. This is particularly important for natural gas infrastructure, building envelopes, district systems, and building HVAC, which may or may not be replaced between now and 2050 depending on the system and use. The Commonwealth can play a key role in ensuring early adoption of alternatives where technological solutions are already available and cost-effective, supporting near-term reductions and health benefits, while avoiding long-term costs in emissions or for their replacement. Where technological solutions are not available or not yet cost effective, the Commonwealth and its partners will need to prioritize near-term solutions.
- **Equipment with shorter lifespans:** Items with shorter useful lives (e.g., household appliances and passenger vehicles) have an opportunity for markets to scale between now and 2030. It is important, however, to maintain steady progress, increasing the proportion of stock turnover converted to 2050-compliant equipment throughout the 2020s to avoid more drastic measures to replace equipment or remake markets in the future. In these instances, the Commonwealth has an opportunity to encourage near-term adoption through a variety of avenues that support market scaling.

Policy implementation timelines, avenues, and funding also impact the rate of stock turnover and thus were factored into the feasibility assessment. Partnerships with the legislature, local governments, and the federal government will be critical for policy implementation that is both timely and appropriately funded, as many policy solutions will depend on actions outside the Executive Branch's direct control.

EEA's analysis of a technically feasible 2030 emissions limit indicated that a 45% emissions reduction not only maximizes the Commonwealth's potential to achieve Net Zero in 2050, but also can be achieved cost effectively by targeting key decision points at the time of stock turnover. EEA's analysis also found that pursuing emissions reductions beyond 45% in 2030 would likely require technological transformations faster than stocks are expected to turnover and before key markets can fully transform. As a result, mandating the achievement of deeper emissions reductions in 2030—far beyond those of any other state in the region—poses the significant risk of placing the Commonwealth at a competitive disadvantage and imposing unacceptably high cost-impact on businesses and families with little to no added benefit to the Commonwealth's transition to Net Zero in 2050. A reduction of 45% is also consistent with a straight-line

reduction from 25% below the 1990 level in 2020 to an 85% reduction below the 1990 level in 2050, keeping the pace of decarbonization steady across decades.

Consistent with the multiple, viable Net Zero pathways explored in the 2050 Roadmap effort, EEA identified several key near-term decarbonization strategies and associated policy and market development efforts capable of achieving "on pace" 45% emissions reduction by 2030 while maximizing the Commonwealth's mid- and long-term options. Those strategies are detailed in the remainder of this report.

Table 1 demonstrates the range of emissions reductions EEA calculated as being feasible and necessary to achieve a 45% reduction below the 1990 emissions level in 2030. Within each following emissions-sector chapters, there is a corresponding table showing how the strategies and policy actions discussed therein work together to ensure the achievability of emissions reductions equivalent to at least a 45% below 1990 level of reduction, even though important elements of the required transformation of equipment and technology are uncertain today. Markets continue to evolve rapidly, especially for electric vehicles (EVs) and cold-climate air-source heat pumps. In that context, long-range, sector-based caps and standards represent an effective method to drive substantial change toward deep decarbonization without predetermining the state of our energy systems a decade from now.

Table 1: Range of GHG reductions estimated for the full and timely implementation of strategies and policy actions outlined in the 2030 CECP.

Sector	***Gross GHG Emissions ($MMTCO_2e$)***			***GHG Reductions in 2030 (from 2017)***
	1990	**2017**	**2030**	
Transportation	30.5	30.5	22.5 - 22.7	7.8 – 8.1
Buildings	23.8	19.7	10.3	9.4
Electricity	28.1	13.6	8.5 - 9.4	4.2 – 5.1
Industrial & Non-Energy	12.0	9.2	7.8 - 9.7	(0.5)* – 1.4
Total	**94.5**	**73.0**	**49.1 – 52.1**	**20.9 – 23.9**
% Reduction From 1990	**-**	**23%**	**45% - 48%**	
*Negative reduction indicates an increase – this reflects partial mitigation of emissions growth				

1.5 Policy Analysis Process

EEA iteratively explored how various policy measures can reduce GHG emissions. This analysis was based upon the projected GHG impact of policies that accelerate the turnover rate of emitting sources replaced with cleaner, 2050-compliant technologies over the next 10 years.

Cost was a major consideration across all policies considered and selected. However, because of the systemic nature of the transformations that must be pursued simultaneously across sectors to achieve a 45% reduction in 2030, it is difficult to accurately attribute individual emissions or cost impacts to one single action. Together, public policies and market trends can accelerate required incremental GHG but the reductions cannot separately and precisely be attributed to each independent action. The same is true for cost. For example, the 2050 Roadmap and the 2030 analysis based upon it confirms that heat pumps and deep building envelope efficiency retrofits are likely to be the least-cost decarbonization solution across all viable pathways for at least 60% (and potentially more than 95%) of households. However, the incremental cost of each intervention and the potential policy actions needed to facilitate those transitions are difficult to precisely calculate and

attribute. Finally, availability of capital and the cost of taking on debt changes dramatically across these types of costs, clouding any direct comparison of cost burdens.

Thus, for purposes of designing policy strategies for the next decade, cost-effectiveness was generally evaluated in the context of packages or suites of policies, non-policy actions, and general trends rather than at the level of an individual policy. However, in some instances, especially evaluating how an entity might be able to leverage low borrowing costs or how to insulate low- and moderate-income consumers from excessive cost burdens, EEA specifically has evaluated individual policy costs or has highlighted areas that future policy must be designed around.

With the goal of establishing and recommending policies that are most equitable, least cost, and ultimately achievable, EEA engaged key stakeholders, as well as the public more broadly, to gather input. EEA has been convening the GWSA Implementation Advisory Committee (IAC)[8] as the primary public body to inform the policy process associated with the 2050 Roadmap and the 2030 CECP. Beginning in 2019, the IAC and their sector-specific work groups on transportation, buildings, electricity, and nature-based solutions provided recommendations on GHG emissions reduction measures for analysis in the 2050 Roadmap.[9] These recommendations were based on EEA's initial analysis of GHG emissions in 2050 in a hypothetical reference case with no new policies after 2020. In 2020, after being briefed on initial results from the 2050 Roadmap, the IAC Work Groups followed up with updated recommended policy priorities for EEA to consider for inclusion in the 2030 CECP.[10]

Understanding the importance of addressing environmental justice in the development of decarbonization policies, in 2019 EEA suggested a formation of a new IAC work group focused on equity issues. The IAC-led Climate Justice Working Group (CJWG) was formed in January of 2020 and is comprised of individuals from various organizations with expertise in environmental justice and equity. The CJWG has since advised the rest of the IAC body and EEA on the development of climate mitigation policies that can benefit EJ populations and other historically marginalized communities. Specifically, the CJWG provided comprehensive comments on a list of guiding questions to inform policy development and consideration,[11] as well as how the IAC's policy recommendations in 2019 can be improved to be people-centered and prioritize equity and environmental justice.[12] Those recommendations were factored into the IAC's recommendations of policy priorities for the 2030 CECP.

[8] The IAC was formed in 2012 to advise EEA on GHG emissions reduction measures, and includes representatives from several sectors, including commercial, industrial, and manufacturing; transportation; low-income consumers; energy generation and distribution; environmental protection; and energy efficiency and renewable energy, as well as from local government and academic institutions.

[9] The IAC recommendations on policies for analysis in the 2050 Roadmap were submitted to EEA on August 22, 2019, and can be accessed at https://www.mass.gov/doc/master-policy-list/download.

[10] The IAC recommendations of policy priorities for the 2030 CECP were submitted to EEA on October 22, 2020, and can be accessed at https://www.mass.gov/doc/iac-work-group-proposed-guiding-principles-and-policy-priorities-updated-10262020/download.

[11] The IAC Climate Justice Work Group's memo providing feedback and suggestions on guiding questions for policies development and consideration can be accessed at https://www.mass.gov/doc/gwsa-iac-climate-justice-working-group-memo/download

[12] The IAC Climate Justice Work Group's memo providing recommendations to improve the IAC's 2019 list of recommended policies can be access at https://www.mass.gov/doc/climate-justice-working-group-policy-recommendations/download.

In addition to specific policy recommendations, many of which are reflected in the strategies and policies outlined in this plan, the IAC developed a set of guiding principles for EEA to consider in both the development and implementation of climate policies. The approach that EEA has taken to develop this plan and evaluate individual policies is consistent with these principles. EEA used a set of guiding questions that were based on the criteria in the GWSA (M.G.L. Chapter 21N, Section 5) for reporting the progress of policy implementation. Both the IAC's guiding principles and the guiding questions used by EEA (see Table 2) highlight the importance of a multi-faceted approach to policy development.

Table 2: Proposed and statutory CECP policy design and evaluation considerations.

Guiding principles for climate policy development and implementation recommended by the GWSA Implementation Advisory Committee (IAC): • Prioritize and anchor equity and justice to reduce burdens and increase benefits to EJ populations; • Support a people-centered approach to policy making, program design, and implementation; • Take a holistic approach to achieving climate goals, including consideration of multiple laws and policies that are directing EEA; • Utilize best available science, technology, and data with timely analysis and transparent and clear public reporting; • Support partnerships and collaboration in every way possible at scale for impact; • Ensure consistent and supportive approaches across climate change policies and strategies to provide consistency and avoid conflicts.
Guiding questions for EEA policy analysis based on criteria in Section 5 of the GWSA: • How does this policy contribute to the system transformations necessary to achieve net-zero emissions by 2050? • Has this policy been piloted in the private sector? If yes, what relevant performance data exist and how have those data informed policy development? • What stakeholder or community engagement is recommended to support development and implementation of this policy? • How can this policy enhance environmental justice in the Commonwealth? • How does this policy support the use of best-available technology today, while remaining flexible for future changes to technology? • What emissions source does this policy impact? What is the anticipated magnitude of reductions associated with this policy? • Are there concerns about leakage to other states? If so, how might they be mitigated? • What are the anticipated economic, job, air quality, public health, and climate resiliency impacts of this policy? • What costs are associated with this policy? What group(s) (i.e., industry, socioeconomic, demographic, geographic) are likely to bear these costs? • What benefits are associated with this policy? What group(s) (i.e., socioeconomic, demographic, geographic, industry) are likely to accrue these benefits? • Given the likely costs, benefits, and jobs impacts, are there equity concerns associated with this policy? Are there equity concerns regarding the utilization of this technology or approach? If so, how might they be mitigated?

In order to finalize a fully informed plan, EEA is once again seeking the public's input. The current 2030 CECP document is an interim plan that proposes a viable set of strategies and policies for the Commonwealth to pursue in the next 10 years to reduce GHG emissions by 45% below the 1990 baseline level. EEA is seeking public comments during the months of January and February before releasing a finalized 2030 CECP in the Spring of 2021. EEA will be conducting public engagement efforts to collect feedback and inform the

finalization of the plan, including releasing a pre-recorded presentation that summarizes the plan and where to submit questions and comments. Additionally, EEA is organizing live webinars in January and February of 2021 where members of the public can ask questions about the 2030 CECP and provide oral comments. All written comments on the draft 2030 CECP will be reviewed by EEA and considered in finalizing the 2030 CECP.

After the 2030 CECP is finalized, EEA will lead the effort to track the implementation of this plan and to communicate the implementation progress to the GWSA IAC and the general public, as well as to the Massachusetts Legislature as part of the GWSA implementation progress report every 5 years. Building upon the last seven years of collecting data on key metrics for tracking policy implementation, EEA will continue to explore multiple avenues to improve existing and gather more data to assess how implementation of the strategies and policies outlined in this plan are helping to achieve the 2030 emissions limit.

Recognizing that technology and market transformations are hard to precisely and accurately predict years in advance, EEA intends to update the 2050 Roadmap analysis in preparation for the required update to the 2030 CECP by the end of 2025. Inputs used in the 2050 Roadmap Study, such as cost and efficiency data of key clean technologies, will invariably change as the adoption of EVs and heat pumps become more widespread, the offshore wind market matures, and new low and zero carbon fuel alternatives are scaled. What is certain is that EEA will continue use the latest science to plan for and achieve 45% emissions reduction in 2030 and Net Zero in 2050.

Chapter 2. Transforming our Transportation Systems

2.1. Sector Overview

The transportation sector currently produces more emissions than any other sector—42% of the Commonwealth's total statewide GHG emissions.[13] More than half of these emissions come from the combustion of fossil fuel in approximately five million light-duty passenger cars and trucks registered in Massachusetts; the remainder comes from the combustion of fossil fuels in the Commonwealth's 138,000 vehicle medium- and heavy-duty fleet and non-roadway vehicles (e.g., construction vehicles, trains, boats and ships, and aircraft). Gasoline is the predominant fuel, accounting for 62% of transportation sector emissions, followed by diesel and jet fuel (kerosene) at 26% and 12%, respectively.[14]

Despite federal- and state-level standards requiring vehicles to become more fuel efficient, transportation emissions have generally remained at or above 1990 levels in the last decade, hovering around 30 $MMTCO_2e$ since 2009. Light-duty vehicles (LDVs)—that is, on-road personal cars and light trucks—are the largest segment of this sector, some 58% of transportation GHG emissions. Since 1990, the number of vehicle-miles traveled (VMT) annually has steadily increased and passenger vehicle purchases have trended toward larger vehicles (e.g., sport utility vehicles) in the last decade.[15] The increase in VMT and vehicle size has largely offset the emissions benefit from more stringent federal fuel efficiency standards.

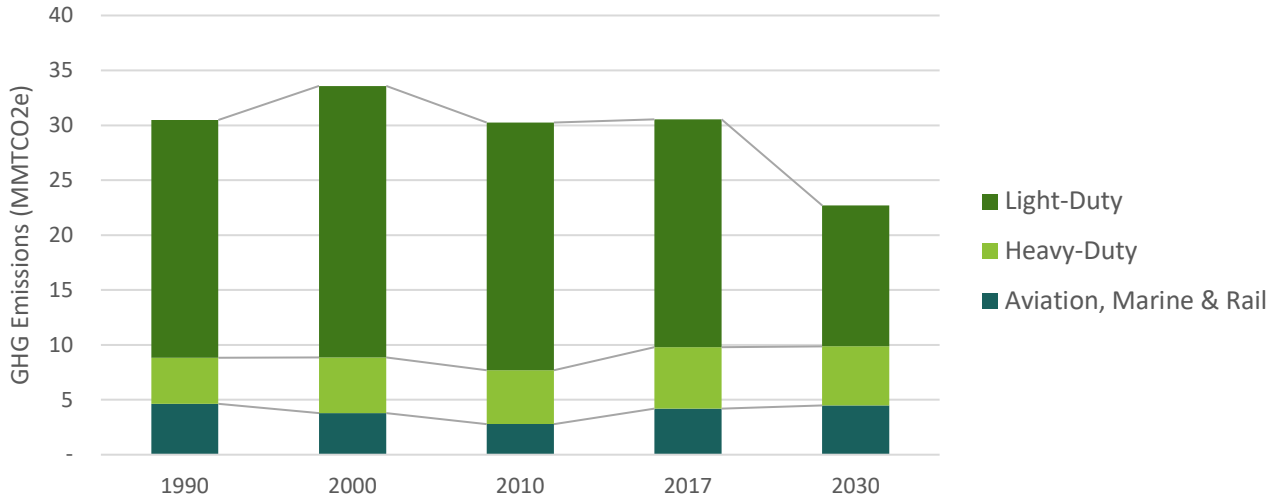
Medium- and heavy-duty vehicles (MDHDV) produce the next largest segment of sector emissions—more than a quarter of emissions from on-road vehicles in 2017. Single-unit short-haul trucks (e.g., box trucks) account for over 60% of all registered MDHDVs in the Commonwealth. The majority of MDHDVs are diesel powered (71%), and the remainder are gasoline powered (less than 1% use alternative fuel or are electric). MDHDV emissions have been growing over time, with diesel fuel consumption in the Commonwealth's transportation sector increasing by 40% between 1990 and 2017.[16]

For the Commonwealth to achieve Net Zero, fossil fuel use must be all but completely eliminated in on-road vehicles by 2050. Given the cost and scarcity of low- or zero-carbon drop-in replacement fuels and the current market and growing availability of high efficiency battery-electric and other zero-emission vehicle (ZEV) alternatives, this likely means reaching near complete electrification of the light-duty fleet. The MDHDV fleet must similarly be decarbonized, though with a greater variety of low- and zero-carbon fuels and on a pace sensitive to the specific performance requirements and comparatively small number of commercially-owned vehicles. In addition to decarbonizing fuels, the Commonwealth will seek to reduce VMT. Although reducing VMT is an important emissions reduction strategy in the near-term, widespread electrification of the majority

[13] MassDEP (2020). Appendix C: Massachusetts Annual Greenhouse Gas Emissions Inventory: 1990-2017, with Partial 2018 Data. Link.
[14] MassDEP GHG Inventory, Appendix C.
[15] From 2010 to 2019, the percentage of Massachusetts' motor vehicle fleet comprising automobiles (primarily sedans) fell from 58% to 38% while the share of the fleet comprising trucks (including most SUVs and pickups) grew from 41% to 50%. FWHA, Highway Statistic Series, Table MV-1, 2010 & 2019, https://www.fhwa.dot.gov/policyinformation/statistics.cfm
[16] EIA, SEDS Table CT-7, https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_use/tra/use_tra_MA.html&sid=MA

of the Commonwealth's vehicles will progressively diminish the effectiveness of decreasing VMT as an emissions reduction strategy between 2030 and 2050.

Figure 6: Historical and anticipated transportation sector GHG emissions.



2.2. Getting to 45% in 2030: ~ 8 MMTCO$_2$e Reduction

To position the Commonwealth to achieve the 2030 emissions limit and be on a pathway to Net Zero in 2050, emissions in the transportation sector must decrease by about 8 MMTCO$_2$e over the next decade, dropping to about 22 MMTCO$_2$e by 2030 (Figure 6). Most of the GHG emissions reductions in this sector are projected to come from electrifying LDVs. For MDHDV, electric powertrains are rapidly emerging, but not yet broadly available, and may not be feasible for many non-road applications (especially long-haul aviation). MDHDV fleet operators also face significant infrastructure costs and logistical challenges to transitioning to EVs. Accordingly, for these fleets reducing the carbon-intensity of the fuels, especially diesel, will be the dominant strategy to offset emissions growth and drive emissions reductions in the next decade. In addition, broad investments are needed in clean transportation infrastructure, including electrification upgrades for truck and bus depots and facilities, expanded opportunities for active transit, and maintenance and expansion of the Commonwealth's public transit systems. These priorities contribute to near-term emissions reductions, help prepare the Commonwealth for long-term reductions, and afford greater equity of access to mobility and the benefits of decarbonization.

With the help of strong state and federal policy incentives and standards, light-duty electric vehicles (EVs) have made rapid progress over the past decade and now represent a feasible solution for many Massachusetts residents. Today's EVs offer exceptional driving performance, low fueling costs, and reduced maintenance requirements. Although EVs still have higher up-front purchase costs, trends in battery technology and vehicle markets have brought down these costs and increased vehicle charge range dramatically; continued improvements are likely to put EVs on the path to upfront cost parity by 2030.[17] No longer limited to sedans,

[17] https://theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf

EVs are increasingly competitive in the market for SUVs, and major releases of electric pickup trucks are coming from manufacturers in the next few years.

Nevertheless, there are still significant obstacles to achieving widespread EV deployment in Massachusetts. EVs require the additional cost of installing electric vehicle supply equipment (EVSE) and Massachusetts residents who do not have access to overnight off-street parking in particular face challenges keeping their vehicles fully charged. Most consumers are not aware of the benefits of driving an EV,[18] many worry about driving range and the availability of charging infrastructure, and few are familiar enough with the technology to make a fully informed purchase decision. The Commonwealth will continue working to accelerate the market for EVs through policies that will help make it easy and affordable to drive an EV. Table 3 summarizes the transportation sector transformations, policies, and associated GHG reductions explored through the rest of this chapter. Detail on each of the numbered strategies and actions can be found in the section to follow.

Table 3: Transportation Sector— illustration of the most likely, cost-effective, and technologically feasible approach to achieve the emissions reduction expected and required by this plan (incorporating background trends and other known or expected non-policy related changes).

Transportation				
Equipment or Subsector	**Metric**	**Strategy**	**Action**	**GHG Emissions Reduction**
Cross-Cutting	≥ $130 million raised per year to invest in clean transportation systems	T1	TCI-P	0.1 $MMTCO_2e$
Light-duty vehicles (LDVs), including passenger cars and trucks	At least 750,000 zero-emission vehicles on the road, depending on standard compliance mechanisms and rebate levels. New rate classes and demand response programs established to enable the participation of EVs in retail and wholesale electricity markets.	T2	ZEV Standards	5.1 – 5.4 $MMTCO_2e$
		T3	ZEV Incentives	
		T4	EVSE Programs	
		T5	Market Facilitation	
Medium-duty and heavy-duty vehicles (MDHDVs)	~ 20% reduction in carbon intensity of diesel fuel.	T1	LCFS	1.8 $MMTCO_2e$
	Pilot deployment of ZEVs across all duty-cycles, engage fleet operators, and invest in EVSE infrastructure.	T2 – T5	Pilot MDHDV Programs	
Vehicle-Miles Traveled (VMT)	LDV VMT stabilized around 56 billion miles per year, despite 7% growth in anticipated fleet size from today.	T6	Smart Growth	0.1 $MMTCO_2e$
		T6	Commuter VMT	0.7 $MMTCO_2e$
Transportation Subtotal				**7.8 – 8.1 $MMTCO_2e$**

[18] Electric vehicles (EVs) are a subset of zero emission vehicles (ZEV) and include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Hydrogen fuel cell electric vehicles (FCEVs) are also considered ZEVs, but are not considered EVs in this document.

Strategies & Policies

Strategy T1: Cap Transportation Sector Emissions and Invest in Clean Transportation Solutions

Massachusetts is leading the implementation of the **Transportation and Climate Initiative Program (TCI-P)**, a multistate effort to create a regional cap-and-invest program in the transportation sector. The program will function similarly to the Regional Greenhouse Gas Initiative (RGGI),[19] creating an annually declining cap on emissions from the transportation sector. Under the program, regulated entities would be required to purchase emissions allowances equivalent to their emissions. By assigning an emissions cost to fossil fuels, TCI-P will incentivize the use of cleaner gasoline and diesel fuel blends and will create more favorable economics for EVs compared to internal combustion engine vehicles (ICEVs). Furthermore, revenue from the sale of emissions allowances can be invested by the Commonwealth into clean transportation options, thus providing a dedicated funding source for increasing EV deployment, expanding the EV charging infrastructure network, and electrifying transit buses, particularly in communities which are overburdened by pollution and underserved by transportation, TCI-P will also help support investments that will make it easier to get around without a car, such as improved public transportation, safe bike and pedestrian infrastructure, and "micro-mobility" solutions such as electric-assist "e-bike" bicycles. The Commonwealth is working to establish the TCI-P cap-and-invest program beginning no later than 2023.

***T1 Strategy Actions*:**

- In 2020, the Commonwealth signed on to the regional TCI-P cap-and-invest program memorandum of understanding; MassDEP will begin implementing the program in 2023.
- After TCI-P is in place, MassDEP will work to develop and implement a regional LCFS no later than 2026.

Following the implementation of TCI-P, the Commonwealth will pursue the development and implementation of a regional **Low Carbon Fuel Standard (LCFS)** designed to substantially reduce the carbon intensity of transportation fuels by 2030 through a market-based crediting program that supports deployment of low carbon substitutes for petroleum-based liquid transportation fuels. Most existing diesel engines can operate with a biodiesel blend up to 20% without any engine modification[20] and, nationally, such fuels retail at or near the price of petroleum diesel.[21] This means compliance with up to a 20% LCFS blend rate would not necessarily result in significant cost impacts for fleet operators or delivered goods. California has scheduled its LCFS to achieve a 20% reduction in fuel carbon intensity by 2030 and is working to align its LCFS and other emissions programs across the Pacific Climate Collaborative (including California, Oregon, Washington, and British Columbia).[22] Building on this program design and experience, Massachusetts will work with its neighbors to develop and implement a regional LCFS no later than 2026. Crediting would be available to technologies based on emissions, thereby encouraging private industry to innovate on how to deliver low-cost, low-carbon solutions. Vehicle electrification may be an alternative compliance mechanism.

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[19] For more information on RGGI, go to: https://www.mass.gov/regional-greenhouse-gas-initiative-rggi

20 U.S. Department of Energy (DOE), Alternative Fuels Data Center (AFCD), "Biodiesel Blends," https://afdc.energy.gov/fuels/biodiesel_blends.html

21 U.S. Department of Energy (DOE), Alternative Fuels Data Center (AFDC), "Average Retail Fuel Prices in the United States," https://afdc.energy.gov/data/10326

[22] CARB, LCFS Basics, September 2020, https://ww2.arb.ca.gov/sites/default/files/2020-09/basics-notes.pdf

Strategy T2: Implement Coordinated Advanced Clean Vehicle Emissions and Sales Standards

Even with anticipated incremental increases in the fuel efficiency of ICEVs over the next decade to achieve 45% in 2030, Massachusetts will need to deploy 750,000 to one million ZEVs in the next decade, representing approximately 17% of the projected light-duty fleet in 2030.[23] In order to achieve this scale of deployment, sales of new ZEVs must increase annually throughout the 2020s, reaching about 50% of all new LDV sales by 2030.

To ensure sufficient availability of ZEVs, the Commonwealth will continue to implement the current and future light-duty ZEV mandates designed and coordinated by California. Although federal statute generally preempts states from setting vehicle standards, California can set its own under the guidelines of the U.S. Clean Air Act, which also allows "Section 177" states like Massachusetts to adopt California's standards.[24] Accordingly, Massachusetts has and will continue to set equivalent regulations to match California's **Advanced Clean Cars (ACC) Program**,[25] which includes GHG emissions standards, criteria pollutant emissions standards, and ZEV sales requirements. The current light-duty ZEV mandate requires auto manufacturers to sell an increasing number of ZEVs in participating states through 2025. Pursuant to an executive order by its Governor,[26] California is currently developing an ACC II regulatory package that will amend ACC program standards, for vehicles starting in Model Year 2026. ACC II will require ZEV sales to ramp up to 100% of new LDV sales by 2035. Once finalized, MassDEP will adopt and implement these new ACC II regulations.

***T2 Strategy Actions*:**

- MassDEP will adopt and implement the California Advanced Clean Cars II Standard (all new LDV sales must be 100% ZEV by 2035) by the end of the year in which the standard is finalized by California.
- MassDEP will adopt and implement the ZEV purchase mandates of the California Advanced Clean Trucks rule by Dec. 31, 2021 and the Advanced Clean Fleets rule by the end of the year in which the rule is finalized by California.
- MassDEP will work with 16 other jurisdictions pursuant to the Zero Emission Medium- and Heavy-Duty Vehicle Memorandum of Understanding and Action Plan to provide a framework for achieving 30% of all new truck and bus sales being ZEVs by 2030 and 100% by 2050.

Similar efforts are underway to decarbonize the MDHDV fleet in Massachusetts. The Commonwealth, along with 15 other jurisdictions including California, committed in July 2020 to the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding, which sets a goal of ensuring that, by 2030, 30% of all new trucks and buses sold are ZEVs and that, by 2050, all such sales are ZEVs. The signatory jurisdictions will develop a Zero Emission Medium- and Heavy-Duty Vehicle Action Plan to

[23] Today, there are just over 5 million light-duty cars and trucks registered in the Commonwealth. That number is expected to grow with population to about 5.7 million by 2030.

[24] The federal government has authority over vehicle efficiency standards. However, there is an exemption under the 1970 Clean Air Act (CAA) for California to set its own emission standards as long as such standards are at least as protective as the EPA's standards (if awarded a waiver by EPA) and for other states to adopt California's standards under Section 177 of the CAA. Massachusetts law, M.G.L. Ch. 111, §142K, requires the Commonwealth to adopt and implement California motor vehicle emissions standards as long as those standards achieve greater motor vehicle pollution reductions than the federal standards.

[25] More information about the Advanced Clean Cars Program is available from the California Air Resources Board here: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program

[26] https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-text.pdf

provide a framework for achieving those goals, including a 2025 progress assessment. As a major action step toward meeting those goals, the California Air Resource Board (CARB) approved the **Advanced Clean Trucks (ACT)** rule, requiring manufacturers of MDHDV to meet increasing percentages of zero-emission truck sales, with the precise requirements varying by truck class and body style. In addition, CARB is developing **Advanced Clean Fleets (ACF)** regulations, which extend the requirements of the ACT rule to specific market segments that might be more readily electrified, such as last-mile delivery and drayage. Adopting these ACC II, ACT, and ACF regulations will provide regulatory certainty for vehicle manufacturers and an adequate supply of ZEVs for consumers in the Commonwealth.

Strategy T3: Reduce Upfront ZEV Purchase Cost Burden

ZEVs generally have lower operating and maintenance costs than gasoline or diesel-powered vehicles, but currently have a higher average upfront cost than comparable ICEVs. However, light- duty EVs are expected to reach upfront cost parity to ICEVs over the next decade. In the interim, the Commonwealth will continue to reduce the up-front purchase cost of most EVs. The **Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program**, administered by DOER, currently provides consumers a $2,500 rebate for the purchase or lease of a new BEV or FCEV and a $1,500 rebate for the purchase or lease of a new PHEV.[27] Coupled with the federal tax credit, these incentives allow consumers to purchase many EV models with up to $10,000 in rebates,[28] although some manufacturers have already exhausted the current federal program. DOER is working with dealerships to pilot providing the MOR-EV incentives at the point of sale, which will help increase the accessibility of EVs. EEA and the Massachusetts Clean Energy Center (MassCEC) are also seeking to develop a low and moderate income (LMI) consumer programs to help provide more equitable access to the benefits of ZEVs.

***T3 Strategy Actions*:**

- DOER will explore providing MOR-EV rebates at point of sale in 2021.
- EEA and MassCEC will investigate development of a low and moderate income (LMI) consumer program for ZEVs.
- DOER will develop a heavy-duty ZEV incentive program in 2021.

Commercial and nonprofit vehicle fleets—which include company-owned vehicles, companies with vans, rental car companies, and companies that provide vehicles to employees instead of reimbursing employees for mileage driven in personal vehicles—are eligible to receive MOR-EV rebates as of June 25, 2020. In addition, municipal governments, public colleges and universities, and state agencies are eligible for **Massachusetts Electric Vehicle Incentive Program (MassEVIP)** subsidies for the purchase or lease of electric light duty fleet vehicles.

Within the MDHDV market, fleet managers are those primarily responsible for the purchase and use of vehicles. As purchase decisions for fleet managers are primarily driven by cost, deployment is expected to accelerate as medium- and heavy-duty ZEV solutions mature and costs decrease. In the near-term, to help reduce the total cost of ownership of ZEVs versus internal-combustion engine MDHDVs, the Commonwealth is continuing to subsidize the purchase of electric and low-emissions transit, school and shuttle buses, shore-power, and airport ground support equipment through the **Volkswagen Settlement Open Solicitation Grants**.

[27] The MOR-EV rebates are only applicable to vehicles with a purchase price of below $50,000. Eligible PHEVs must have an all-electric range of 25 miles or greater.
[28] See https://www.irs.gov/instructions/i8936

In addition, DOER is developing a new rebate program—**MOR-EV Truck**—for electric and zero-emission heavy-duty vehicles.

Strategy T4: Deploy Electric Vehicle Supply Equipment & Enable Smart Charging

Transitioning LDVs in Massachusetts to EVs requires the deployment of residential EV charging infrastructure as well as workplace and public charging. As more and more EVs are deployed across Massachusetts, EV charging will become an increasingly critical element of both transportation and electricity sector policies.

Currently, the majority of EV charging occurs at vehicle owners' homes, where most vehicles are parked overnight, providing a convenient and inexpensive way to "refuel" EVs. Since nighttime also tends to represent periods of low overall electricity demand, supporting home charging represents a key opportunity to optimize grid infrastructure and reduce ratepayer costs. As such, the Commonwealth's Electric Distribution Companies (EDCs) have proposed several EV programs as part of rate proceedings at the Department of Public Utilities (DPU). Residents of communities with municipal electric providers are already eligible for funding for residential electric vehicle supply equipment (EVSE).[29] The Commonwealth will continue to develop new ways to provide additional utility-based consumer incentives for residential EVSE. In addition to building on existing municipal electric programs,[30] EEA will work with Mass Save® and the DPU to evaluate active demand-side management and other program designs for expanding EVSE incentive opportunities to new customers.

***T4 Strategy Actions*:**

- EEA and DOER will explore a utility-based residential charging incentive program.
- EEA, DOER, and MassCEC will address how to improve DCFC financial viability through pilot projects and seeking to resolve alter current punitive rate structures.
- DOER will analyze and propose potential revisions to rate structures (e.g., demand charges) that may represent barriers to public charging.
- EEA and DOER will explore and support Time-Varying Rates (TVR) and Active Demand Response (ADR) programs, including as part of demand response programs in the next Mass Save® Three-Year Plan (2022-2024).

While home charging will probably meet the majority of current EV drivers' charging needs, workplace, public, and direct current fast charging (DCFC) infrastructure are also important to support more EV drivers, especially for those who do not have dedicated off-street parking suitable for charging their vehicles. MassDEP has dedicated the maximum 15% allowed under the Volkswagen Settlement ($11.3 million) for EVSE at locations such as multi-unit dwellings, workplaces, public locations, municipal sites, educational facilities, and state facilities. Additionally, the DPU has approved Eversource and National Grid EV Make-Ready Programs for $40 million and $25 million, respectively, focusing on installation of make-ready infrastructure to support public, multi-unit dwelling, and workplace charging, with additional support for charging equipment in Environmental Justice communities in Eversource territory. The DPU has also approved fleet advisory services for public

[29] See https://munihelps.org/ev-charger-incentive-2/
[30] See https://ev.ene.org/ and https://munihelps.org/mmwec-ev-program/

transit, school buses, and government fleets, as well as demand response programs for residential chargers.[31] As the Commonwealth looks to expand the DCFC network, EEA, DOER, and MassCEC will need to collaborate with Municipal Light Plants (MLPs), EDCs, and third-party companies to improve DCFC financial viability through rate design and competitive markets.

Without affirmative steps to encourage smart charging behavior, EV charging could increase electric loads during certain hours in a way that could induce significant infrastructure upgrades to the electric grid resulting in increased costs for ratepayers. Alternatively, managing EV charging to occur during times of relatively low grid demand (currently, overnight) or during periods of high renewables production would mitigate rate impacts and facilitate the integration of renewable energy onto the grid, especially if vehicle-to-grid (V2G) capabilities can add further flexibility. Enabling cost-effective smart charging of EVs and bi-directional V2G connection will likely require the Commonwealth to deploy advanced metering infrastructure (AMI) for electric customers and establish rates and incentive programs that encourage EV drivers to charge overnight or at other times beneficial to the grid. The state is currently considering how Time-Varying Rates (TVR) and Active Demand Management (ADM) programs, potentially in combination with the Clean Peak Standard, could help facilitate smart charging.[32] In the meantime, a significant number of towns and cities with MLPs[33] have already adopted smart charging incentive programs, and Eversource and National Grid are developing smart charging programs as part of Mass Save®.[34]

Strategy T5: Engage Consumers & Facilitate Markets

Some of the most important benefits of EVs, such as reduced maintenance and the potential to charge from home, are not readily apparent to the average car owner. Massachusetts has several important programs that are helping to spread the word about the benefits of driving an EV, many of which are supported by state policy.

The **MassEVolves** program provides education, technical assistance, ride-and-drive events, and public recognition for the universities and workplaces in Massachusetts that are leading the charge towards EVs. The **Drive Green** program run by Green Energy Consumers Alliance with partial support from MassCEC has helped hundreds of Massachusetts residents

***T5 Strategy Actions*:**

- EEA will explore additional ways to raise consumer awareness of the ownership benefits of electric vehicles.
- MassCEC will fund pilot programs on medium- and heavy-duty ZEVs, urban delivery & fleet electrification, and EV charging infrastructure deployment by the end of 2021.
- MassCEC will offer technical assistance for MDHDV depot make-ready and fleet transitioning by the end of 2021.
- MassCEC will continue and expand market development efforts in relation to the clean transportation market.

[31] Eversource's EV Make Ready Programs (https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles/charging-stations) and National Grid's EV Make Ready Programs (https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/Electric-Vehicle-Charging-Station-Program)
[32] DPU 20-69 (Investigation by the Department of Public Utilities on its own Motion into the Modernization of the Electric Grid - Phase II).
[33] See https://ev.ene.org/ and https://munihelps.org/mmwec-ev-program/
[34] See https://www.connectedsolutionsev.com/

purchase a new or used EV through education and group purchasing discounts. Building on these initiatives through new creative partnerships and projects with community organizations, electricity suppliers, and car dealerships will accelerate EV adoption.

While light-duty EVs are commercially available now and the market for medium and heavy-duty ZEVs has significantly advanced, further state actions and public-private partnerships are needed in the next few years to encourage private sector investment, experimentation, and business model innovation that will accelerate adoption of EVs and EVSE statewide. The **Accelerating Clean Transportation Now (ACTNow)** program by MassCEC[35] aims to catalyze adoption of clean transportation solutions via business and project finance models, user engagement, technology, or other innovative approaches while prioritizing positive environmental justice impacts. In the second round of ACTNow, in 2021, the program will focus on charging infrastructure deployment, multimodal and mass transit access, and urban delivery and fleet electrification.[36] The DPU has already authorized National Grid to provide fleet advisory services for public sector fleets, which will help provide public fleets with the information they need to understand the full costs, benefits, and logistics of fleet electrification. In 2021, a MassCEC pilot will expand these services to medium- and heavy-duty commercial fleets, offering technical assistance for depot make-ready and fleet transitioning, as well as expanding pilot and demonstration funding and workforce development support.

Strategy T6: Stabilize Light-Duty VMT & Promote Alternative Transportation Modes

In the absence of policy interventions, the number of annual vehicle-miles travelled (VMT) by light-duty cars and trucks is expected to continue to grow, making it more difficult to reduce transportation sector GHG emissions. Decreasing the amount of VMT from commuting and increasing the density of development are two ways, among others, to help curb the growth of light-duty VMT.

MassDEP currently implements the **Massachusetts Rideshare Regulation** (310 CMR 7.16), which requires certain facilities to implement and maintain measures designed to achieve a non-binding goal of reducing single-occupancy vehicle (SOV) commutes by 25% and annual reports detailing steps taken to achieve that goal. Broadening the scope of this regulation or utilizing a complementary policy approach can help to reduce traffic congestion, air pollution, and GHG emissions. The response to the first wave of the COVID-19 pandemic in the spring of 2020 demonstrated that telework can be a viable and productive alternative to the daily physical commuting that was traditional for many jobs. As part of a holistic update of the Commonwealth's commuter-focused policies in the early 2020s, MassDEP will evaluate the role telework may play in the future of the Commonwealth's economy and its GHG and VMT reduction strategies.

***T6 Strategy Actions*:**

- EEA, MassDEP, and MassDOT will explore options to incentivize or require reductions to single-occupancy vehicle commuting, targeting a 15% reduction in average commuted VMT per employee by 2030.
- The Commonwealth will continue to encourage and incentivize a broad range of Smart Growth policies.

[35] https://www.masscec.com/accelerating-clean-transportation-now-actnow

[36] https://files-cdn.masscec.com/basic-page-image/ACTNow%20II%20Notice%20of%20Intent_Final.pdf

The Commonwealth will also continue to pursue a **Smart Growth policy package**. Development patterns significantly influence land consumption and VMT, which could both be reduced by zoning that drives construction to previously developed parcels and/or near public transportation and commercial centers. Smart Growth encourages fewer and shorter motor vehicle trips and enables the use of alternative zero-carbon mobility options like walking and biking. Massachusetts currently supports Smart Growth through several different programs and policies. Technical assistance is offered in the form of Land Use Planning Grants, District Local Technical Assistance, the Smart Growth/Smart Energy Toolkit, and other programs. State infrastructure and construction programs such as MassWorks, Chapter 43D, and MassDOT's project selection process include preferences for Smart Growth development in their criteria for funding decisions. These programs recognize that state investments, particularly those in infrastructure and buildings, influence where and how growth occurs. However, enhanced emphasis along with new, complementary policies that focus on state and local plans (e.g., zoning reforms), regulations, and investments would help achieve growth that reduces land conversion and vehicle travel, and associated GHG emissions. Better land use can help reduce GHG emissions from the transportation sector as well as protect carbon sequestration by forests and other natural lands. It will also have many co-benefits for the environment and public health. An enhanced level of commitment to current policies along with the implementation of new policies and programs will help realize the 2030 and 2050 GHG emission limits.

Chapter 3. Transforming our Buildings

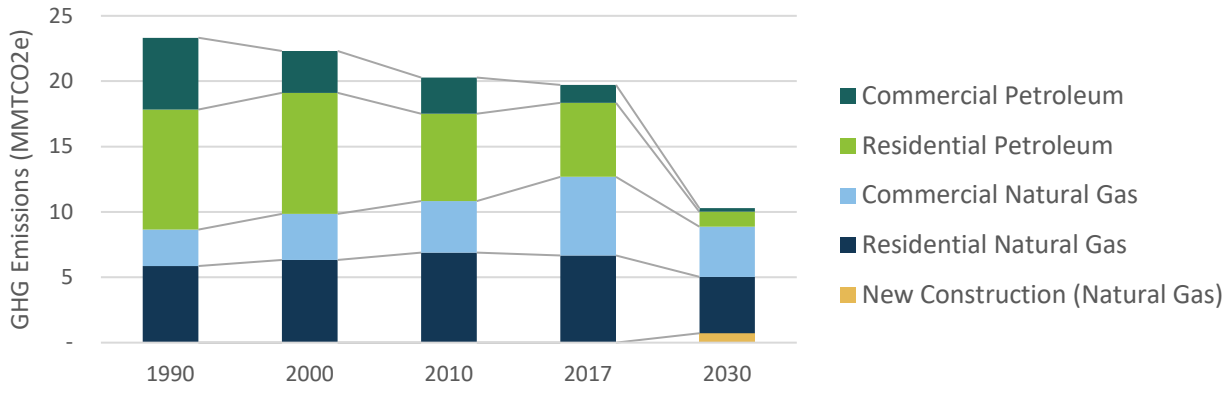
3.1. Sector Overview

The buildings sector in Massachusetts is large and diverse, with over two million individual buildings spanning a wide range of construction styles, occupancy needs, ownership, and equipment and with thermal requirements that vary greatly based on building configuration, size, age, and use. Currently, emissions in the building sector are driven by the combustion of fossil fuels on-site for space and water heating. Although emissions in residential and commercial buildings have generally trended downward since 1990 with the deployment of energy efficiency measures, weather variation contributes significantly to annual GHG emissions from the building sector, with longer and colder winters leading directly to more combustion of fuel oil, propane, and natural gas for space heating.

Because of Massachusetts' old building stock and cold winters, buildings currently account for almost a third (27%) of the Commonwealth's statewide GHG emissions, second only to the transportation sector. As a result, increasing building energy efficiency and electrifying end uses, especially heating, represent a significant opportunity to decrease emissions from this sector while reducing homeowner costs and increasing comfort.

In exploring a Net Zero future—including one pathway designed to specifically test the continued widespread use of natural gas, hydrogen, and renewable gas combustion for building services—the 2050 Roadmap pathways converged around the deployment of electrification and envelope efficiency improvements for the vast majority (at least 60% and potentially over 95%) of all buildings in the Commonwealth by 2050. Importantly, to achieve Net Zero in 2050 via either a lower-risk, lower-cost "high electrification" scenario or a higher-risk, higher-cost "decarbonized gas" scenario,[37] the core required transformations in the building sector over the next 10 years are the same. The number of buildings using natural gas, fuel oil, and propane for space and water heating must begin to steadily and permanently decline, and the deployment of heat pumps and building envelope improvements retrofits must become widespread.

Figure 7: Historical and anticipated buildings sector GHG emissions.



[37] These risk and cost dynamics are discussed in detail in Chapter 4 of the 2050 Roadmap report and in the accompanying *Energy Pathways Report* and are subject to unanticipated future technological and market break-throughs that are unknowable today.

3.2. Getting to 45% in 2030: ~ 9.4 $MMTCO_2e$ Reduction

To achieve the 2030 emissions limit and position the Commonwealth to be on a viable pathway to Net Zero in 2050, emissions in the buildings sector must decrease by about 9.4 $MMTCO_2e$ over the next 10 years, dropping to about 10 $MMTCO_2e$ sector-wide by 2030 (Figure 7).[38] The reductions modeled above are split proportionally between residential and commercial properties, and require very significant reductions from buildings using high-emitting petroleum-based heating fuels: fuel oil and propane. New construction is projected to increase emissions between now and 2030, but low-cost policies to accelerate efficiency and electrification primarily through a high-performance stretch energy code will greatly reduce the impact from, and future retrofit costs associated with, newly constructed buildings. Electrification of space and water heating and the deployment of building envelope efficiency improvements (additional wall and ceiling insulation, air sealing, better weatherization, new windows) are the primary drivers of emissions reductions.

Transitioning the buildings sector in a strategic and least cost manner is challenging, as it relies on immediately starting to leverage stock-turnover points. The relatively long life of HVAC equipment, often 20-30 years, means that equipment installed in the 2020s may still be in service by 2050. This underscores that sales of electrified and other clean or renewable heating alternatives need to ramp up quickly to take advantage of as many of these transition points—the times during the 2020s when businesses and homeowners will be replacing heating systems—as possible.

About one million residential gas, oil, and propane furnaces and boilers will likely reach their end-of-life between 2021 and 2030. Heat pump systems, which provide both winter heating and summer cooling, are poised to provide a ready, cost-effective 2050-compliant replacement as they can provide efficient heating in cold climates even at outdoor temperatures as low as -15°F. This transition will also provide opportunities for households to install high efficiency air conditioning at no additional cost, which is increasingly important in a warming climate. However, only a limited number of HVAC installers in Massachusetts have significant experience with using heat pumps as a whole home primary heating systems.

Transitioning to a heat pump HVAC system will have varying impacts on consumer energy costs. Households heating with higher cost heating fuels (like oil and propane) will likely have similar or reduced total heating costs immediately, while those currently using natural gas for heat may see marginal cost increases in the near term that in most cases can be fully offset by future operating cost savings. This consumer cost discrepancy is of particular concern regarding low-income households, where any increase in energy cost, even if temporary, has the potential to result in financial hardship. Despite potential near-term impacts for current natural gas customers, widespread deployment of heat pump systems will translate to overall societal cost savings in the coming decades.

In commercial buildings, about 40% of HVAC equipment is also expected to retire in the next decade. The 2050 Roadmap analysis indicates that for many of these buildings, heat pump systems will be the least-cost decarbonization option, although the diversity of applications and scale in the commercial sector will require

[38] The substantial emissions reductions required in the 2020s for the building sector reflect a 2050-compliant "on-pace" number of stock-rollover building conversions initially focused on higher per-conversion emissions reductions from fuel oil to heat pump transitions together with structural, non-jurisdictional limits on the pace of electrification in the transportation sector.

the use of a range of clean heating solutions. As is the case for residential buildings, these commercial replacements represent both the key opportunity for, and the key check on the pace of, cost-effective emissions reduction by 2030.

As building owners deploy heat pumps and other clean heating solutions, it will be very advantageous to simultaneously perform (or have previously performed) a deep energy efficiency upgrade to the building envelope – its windows, siding, insulation, and roofing. As with other building systems, however, the components of a building's envelope similarly "turn over" infrequently, needing to be replaced only after decades of service or as part of a voluntary renovation. Assessing and coordinating stock-turnover and investment opportunities for any residence or business, therefore, will be essential to any specific implementation strategy. Table 4 summarizes the buildings sector transformations, policies, and associated GHG reductions, explored through the rest of this chapter. Detail on each of the numbered strategies and actions can be found in the section to follow.

Table 4: Buildings Sector—illustration of the most likely, cost-effective, and technological feasible approaches to achieve the emissions reduction expected and required by this plan (incorporating background trends and other known or expected non-policy related changes).

Buildings				
Equipment or Subsector	**Metric**	**Strategy**	**Action**	**GHG Emissions Reduction**
Thermal Electrification	Electric space heating deployed across approximately one million households and 300-400 million square feet of commercial real estate.	B2	Incentivize and Enable Heat Pump Adoption	6.8 $MMTCO_2e$
		B3	Heating Fuel Emission Cap	
Decarbonized Fuel Blending	Consistent with diesel fuel in the transportation sector, fuel oil blended to achieve a ~ 20% reduction in carbon intensity by 2030. Pipeline natural gas reduced in carbon intensity by 5%.	B3	Heating Fuel Emission Cap	2.1 $MMTCO_2e$
Building Envelope	20% of building stock receives a deep energy retrofit, representing about three-quarters of all replacement points for windows, roofs, etc.	B2	Realign Mass Save® incentives	1.3 $MMTCO_2e$
		B3	Heating Fuel Emission Cap	
New Construction	A high-performance, passive-house level of envelope efficiency building code will contribute to the metrics above supporting heating fuel emissions caps.	B1	Building Code	(0.8) $MMTCO_2e$*
		B3	Heating Fuel Emission Cap	
Buildings Subtotal				**9.4 $MMTCO_2e$**
*Negative reduction indicates an increase – this reflects partial mitigation of emissions growth				

Strategies & Policies

Strategy B1: Avoid Lock-In of Building Systems That Are Not 2050-Compliant

Building stock turns over slowly, and virtually all buildings constructed in the 2020s are expected to still be operational in 2050. Limiting the number of new buildings and building energy systems that must later be retrofitted and limiting new emissions and emission sources added in the buildings sector are necessary to achieve both 45% in 2030 and Net Zero in 2050. This means avoiding new infrastructure or construction that is based on fossil-fuels for heating which would not be 2050 compliant, as well as ensuring that new equipment and products within buildings are on the path towards 2050 compliance.

High-performance stretch energy codes, which focus on deep efficiency and electrification, represent a key priority to ensure newly constructed buildings are built to minimize emissions. Highly efficient building envelopes can typically be obtained for little to no incremental cost when constructing a new building. Installing heat pumps or other clean heating solutions in new buildings can maximize the effectiveness of the equipment while minimizing costs. New construction in the 2020s is projected to produce approximately one billion square feet of additional building space in Massachusetts by 2030. Without improving building envelopes over the current baseline building code, where the current fossil fuels are the primary source for heating, those new buildings would likely result in annual demands of about 45 trillion additional BTUs of fossil fuels (almost all natural gas), and more than 2 $MMTCO_2e$ per year in additional GHG emissions by 2030.

***B1 Strategy Actions*:**

- DOER will present a new high-performance stretch energy code to the Board of Building Regulation and Standards in 2021 that allows for Green Communities to opt in starting in 2022 and will become mandatory and effective statewide no later than January 1, 2028.
- DOER will work to eliminate Mass Save® incentives for fossil fuel equipment in new construction in 2022 and align incentives with a high-performance building code including incentives for Passive House construction.
- EEA will support establishing state appliance standards by statute. DOER will work to support similar action at the federal level.

Using a phased approach—one that allows Green Communities to opt-in to a new, high-performance stretch energy code requiring passive-house level building envelope efficiency starting in 2022, and that is effective as the statewide energy code no later than 2028—will allow the building design and construction industry to transition while capturing up to 50% or more of all square feet built between 2022 and 2030. Such an approach has the potential—given reasonable forecast uncertainties, particularly regarding the variety of possible commercial sector energy uses—to cut new building energy use in half, resulting in significant cost savings for building owners and occupants and in GHG emissions reductions of more than 1 $MMTCO_2e$ per year

by 2030 compared to the status quo.[39]

Looking directly at end-uses installed in buildings, it is increasingly important to ensure that any new equipment or products are as energy efficient as possible. For products with potentially shorter lives—such as dehumidifiers or consumer electronics—improving efficiency through **federal and state appliance standards** will help the Commonwealth meet the 2030 emissions reduction target as well as set up a product development cycle whereby product improvements and innovation push towards more efficient and lower-cost products for all.

Strategy B2: Pivot the Market for Building Envelope Retrofits and Clean Heating Systems

To achieve emissions reductions of 45% below 1990 levels in 2030 and Net Zero in 2050, the deployment of electric and other clean HVAC systems, as well as building envelope improvement retrofits across the existing building stock, must rapidly scale. Although the strategies presented herein will allow for other actions to help achieve required emissions reductions, the lowest-cost strategies identified in the 2050 Roadmap called for the deployment of heat pumps in the vast majority of the Commonwealth's three million residential households, a combination of electrification solutions for commercial buildings, and building envelope upgrades reaching about 75% of all building shells by 2050. This represents a significant challenge to be undertaken over the next 30 years, and, because new equipment installed in the next ten years is likely to still be in service by 2050, highlights the importance of not deferring deployment of these solutions. As part of that deployment, the biggest cost-savings and emissions reduction opportunity in the next decade is the simultaneous electrification of high-cost, high-emissions fuel oil heating systems together with the deployment of building envelope efficiency upgrades in older homes.

***B2 Strategy Actions*:**

- DOER will work to phase out incentives for fossil fuel heating systems as soon as possible, limiting fossil fuel heating system incentives in the 2022-2024 Three Year Plan, and ending all fossil fuel heating system incentives by the end of 2024.
- DOER will work to increase electrification through Mass Save® programs through air source and ground source heat pump incentives and consumer education in 2022-2024.
- DOER will work to expand access to energy efficiency and clean heating for low- and moderate-income renters and homeowners in EJ communities through targeted community-based incentives and outreach programs, and increased funding for pre-weatherization barriers.
- EEA and DOER will seek near-term means to enhance MassCEC funding to support continued market development for building decarbonization.
- MassCEC will refine and enhance workforce development programs related to building decarbonization and will investigate the need for air-source heat pump certification and workforce training.

Mass Save®, the statewide efficiency program, is one tool primed to help drive the near-term delivery and installation of decarbonization technology as additional programs and policies are developed. In order to better align Mass Save® with the state's GHG emissions reduction targets and requirements, DOER will work with the Commonwealth's Energy Efficiency Advisory Council (EEAC) and Mass Save® program

[39] The COVID-19 pandemic adds significantly to uncertainty in the new construction industry, as new development patterns may not reflect previous population forecasts nor will distribution of housing and commercial typologies necessarily reflect previous patterns.

administrators with the goal of ensuring that the cost of long-term GWSA compliance is included in all program cost-benefit calculations, incentives for fossil-fuel heating systems are limited during the program's next 3-year cycle (2022-2024), and all available program resources are directed to clean heating systems no later than the end of 2024. DOER will also work to ensure that Mass Save® develops increased air source and ground source heat pump incentives and consumer education in 2022-2024 and expands access to energy efficiency and clean heating for low- and moderate-income renters and homeowners in Environmental Justice communities through targeted community-based incentives and outreach programs, and increased funding for pre-weatherization barriers.

In addition to Mass Save® driving near-term market adoption, there are other programs through municipal utilities, non-profits, municipalities, and MassCEC that can and must continue to focus their attention on **incentivizing and enabling heat pump adoption and building envelope improvements**, especially in residential buildings, which represent the single biggest source of building emissions in Massachusetts. MassCEC will continue to expand market development initiatives to demonstrate cost-effective building decarbonization solutions; engage, educate, and facilitate consumers and communities to increase the breadth and depth of adoption; and work with industry to facilitate development of the technologies, workforce, practices, and business models needed to achieve this aggressive trajectory of building decarbonization. MassCEC will also work in conjunction with Mass Save® to establish and implement strategies to increase heat pump adoption, enhance realization of consumer benefits for households and communities that are underrepresented in building decarbonization (including those that are low- and moderate-income, renters, minorities, and limited English language proficiency and develop innovative solutions that can be scaled.

Broader **consumer education** around the need for, and the benefits of, building electrification has the potential to help inform wise investments over the next ten years. DOER has developed a **Home Energy Scorecard** that works with both the U.S. Department of Energy Home Energy Score designed for existing homes and the Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) ratings used in most newer homes and, if implemented, would help inform homeowners and renters alike of the potential improvements in efficiency and GHG reduction opportunities in their homes.

Strategy B3: Convene the Commission and Task Force on Clean Heat & Cap Heating Fuel Emissions

Decarbonizing over two million individual buildings in Massachusetts is an immense challenge in terms of scale and logistics. While the 2050 Roadmap and other similar studies have found air-source heat pumps to be the most economical clean heating solution for almost all single-family homes and other small residential buildings, the diverse building stock in Massachusetts will require a range of options. There is not a one-size-fits-all solution, and not every building in Massachusetts can currently be cost-effectively electrified. Nevertheless, the current level of natural gas use for building heating and the continued use of petroleum heating oil is inconsistent both with achieving Net Zero in 2050 and a 45% reduction from the 1990 baseline in 2030.

Given the urgency and difficulty of meeting our goals in the buildings sector, by 2023 the Commonwealth will impose a **long-term, declining caps on heating fuel (gas, oil, propane) emissions**. In 2021, the Commonwealth will convene a special Commission on Clean Heat supported by an EEA-led, cross-secretariat, inter-agency Task Force on Clean Heat.

With consideration given to differences across the state, the Commission and Task Force will make a recommendation to EEA before the end of 2021 regarding the structure and levels for long-term emissions caps on heating fuels consistent with the findings of the 2050 Roadmap, the 2030 emissions limit, and this plan. By the end of 2022 and after considering the findings of the related, on-going DPU investigation,[40] the Commission and Task Force will propose the **statutory, regulatory, and financing mechanisms** needed to ensure the development of reliable and affordable clean heat solutions for the Commonwealth's buildings.

***B3 Strategy Actions*:**

- The Baker-Polito Administration will convene a Commission and Task Force on Clean Heat by May 2021.
- MassDEP will develop and implement by 2023 a long-term declining emissions cap on heating fuels following consultation in 2021 with the Commission and Task Force on Clean Heat regarding the cap structure and levels consistent with meeting or exceeding GWSA required emissions reduction levels.
- The Commission and Task Force on Clean Heat will propose, by 2023, statutory, regulatory, and financing mechanisms needed to ensure the development of reliable and affordable clean heat solutions for the Commonwealth's buildings.

In addition to the structure and levels for long-term emissions caps on heating fuels, and the findings of the on-going DPU investigation working to safely and equitably align utility business models with the achievement of Net Zero in 2050, additional issues for consideration by the Commission and Task Force include:

- Innovative utility business models to affordably deploy clean heating systems and deep energy retrofits;
- Zero up-front capital solutions for low income and affordable housing residents;
- Performance and reporting standards and requirements for large, commercial, and industrial buildings;
- Long-term financing mechanisms to support and enable building decarbonization;
- Potential for sustainable and cost-effective market deployment of biofuels, renewable natural gas, and hydrogen for space heating;
- Market support for air- and ground-source heat pumps and other clean heat solutions;
- Supply chain and workforce development;
- Transparency, benchmarking, labeling, and rental standards.

* * *

While other sectors in this report are presented with an emissions range, representing both uncertainty and a greater level of program optionality, driving the most aggressive pace possible in the building sector represents a key element to position the Commonwealth to achieve Net Zero by 2050 given the slow pace of building equipment turnover. The holistic sector caps identified here establish the boundaries of the emissions reductions the Commonwealth must achieve without dictating the means by which it will do so. This stands in contrast, for example, to more technology-specific policies discussed in the Transportation Sector, in which the

[40] DPU 20-80, investigation by the Department of Public Utilities on its own Motion into the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals.

relatively shorter lifespans of LDVs affords more flexibility to allow the ZEV market to scale more organically. The Commission and Task Force's work to recommend specific cap levels and the implementation approaches to reach them, will be undertaken with the understanding that the level of required emissions in the Building Sector implicates not only the ability of the Commonwealth to achieve 45% in 2030, but also its ability to achieve Net Zero in 2050.

Chapter 4. Transforming our Energy Supply

4.1. Sector Overview

The Commonwealth has made significant progress in decarbonizing its electricity generation and energy supply systems. Since 1990, power sector emissions have fallen nearly 50%, in large part due to the closure of coal- and oil-fired power plants. As of 2017, the electricity sector in Massachusetts accounted for 13.6 $MMTCO_2e$, or approximately 19% of statewide emissions. Natural gas is the predominant source of GHG emissions, accounting for 66% of power sector emissions, followed by imported electricity (16%), waste combustion (9%), coal (8%), and petroleum (2%).

Renewable energy sources already comprise a growing portion of power generation within the Commonwealth. This increase is driven in part by existing state policies and programs intended to reduce emissions in line with the GWSA, including:

- **Clean Energy Standard (CES) and CES-E**: The CES sets a minimum percentage of electricity sales that retail electricity suppliers must procure from new clean energy sources beyond the RPS requirements. The CES began in 2018 at 16% and increases 2% annually to 80% in 2050. The CES-E applies to clean generating resources that pre-existed the RPS and is 20% for 2021.
- **Solar Carve-Out (SCO) & Solar Massachusetts Renewable Target (SMART):**[41] As part of the RPS, the SCO program, initiated in 2010 and expanded in 2014, requires electricity suppliers to meet a portion of the RPS obligation through solar energy. To further support the growth of solar and reduce ratepayer costs, Massachusetts launched the SMART program in 2018 to incentivize the development of 3,200 MW of new solar generating capacity via a declining block tariff.
- **Massachusetts Renewable Energy Portfolio Standard (RPS):** The RPS requires retail electricity suppliers to procure an annually increasing percentage of the power they provide to end-use customers from qualified renewable sources. RPS compliance is divided into classes and sub-classes, including Class I (new renewables), Class II (existing renewables), and Class II (waste-to-energy). Beginning in 2020, the RPS obligation was modified from a 1% increase to a 2% increase per year until 2029, resulting in a minimum obligation of 35% renewables by 2030.
- **An Act to Promote Energy Diversity**:[42] In Chapter 188 of the Acts of 2016, An Act to Promote Energy Diversity, the Commonwealth established ambitious targets for clean energy procurement. The Act required utilities to solicit a total of 1,600 megawatts of offshore wind by 2027, which is currently under contract to be filled with the Vineyard Wind and Mayflower Wind offshore wind projects. The offshore wind procurement target was increased in 2019 to 3,200 megawatts by 2035. The Act further required the EDCs to competitively solicit 9.45 TWh per year of clean energy generation, which was successfully contracted through the New England Clean Energy Connect project for Canadian hydroelectric generation.

[41] https://masmartsolar.com/ https://masmartsolar.com/
[42] https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter188

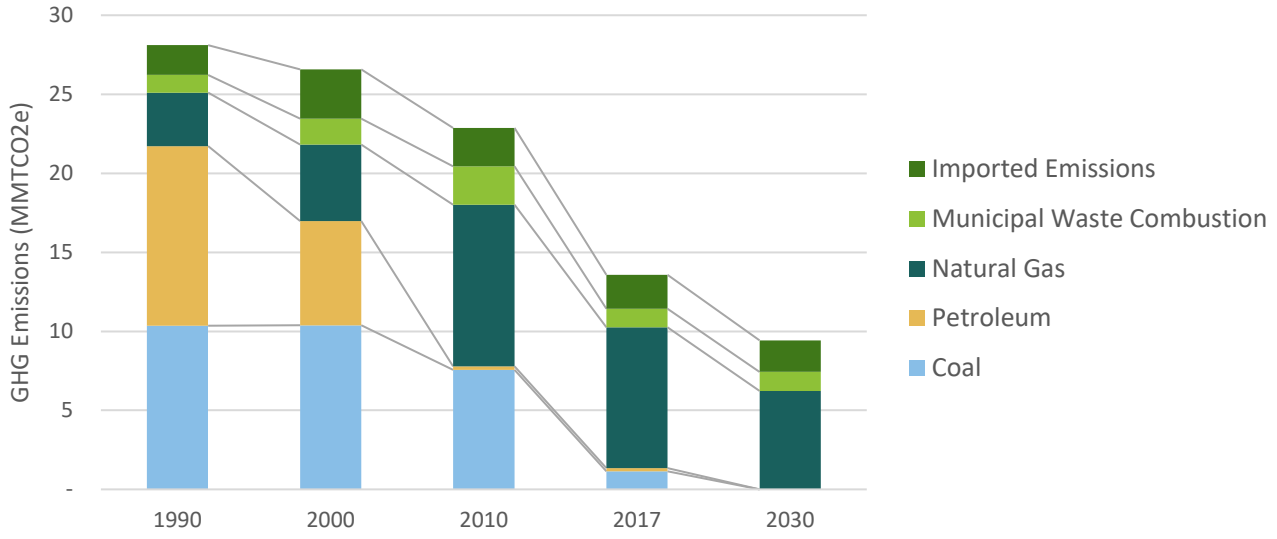
Despite progress in reducing electricity sector emissions, significant work is still needed in order for Massachusetts to meet its anticipated electricity demand with clean and renewable resources, which is essential for achieving economy-wide decarbonization by mid-century.

Electricity demand is projected to more than double by 2050 due to the widespread electrification of building and transportation services. Thus, the emissions intensity of electricity must continue to decline dramatically even while total generation increases. Offshore wind is anticipated to be the primary source of electricity for a decarbonized energy system, including at least 31 GW of capacity in the waters off the coast of New England, about half of which would likely need to be interconnected to land in and throughout Massachusetts. Solar resources represent a key complementary resource, reaching optimal production during the day and summer compared to offshore wind's peak production at night and in the winter.[43]

Reliably operating a cost-effective, ultra-low emissions electricity grid based on variable renewable resources requires a balanced portfolio of complementary resources and technologies. That portfolio includes specific reliability resources (i.e., infrequently used thermal generating capacity and/or new bulk storage) that will be needed to maintain reliability during infrequent, potentially multi-day, periods of very low offshore wind generation. A significant expansion of transmission and distribution systems (i.e., additional high-voltage interstate transmission) within and beyond Massachusetts will also be needed.

Since the 1970s, the Commonwealth's bulk electricity system has been operated in close coordination with other New England states, first as part of the New England Power Pool (NEPOOL) and then within the operational jurisdiction of the regional independent system operator of New England (ISO-NE).[44] As the Commonwealth and other states across New England work to decarbonize their economies, there is a similar need and cost-savings opportunity for continued, close regional cooperation. However, to achieve the energy system transition described in the 2050 Roadmap, the least-cost facilitation of the states' decarbonization efforts must become the primary focus of regional system planning and markets in the next decade.

Figure 8. Historical and anticipated electricity sector GHG emissions.



[43] The 2050 Roadmap and Energy Pathways Report provide additional details.
[44] ISO-NE is the FERC-regulated independent system operator for New England.

4.2. Getting to 45% in 2030: > 4.2 $MMTCO_2e$ Reduction

To achieve a statewide 45% emissions reduction below the 1990 baseline in 2030, GHG emissions in the electricity sector must decrease by more than 4.2 $MMTCO_2e$ over the next 10 years, dropping to less than 10 $MMTCO_2e$ sector-wide by 2030 (Table 5). Massachusetts is largely on track to attain this reduction due to key regulations and programs, including CES, RPS, SMART, and the offshore wind and hydroelectric procurements that are already being advanced. Some additional policies to realign regional markets for clean electricity and encourage greater regional cooperation toward clean energy goals will lead to greater emissions reduction and overall system benefits.

Successfully implementing currently planned clean and renewable energy programs and procurements will keep the Commonwealth's development of clean energy resources on pace to support the achievement of Net Zero in 2050. However, the Commonwealth must begin preparing for the additional transformations that will be required to continue the momentum of these efforts and accelerate regional resource development between 2030 and 2050. This includes continued work driving the deployment of solar and offshore wind at scale; investing in a flexible, responsive, and reliable electricity grid; and developing partnerships across state and international borders to ensure the entire Northeast region moves together cost-effectively toward a shared clean energy future. Table 5 summarizes the electricity sector transformations, policies, and associated GHG reductions explored through the rest of this chapter. Detail on each of the numbered strategies and actions can be found in the section to follow.

Table 5: Electricity Sector—illustration of the most likely, cost-effective, and technologically feasible approaches to achieve the emissions reduction expected and required by this plan (incorporating background trends and other known or expected non-policy related changes).

Electricity				
Equipment or Subsector	**Metric**	**Strategy**	**Action**	**GHG Emissions Reduction**
Clean Energy Resources	7 GW of new clean energy projects deployed, including 3.2 GW of solar, 3.2 GW of offshore wind, and 1 GW of new transmission to Quebec.	E1	Fill existing standards	2.7 $MMTCO_2e$
			Execute current procurements	
Renewable Scaling	2 additional GW of solar deployed. Planning underway for 6 additional GW of offshore wind by 2040.	E4	Solar market facilitation and guidance.	0.2 $MMTCO_2e$
		E5	Offshore wind market development	-
Regional Markets	Emissions from imported electricity limited to 2 $MMTCO_2e$.	E2	Coordination with ISO-NE & NESCOE	1.3 – 2.2 $MMTCO_2e$
		E3	Align attribute obligations	
		E2	Regulate MLP emissions	
Grid Upgrades	Supports other efforts.	E6	Distribution-level Policy Considerations	-
Electricity Subtotal				**4.2 – 5.1 $MMTCO_2e$**

Strategies & Policies

Strategy E1: Fill Current Standards & Execute Procurements

The current clean energy standards and procurements authorized for 2030 set Massachusetts on a path toward deep decarbonization. **Fully executing the Commonwealth's existing solar programs and offshore wind procurements** aligns with the scale of renewable growth needed by 2030 in the 2050 Roadmap. In addition, the on-going procurement of clean hydropower via a new high-voltage transmission line represents a critical, early action necessary to cost-effectively and reliably achieve Net Zero in 2050. Although these programs and procurements will likely satisfy the Commonwealth's RPS and CES in 2030, the continued evolution of both standards, before and after 83C and 83D offshore wind and hydroelectric projects become operational, puts pressure on regional markets to develop additional renewable resources. In addition, the CES-E program provides a regulatory framework to maintain important existing clean energy resources across New England, while the Commonwealth's 310 CMR 7.74 regulation works to reduce GHG emissions from power plants in Massachusetts. This mix of procurements, standards, and regulations will largely support the Commonwealth's electricity sector decarbonization goals for 2030, while the additional policy mechanisms, described below, provide additional guidance and management of the sector's transition in the near and long-term.

***E1 Strategy Actions*:**

- EEA, with partners across the Commonwealth, will continue to ensure all existing procurements for renewable energy and transmission are completed on -time.
- EEA and agency partners will ensure compliance with existing portfolio standards and emissions regulations.

Strategy E2: Develop and Coordinate Regional Planning and Markets

As Massachusetts and its neighbors work towards a common clean energy future, cooperation and coordination with other New England states and across the Northeast will help to ensure that renewable resources, such as offshore wind leasing areas, are utilized in the most effective manner and accomplish mutual goals for deep decarbonization. In addition, because sharing resources across larger areas can reduce cost and is necessary to ensure the reliability of a deeply decarbonized electricity grid, **regional cooperation on electricity system planning** will be necessary to plan and site new interstate and interregional transmission capacity.

The pace and magnitude of required renewable generation and transmission development outlined in the 2050 Roadmap also indicates the need to make significant changes not only in the pace of federal siting approvals, but also in the design and function of the New England electricity markets. For example, if multiple large projects were to come online in the same year, the regional market for clean energy attributes (e.g., RECs or CECs) could be flooded with new resources, potentially reducing revenue streams for existing and future projects. Alternatively, if regional RPS standards increase too quickly, total supply of clean energy might lag those demands, leading to increased compliance costs which would be reflected in higher electricity bills. **Coordination with other states on their new or existing clean energy standards** will help to ease any impacts to the clean energy attributes markets related to regional demand and supply of clean energy generation. In addition to the suppliers and consumers of electricity, ISO-NE will need to fundamentally shift its operation

and planning paradigms to become a committed partner in the Commonwealth's economy-wide decarbonization effort.

***E2 Strategy Actions*:**

- In coordination with other New England states, the Commonwealth is actively working to ensure that the states are served by a regional electricity system operator and planner that is a fully committed partner in their decarbonization efforts.
- EEA/DOER will continue working with other New England states to coordinate procurement and programming for new and existing clean energy resources.

Recognizing the urgency for, and complexity of, such change, Governor Baker, along with four other New England Governors, issued a joint statement in October 2020 articulating the need for comprehensive, decarbonization-focused reform of the regional electricity system.[45] Referencing the 2050 Roadmap analysis and similar modeling in other states, the Governors described the misalignment that is now evident between today's grid and the one needed to achieve the states' deep decarbonization goals. Going forward, that misalignment must be corrected so that the Commonwealth and other New England states working toward deep decarbonization are served by a regional electricity system operator and planner that is a committed partner in their decarbonization efforts:

- Proactively developing market-based mechanisms, in concert with state policymakers, that facilitate growth in clean energy resources and enabling services, while fully accounting for on-going renewable energy investments made pursuant to enacted state laws;
- Conducting best-in-class system planning activities that proactively address state clean energy needs; and
- Ensuring grid resiliency and reliability at least cost in a manner that is responsive to state and consumer needs.

Through the New England States Committee on Electricity (NESCOE), the New England states have issued a vison statement with detailed recommendations regarding how to begin immediate collaborative work to correct that misalignment.[46]

Strategy E3: Align Attribute Markets with GWSA Compliance

Emissions from the electricity system in 2030 are expected to come from a combination of in-state fossil fuel generation, municipal solid waste combustion, and imported fossil fuel generation. Tightening regulations on in-state generators (e.g., 310 CMR 7.74) has the potential to reduce emissions but requires thoughtful planning to ensure this potential is not offset by increases in imported electricity emissions. Coordination among New England states can maximize regional clean energy capacity, which increases the likelihood that any such new imports would also be clean. Standards and procurements can also bring new clean energy to Massachusetts to replace these polluting resources.

[45] Governors Statement on Electricity System Reform 2020 (Oct. 14, 2020), http://nescoe.com/resource-center/govstmt-reforms-oct2020

[46] New England States Vision Statement (Oct. 16, 2020), http://nescoe.com/resource-center/vision-stmt-oct2020

The Commonwealth has a variety of tools at its disposal (RPS, CES, etc.) to help align regional attribute markets, which can help ensure that electricity consumed in Massachusetts reflects a sufficiently clean supply mix to achieve the > 4.2 $MMTCO_2e$ by 2030 electricity sector emissions reduction goal. Given currently anticipated load growth and execution of current procurements, **raising clean energy delivery obligations** is likely the simplest and most cost-effective mechanism to maintain pressure on regional markets to continue developing new clean generating sources.

Adjusting the CES represents the ideal method to iteratively "tune" the Commonwealth's various attribute markets to each other and to activity and pricing in regional markets, because the standard is promulgated through administrative rulemaking rather than legislative action and is already scheduled for a program review in 2021. To impact markets for new clean generating resources in 2030, the CES would need to be raised from 40% to at least 60%, to exceed the RPS and not be overtaken by the clean energy anticipated under the section 83D hydroelectric procurement. Any such increase will be coordinated with the CES-E, which applies to existing clean generating resources such as regional nuclear assets and some small hydroelectric plants. Raising the CES-E modestly may be a possibility because the standard was set conservatively, but the potential role of CES-E for this purpose is limited because it does not incentivize the development of the new clean regional resources that are needed to reduce emissions in the long-term.

***E3 Strategy Actions*:**

- By the end of 2022, EEA and DOER will complete a review of current attribute markets (including RPS, solar carve-outs, APS, and CPS) to ensure those programs continue to support "on pace" clean energy deployment in a strategic, cost effective way.
- In its scheduled program reviews of the CES and CES-E in 2021, MassDEP will assess program levels in light of the anticipated need for regional clean energy resource deployment, including MLPs in each program after taking into account, as may be relevant, their size and structure as well as their existing programs, contractual obligations, and asset ownership.

Finally, the 41 MLPs that generate, procure, and sell clean and emitting electricity to approximately 50 Massachusetts cities and towns (representing about 14% of Massachusetts electricity consumption) will need to be carefully considered. The MLPs are not currently subject to the RPS, CES, or CES-E. However, they have access to a range of clean electricity sources through existing power purchase agreements, which potentially complicates their participation in regional attribute markets. **Ensuring that MLP electricity supplies are decarbonized on pace**, in coordination with the rest of the Commonwealth's electricity supply, is critical to achieving both a 45% reduction in emissions below the 1990 baseline in 2030 and Net Zero in 2050.

Strategy E4: Continue to Deploy Solar in Massachusetts

The Commonwealth's current solar programs are anticipated to sunset after 2025, but the state and region will need to steadily continue to deploy solar generation over the next three decades to meet anticipated increased electricity demand in 2050. Massachusetts is home to a vibrant economy of solar (and storage) developers, installers, and suppliers, who have over time successfully adapted to changes in the policy landscape. However, expansion of solar resources touches on two complicated systems: interconnection of distributed energy resources and impacts on natural and working lands. Regardless of market development,

further policy will be needed to ensure sufficient on pace solar deployment and to manage how such necessary development interacts with both of those systems. It is anticipated that, as a result, DOER, DPU, and MassCEC will continue to play important roles in administering solar policy through 2030 and beyond to help mediate the relationship between solar developers and the Commonwealth's utilities, coordinate the Commonwealth's need for additional solar resources with other critically important land use goals (including the continued protection of critical habitat necessary for the protection of key Massachusetts species and ecosystems), and **facilitate on pace market development for the solar and storage** industries.

Interconnection of clean distributed energy resources (DERs) and the associated distribution system improvements present technical challenges for the distribution grid, which was constructed to rely on a small number of large, centralized power plants. In addition, interconnecting and incorporating a myriad of small, clean distributed energy resources could present an operational challenge for grid managers and their need to maintain power reliability standards. However, by reducing the need to transmit large amounts of electricity from centralized locations to end-users, distributed generation also creates significant potential benefits for grid operators, especially cost savings from the reduced need to build and maintain transmission and distribution infrastructure. In addition, the interplay of distributed energy production from behind the meter solar, storage, and demand-side flexibility represents a key area of opportunity and innovation that can facilitate the operation of an ultra-low carbon regional grid based on highly-reliable, but variable, renewable generation like offshore wind.

***E4 Strategy Actions*:**

- DOER and MassCEC will collaborate to develop a mechanism to support the minting of RECs from solar systems in previously eligible SREC I and II programs.
- EEA and DOER will work with electric utilities to support detailed planning for the integration of distributed energy resources to ease system operations, help to reduce barriers from interconnection, and pilot innovative grid flexibility technologies.
- EEA and DOER will lead planning for ground-mounted solar development to ensure best land management practices that protect critical Massachusetts species and ecosystems, while MassCEC works to identify market mechanisms to incentivize alternative siting.
- Pending these studies, DOER will facilitate a path to market for an additional 2 GW of new distributed clean generation between 2025 and 2030.

To support widespread electrification, New England must likely deploy more than 40 GW of solar resources by 2050, which will exceed the total area of available rooftops in the region. In Massachusetts, even with maximal rooftop deployment far in excess of historic levels, that will require the installation of ground-mounted solar on approximately 60,000 acres of land in Massachusetts over the next thirty years. Breakthroughs in solar panel efficiency could potentially reduce that area significantly, but if other necessary clean energy resources such as offshore wind, inter-state transmission, or thermal capacity are constrained, the amount of required ground-mounted solar could potentially double. Considering the regional nature of electricity markets, overly constraining the development of ground-mounted solar in Massachusetts would likely cause this demand to simply leak across the Commonwealth's borders.

Certain development practices, especially when paired with policy favoring on-site storage capacity, can optimize solar production while minimizing total land requirements. In addition, all the land used for solar

need not be forest or other natural landscape – Massachusetts is home to more than a million acres of "built" landscape, only half of which comprises its two million rooftops, while the other half comprises lawns, fields, roads, and parking lots, much of which may be suitable for deployment of solar resources. Further study and policy guidance will be needed to manage where and how much solar is to be sited in the Commonwealth consistent with the protection of critical Massachusetts lands and habitat.

Strategy E5: Develop a Mature Offshore Wind Industry in Massachusetts

Offshore wind represents one of the most abundant and reliable clean energy resources available to Massachusetts and is critical to the development of a low-cost decarbonized electricity system for the Commonwealth and for New England. However, several elements must move in parallel to realize the benefits of offshore wind. The Commonwealth will continue to work with other New England states, federal agencies, and local municipalities to **address onshore siting of transmission upgrades** and coordinate procurements that support the region's ambitious clean energy goals. Further work to catalyze industry growth will help build a vibrant local economy around offshore wind that will bring new jobs and significant economic investment to Massachusetts.

The scale of offshore wind needed to achieve a deeply decarbonized electric grid in New England by 2050 will require substantial additional offshore wind lease areas in federal waters. As a member of several of the U.S. Bureau of Ocean and Energy Management's (BOEM) Intergovernmental Task Forces for Renewable Energy, Massachusetts has worked closely with partners on the planning, analysis, identification, and leasing of wind energy areas in federal waters south of Nantucket and Martha's Vineyard. This collaboration will continue to address known data and information gaps, such as the distribution and abundance of marine mammals, to identify new lease areas that avoid and minimize impacts on commercial fishing and wildlife. In addition to new lease areas, the Commonwealth will work with ISO-NE and other New England states to responsibly connect offshore wind resources to the grid and to balance the timing of new offshore wind projects with growing renewable and clean energy portfolio standards across the region.

***E5 Strategy Actions*:**

- MassCEC will continue to support development of the offshore wind workforce, build local supply chains, ensure adequate port infrastructure, and advance research and innovation.
- The Commonwealth will work with BOEM and regional stakeholders to identify new lease areas, coordinate project schedules, and support an efficient, on-pace federal permitting process.
- EEA and its agencies will commence planning to procure, construct, and interconnect an additional 6 GW of offshore wind through to Massachusetts between 2030 and 2040.

Supporting the successful execution and operation of the Commonwealth's 83C offshore wind projects and the continued growth of the offshore wind industry more broadly, Massachusetts will continue to develop the offshore wind workforce, build local supply chains, ensure adequate port infrastructure, and advance research and innovation. MassCEC's Offshore Wind Program works to reduce project-related risks, catalyze industry development, develop new tools and technologies, and support local economies and jobs associated with offshore wind. With strategic investments in key infrastructure—in the New Bedford Marine Commerce Terminal and the Wind Technology Testing Center in Charlestown—and in workforce development, supply

chain expansion, and research and innovation, MassCEC has helped establish the Commonwealth as a national hub and first mover for the offshore wind industry. In coordination with other states and federal partners and stakeholders, planning for future lease areas and a transmission system to support increased offshore generation will also be necessary to guide the region's budding industry to both meet local clean energy needs and to become a mature global market.

Strategy E6: Incorporate GWSA into Distribution-Level Policy Considerations

Distribution system planning and grid modernization will be required to maintain a reliable and resilient system as clean energy policies increase the number of DERs interconnected to the grid. A more dynamic, bi-directional distribution system will allow for greater electrification and minimize the cost of integrating DERs. A modern grid will also support the growth of non-emitting technologies like EVs, distributed solar, and electric heating that provide lasting emissions reductions throughout the economy. By reducing cost burdens, it can even accelerate the adoption of these non-emitting technologies. As clean energy policies increase the use of the distribution system to support both the transportation and building sectors, a low-cost, reliable electric system will become even more important for consumers.

***E6 Strategy Actions*:**

- EEA will work with DPU, DOER, the Office of the Attorney General, and the Legislature to ensure the planning, development, and cost-benefit analysis for the Massachusetts distribution system are designed to maximize the ability of the Commonwealth to achieve Net Zero in 2050.

Grid modernization requires investment in system upgrades, which are included in the cost of electricity service. In previous proceedings, the Department of Public Utilities found that many grid modernization options, such as advanced metering infrastructure ("smart meters"), were not cost-effective, although continued evolution of this technology and/or changes in how DPU accounts for decarbonization goals could alter this dynamic. Ultimately, additional grid-focused investments will be necessary to accommodate and enable electrification-driven load growth, as well as additional growth in distributed energy resources (such as solar and storage). The DPU is currently investigating issues associated with grid modernization and distribution planning in several ongoing dockets,[47] with participation from DOER and MassCEC. Incorporating GWSA compliance as a necessary parameter of planning processes would identify the cost savings that grid modernization would unlock in a deeply decarbonized and significantly electrified economy, avoiding or mitigating the need for system upgrades. This allows for greater investment to ensure that the net-zero emissions limit can be reached while maintaining a safe, cost-effective, and reliable distribution grid.

[47] Including DPU 19-55 (Inquiry by the Department of Public Utilities on its own Motion into Distributed Generation Interconnection), 20-69 (Investigation by the Department of Public Utilities on its own Motion into the Modernization of the Electric Grid - Phase II), 20-75 (Investigation by the Department of Public Utilities On Its Own Motion Into Electric Distribution Companies' (1) Distributed Energy Resource Planning and (2) Assignment and Recovery of Costs for the Interconnection of Distributed Generation), and the forthcoming second Grid Modernization filings from the EDCs.

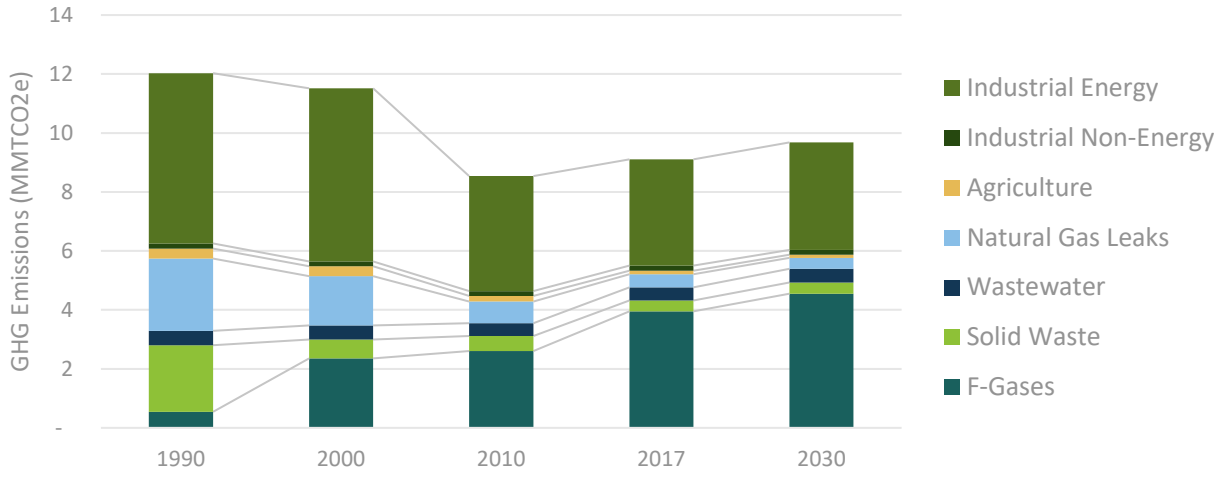
Chapter 5. Mitigating Other Sources of Emissions

5.1. Sector Overview

Massachusetts has a relatively small industrial sector, which consumes electricity, natural gas, petroleum, and coal to manufacture products, such as kilned ceramics, semiconductors, and some heavy equipment. Although emissions from industrial fuel use have been traditionally accounted for in the buildings sector,[48] they have been separated for the purposes of the 2050 Roadmap and this plan because the energy needs for manufacturing are fundamentally different from the comparatively low-temperature processes needed to heat and cool air and water in residential and commercial buildings. A combination of policies and economic factors have contributed to emissions from industrial energy use declining by about 20% since 1990.

Non-energy emissions are methane (CH_4), nitrous oxide (N_2O), and fluorinated gas (F-gas) emissions from anthropogenic activities other than those created by fossil fuel combustion including: refrigeration, cooling and electrical switchgear; solid waste management, including landfills, composting and anaerobic digestion, and municipal waste combustion; wastewater treatment, including septic tanks, wastewater treatment plants, and effluent management; natural gas transmission and distribution; agricultural practices; and non-combustion industrial processes. In 2017, industrial energy use was responsible for 5% (3.6 $MMTCO_2e$) of the Commonwealth's emissions while non-energy emissions comprised approximately 8% of emissions (5.6 $MMTCO_2e$). Total non-energy emissions have been effectively constant since 2005, though certain non-energy emission subsectors have grown and declined during that time. The use and leakage of high-Global Warming Potential (GWP) hydrofluorocarbon (HFC) F-gases is the fastest-growing source of GHG emissions in Massachusetts. To meet aggressive decarbonization goals in the Commonwealth by mid-century, it is important to establish realistic pathways for emissions stabilization and reductions in this sector using active management and best practices.

Figure 9. Historical and anticipated industrial and non-energy GHG emissions.



[48] The Massachusetts Annual GHG Emissions Inventory has included emissions associated with industrial energy consumption under the Buildings Sector heading. However, industrial energy use differs substantially from the space and water heating demands that drive emissions in residential and commercial buildings and, thus requires different decarbonization solutions.

5.2. Getting to 45% in 2030: Stabilizing emissions

The 2050 Roadmap analysis found that with concerted efforts starting immediately, it would be possible to curb the expected growth in non-energy emissions through the 2020s and begin to see significant emissions reductions by 2050. In the next decade, the Commonwealth will support and work to enact policies that will achieve flat (zero growth rate) industrial and non-energy sector emissions by 2030 and put Massachusetts on a path for substantial emissions reductions from this sector by 2050. The main opportunity for substantial reductions in the 2020s involves new and strengthened regulations of F-gases. Figure 9 shows the historic and projected GHG emissions from this sector, while Table 6 summarizes the transformations, policies, and associated GHG reductions explored through the rest of this chapter. Detail on each of the numbered strategies and actions can be found in the section to follow.

Table 6: Industrial & Non-Energy Sector—illustration of the most likely, cost-effective, and technologically feasible approaches to achieve the emissions reduction expected and required by this plan (incorporating background trends and other known or expected non-policy related changes).

Industrial & Non-Energy				
Equipment or Subsector	**Metric**	**Strategy**	**Action**	**GHG Emissions Reduction**
Industrial energy	Emissions remain steady.	N2	-	-
Process CO2		N2	-	-
Gas Leaks		N1	GSEP	-
Solid Waste		N2	SWMP	-
Switchgear		N1	-	-
Wastewater & Agriculture		N2	-	-
ODS Substitutes	F-gas emissions kept below 5 $MMTCO_2e$, or even rolled back by 2030.	N1	310 CMR 7.76	(0.5) $MMTCO_2e$*
		N1	Kigali Amendment	0 - 1.9 $MMTCO_2e$
Industrial & Non-Energy Subtotal				**(0.5) – 1.4 $MMTCO_2e$***
*Negative reduction indicates an increase – this reflects partial mitigation of emissions growth				

Strategies & Policies

Strategy N1: Target Non-Energy Emissions That Can Be Abated or Replaced

The most impactful strategy for the 2020s is to minimize the growth of non-energy emissions, particularly emissions of high GWP gases associated with uses that are expected to grow through the next decade: HFCs used in refrigeration, air conditioners, and heat pumps, and SF_6 used in gas-insulated electrical infrastructure switchgear.

In December 2020, MassDEP promulgated **regulations prohibiting the use of HFCs** (310 CMR 7.76) in a broad range of existing end-uses. Through the 2020s, the Commonwealth will need to consider strengthening and expanding that regulation to address additional end uses, like heat pumps, as they become more widely deployed. The Commonwealth's and other jurisdictions' HFC regulations typically apply only to new

equipment, though leakage from such equipment occurs from manufacture until decommissioning. To maximize the regulations' effect on emissions reductions by 2050, additional HFC regulations are best implemented as soon as possible. Additionally, the application of **refrigerant-handling best practices** when installing or removing equipment with refrigerants helps to mitigate emissions associated with leakage. As the heat pump installation market ramps up in the next decade, an excellent opportunity exists to train the installation workforce in best practices for mitigating HFC emissions from the existing stock, as well as train them to work with zero and low-GWP alternative refrigerants.

The continued and strengthened **regulation of SF_6 leakage rates** will similarly be valuable. MassDEP's Reducing Sulfur Hexafluoride regulation (310 CMR 7.72) requires newly-purchased electrical transmission equipment to have a low leak rate. Specifically, each utility's system-wide gas insulated switch gear SF_6 leakage must be reduced to 1% or less by 2020. This policy has been effective to reduce SF_6 to-date, though with expected growth in electrical distribution infrastructure, it will likely be valuable to revisit and potentially tighten this policy. California regulators have proposed requiring utilities to phase out the use of SF_6 in gas-insulated switchgear and other electrical equipment.[49] This regulation would require all gas-insulated electrical equipment to be replaced with technology that uses insulating gas with lower GWP than SF_6 or some alternative, zero-GWP technology. At present, the market for these non-SF_6 equipment is immature, but as more jurisdictions set schedules for replacement, new options are expected to emerge.

***N1 Strategy Actions*:**

- MassDEP will implement regulation limiting the sale of HFCs and support Kigali-compliant policies at the state, regional, and federal level.
- MassDEP will explore additional regulations to minimize SF_6.

Finally, **methane leaks from the natural gas distribution network** are substantial, but are being reduced significantly because of existing policies, most notably MassDEP's Reducing Methane Emissions from Natural Gas Distribution Mains and Services regulation (310 CMR 7.73). This regulation works with the gas distribution companies' Gas System Enhancement Plans (GSEPs) that were approved by DPU to ensure replacement of leak-prone iron and unprotected steel pipes and services with newer, less leaky pipes. In addition to leaks from distribution system pipes, natural gas also leaks in small volumes from customer meters and customer-owned "behind the meter" piping and appliances. With the widespread deployment of heat pumps and other clean heating systems, it is possible that a planned, geographic contraction of the gas distribution system could further reduce all such natural gas system emissions.

Strategy N2: Implement Best Practices Around Residual Non-Energy Emissions

For non-energy emissions, many of which are difficult or impossible to fully curtail and are expected to grow with the Commonwealth's human population, best practices can and should be established to keep them as low as possible.

[49] CARB. 2020. "Staff report: Initial statement of reasons." Regulation for Reducing Sulfur Hexafluoride Emissions from Gas Insulated Switchgear. https://ww2.arb.ca.gov/rulemaking/2020/sf6 (retrieved 28 September 2020).

The major source of emissions from **solid waste disposal** is the seven municipal waste combustors (MWCs) operating in the Commonwealth, which burn municipal solid waste (MSW) to reduce the volume of disposed garbage while producing useful heat and electricity. Initial diversion of plastic, paper, and other incinerable materials from the waste stream as called for in the Draft 2030 Solid Waste Master Plan (SWMP)[50] is expected to reduce GHG emissions from MWCs. Two long-range trends will affect the volume of disposed-of garbage by MWC facilities operating in Massachusetts. First, the Massachusetts Draft 2030 SWMP articulates a commitment to the longer-term goal of reducing the Commonwealth's solid waste disposal by about 90%, to 570,000 tons by 2050, and diverting recoverable material from disposal to higher uses. On such a trajectory, Massachusetts would require less than its current MWC capacity to meet its solid waste management needs. Second, and consistent with its obligations to protect the environment and to help the Commonwealth comply with the GWSA, in the event MWCs seek to modify or rebuild facilities, MassDEP would require tighter emissions standards and increased efficiency standards based on the latest technology. MassDEP will reassess progress towards this goal in a solid waste program review to be conducted in 2025. The disposal of organics waste can also be managed, with potential benefits from anaerobic digestion and opportunities to mitigate emissions from compost.

***N2 Strategy Actions*:**

- EEA will work with agencies across the Commonwealth to ensure best practices are in place around waste, wastewater, and agricultural emissions.
- MassDEP will require tighter emissions standards and increased efficiency standards based on the latest technology if Municipal Waste Combustors seek to modify or rebuild facilities.

For **wastewater processing**, there are opportunities to help stabilize emissions which are directly tied to population. Transitioning more residences from stand-alone septic systems to managed sewer systems would likely reduce methane emissions from septic tanks, as would encouraging (or requiring) septic system owners to follow best practices. Expanding the use of anaerobic digesters at wastewater treatment plants (WWTPs) would avoid many of the methane emissions from WWTPs and have the compounded advantage of converting sewage sludge into usable fuel.

For **agricultural** emissions, which are very small in Massachusetts, improved practices may make sense to pursue for a variety of reasons in addition to their contribution to emissions reductions or stabilization. In large agricultural states like California, agricultural emissions mitigation policies, practices, and technologies have been explored.[51] The Commonwealth has explored the potential for best practices to improve soils through the Healthy Soils Action Plan (HSAP).

[50] https://www.mass.gov/guides/solid-waste-master-plan

[51] CARB. 2020. "Research on Agricultural Emissions & Mitigation." Available at https://ww2.arb.ca.gov/research/research-agricultural-emissions-mitigation (retrieved 18 August 2020).

Chapter 6. Protecting our Natural and Working Lands

6.1. Sector Overview

The use, management, and development of natural and working lands have implications for both carbon emissions and carbon sequestration in the Commonwealth. The implications of development and development patterns are discussed in greater detail in previous sections as they related to building and transportation sector emissions. This section addresses the importance of terrestrial carbon fluxes and strategies related to the protection of natural and productive landscapes.

Forests are of principal concern when estimating terrestrial carbon budgets. Forest ecosystems sequester atmospheric carbon as biomass as they grow and they emit carbon back into the atmosphere as part of dynamic natural processes or when they are stressed or disturbed, whether by natural or human forces (including introduced invasive species or fire).[52]

In Massachusetts, 64% of the land area (approximately 3.3 million acres) is categorized as forested (see Figure 10). Like many temperate forests throughout the world,[53] those in Massachusetts are regrowing following regional farm abandonment and reforestation in the nineteenth and early twentieth centuries and subsequent impacts of the 1938 hurricane and logging in the last century. The 2050 Roadmap determined that Massachusetts forests have the capacity to sequester about 5 $MMTCO_2e$ per year from now through 2050. This is equivalent to roughly 7% of the Commonwealth's current emissions and roughly half of allowable residual emissions in 2050.

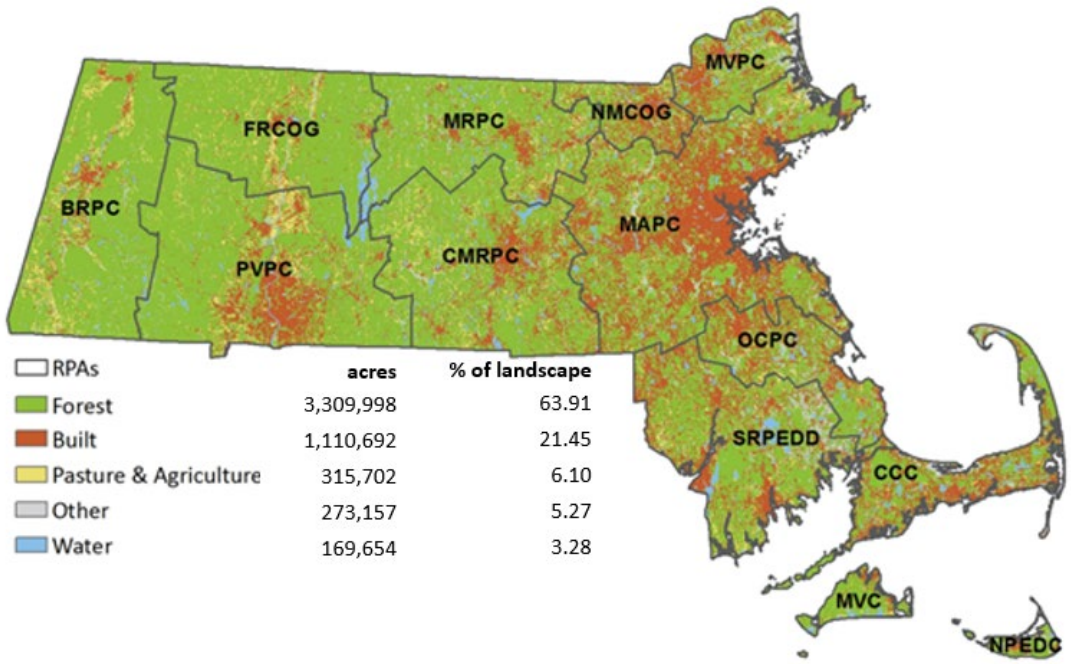
Given their size, protecting Massachusetts' forests—to preserve both their existing stores of terrestrial carbon and their capacity to continue to sequester large amounts of carbon into the future—is among the most important considerations for the Commonwealth with respect to ensuring it has sufficient sequestration to achieve Net Zero by 2050. However, efforts to conserve forested land or alter management practices thereof must be broadly inclusive and able to balance a range of uses, as more than 65% of Massachusetts' forests are owned and managed by a large and diverse group of individuals and families,[54] with more than 30,000 privately-owned parcels greater than ten acres in size.[55]

Massachusetts currently has a suite of programs, plans, and policies that seek to support land conservation and sustainable management practices in ways that are aligned with ensuring forested land across the

[52] Estimates vary, but the trees in Massachusetts' forested lands currently contain about 100 million metric tons (MMT) of carbon (one metric ton of forest carbon is the equivalent of 3.67 metric tons of CO_2). USDA Forest Service, Forest Inventory and Analysis Program, Wed Oct 28 15:51:30 GMT 2020. Forest Inventory EVALIDator web-application Version 1.8.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station; Domke et al., "Greenhouse Gas Emissions and Removals from Forest Land , Woodlands , and Urban Trees in the United States , 1990-2018 Appendix 1 .– National Scale Estimates for Individual States , 1990-2018," *USDA US Forest Service*, 2020, 1–5..
[53] Cook-Patton et al., "Mapping Carbon Accumulation Potential from Global Natural Forest Regrowth," *Nature* 585, no. 7826 (2020): 545–50.
[54] Butler et al., "The Forests of Southern New England, 2012 A Report on the Forest Resources of Connecticut, Massachusetts, and Rhode Island," *U.S. Department of Agriculture, Forest Service, Northern Research Station*, 2015, 1–42.
[55] Butler et al., "USDA Forest Service National Woodland Owner Survey," *Resource Bulletin NRS-99*, 2016.

Commonwealth can continue to provide valuable ecosystem services, including those related to both climate mitigation and adaptation.

Figure 10: Land cover classes in Massachusetts by regional planning agencies (RPAs). Forests cover more than three million acres of land in Massachusetts, by far the largest land cover type. Built classes, which includes buildings, parking lots, lawns, and other infrastructure, cover about one million acres.



6.2. Priorities for 2020-2030

Particularly as regional ecosystems are beginning to experience climate change induced stresses (e.g., from extreme weather and invasive pests), ensuring the continued health and viability of Massachusetts' existing 3.3 million acres of forested land is the primary strategy to ensure this valuable sequestration potential is available in 2050 and beyond. In addition, since the Commonwealth will require additional sequestration services beyond what those lands are sustainably capable of providing, it is critically important that the Commonwealth develop sequestration accounting and measurement frameworks, together with neighboring states across the Northeast, that can also support, protect, and improve natural and working lands across the region.

Strategies & Policies

Strategy L1: Protect Natural and Working Lands

In 2019, EEA began the Resilient Lands Initiative to develop a comprehensive vision and a ten-year plan for land conservation, stewardship, and restoration across the Commonwealth. The plan aims to reduce the Commonwealth's vulnerability to climate change, build resilience, and improve quality of life through **land conservation and stewardship** initiatives that conserve and enhance the health of forests, farms, and soils. One of the core elements of the Initiative and associated plan is the goal of achieving "no net loss" of farm and forest land by 2030 through smart growth, conservation, and restoration initiatives. Upon the release of the

plan in 2021, EEA will explore creating and funding an expanded suite of incentive-based programs designed to achieve "no net-loss" of farm and forest land statewide.

While annually they sequester a relatively small amount of carbon, both **inland and coastal wetlands** have significant stores of carbon which can be released when they degrade. As such, continued measures to ensure protection and restoration of wetlands will be beneficial. EEA will continue to help develop the latest blue carbon mapping and inventory techniques while monitoring potential increases in methane emissions from degraded wetlands.

***L1 Strategy Actions*:**

- As part of the Resilient Lands Initiative, EEA will explore creating and funding an expanded suite of incentive-based programs designed to achieve no net-loss of forest and farmland.
- EEA will continue to protect and restore inland and coastal wetlands.

Strategy L2: Manage for Ecosystem Health and Enhanced Carbon Sequestration

Using best practices to sustainably improve diversity and ecosystem health on natural and working lands – including portions of those that are conserved and protected – can simultaneously achieve a range of important goals including climate resilience, habitat improvement, watershed protection, and carbon sequestration and storage.

In conjunction with EEA's Resilient Lands Initiative, the Department of Conservation and Recreation is working with forest and conservation stakeholders across New England to develop a **practice-based forest resilience and carbon storage program** for private and municipal forest owners that is an important part of enhancing forest carbon storage and climate resilience out to 2050. The Resilient Lands Initiative has a goal of adding 100,000 acres into this new program over the next 10 years.

***L2 Strategy Actions*:**

- EEA will work to implement and incentivize best management practices identified in the Healthy Soils Action Plan and the Resilient Lands Initiative.
- EEA will commission additional forest carbon sequestration research, building upon the land use analysis in the 2050 Roadmap, to assess the long-term impacts of sustainable forest management practices.

Given the large volume of carbon stored in Massachusetts soil, and the potential for its release when soil is degraded, the **protection, restoration, and better management of soil** could be a valuable component of the Commonwealth's effort to achieve Net Zero by 2050. EEA is currently developing a Healthy Soils Action Plan, which assesses forests, wetlands, agriculture, recreational/ornamental (i.e., lawn), and impervious/urbanized lands and provides recommendations for limiting conversion of land, restoring the functional capacity of soils, expanding support for land managers, incorporating soil-based criteria and performance standards, and enhancing the measurement and monitoring of soil health in Massachusetts. Upon its release in 2021, EEA will work to implement and incentivize best management practices identified in the HSAP.

Finally, EEA will commission **additional forest carbon sequestration research**, building upon the land use analysis in the 2050 Roadmap, to assess the long-term impacts of sustainable forest management practices. While the 2050 Roadmap analysis was valuable to help the Commonwealth gauge the carbon sequestration

potential of our natural and working lands through 2050, additional analysis of forest management practices, carbon sequestration, forest health and resilience over longer durations is recommended. Additional research will examine how various forest management practices implemented in the early 2020s may affect the carbon sequestration potential of forests in Massachusetts beyond 2050.

Strategy L3: Incentivize Regional Manufacture and Use of Durable Wood Products

In addition to protecting and sustainably managing our land, there is an opportunity to reduce emissions from forest-related activities by incentivizing and accelerating the adoption of harvested wood in long-lived products.

As discussed in the 2050 Roadmap, the fate of harvested or removed biomass is a key consideration in the carbon balance of any forest disturbance. All forest removals are initially assumed to result in the release into the atmosphere of the entire removed stock, with 14% lost regardless of subsequent use during cutting and removal.[56] Depending on the fate of removed wood, however, the total emissions associated with the removal can be reduced. While burning wood as a source of energy releases all of the stored carbon back into the atmosphere, using harvested wood to produce durable goods and materials can maintain a portion of the removed carbon in storage for years (e.g., paper produced from pulp), to decades (e.g., furniture), to over a century (e.g., cross-laminated timber or insulation in buildings), reducing the emissions associated with the original removal activity, perhaps dramatically. To the extent such products displace those with a higher embodied carbon footprint, additional global carbon reductions are possible.

***L3 Strategy Actions*:**

- EEA will continue exploring opportunities to incentivize the regional use of harvested wood in long-lived products, such as cross laminated timber and wood-based building insulation.

With the anticipated approval in the 2021 International Building Code of cross-laminated timber (CLT) structures up to 18 stories (270 feet) in height, the potential for the use of CLT in multi-family and commercial new construction in Massachusetts and across the Northeast is rapidly growing. Recognizing that potential, EEA has commissioned research into the feasibility of using common tree species in Western Massachusetts as CLT feedstock, has provided funding for the construction of a full-scale model CLT beam made from Massachusetts hemlock, and is exploring options for bringing CLT to market in New England, including the possibility of providing incentives to encourage CLT manufacturing and use in the region.

Strategy L4: Develop Sequestration Accounting and Market Frameworks

Achieving Net Zero in 2050 will require the ability to track and verify the annual removal from the atmosphere and storage of as much as 14.2 million metric tons of CO_2 by resources in, or attributable to, the Commonwealth. As Massachusetts' natural and working lands are projected to be capable of providing no more than about half of the annual carbon sequestration the Commonwealth will likely require in 2050,[57]

[56]Methodology established by Reinmann et al., "Assessing the Global Warming Potential of Human Settlement Expansion in a Mesic Temperate Landscape from 2005 to 2050," *Science of The Total Environment* 545–546 (2016): 512–24.
[57] If statewide emissions are reduced 90% below 1990 levels in 2050 (to 9.45 $MMTCO_2e$), Massachusetts forests could potentially provide just under 53% of required annual sequestration.

developing regionally consistent sequestration measurement, accounting, and market frameworks that will allow Massachusetts to purchase additional, least-cost sequestration services from its neighbors across the Northeast is critical to the Commonwealth's ability to achieve Net Zero in 2050.

Because no such carbon sequestration accounting or market framework currently exists,[58] the Commonwealth is currently leading a multi-state effort with the support and facilitation of the U.S. Climate Alliance to develop one. Working closely with other Northeast states that are also working towards mid-century carbon neutrality, this effort aims to develop, by 2025, a framework design of the necessary elements (e.g., eligibility, registry, measurement, crediting, monitoring and enforcement) of a viable carbon sequestration market.

***L4 Strategy Actions*:**

- EEA will continue working with states and stakeholders across the Northeast to develop the measurement, accounting, and market frameworks necessary to support development of a regional carbon sequestration offset market by the end of 2025.
- EEA will convene an inter-agency Carbon Sequestration Task Force beginning in 2021.
- MassDEP will update the statewide biogenic emissions inventory as needed to support and track verified carbon sequestration.

To advise EEA during the multi-year, multi-state effort and to help guide related updates to Massachusetts' biogenic emissions inventory as early as 2023, EEA will convene an inter-agency Carbon Sequestration Taskforce in 2021. The Taskforce will also advise EEA on stakeholder engagement around the carbon market framework as well as other carbon sequestration related issues as needed.

[58] Although a carbon sequestration market may resemble, and perhaps be capable of interacting with, current and future carbon offset markets, it is anticipated that the carbon sequestration market would deliver a separate and distinct product that is not equivalent to technologically and economically feasible offsets of emissions.

Public Comment Request

As detailed in Chapter 1, to finalize a fully informed plan EEA is once again seeking the public's input. The current 2030 CECP document is an interim plan that proposes a viable set of strategies and policies for the Commonwealth to pursue in the next 10 years to reduce GHG emissions by 45% below the 1990 baseline level. EEA is seeking public comments during the months of January and February before releasing an updated 2030 CECP in final in the Spring of 2021. EEA will be conducting public engagement efforts to collect feedback and inform the finalization of the plan, including releasing a pre-recorded presentation that summarizes the plan and where to submit questions and comments. Additionally, EEA is organizing live webinars in January and February of 2021 where members of the public can ask questions about the 2030 CECP and provide oral comments. All written comments on the draft 2030 CECP will be reviewed by EEA and considered in updating and finalizing the 2030 CECP.

EEA will lead the effort to track the implementation of this plan and to communicate the implementation progress to the GWSA IAC and the general public, as well as to the Massachusetts Legislature as part of the GWSA implementation progress report every 5 years. Building upon the last 7 years of collecting data on key metrics for tracking policy implementation, EEA will continue to explore multiple avenues to improve existing data and gather more to assess how implementation of the strategies and policies outlined in this plan are helping to achieve the 2030 emissions limit.

Please visit www.mass.gov/2030CECP for more information.