Montachusett Regional Planning Commission and John Snell LLC

Community Decarbonization Report
for
The Town of Athol
May 4, 2023

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Town of Athol,

Thank you for the opportunity to help provide background information for Athol's Draft 2025 and 2030 Decarbonization Plan. With financial assistance from the MA Department of Energy Resources (MA DOER), the Montachusett Regional Planning Commission (MRPC) has prepared the following community decarbonization report for the Town of Athol.

The plan was developed by MRPC and its consultant John Snell LLC who are solely responsible for the accuracy of this report. We have worked closely with Eric Smith to confirm the information in this report and to shape the timing and scale of potential activities designed to meet the state's 50% by 2030, 75% by 2040, and net zero (85%) by 2050 decarbonization goals.

The process that we followed to produce this report included:

1. Prepared a preliminary community-level greenhouse gas emission inventory
2. Estimated potential building, vehicle, and off-road equipment decarbonization investments
3. Reviewed draft reports with town staff and committees
4. Prepared a final report and provided Athol with the supporting analysis files for future reference

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Table of Contents

Executive Summary

Athol's Energy Committee[1], has reviewed Athol's community-wide greenhouse gas emissions and developed a series of recommended next steps to support the Town's efforts to reduce its greenhouse gas emissions. The committee has identified and approved the following eight key actions:

1. **Assign a task force with representatives from the Planning Department, DPW, Energy Committee, and National Grid to assess and recommend a municipal-wide EV charging station plan. The task force will review options to accelerate multifamily, community-based fast charge DC stations, fleet EV stations, and managed home charging stations**
2. **Request Municipal approval for a PACE program[2]**
3. **Request DPW and the Planning Board to assess opportunities to construct or expand managed sewer systems in place of stand-alone septic systems**
4. **If appropriate and acceptable to Wastewater Treatment Plant staff, request the wastewater treatment plant to monitor opportunities to construct or expand potential anaerobic digesters**
5. **Request the Conservation Commission to monitor and support DCR's new Forest Resilience Program, EEA's new Chapter 61C program, and MDAR's MA Coordinated Soil Health Program**
6. **Request the Conservation and Shade Tree Commissions to identify potential riparian tree planting locations**
7. **Monitor and inform the community about a potential Clean Heat Clearinghouse and MassCEC's Clean Energy Lives Here technical resources**
8. **Monitor and assess opportunities to facilitate solar PV installations in Athol that MA DOER identifies. MA DOER has initiated a Technical Potential of Solar Study to identify suitable sites for solar development and educate the public about the need to foster solar growth while protecting our important natural and working lands**

These eight actions will serve as important first steps in the town's efforts to help meet the state's goal to reduce its carbon emissions 50% by 2030 and 85% by 2050.

Education will be an important part of each of these actions. Athol's Energy Committee will evaluate and help implement education and outreach opportunities to support these actions. The Mass Save Education Grant awarded to the Town in January 2023 will offer a great opportunity to further the education effort. Obtaining grant funding or other sources of income will be critical to hire an energy consultant or staff member whose to staff the Energy Committee and Municipal Decarbonization Task Force as well as perform outreach on behalf of the Energy Committee and goals within the Municipal Decarbonization Task Plan.

[1] with assistance from the MA Department of Energy Resources (MA DOER) and the Montachusett Regional Planning Commission (MRPC)

[2] MassDevelopment is coordinating with DOER to offer financing through the Property-Assessed Clean Energy (PACE) program for commercial properties

Explanation of Terms and Acronyms

AMI –Advanced Metering Infrastructure. Also known as a smart meter

BEV – battery electric vehicles

Biodiesel - a renewable, biodegradable fuel manufactured domestically from vegetable oils, animal fats, or recycled restaurant grease.

Btu – British thermal unit. A unit of heat equivalent to

Carbon Sequestration - The removal and storage of carbon dioxide from the atmosphere, commonly by plants and soil.

CECP - Clean Energy and Climate Plan

CES - Clean Energy Standard

CO2 - Carbon Dioxide

CPACE – Commercial Property Assessed Clean Energy program

DCR - Massachusetts Department of Conservation and Recreation

DOE – US Department of Energy

DOER - Massachusetts Department of Energy Resources

DPU - Massachusetts Department of Public Utilities

DVMT – Average Vehicle Miles Travelled per Day

Ductless Minisplit Heat Pump – (Ductless) -

E-Bike – Electric bike

EEA - Massachusetts Executive Office of Energy and Environmental Affairs

EEAC - Energy Efficiency Advisory Council

EIA - US Energy Information Administration

EPA – US Environmental Protection Agency

EUI – Energy use intensity

EVs - Electric Vehicles

FCEV – Hydrogen fuel cell electric vehicles

FlexFuel - Flexible fuel vehicles (FFVs) have an internal combustion engine and can operate on gasoline and any blend of gasoline and ethanol up to 83%.

Fossil Fuel - Fossil fuels are made from decomposing plants and animals. These fuels are found in the Earth's crust and contain carbon and hydrogen, which can be burned for energy. Coal, oil, and natural gas are examples of fossil fuels.

Fuel Cell - A fuel cell uses the chemical energy of hydrogen or other fuels to cleanly and efficiently produce electricity. If hydrogen is the fuel, the only products are electricity, water, and heat.

GHG – (Greenhouse Gas) Greenhouse gases, such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), different types of hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF6), trap heat and cause the average global air temperature to rise, thus changing weather patterns globally.

GHG Inventory - Greenhouse Gas Inventory – A list of emission sources and their annual emissions quantified using standardized methods.

Ground-Mount Solar - Solar panels that are set up on the ground to capture energy from the sun to create electricity. Rooftop solar is solar panels that are installed on top of buildings.

Ground-Source Heat Pump – (Ground)

GW - Gigawatt

GWSA - Global Warming Solutions Act, signed into law in Massachusetts in 2008

Heat Pump - Like your refrigerator, heat pumps use electricity to transfer heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. During the heating season, heat pumps move heat from the cool outdoors into your warm house. During the cooling season, heat pumps move heat from your house into the outdoors.

HDV – Heavy duty vehicle

HVAC - Heating, ventilation, and air conditioning system

HEV (Hybrid) – A vehicle that runs on electricity and an internal combustion vehicle

Hydrogen – The fuel used to run fuel cell electric vehicles

ICE – Internal Combustion Engine

ISO-New England - Independent System Operator-New England

kBtu – 1,000 British Thermal Units (Btus)

kW – 1,000 Watts. A unit of measurement for electricity capacity/volume

kWh – 1,000 Watt Hours. A unit of measurement for electricity use or output

LDV – Light duty vehicle

MassCEC - Massachusetts Clean Energy Center

MassDEP - Massachusetts Department of Environmental Protection

MassDOT - Massachusetts Department of Transportation

MBTA - Massachusetts Bay Transportation Authority

MDV – Medium duty vehicle

MHDV – Medium and heavy-duty vehicles

MMTCO2e - Million metric tons of carbon dioxide equivalent – This is a measure of how much greenhouse gas is emitted into our atmosphere. An emission of 1 MMTCO2e is equivalent to burning 112,523,911 gallons of gasoline.

MSW - Municipal Solid Waste

MT CO2 Metric tons of carbon dioxide

MT CO2e Metric tons of carbon dioxide equivalent. This includes the carbon dioxide equivalent emissions from methane (CH4), nitrous oxide (N2O), different types of hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF6)

MW - Megawatts

MWC - Municipal Waste Combustors – Also known as incinerators or waste-to-energy plants.

Net Zero - Net zero refers to the balance between the amount of greenhouse gas (GHG) that's produced and the amount that's removed from the atmosphere. It can be achieved through a combination of emission reduction and emission removal

NWL - Natural and working lands as defined in Chapter 8 of the Acts of 2021.

Off-Road Vehicle – Off-road vehicles include industrial equipment, lawn and garden equipment, light commercial equipment, and construction equipment

PACE – Property-Assessed Clean Energy program

PHEV - A vehicle that runs on electricity and an internal combustion vehicle that can be plugged into an electric outlet to charge the battery

PPA – Power Purchase Agreement

PV - Photovoltaic

REC – Renewable Energy Credit

RGGI – Regional Greenhouse Gas Initiative

RPACE – Residential Property Assessed Clean Energy program

RPS - Renewable Energy Portfolio Standard

Solar PV – Solar photovoltaic electricity generating panels that convert energy from the sun into electricity

SOV – Single Occupancy Vehicle

Therm – A quantity of heat that equals 100,000 British thermal units

Ton - A ton of heating or cooling is 12,000 British thermal units

VMT – Annual Vehicle Miles Travelled

VRF Heat Pump – (VRF) Variable refrigerant flow heat pump

WWTPs - Wastewater Treatment Plants

ZEV - Zero Emission Vehicle (battery electric (BEV) and hydrogen fuel cell (HFCV) vehicles)

Introduction

In December 2020, Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA) released the *Massachusetts 2050 Decarbonization Roadmap*[3]. The roadmap called for the state to reduce its 1990 baseline carbon emissions 50% by 2030, 75% by 2040, and to achieve net zero (85%) by 2050.

In June 2022, MA EEA released the Commonwealth's Clean Energy and Climate Plan (CECP) for 2025 and 2030[4]. As required by the legislature, MA EEA will provide similar reports every 5 years as the Commonwealth works to achieve net zero carbon emissions by 2050.

MRPC's report summarizes Athol's total greenhouse gas emissions by major sector. The four sectors include buildings, vehicles, off-road equipment, and waste management. In addition, the report describes how Athol can align itself with the State's carbon reduction goals using 2017 as the town's carbon emissions baseline year.

At the end of the report, we've included several appendices with more detailed information.

Appendix A includes the Commonwealth's 2025 and 2030 proposed actions and strategies to meet the Commonwealth's legislated carbon emission reduction goals. MRPC has either copied verbatim or paraphrased these goals. In addition, MRPC has included draft recommendations for proposed municipal actions for each action. In several cases, no municipal action is required.

Appendix B includes useful greenhouse gas reduction resources.

Appendix C explains the State's Renewable Energy Portfolio Standard (RPS) and Clean Energy Standard (CES)

Appendix D includes Table and Figure sources and assumptions.

Appendix E. discusses electric vehicle (EV) and Charging stations considerations

Appendix F. describes electric grid considerations and resources.

Appendix G. offers sample decarbonization reports.

Appendix H. provides carbon emission costs and investment approaches.

[3] https://www.mass.gov/info-details/ma-decarbonization-roadmap

[4] The full report and supporting documentation are available at https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-plan-for-2025-and-2030

Athol's Greenhouse Gas Emissions

Athol's residential and commercial buildings, vehicles, off-road equipment, and waste facilities emitted about **95,408 MT CO2e**[5] greenhouse gas emissions in 2017[6]. Beginning with the Global Warming Solution Act (GWSA) signed into law in 2008 and most recently updated by *An Act Creating A Next-Generation Roadmap for Massachusetts Climate Policy* in 2021, Massachusetts has established clear greenhouse gas (GHG) emission reduction targets for the state. The state's decarbonization targets are 50% below its 1990 GHG emissions baseline by 2030 and 75% by 2040 below 1990 emission levels, and net zero (85%) by 2050.

As of 2017, Massachusetts reported that it had reduced statewide GHG emissions 23% below its 1990 carbon emissions baseline. The primary source for these GHG emission reductions were from cleaner electricity generation.

This report provides background information to help the Town of Athol develop a community decarbonization plan that supports the state's greenhouse gas emission reduction goals.

The four primary sources of carbon emissions that we identified for Athol were:

1. Fuel combustion for electricity generation
2. Fuel combustion for space and water heating in buildings
3. Gasoline and diesel fuel combustion for vehicles
4. Fuel combustion for off-road equipment.

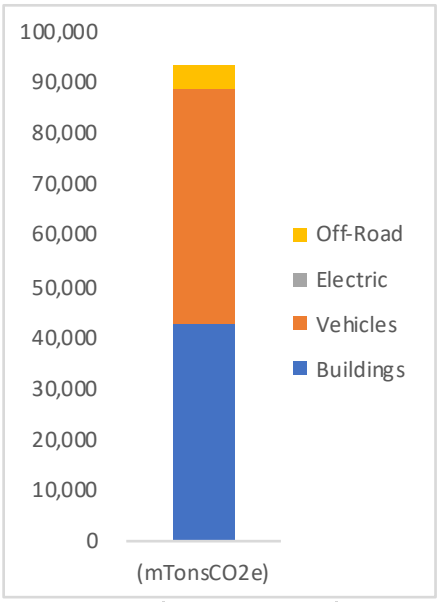
[5] Metric tons of carbon dioxide equivalent

[6] Please refer to Athol's February 7, 2022, Greenhouse Gas (GHG) Inventory report and associated spreadsheet file for more details regarding the breakout of GHG emissions by municipal sector.

Table 1 summarizes the greenhouse gas emissions by community sector. Carbon emissions include electricity generation and local fuel combustion for space and water heating, and off-road purposes. Other greenhouse gas emissions include methane (CH4), and nitrous oxide (N2O).

Table 1. Greenhouse gas emissions by community sector[7]

Community Sector	Total Carbon Emissions (mTonsCO2e)	Emissions (%)
Buildings		
Residential	33,536	35%
Commercial	8,857	9%
Vehicles		
Gasoline	45,103	47%
Diesel	1,356	1%
Electric	0	0%
Off-Road	4,246	4%
Waste	2,310	2%
Total	95,408	100%



For the buildings sector, 39% of the carbon emissions are from electricity generation and 61% are from fuel combustion. The vehicle and off-road sector emissions are 100% from fuel combustion. Waste emissions are from direct, incineration, and effluent emissions.

Table 2 summarizes the total energy use by community sector.

Table 2. Energy use sources by community sector

Community Sector	Electricity (kWh)	Oil (Gallons)	Gasoline (Gallons)	Diesel (Gallons)
Buildings	70,764,000	2,530,662		
Vehicles			5,085,216	131,476
Off-Road			411,009	
Total	70,764,000	2,530,662	5,496,225	131,476

[7] As of 2017

Recommendations

MRPC recommends that Athol reduce its greenhouse gas emissions with a series of initiatives and actions that address building, transportation, and electricity generation greenhouse gas emissions. The three primary strategies to reduce carbon emissions from these sources include:

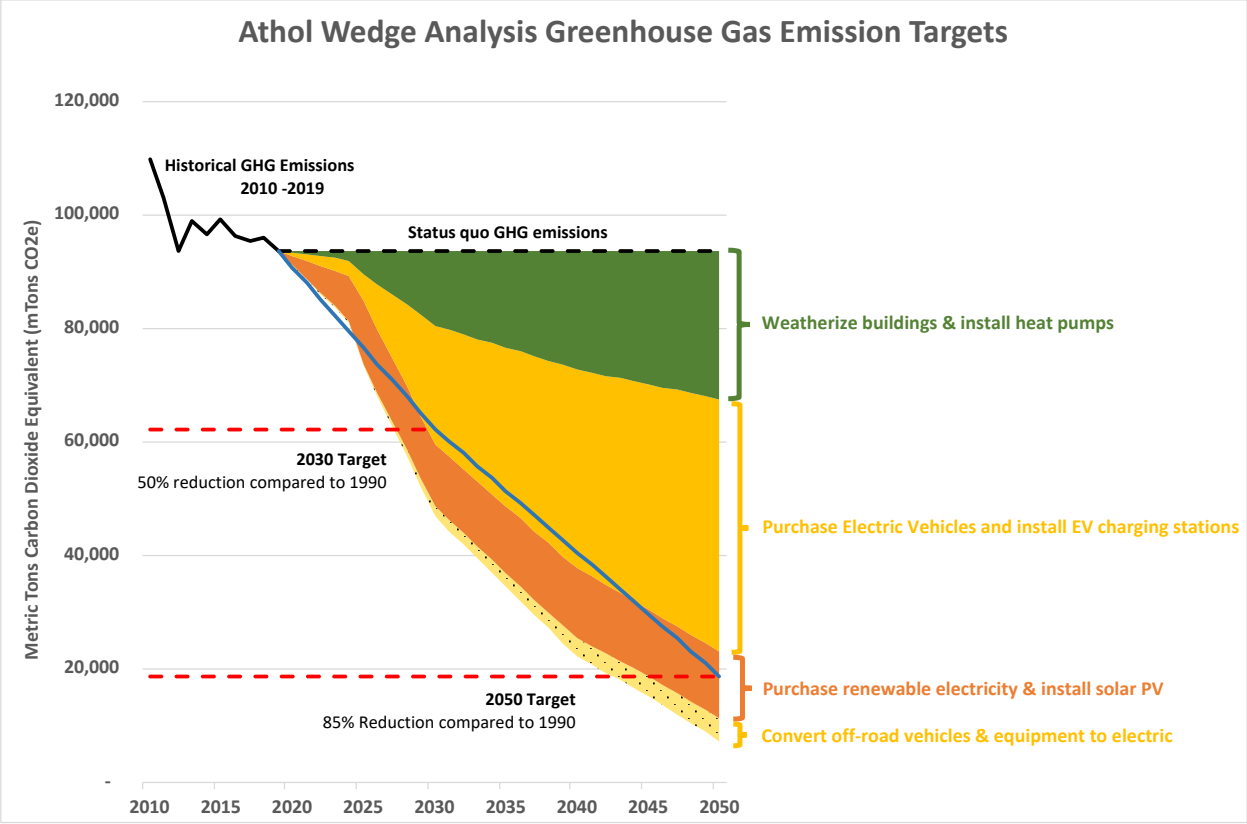
Recommendations to reduce carbon emissions from these sources include:

1. Convert space and water heating systems from fuel to high efficiency electricity
2. Convert residential and commercial vehicles from internal combustion engines to electric motors
3. Convert off-road equipment from internal combustion engines to electric motors

This approach focusses on fossil fuel-fired equipment replacement with high efficiency electric equipment. Converting heavy-duty vehicles will be challenging in the near term. In addition, unknown technologies like hydrogen or biodiesel might be better solutions longer term for heavy equipment.

Figure 1 provides a vision of how Athol can achieve a 50% GHG emissions reduction by 2030 and exceed the State's 85% GHG emissions reduction by 2050. The blue line and red dashed lines represent the state's 2030 and 2050 target decarbonization glide path.

Figure 1. Wedge analysis of Athol GHG emission reduction targets



The following sections provide supporting documentation and recommendations for these three areas.

1. Convert space and water heating systems from fuel to high efficiency electricity

Residential Buildings

Athol has about 4,627 households with a total floor area of about 11,438,847 square feet. These households primarily burn oil for space and water heating. About 70% heat with oil, 13% heat with electricity, and about 7% heat with wood. About 5% of the households use propane and about 3% of the households use natural gas.

To help the state meet its 50% by 2030 carbon reduction target, Athol will need to convert 2,314 homes from oil (or propane) to high efficiency electric space and water heating between now and 2030. This is an average of 331 homes or about 7% of the town's housing stock per year for 7 years.

Table 3 summarizes average annual electricity and oil use per household.

Table 3. Average residential energy use

Facility name	Homes (#)	Average Area (SF)	Average Electricity (kWh)	Average Oil (gallons)
Single-Family- Detached	3,351	2,977	9,359	640
Single-Family- Attached	73	2,038	6,407	438
Multi-Family, 2-4 Units	792	1,191	3,744	256
Multi-Family, 5+ Units	290	849	2,669	182
Mobile Homes	121	1,030	3,238	221
Total	4,627			

Table 4 summarizes total residential electricity and oil use by housing type.

Table 4. Total residential energy use[8]

Facility name	Homes (#)	Total Area (SF)	Total Electricity (kWh)	Total Oil (gallons)
Single-Family- Detached	3,351	9,975,927	31,361,057	2,142,993
Single-Family- Attached	73	148,774	467,697	31,959
Multi-Family, 2-4 Units	792	943,272	2,965,339	202,630
Multi-Family, 5+ Units	290	246,244	774,111	52,897
Mobile Homes	121	124,630	391,796	26,773
Total	4,627	11,438,847	35,960,000	2,457,252

Commercial Buildings

Athol has about 1,719 employees working in commercial buildings. To help the state meet its 50% by 2030 carbon reduction target, Athol will need to convert 36,705 gallons of oil use to

[8] Total electricity use for residential electric accounts is from National Grid. Electricity use for individual categories is estimated based on the total square feet. Total oil use is estimated based on national and state averages per household.

high efficiency electricity between now and 2030. This is an average reduction of 5,244 gallons of oil use or about 7% of the town's commercial stock per year for 7 years.

Table 5 summarizes the estimated total energy use for the commercial categories identified by the US Energy Information Administration (EIA).

Table 5. Total commercial building energy use[9]

Facility type	Number of Employees	Employees (%)	Total Electricity (kWh)	Total Oil (gallons)
Commercial				
Office	601	35%	12,168,240	25,666
Food Sales	407	24%	8,240,389	17,381
Food Service	172	10%	3,482,425	7,345
Service	157	9%	3,178,725	6,705
Health Care Outpatient	146	8%	2,956,012	6,235
Mercantile Retail (other than mall)	118	7%	2,389,105	5,039
Religious Worship	61	4%	1,235,046	2,605
Mercantile Enclosed and Strip Malls	49	3%	992,086	2,093
Other	8	0%	161,973	342
Total	1,719	100%	34,804,000	73,410

MA 2050 Report Guidance

In its 2050 Decarbonization Roadmap, Massachusetts recommends the following actions to decarbonize buildings:

- Heat pumps are the most cost-effective decarbonization strategy for buildings
- The most cost-effective time to install a heat pump is during routine home improvements or when an older HVAC system must be replaced
- HVAC systems generally turn over once every 15 to 30 years leaving relatively few opportunities to decarbonize buildings
- Ideally, almost every building would get some degree of envelope improvement, with at least two-thirds receiving deep energy efficiency improvements[10]
- New and expanded financing strategies will be needed to defray upfront costs
- The transition to widespread electrification will disrupt the current gas and oil distribution network
- New state and local policies will be needed to manage the equitable drawdown of fossil fuel use and infrastructure. Higher costs cannot be borne by the consumers least able to pay, and steps must be taken to provide for an orderly and equitable transition.

[9] Total electricity use for commercial electric accounts is from National Grid. Electricity use for individual categories is estimated based on the number of employees. Total oil use is estimated based on national and state averages per employee.

[10] Deep energy efficiency improvements include above-code roof and wall insulation, triple-pane windows, and Passive House air tightness and energy recovery ventilation.

Fuel to Electricity Conversion Cost Implications

Converting Athol's residential and commercial buildings from fuel combustion to high efficiency electric space and water heating systems is key to the town's decarbonization efforts. Carbon emission rates will remain high until fossil-fueled space and water heating equipment is replaced.

Tables 6 and 7 list very preliminary estimated costs per ton[11] and total costs to install three alternative types of high efficiency electric heat pump equipment[12] in Athol's residential and commercial buildings. Both tables assume that heat pumps are 250% efficient.

Table 6. Residential building estimated fuel conversion equipment costs

Facility name	Homes (#)	Estimated Electric Equipment Output (Tons)	$7,500 Ductless Cost ($)	$15,000 VRF Cost ($)	$25,000 Ground Cost ($)
Single-Family- Detached	3,351	19,398	145,482,269	290,964,538	484,940,896
Single-Family- Attached	73	289	2,169,621	4,339,242	7,232,069
Multi-Family, 2-4 Units	792	1,834	13,756,050	27,512,100	45,853,500
Multi-Family, 5+ Units	290	479	3,591,058	7,182,116	11,970,193
Mobile Homes	121	242	1,817,521	3,635,042	6,058,403
Total	4,627	22,242	$166,816,518	$333,633,036	$556,055,061

Table 7. Commercial building estimated fuel conversion equipment costs

Facility type	Number of Employees	Estimated Electric Equipment Output (Tons)	$7,500 Ductless Cost ($)	$7,500 VRF Cost ($)	$7,500 Ground Cost ($)
Commercial					
Office	601	18	133,976	267,953	446,588
Food Sales	407	45	340,331	680,662	1,134,437
Food Service	172	126	945,708	1,891,415	3,152,358
Service	157	93	699,977	1,399,954	2,333,257
Health Care Outpatient	146	55	413,873	827,746	1,379,576
Mercantile Retail (other than mall)	118	54	406,854	813,708	1,356,180
Religious Worship	61	39	294,217	588,435	980,724
Mercantile Enclosed and Strip Malls	49	61	460,038	920,075	1,533,459
Other	8	2	17,834	35,668	59,446
Total	1,719	495	$3,712,808	$7,425,616	$12,376,026

The first two heat pump technologies listed in Tables 6 and 7 are air-source. Ductless heat pumps are used both in residential and commercial applications and are the most cost-effective

[11] A ton of heating or cooling is 12,000 Btus

[12] Actual equipment costs will vary significantly depending on site specific conditions. The emphasis here is that ductless heat pumps are significantly less expense to install than VRF and ground source heat pumps. Estimated costs per ton are preliminary and should only be used to assess the rough level of scale for potential investments.

fuel conversion option. Variable Refrigerant flow (VRF) heat pumps are primarily used in commercial applications.

The third heat pump option is ground-source heat pumps (Ground) sometimes referred to as geothermal. Ground-source heat pumps require a large water source in the form of a pond, stream, or well. Ground source heat pumps are used both in residential and commercial applications.

Ductless heat pumps serve one or two rooms and require multiple systems to serve a large room. VRF and ground source heat pumps serve multiple rooms. The cost for VRF and ground source heat pump systems is higher than ductless heat pump systems because they include the cost to install custom heating and cooling distribution components and advanced control systems. Ductless heat pumps are essentially “plug and play”.

All three heat pump options provide heating and cooling at very high efficiency. Athol should assume that all existing HVAC equipment should be removed or abandoned in place when new heat pump technology is installed. All three heat pump technologies will provide better occupant comfort in buildings with adequate insulation and airsealing. Temperature recovery from night or vacation temperature setbacks or power outages will take longer with heat pump systems than fossil fuel-fired systems.

Water heating conversion options include solar, heat pump, and electric resistance water heating systems. Solar and hybrid heat pump domestic hot water systems are better for high-use commercial systems. Small well insulated electric resistance or heat pump domestic hot water systems are better for low-use settings.

Energy Efficiency Projects

In parallel with electric conversions, Athol should assist residents and commercial businesses with energy efficiency investments. Energy efficiency investments are the most cost-effective solution to reduce total energy use in Athol’s residential and commercial buildings. Energy efficient buildings are often more comfortable, durable, and healthier to work in than less efficient buildings. In addition, energy efficient buildings require smaller heating systems and are less susceptible to high energy use and cost spikes caused by extreme weather or other energy-related conditions than less efficient buildings.

A reasonable high performance energy target for new construction is about 25 kBtu[13] per square foot for all energy use. This metric is termed energy use intensity (EUI). The actual target EUI will vary significantly by specific building type. We can use this value to identify potential energy efficiency opportunities for residential and commercial buildings with EUIs higher than 25 kBtu/SF Energy efficiency measures can be implemented as part of scheduled building maintenance and/or major renovation and rehabilitation investments. Existing buildings require a significant financial investment to achieve these energy performance standards.

[13] Thousand British Thermal Units

2. Convert residential and commercial vehicles from internal combustion engines to electric motors

Community-wide, Athol has about 8,222 vehicles. Most of the vehicles have gasoline and diesel internal combustion engines (ICE).

Table 8 summarizes estimated miles per gallon, miles travelled, and annual fuel use by these vehicles.

Table 8. Passenger and commercial vehicle miles & fuel use

Passenger Vehicles

Vehicle type	Quantity (vehicles)	Average Miles/ Day (DVMT)	Average Fuel Economy (MPG)	Annual Vehicle Miles Travelled (VMT)	Annual Diesel/ Gasoline (Gallons)
Gasoline	7,479	34.9	20.5	95,172,148	4,652,303
Diesel	104	27.0	15.9	1,023,781	88,604
FlexFuel	418	36.8	18.8	5,611,280	299,047
Hybrid	67	55.9	45.1	1,367,191	30,282
Electric	4				
Total	8,072			103,174,401	5,070,236

Commercial Vehicles

Vehicle type	Quantity (vehicles)	Average Miles/ Day (DVMT)	Average Fuel Economy (MPG)	Annual Vehicle Miles Travelled (VMT)	Annual Diesel/ Gasoline (Gallons)
Gasoline	107	29.5	16.9	1,151,170	68,092
Diesel	22	29.0	12.6	233,104	18,496
FlexFuel	20	45.5	16.2	331,828	20,513
Hybrid	1	44.1	25.6	16,097	628
Electric	0				
Total	150			1,732,198	107,728

Light-Duty Vehicles

Light-duty vehicles are the primary source of gasoline fuel consumption. Affordable electric motor vehicles are available to replace the community's light-duty vehicles that are scheduled for retirement in the next few years. The replacement cost for electric-powered light-duty vehicles has dropped significantly and is close to or on par with internal combustion engine vehicle costs.

Heavy-Duty Vehicles

Heavy-duty vehicles are the primary source of diesel fuel consumption. Few affordable electric-powered vehicles exist to replace the community's heavy-duty vehicles.

Heavy-duty vehicle conversions will most likely need to wait until the electric and fuel cell-powered heavy-duty vehicle market develops further. Interim retrofit options exist for heavy-duty vehicles including brake-assist and engine idling management systems.

Expanded Rail Access

The expansion of passenger rail west of Fitchburg is currently being assessed through a Commonwealth of Massachusetts Northern Tier Passenger Rail Study. The Town would benefit from expanded passenger rail by providing an alternative to automobile travel for trips into Boston.

Charging Stations and Load Management

Part and parcel with converting vehicles from fuel to electricity, Athol needs to anticipate how to pay for, locate, and manage associated electric charging stations. Athol will need to purchase and place electric charging stations in convenient locations and get approval to connect them to the utility grid.

We recommend that Athol develop a charging station plan for 100% community-wide electric-vehicle market penetration for the town. Athol can then work backwards to determine the location for Athol's first wave of electric charging stations. Rapid changes in EV vehicle technology combined with the investment in EV charging stations included in the recently approved Infrastructure bill will undoubtedly create a long-term need for more electric charging stations. On the flip side, most homes might install their own EV chargers and public charging stations may be less important than they are now.

Athol will need to develop a load management plan with National Grid with this information and coordinate a phased installation plan with the utility company. Charging multiple vehicles rapidly and concurrently will add significant electrical load to the existing utility distribution infrastructure. On a more positive note, connecting multiple electric vehicles with large batteries to the utility distribution system will also offer significant load management opportunities.

MA 2050 Report Guidance

In its 2050 Decarbonization Roadmap, Massachusetts recommends the following actions to decarbonize vehicles:

- The primary strategy to reduce light-duty transportation emissions is switching from fossil-fueled vehicles to zero emissions vehicles.
- Other priorities include maintaining and supporting existing public transit systems, reducing single occupancy vehicle use where possible, making complementary land use decisions, and supporting active transportation infrastructure such as bike lanes and sidewalks
- most vehicles will be replaced only twice between now and 2050
- the current pace of EV adoption in the Commonwealth lags the pace necessary to achieve interim decarbonization targets compliant with the GWSA
- The majority of EV charging typically happens at home where most vehicles are parked overnight
- the transition from ICE to EV may initially be easiest and cheapest for vehicle owners living in single family or multifamily homes with access to a garage or off-street parking

- Deployment of battery electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEVs) in the medium-duty and heavy-duty vehicle (MDHDV) classes will require retrofits to depots and fueling stations to provide charging and/or hydrogen services.
- Addressing issues including siting, permitting, interconnecting, rate design, and distribution system improvements are required to increase MDHDV BEV and FCEV adoption.

3. Convert off-road equipment from internal combustion engines to electric motors

Table 9 on the next page summarizes the estimated carbon emissions from off-road energy use and the assumptions associated with these carbon emission estimates.

Table 9. Off-Road Carbon Emissions

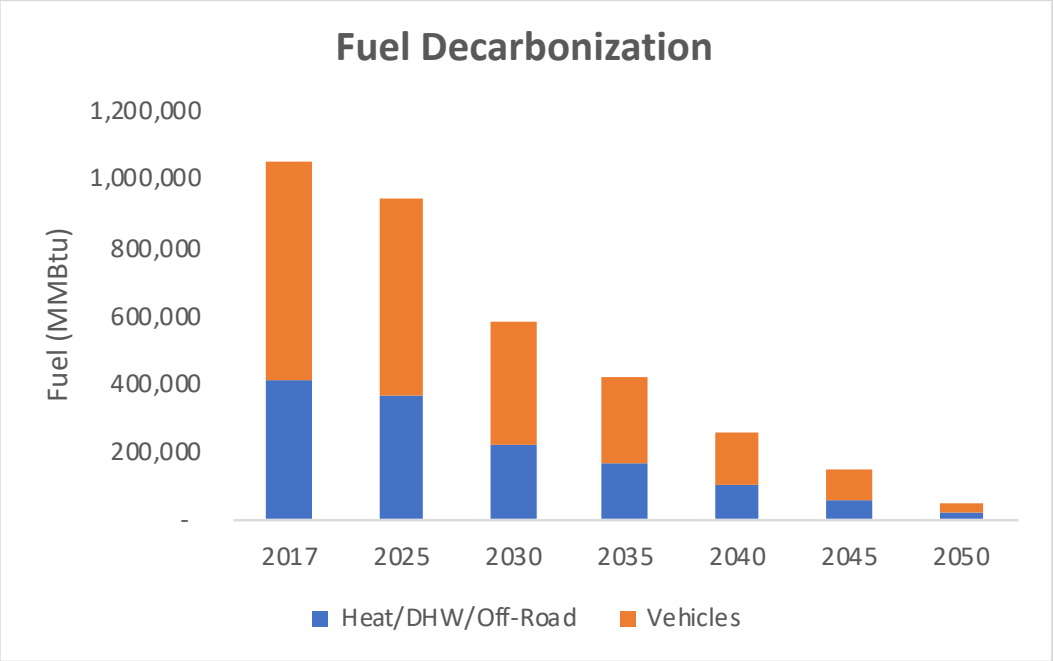
Emissions Source	County-Level Emissions Allocated to City/Town By:	City/Town Allocation Category Count	GPC Subsector	Off-road CO2 Emissions (MT CO2)
Industrial Equipment	Manufacturing Jobs	1,206	Manufacturing Industries	2,821
Lawn and Garden Equipment	Square Feet of Landscaped Area	49,552,044	Comm. & Inst. Buildings	814
Light Commercial Equipment	All Sectors Jobs Excl. Manufacturing	4,120	Comm. & Inst. Buildings	560
Construction Equipment	Square Feet of Construction	0	Construction	0
Off-road Emissions Attributable to Manufacturing Industries Subsector:				2,821
Off-road Emissions Attributable to Commercial & Institutional Buildings				1,374
Off-road Emissions Attributable to Construction Subsector:				0
All Off-Road Emission Sources				4,195

A more detailed survey of these off-road categories will clarify actual off-road carbon emissions in Athol. Like buildings and vehicles, Athol will need to identify opportunities to convert primarily fuel-based equipment to high efficiency electric equipment. For this report, we assume that Athol can make this transition at the same rate as buildings are converted from fuel-based equipment to high efficiency electric equipment.

Potential Fuel Decarbonization Path

Figure 2 summarizes Athol's estimated fuel-based (oil, natural gas, gasoline, and diesel) energy use reduction through 2050. The chart assumes 5-year building and vehicle conversion rates from fuel use to high efficiency electricity use of about 10% by 2025, 45% by 2030, 60% by 2035, 75% by 2040, 85% by 2045, and 95% by 2050. Assuming this level of market penetration, Athol reduces the Town's community-wide GHG emissions 51% by 2030 and 94% by 2050.

Figure 2. Total Fuel Decarbonization



Potential Electricity Decarbonization Path

Athol uses electricity for its residential, commercial, and industrial buildings. Total community-wide electricity purchased from National Grid in fiscal year 2017 was about 35,960,000 kWh for residential electric accounts and about 34,804,000 kWh for commercial electric accounts.

Electricity that Athol customers purchase from National Grid include electricity generated from fossil-fuel and multiple grades of renewable energy electrical generation plants. National Grid's electricity generation sources in 2019 were 76% fossil fuel (mostly natural gas) and 24% renewable energy. In 2023, the generation sources are 46% fossil fuel and 54% "clean energy".

Table 10 summarizes the projected increase in the default electricity supply that utility companies must provide customers. Please refer to Appendix B for more detailed information.

Table 10. Renewable Energy and Clean Energy Portfolio Standard generation targets

Year	Total RPS & CES Generation
2019	24.2%
2025	57.3%
2030	67.1%
2035	77.1%
2040	87.1%
2045	95.0%
2050	95.0%

State legislation requires National Grid to increase the percent of renewable energy generation 2% each year until 2029 when the increase is reduced to 1% each year. The state added a formulaic (starting at 20%) clean existing generation standard in 2021. Other electricity suppliers offer higher levels of renewable energy. The State's 2050 Decarbonization Report suggests a 95% renewable energy target that reserves about 5% for utility grid electricity generation and load stability control.

Variables to consider regarding grid-level renewable energy procurement include class, source (local, regional, or national), and renewable energy credit (REC) status. Class I local renewable energy that have not sold the renewable energy credits are the highest quality. Athol electricity customers can consider transitioning from "lower quality" to "high quality" renewable energy over time to keep grid-level renewable energy procurement more cost-effective.

According to US EPA[14], "on-site power generation provides local governments with the most direct access to renewable energy. In addition to the overall benefits, on-site projects also provide a hedge against financial risks and improve power quality and supply reliability." Overall benefits from local and regional renewable energy include:

- Reduced demand on our regional electricity and gas utility infrastructure to generate and supply electricity from large fossil-fuel power plants
- Direct public health benefits from reduced fossil fuel power plant operation
- Direct economic benefits from local jobs created to install local and regional renewable energy systems

The Town of Athol purchases 100% of its municipal electricity consumption through the purchase of net metering credits from a 3.4MW solar PV array in Hardwick, MA, a project built in response to a public procurement in 2010.

We project that the total electricity use by Athol electricity customers will increase about 147% by 2050. This includes additional electricity use for proposed fuel to electric space and water heating conversions and proposed vehicle fuel to electricity conversions. It also takes into

[14] https://www.epa.gov/statelocalenergy/local-renewable-energy-benefits-and-resources

consideration proposed energy efficiency projects. Other variables that will affect future electricity use include the economy and the electricity industry's historic 3% per year increase. Recent events and technologies have disrupted and will most likely continue to disrupt small, predictable annual electricity use increases.

Grid Electricity

We project that the source of Athol's electricity could shift away from grid-provided renewable electric generation sources to about 57% local renewable generation by 2050. Athol will continue to connect to the local and regional ISO NE[15] electric grid but the source of electricity could increasingly shift to local sources.

Figure 3 summarizes one potential scenario for Athol's electricity use and mix of electricity generation transition through 2050. The chart assumes default electricity from National Grid except between 2025 and 2040. During this timeframe, MRPC recommends that Athol procure 100% renewable electricity through a Municipal aggregation program. The chart assumes an 80% customer participation rate in the aggregation program.

Figure 3. Potential electricity load and fuel mix

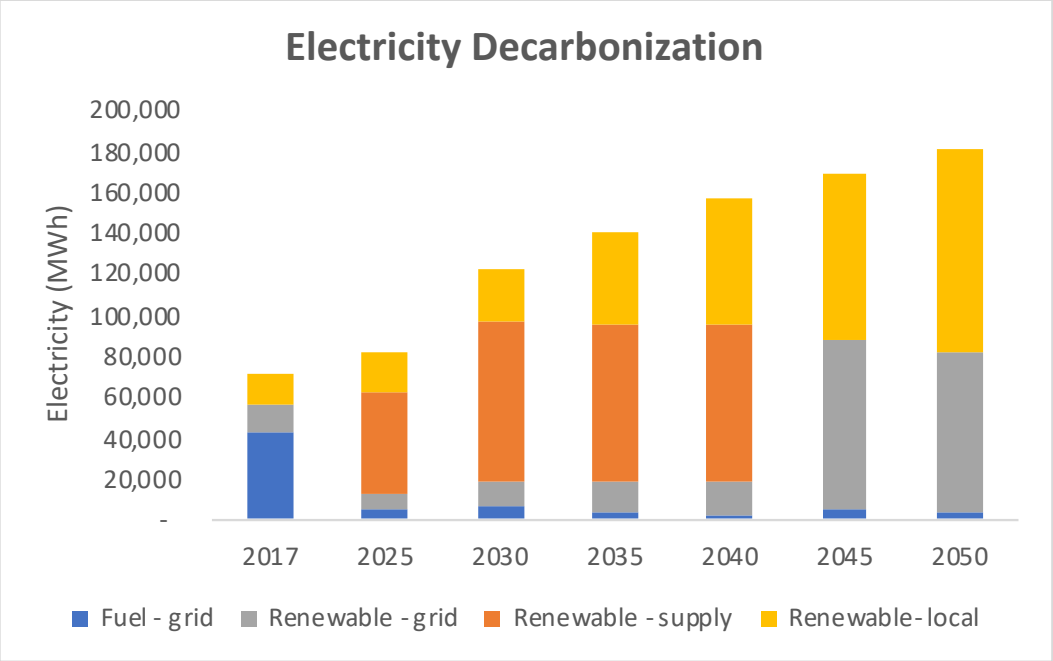


Figure 3 demonstrates a rapid decline in fossil fuel grid electricity and highlights the potential impact of a 100% renewable supply electricity procurement, roof-mounted (20% of all residential properties), parking lot, and commercial ground-mounted local renewable energy solar PV initiatives.

[15] **ISO New England Inc.** (ISO-NE) is an independent, non-profit organization that oversees the operation of New England's bulk electric power system and transmission lines.

Local Renewable Electricity

Table 11 identifies current and potential solar PV installation locations on Athol's residential and commercial facilities, private and town-owned land, and independent power purchase agreements.

Table 11. Solar PV area requirements, peak output, and potential costs

Facility name	Available Roof Area (SF)	Available Land Area (Acres)	Estimated Solar PV Peak Output (kW)	$3,496 < 250 kW Roof ($)	$5,000 < 1 MW Parking ($)	$1,200 >1 MW Ground ($)	Total Solar PV ($)
Single-Family- Detached	498,796		4,988	17,437,596			17,437,596
Single-Family- Attached	7,439		74	260,052			260,052
Multi-Family, 2-4 Units	47,164		472	1,648,809			1,648,809
Multi-Family, 5+ Units	12,312		123				-
Mobile Homes	6,232		62	217,849			217,849
Parking lots		5.0	658		3,289,474		3,289,474
Parking lots		-	-		-		-
Parking lots		5.0	658		3,289,474		3,289,474
Parking lots		-	-		-		-
Parking lots		-	-		-		-
Parking lots		-	-		-		-
3.4 MW Hardwick PV		25.8	3,400				-
Athol Landfill PPA		30.0	3,947			4,736,842	4,736,842
Commercial PPA		100.0	13,158			15,789,474	15,789,474
Commercial PPA		100.0	13,158			15,789,474	15,789,474
Commercial PPA		100.0	13,158			15,789,474	15,789,474
Commercial PPA		100.0	13,158			15,789,474	15,789,474
Total	571,942	465.8	61,357	$19,564,306	$6,578,947	$67,894,737	$94,037,990

Table 12 suggests target installation dates and projected annual electricity generation.

Table 12. Solar PV placeholder target installation dates and projected annual electricity generation

Facility name	2025 Solar PV Electricity (kWh)	2030 Solar PV Electricity (kWh)	2035 Solar PV Electricity (kWh)	2040 Solar PV Electricity (kWh)	2045 Solar PV Electricity (kWh)	2050 Solar PV Electricity (kWh)	Total Solar PV Electricity (kWh)
Single-Family- Detached	317,983	953,948	953,948	1,271,931	1,271,931	953,948	5,723,688
Single-Family- Attached	4,742	14,227	14,227	18,969	18,969	14,227	85,359
Multi-Family, 2-4 Units	30,067	90,200	90,200	120,267	120,267	90,200	541,202
Multi-Family, 5+ Units	7,849	23,547	23,547	31,396	31,396	23,547	156,981
Mobile Homes	3,973	11,918	11,918	15,890	15,890	11,918	71,506
Parking lots	838,816						838,816
Parking lots		-					-
Parking lots			838,816				838,816
Parking lots				-			-
Parking lots					-		-
Parking lots						-	-
3.4 MW Hardwick PV	4,335,000						4,335,000
Athol Landfill PPA		5,032,895					5,032,895
Commercial PPA			16,776,316				16,776,316
Commercial PPA				16,776,316			16,776,316
Commercial PPA					16,776,316		16,776,316
Commercial PPA						16,776,316	16,776,316
Total	5,538,429	6,126,734	18,708,971	18,234,769	18,234,769	17,870,156	84,729,526

Variables to consider regarding grid-level renewable energy procurement include class, source (local, regional, or national), and renewable energy credit (REC) status. Class I local renewable energy that have not sold the renewable energy credits are the highest quality. Athol can consider transitioning from "lower quality" to "high quality" renewable energy over time to keep grid-level renewable energy procurement more cost-effective.

According to US EPA[16], "on-site power generation provides local governments with the most direct access to renewable energy. In addition to the overall benefits, on-site projects also provide a hedge against financial risks and improve power quality and supply reliability." Overall benefits from local and regional renewable energy include:

- Reduced demand on our regional electricity and gas utility infrastructure to generate and supply electricity from large fossil-fuel power plants
- Direct public health benefits from reduced fossil fuel power plant operation
- Direct economic benefits from local jobs created to install local and regional renewable energy systems

We recommend that Athol prepare or hire a consultant to assess all potential solar PV sites on municipally owned or controlled land for public review. Sites to review include the rooftop, parking lot, and potential open land sites listed in Table 3. The assessment should include aerial surveys of the sites, potential electricity peak output and annual electricity generation, estimated costs, and solar site ratings.

Athol will need to stay attuned to potential grant opportunities, rapidly changing federal and state incentive programs, and the price of large-scale renewable energy installations.

Other potential local renewable energy resources include wind and hydropower. Athol will review opportunities to support private investments for these local renewable energy resources.

MA 2050 Report Guidance

In its 2050 Decarbonization Roadmap, Massachusetts recommends the following actions and considerations for the electric grid:

- As more end uses rely on the electricity system, the carbon intensity of emissions from the electricity system will need to approach zero at the same time as installed generating capacity more than doubles
- Offshore wind and solar must be deployed at scale (15-20 GW for both wind and solar) in the Commonwealth over the next 30 years
- Specific reliability resources (infrequently used thermal capacity without carbon capture, and/or new bulk storage) will be needed
- Wind and solar resources will be complemented by imports of hydroelectricity and renewables from neighboring states and regions, and a modest amount of in-state generation from fossil fuels.
- Storage and other flexible loads will also contribute to the future grid

[16] https://www.epa.gov/statelocalenergy/local-renewable-energy-benefits-and-resources

- Bringing large volumes of offshore wind onshore and delivering it to demand centers will require substantial upgrades to the onshore bulk power grid
- Solar deployment involves several challenges such as land use concerns and the need to interconnect and manage many small, distributed energy resources on the grid
- Limits to solar development in Massachusetts will likely encourage solar deployment in other states, especially in Northern New England where the cost of land is lower.
- the strategic implementation of solar more locally may result in distribution system benefits, including line loss savings and reduced costs to build out and maintain transmission and distribution infrastructure, as well as improved local resilience
- A variety of different demand-side technologies – many in use today – can help to manage hourly and daily flows and peaks in electricity demand
- The abundant hydropower available in New England, New York, Quebec, and New Brunswick represents a valuable resource for New England. The cumulative quantity of stored energy in dammed reservoirs is a key solution to balance and manage a regional electricity system with high penetrations of renewable generation.
- If offshore wind resources cannot be fully realized, new nuclear resources would be an economically viable alternative for supplying low-carbon electricity
- Currently, the lowest cost method for maintaining reliability on the few days each year with very low renewable energy production is the intermittent use of thermal power plants, primarily gas-fired power plants
- Restricting either regional transmission buildout or retiring existing thermal capacity – in the absence of a technological, cost, and commercialization breakthrough in long-duration energy storage or another dispatchable resource – could have significant cost and resource tradeoffs

2025 and 2030 Decarbonization Targets – Transportation

Table 13 summarizes Athol's 2017 historical, and state recommended 2025, and 2030 transportation decarbonization targets. The state's 2025 and 2030 targets are a 33% GHG emissions reduction by 2025 and 50% GHG emissions reduction by 2030 below the state's 1990 baseline GHG emissions.

Highlights include:

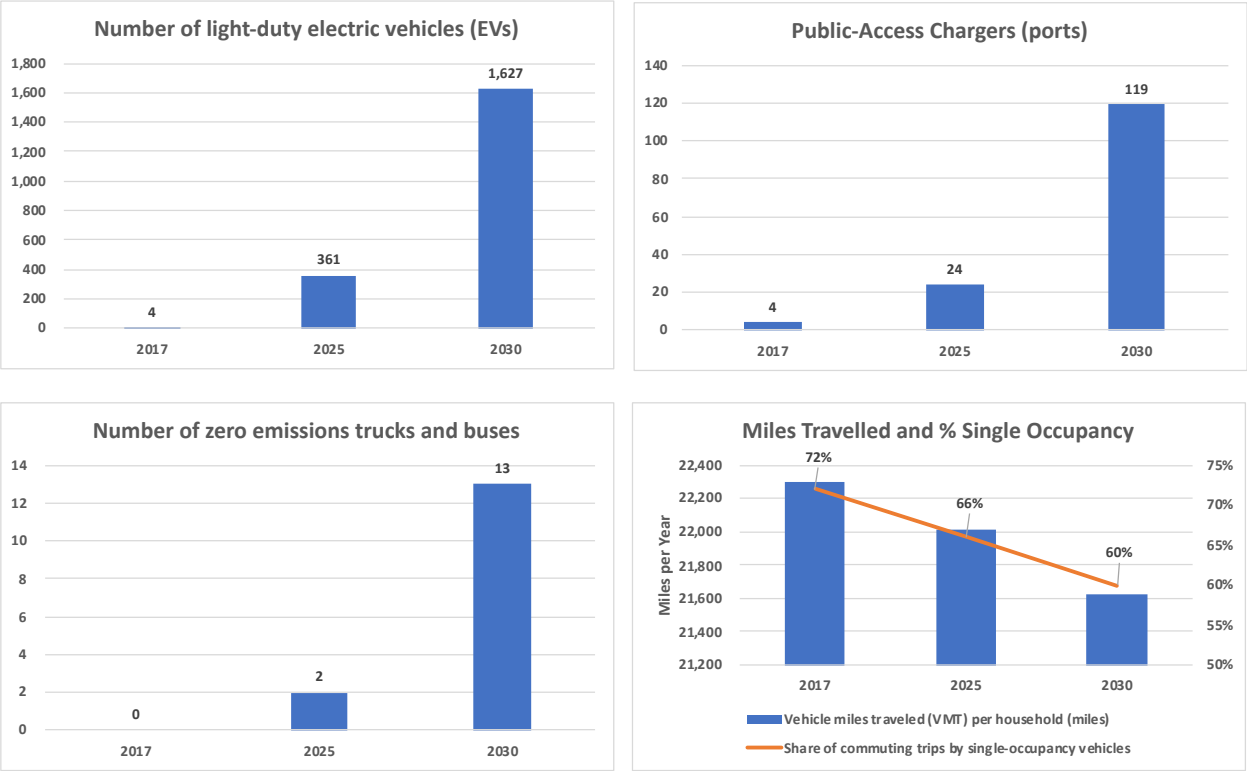
- An increase in the number of light-duty vehicles and total miles driven
- A decrease in the number of medium and heavy-duty vehicles
- A decrease in vehicle miles driven/household and single occupancy commuting trips.
- 4.3% light duty electric vehicles by 2025 and 19.2% by 2030
- 1.3% medium & heavy-duty vehicles by 2025 and 9.9% by 2030
- 24 charging ports by 2025 and 119 by 2030

Table 13. Transportation decarbonization targets

Transportation Sector	2017 Historical	2025 Targets	2030 Targets
Travel Demand			
Total annual light duty VMT (miles)	103,174,401	111,451,452	113,761,327
Total light-duty vehicles	8,072	8,393	8,472
Total medium- and heavy-duty vehicles	150	121	136
Light-duty vehicles per household	1.7	1.7	1.6
Total households	4,627	5,063	5,262
Vehicle miles traveled (VMT) per household (miles)	22,298	22,013	21,619
Share of commuting trips by single-occupancy vehicles	72%	n/a	60%
Vehicle Electrification			
Number of light-duty electric vehicles (EVs)	4	361	1,627
EV Share of light-duty vehicles	0.05%	4.3%	19.2%
Number of zero emissions trucks and buses	0	2	13
EV share of MHDV fleet	0.0%	1.3%	9.9%
Public-Access Chargers (ports)	-	24	119

Figure 4 provides this information in graph format.

Figure 4. Transportation decarbonization targets



2025 and 2030 Decarbonization Targets - Buildings

Table 14 summarizes Athol's 2017 historical and 2025 and 2030 building decarbonization targets.

Highlights include:

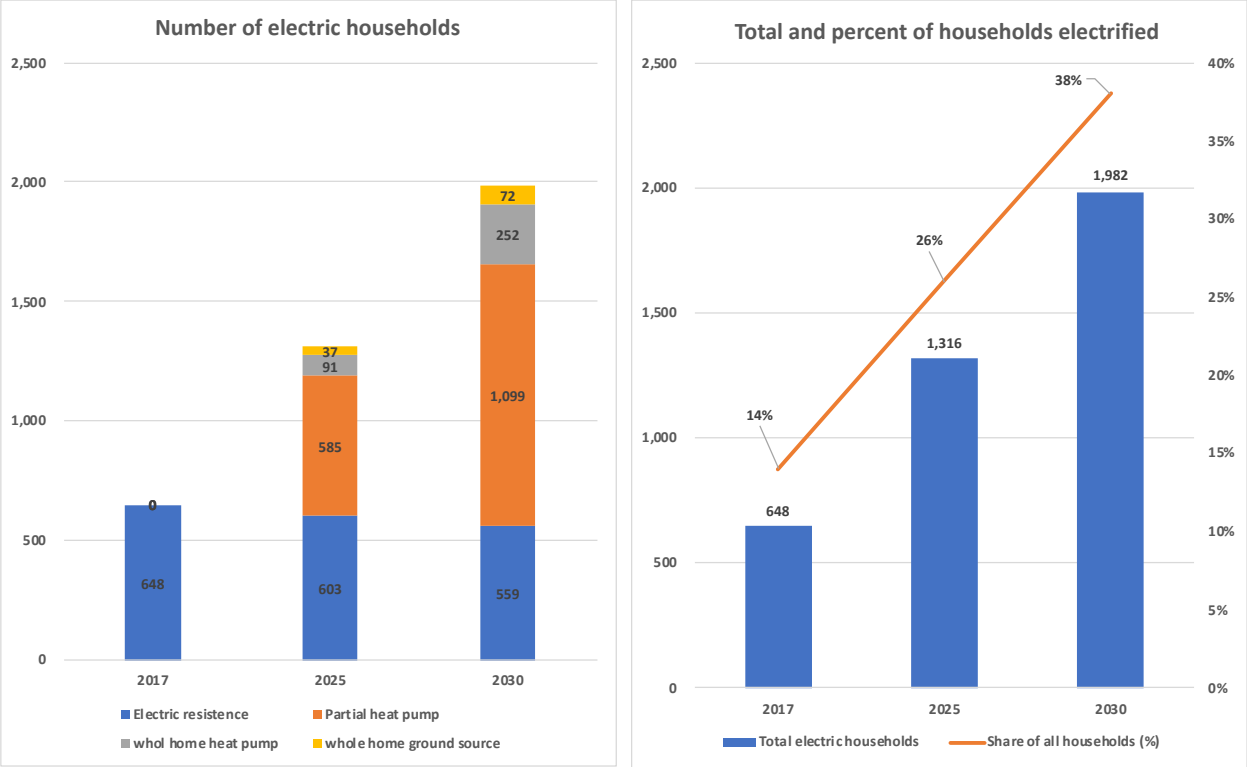
- An increase in the projected number of households
- 585 homes with partial-home heat pump space heating by 2025 and 1,099 by 2030
- 128 homes with whole-home heat pump space heating by 2025 and 324 by 2030
- 26% households electrified by 2025 and 38% by 2030
- 91 households fully weatherized by 2025 and 417 by 2030
- Figure 4 on the next page provides this information in graph format.

Table 14. Building decarbonization targets

Buildings Sector	2017 Historical	2025 Targets	2030 Targets
Total households	4,627	5,063	5,262
Primary Electric Space Heating			
Total homes with electric space heating	648	1,316	2,000
Homes with electric resistance space heating	unknown	603	559
Homes with partial-home heat pump space heating	unknown	585	1,099
Homes with whole-home air source heat pump space heating	unknown	91	252
Homes with whole-home ground source heat pump space heating	unknown	37	72
Share of total households electrified (estimated)	14%	26%	38%
Weatherization			
Total households with upgraded envelopes	unknown	91	417

Figure 5 provides this information in graph format.

Figure 5. Building decarbonization targets



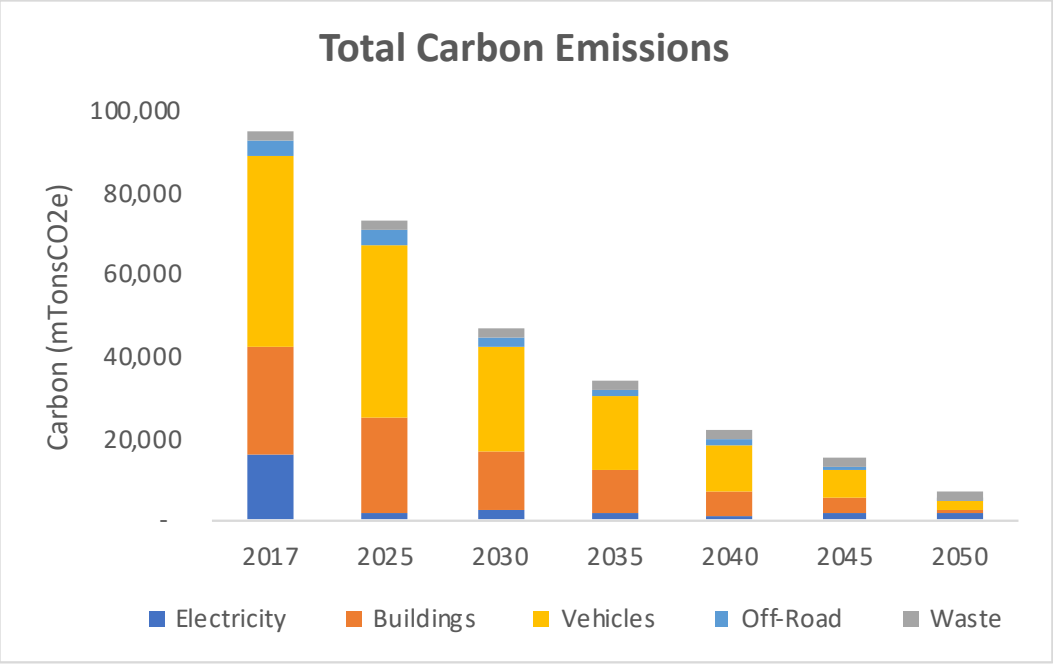
Net Carbon Emissions Reduction

The preliminary schedule of investments suggested in this report will reduce total greenhouse gas emissions in Athol by about 51% in 2030 and about 92% by 2050 below the town's 2017 baseline GHG emissions. This exceeds the state's 50% decarbonization and the state's 85% decarbonization by 2050 carbon reduction target. The difference in Athol's proposed schedule of GHG emissions reductions and the state's target GHG emissions reductions reflects Athol's assessment of current market conditions and the potential for Athol residents and businesses to procure high efficiency electric equipment and energy efficiency measures. As mentioned earlier, Athol needs an average of 7% carbon emissions reduction per year for the next 7 years to meet the 50% by 2030 carbon emissions reduction target. This level of market penetration for new technology is a very high bar to set.

Carbon Emissions Reduction

Figure 6 represents the cumulative impact of the measures discussed in this report on Athol's potential carbon emissions through 2050.

Figure 6. Total carbon emissions reduction



Building, vehicle, and off-road emissions are for fuel only. About 83% of Athol's carbon emissions in 2017 came from building and vehicle-related fuel combustion and about 17% of the carbon emissions are from electricity generation fuel consumption.

Fuel-related carbon emissions will drop in close correlation with the speed and scale that Athol can convert fuel-based combustion equipment to electric-powered equipment. Electricity-related carbon emissions will drop in relation to the amount of additional electricity that Athol electricity customers use and how quickly renewable energy can be added to the local and regional electricity generation mix.

Carbon Capture

Massachusetts is working on a plan (unreleased) to incorporate carbon sequestration opportunities in forests and fields to offset carbon emissions with the state's decarbonization initiatives. In addition, MA DEP and MA Audubon have developed supporting material for municipal carbon offset initiatives.

We recommend that Athol monitor opportunities to enroll town-owned or controlled land into carbon sequestration-focused forest management programs. The minimum recommended size for a formal carbon offset project is about 3,000 acres. Other programs may come online in the future for smaller land parcels. Carbon offset projects would allow Athol to prepare a sequestration forest management plan.

Athol could either sell the carbon credits to offset the cost of the forest management plan and sequestration forest management tasks or not. Selling the carbon credits would allow a buyer the opportunity to continue emitting carbon but offset the emissions with Athol's carbon sequestration efforts. MA Audubon is the best resource to contact for more information and regional examples of successful projects. and qualify for in-house or voluntary carbon market credits.

MA 2050 Report Guidance

In its 2050 Decarbonization Roadmap, Massachusetts recommends the following actions and considerations for carbon capture:

- Massachusetts forests are projected to have the capacity to sequester about 5 MMTCO2e per year from now through 2050
- Encouraging dense development and best management practices for commercial timber harvesting can increase forest carbon sequestration, but only minimally
- A more complete accounting of land use impacts on human and natural systems is needed to understand the long-term systemic effects and the balance of ecosystem benefits

Next Steps

1. **Share this background information with Athol's technical and financial partners at MA DOER and MRPC**

The Green Communities program run by MA DOER is the primary conduit between municipalities and the state's decarbonization efforts. Sharing this roadmap with Athol's Green Community Regional Coordinator is an opportunity to help inform the state how Athol and other community's decarbonization efforts align with the state's 85% Decarbonization by 2050 plan. MRPC can assist with this communication.

In addition, the Town of Athol and its residents and businesses will need additional technical and financial support to plan for and implement the building, vehicle, and renewable energy actions recommended in the roadmap. MRPC can continue to help apprise Athol of technical and financial planning resources as they become available. Specific planning needs for building, vehicle, and renewable energy actions recommended in the roadmap include:

a. Buildings

Each residential and commercial building in Athol should receive a detailed technical and financial analysis for one of two options. The first option is to replace the existing fossil fuel mechanical equipment with high efficiency electric mechanical equipment. The second option is to replace the existing fossil fuel mechanical equipment replacement and install comprehensive measures to upgrade the building's thermal performance.

Building energy reports should document each building's current energy performance, utility bill rates and cost, existing equipment, and provide budget level cost estimates for the proposed equipment and building energy performance upgrades that include net zero upgrades. The reports should include examples of comparable upgrades to similar buildings in Massachusetts and lessons learned. Mass Save is the primary conduit for financial and technical support for building-related energy upgrades in Massachusetts.

b. Vehicles

Athol will need to align the implementation of its vehicle conversions with the state's EV infrastructure upgrades, vehicle procurement, and vehicle incentive programs. The state's EV deployment plan is available at https://www.mass.gov/doc/transportation-sector-technical-report/download

EV incentive programs are available for light, medium, and heavy-duty vehicles at https://www.mass.gov/service-details/mor-ev-rebate-program

c. Renewable Electricity

Athol should request technical and financial support to develop a solar PV blueprint for the town. The blueprint would identify potential local solar PV sites on rooftops, parking lots, and open space and rank them based on community-developed criteria. Criteria can include but not limited to potential electricity generation, ease of construction, competing land use values, and visual impact.

2. Work closely with National Grid and Mass Save to shape, manage, and fund Athol's transition to high efficiency electric space and water heating equipment and electric vehicles.

National Grid serves two roles in the 85% decarbonization by 2050 implementation process. The first role is faciliatory. National Grid can help identify and coordinate technical and financial support that's available through Mass Save and National Grid. The second role is to help coordinate the nuts-and-bolts details of connecting proposed projects to the local electric grid.

The proposed actions in this roadmap will have a significant impact on the local electrical grid. Advanced discussions with National Grid about the proposed scale and timing of these actions will assist National Grid with their local grid upgrade plans. Local and regional electrical grid upgrades often require 2-5 years to implement. The state and National Grid will need to anticipate and plan for similar actions by Athol's citizens and businesses as well.

3. Develop a financial model to achieve the state's 2025 and 2030 Decarbonization targets

Financing and procuring the projects and equipment necessary to achieve the state's 85% decarbonization by 2050 goals will be a major challenge and test Athol's residents and commercial businesses financial resiliency. We recommend that the town convene a task force or convene a workshop to develop a plan that identifies funding and technical resources to assist residents and commercial buildings with this transition.

Financial alternatives should include but not be limited to grant and energy incentive resources, residential and commercial property assessment financing (PACE, CPACE), lease-to-own, and related power purchase agreement options.

4. Communicate the findings and recommendations

The scale of the transition proposed by the state's 85% decarbonization by 2050 report is significant[17]. Effective, transparent communication with the town's citizens, businesses, and industry will be critical to the success of these projects.

In addition, the pace of implementation necessary to meet the state's 50% decarbonization by 2030 target is significantly greater than historic levels of energy project implementation. For example, MASS Save, one of the nation's most successful energy efficiency programs, addresses energy efficiency investments in about 3% of MA households per year. As suggested in this report, The state and Town of Athol need to address large scale energy-related investments in about 7% of the Town's population per year. Town support and town communications will be important tools and resources to help residents and commercial business orders make the transition from fossil fuel equipment and vehicles to high efficiency electric equipment and vehicles.

Town support and town communications will be important tools and resources to help residents and commercial business orders make the transition from fossil fuel equipment and vehicles to high efficiency electric equipment and vehicles. Recent research about social change points to the importance of clusters of success – neighborhood by neighborhood transitions.

Education will be an important part of each of these actions. Athol's Energy Committee will evaluate and help implement education and outreach opportunities to support these actions. The Mass Save Education Grant awarded to the Town in January 2023 will offer a great opportunity to further the education effort.

[17] https://www.mass.gov/info-details/ma-decarbonization-roadmap

Conclusion

Athol's residential and commercial buildings, vehicles, off-road equipment, and waste facilities emit about 95,408 mTonsCO2e greenhouse gas emissions per year. Methodical replacement of fossil fuel-powered equipment with high efficiency electric-powered equipment and fuel-generated electricity with local renewable energy-generated electricity provides a framework for the town to reduce GHG emissions 51% by 2030, and 92% by 2050 below the town's 2017 baseline GHG emissions.

Our report recommends that the town energy committee bring a decarbonization roadmap that facilitates the transition forward for town approval. Ultimately if the City pursues the energy reduction and clean energy projects, it will comply with the Massachusetts decarbonization standards and move towards an economically and environmentally sustainable and resilient community for years to come.

Appendix A: Commonwealth's Clean Energy and Climate Plan for 2025 and 2030

In June 2022, the Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA) released the Commonwealth's Clean Energy and Climate Plan (CECP) for 2025 and 2030. MA EEA is required by law to provide similar reports every 5 years as the Commonwealth works to achieve net zero carbon emissions by 2050. The CECP report provides an opportunity for the town of Amesbury and its citizens to align the community with the actions and funding proposed by the Commonwealth's clean energy and climate plan.

Following is a summary of the CECP report and supporting documentation with the proposed carbon emission strategies set by the state

Transforming our Transportation Systems

STRATEGY T1: PROMOTE ALTERNATIVES TO PERSONAL VEHICLE TRAVEL

- A recent change to the state zoning law requires 175 communities within the MBTA service area to have at least one zoning district of reasonable size where multifamily uses are allowed as of right. The Department of Housing and Community Development (DHCD), in consultation with MBTA and Mass DOT, will issue final guidelines this year (2022) advising communities on how to comply with this new requirement.
- State agencies will continue to support Massachusetts cities and towns to address some of the additional barriers to smart growth and transit-oriented development, such as excessive parking requirements, minimum lot size requirements, set-asides, and limits on accessory dwelling units, particularly as these rules limit housing production near public transit. The Commonwealth will continue to provide a Smart Growth / Smart Energy Toolkit that provides local government with technical support in achieving smart growth goals. A package of zoning reforms proposed by the Governor and signed into law in January 2021 has created a more predictable process at the local level for the adoption of housing best practices.
- Modernize MBTA buses - convert its entire bus fleet to battery electric buses by 2040
- Massachusetts will assess commuter rail electrification options.
- Through MassDOT's Complete Streets and Shared Streets and Spaces municipal grant programs, Massachusetts cities and towns create dedicated lanes for bikes or buses, better sidewalks, better accessibility for people with disabilities, better community places and spaces, and street designs that promote pedestrian safety. on bike lanes and sidewalks. With additional funding, Massachusetts could expand and accelerate the work of all these programs.
- Massachusetts will look to achieve sustained reductions in vehicle miles travelled (VMT) below baseline projections, as Massachusetts' economy and population continue to grow.
- Reduce Single-occupancy vehicle (SOV) commuting - 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 to produce annual reports detailing steps taken to achieve that goal. MassDEP will evaluate the role telework may play in the future of the Commonwealth's economy and its GHG and VMT reduction strategies.
- Launch an e-bike incentive Program. Studies confirm that e-bikes can potentially replace car trips for some commuters. Making the most of this technology will require both incentives and continued improved bike infrastructure to ensure the safety of e-bike users and pedestrians. EEA will look to complement these investments with a statewide e-bike incentive. At the same time EEA, MassDOT, and DCR will work with the legislature to update the underlying statute, and the Executive branch will develop e-bike regulations that promote safety for all road users.

Proposed Municipal Action(s)

- **Request the Planning Board to assess by right multifamily and smart growth zoning district opportunities. Athol is not included within the 175 MBTA communities. Athol already allows multifamily by-right in its Central Commercial Zoning District. This District covers most of Athol's Downtown area**
- **Athol already participates in the Complete Streets Program. The Town has an approved Complete Streets Plan and received $400K back in 2020 that was used to reconstruct the sidewalks along Fish Park and Ridge Avenue. Athol is looking into the new Federal Safe Streets For All (SS4A) Program for additional funding.**
- **Request the Planning Board and DPW to monitor MassEEA's e-bike incentive programs and potential e-bike related infrastructure upgrades.**
- **The Town should pursue bike and pedestrian safe routes, including the Rabbit Run Rail Trail, which would offer a safe, pedestrian route parallel to South Athol Road, and the Millers River Greenway, which would offer a safe, pedestrian route between Downtown Athol and Downtown Orange.**

STRATEGY T2: IMPLEMENT COORDINATED ADVANCED CLEAN VEHICLE EMISSIONS AND SALES STANDARDS

- California is now moving forward with post-2025 regulations that would for the first time set a pathway for 100% of all passenger vehicle sales to be zero-emission, as well as new sales requirements on medium- and heavy-duty vehicles. The Commonwealth is in the process of following suit by the end of 2022. 100% passenger EV's by 2035. Truck emission regulations have been in place as of 2021. ZEV Truck sales Begin in 2025.

No municipal action required except community outreach.

STRATEGY T3: EXPAND ELECTRIC VEHICLE INCENTIVES

- Massachusetts will reform the current EV incentive programs to increase accessibility. One key reform will be to make incentives available to consumers at the dealership when they purchase the vehicle, rather than waiting for their rebate after the purchase. Massachusetts will target incentives toward low- and moderate-income purchasers and less expensive vehicle models, where incentive dollars can impact more consumer decisions.
- Medium- and heavy-duty vehicles represent less than 10% of the vehicles on the road, but they are responsible for about 40% of total GHG emissions. Massachusetts launched its first incentive for electric medium- and heavy-duty vehicles in 2020, MOR-EV Trucks, which provides purchase incentives for medium- and heavy-duty vehicles in Massachusetts, from Class 2b trucks to Class 8 tractor trailers and buses.

No municipal action required except community outreach.

STRATEGY T4: ACCELERATE ELECTRIFICATION IN FLEETS WITH CRITICAL EQUITY AND PUBLIC HEALTH IMPLICATIONS

- Electrification of vehicles for hire can be an opportunity to increase utilization of charging infrastructure in communities with low-income and EJ population, paving the way for broader adoption. The Commonwealth will implement a program to electrify this subsector, including expanded incentives, support for infrastructure, and outreach and education. The Commonwealth will consider how to use and access incentives at Logan Airport; about half of all taxi and a large proportion of ride hailing trips start and end at Logan Airport.
- E-commerce sales have increased by 34% since the start of the COVID-19 pandemic. Over 40% of restaurants have added delivery options to their services and 21% of consumers have tried using a delivery service for their groceries for the first time. MassCEC will continue to develop programs that provide incentives to businesses to decrease emissions from high-mileage, low-radius fleets. Alternatives to traditional fleet expansion include vehicle conversion to zero-emission technologies, duty cycle management, route planning, zoning, and idle reduction.
- MassCEC will provide infrastructure and technical support to ensure that Massachusetts schools are well prepared to take advantage of federal funds to support rapid electrification of school bus fleets.
- Through the ACT4All program, EEA and MassCEC are directly partnering with community organizations to support efforts to reduce transportation emissions with a focus on expanding mobility and improving air quality in EJ communities and diversifying the EV consumer base.

Proposed Municipal Action(s)

- **Request the School Department or School District to contact MassCEC and develop a plan to electrify its school buses that it owns or contracts out.**
- **Request the Energy Committee to identify and support potential EJ community air quality and EV procurement opportunities developed through MassEEA and MassCEC's ACDT4All program.**
- **Explore grant opportunities for the purchase of vehicles to accommodate hybrid or electric vehicle replacement as vehicles age and need to be replaced.**
- **Develop a pilot program for one of the first hybrid or electric vehicles purchased where actual costs are tracked (I.e. fuel, mileage per gallon, maintenance.**

STRATEGY T5: BUILD ELECTRIC VEHICLE CHARGING STATIONS AND ENCOURAGE SMART CHARGING

- The Infrastructure Investment and Jobs Act (IIJA) provides approximately $60 million over five years to Massachusetts to fund fast charging stations along major highway corridors. MassDOT and EEA are working together to develop and implement plans to support the build out of these fast-charging stations. The IIJA also provides the

Commonwealth with competitive grant funding opportunities to support community-based charging locations.

- Encourage private investment through competitive bids for community-based DC current fast charge stations with pilot grants. EEA and DOER will leverage pairing charging stations with solar PV and electrical storage systems
- EEA and DOER will develop a model building code for municipalities that requires make-ready charging in all new commercial and residential buildings. DOER will develop model municipal building codes for new construction. Stretch code will require 10% EV-ready parking spaces.
- The Commonwealth is currently evaluating options and programs proposed by the electric distribution companies to make installing home charging stations as affordable and convenient as possible for customers who are willing to sign up for managed charging. In addition, the state or electric utilities' program will help support building charging stations in apartment buildings and thereby support, in some cases, tenants who wish to charge at home. smart residential charging in a is reviewing utility proposals for affordable, convenient, managed home charging stations.

Proposed Municipal Action(s)

- **Assign a task force with representatives from the Planning Department, DPW, Energy Committee, and National Grid to assess and recommend a municipal-wide EV charging station plan. The task force will review options to accelerate multifamily, community-based fast charge DC stations, fleet EV stations, and managed home charging stations.**
- **Request DPW to investigate and submit IIJA-related grant applications for highway fast charging stations.**
- **Request the Energy Committee and DPW to solicit private sector bids for community-based DC fast charge stations paired with solar PV and electrical storage systems. Athol's Town Manager is the town's Chief Procurement Officer and may need to participate in the EV solicitation.**
- **Adopt MassEEA and MassDOER's model building code that requires make-ready charging in all new and major renovation commercial and residential buildings.**

STRATEGY T6: ENGAGE CONSUMERS AND FACILITATE MARKETS

- MassCEC has developed a fleet advisory service program that can help inform fleet operators as they transition to EVs. It will complement this fleet advisory service program with direct infrastructure support to ensure that the transition to EVs is cost-effective for public and commercial fleets.
- MassCEC will aim to assist outreach to all purchase decision-makers, particularly focusing on low- and moderate-income consumers.
- MassCEC is conducting a workforce needs assessment to support the 2030 targeted technology rollout. One anticipated outcome of this study will be a framework for workforce development needs that will help integrate lessons learned into follow-on programming to train and re-train workers in the growing clean transportation sectors.

- Rail, on-road heavy or long-distance freight, and port and marine vehicles are difficult and/or very expensive to electrify. Massachusetts will develop strategies to decarbonize these transportation modes and pilot technology approaches as appropriate. Advanced synthetic fuels and hydrogen may be viable paths as discussed in the 2050 Roadmap Study.
- Electrified short-haul aviation equipment options are nearing commercial readiness. Electrified Aviation (EA) infrastructure, which includes charging stations and energy storage, will be necessary to support the growth of this segment.

No municipal action required except community outreach. The Town of Athol is participating in National Grid's FASP support services for town-owned vehicles.

Transforming our Buildings

STRATEGY B1: CAP ON EMISSIONS FROM HEATING

- The 2021 Climate Law charges the MassDEP with promulgating "regulations regarding sources or categories of sources that emit GHG to achieve the GHG emissions limits and sub limits." Before the end of 2022 Mass DEP will initiate a stakeholder process with a goal of finalizing regulations by the end of 2023 for early 2024 implementation.
- MassDEP will develop a high-level program and a set of draft regulations. One of these regulatory options being considered by the Commission on Clean Heat (the Commission) is to develop a Clean Heat Standard for buildings.

Proposed Municipal Action(s)

- **Request the Energy Committee to monitor and provide stakeholder responses to MassDEP's building heating emissions regulations in 2022.**

STRATEGY B2: PERFORMANCE BENCHMARKS & STANDARDS

- As "directed by the 2021 Climate Law, DOER is promulgating a high-efficiency **specialized opt-in energy code** for which municipalities can choose to adopt starting in December 2022. The specialized code reflects more stringent energy standards that align with the Commonwealth's long-term building decarbonization goals. In addition, DOER is updating the **stretch energy code** which most municipalities have currently adopted as a prerequisite to enrolling in the **Green Communities Grant Program**."
- In 2022, DOER will begin administrative processes to revise the Alternative Energy Portfolio Standard (APS) program to align with the Commonwealth's 2025 and 2030 limits and sub limits.
- Before the end of 2023, if recommended by the Commission, DOER will develop a uniform building performance reporting approach and related technical resources.

Proposed Municipal Action(s)

As summarized by MassDOER;

"There will be 2 versions of the stretch code – so a total of 3 energy code options once the stretch and specialized codes are finalized later this year – so municipalities have a choice. The base energy code is the IECC2021 with modest MA amendments, the Stretch code builds on that to increase the energy efficiency requirements, and the new Specialized code goes further and requires pre-wiring or full electrification and on-site solar requirements for buildings that choose to use fossil fuels."

"For communities that have already adopted the stretch code they would not need to take any municipal action to transition from the outgoing stretch code to the incoming stretch code."

"For communities interested in adopting the new Municipal Opt-in Specialized Stretch code (Specialized Code), that would require a municipal vote – a town meeting bylaw or city council ordinance."

"The Green communities Division is working on model bylaw/ordinance language to provide guidance on how to do this consistently."

The Town will have to opt-in for the specialized Municipal Stretch Code. Athol will get the Stretch Code updates by virtue of the original Stretch Code adoption by the town.

STRATEGY B3: DELIVERING RESULTS AT SCALE

As a part of the Commission on Clean Heat's deliberation and preliminary recommendation, **climate finance** programs can help address a portion of the cost barrier and expedite the deployment of clean heat solutions.

- the Commission on Clean Heat has discussed and suggested that the Commonwealth explore setting up a **centralized clean heat clearinghouse** to access consistent guidance, technical assistance, and grant financing to drive enrollment of "clean square feet."
- Mass Save is currently the best resourced and farthest-reaching policy tool that the Commonwealth can leverage to achieve GHG emission reductions from the building sector. Mass Save's 2022-2024 Energy Efficiency Plan is forecast to reduce GHG emissions by about 845,000 MTCO2e. The required GHG emissions reduction between 2025 and 2030 is 5,100,000 MTCO2e. The scope and nature of Mass Save may need to be updated to fully meet the emissions sub limits for 2030. The Commission will deliberate if legislation may be needed to update the role and charge of Mass Save.
- **Massachusetts Environmental Policy Act (MEPA)** reviews include the environmental impacts of any large construction projects and develop approaches to mitigate environmental damage. These approaches include but are not limited to enhanced building designs that can reduce GHG emissions from energy consumption.
- For existing large buildings, clean energy retrofits often require expensive upgrades which may have very long payback periods. MassDevelopment, in coordination with DOER, has begun to offer financing options for businesses and developers through its

Property-Assessed Clean Energy (PACE) program, which allows building owners to finance clean energy upgrades through a long-amortization, low-interest lien placed on the property itself.

- Since 2020, MassCEC has run **Clean Energy Lives Here***,* a consumer education and engagement campaign around home decarbonization. This platform supports consumers in their building decarbonization journey, from initial education to planning and implementation. MassCEC will continue to expand these efforts and coordinate with new incentives and marketing efforts around building electrification from **Mass Save**.
- In 2022, MassCEC is initiating a **Workforce Needs Assessment** based on the state's climate commitments. The study will include best practices for engaging and supporting women- and minority-owned businesses, EJ populations, and fossil fuel workers to transition to clean energy occupations.

Proposed Municipal Action(s)

- **Request the Energy Committee to monitor and inform the community about a potential Clean Heat Clearinghouse and MassCEC's Clean Energy Lives Here technical resources.**
- **Request municipal approval for a Property-Assessed Clean Energy (PACE) program.**
- **Monitor and support potential legislation to update and charge of MassSave.**

STRATEGY B4: INFRASTRUCTURE PLANNING AND TECHNOLOGY INNOVATION

Although it is unlikely that heat pump adoption would drive peak growth until sometime after 2030, investment in electric infrastructure should be planned today.

- Considering the potential implications that deep decarbonization holds for the future of gas infrastructure and gas customers, the Massachusetts DPU issued an order in October 2020 opening **Docket 20-80**, an investigation into the role of the investor-owned gas utilities in a net zero economy in 2050.
- The effort to decarbonize building heat systems and transition away from fossil fuel-based heat systems should include coordinated planning with the electric utilities to facilitate electrification alongside the targeted decommissioning of the natural gas pipeline systems.
- The DPU will work with the electric utilities and stakeholders to develop alternative **rate structures** for customers with electric heating (similar work on electric vehicle charging is ongoing) that would increase incentives for the adoption of clean technologies, while protecting energy-burdened households to ensure that everyone across the Commonwealth can reach equal and fair access to the clean technologies.

Proposed Municipal Action(s)

- **Request the Energy Committee to monitor the progress of DPU Docket 20-80. In addition, town staff and the Energy Committee should work closely with National Grid to share Athol's projected fuel to electricity conversation rates and scheduled and/or necessary electricity infrastructure changes that may be required.**

Transforming our Energy Supply

STRATEGY E1: EXECUTE CLEAN ENERGY PROCUREMENTS

The New England Clean Energy Connect (NECEC) transmission project is a critical component of Massachusetts' ability to achieve its emissions limits. Massachusetts will need additional transmission capacity to deliver additional renewable electricity into the market as we approach net zero in 2050.

No municipal action required. There are plans for National Grid to upgrade the transmission lines that service Athol. National Grid just released the EENF documentation for that proposed project. Construction is anticipated to start in 2025 with completion targeted for 2028. Athol should "support and/or follow the National Grid Transmission Line Updates that service Athol." These upgrades are critical to support more solar power that can be connected to the power grid.

STRATEGY E2: CLEAN ENERGY ATTRIBUTE MARKETS

- The 2021 Climate Law raised the RPS minimum standard to 40% by 2030. Subsequently, MassDEP has proposed to increase the CES minimum standard to 60% by 2030 (20% incremental above the RPS)[18]. In addition, the CES for existing resources (CES-E) provides support for existing nuclear and large hydroelectric resources in New England. As currently promulgated, the CES-E would apply to about 20% of retail load in 2030 over and above the proposed 60% for CES.
- The Commonwealth has additional regulations and programs that aim to reduce GHG emissions in the electricity sector. The Electric Generator Units (EGU) emissions cap (310 CMR 7.74) sets a declining cap on carbon dioxide emissions from large power plants physically located in the Commonwealth. Emissions from power plants in Massachusetts are also subject to the emissions limits set by RGGI.

No municipal action required.

STRATEGY E3: DEVELOP AND COORDINATE REGIONAL PLANNING AND MARKETS

Regional cooperation on electricity system planning and advancing wholesale electricity market reforms will be necessary. The required changes include:

- Develop market-based mechanisms, in concert with state policymakers, that facilitate growth in clean energy resources and enabling services, while fully accounting for ongoing renewable energy investments made pursuant to enacted state laws.

[18] RPS stands for Renewable Portfolio Standard. CES stands for Clean Energy Standard. "The difference between a RPS and a CES comes down to how a particular state defines what is a "renewable" versus a "clean" source of energy. Clean energy typically refers to sources of energy that have zero carbon emissions." https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

- Conduct best-in-class system planning activities that proactively address state clean energy needs.
- Ensure grid resiliency and reliability at least cost in a manner that is responsive to state and consumer needs.

No municipal action required.

STRATEGY E4: SUPPORT OFFSHORE WIND AND SOLAR INDUSTRY DEVELOPMENT

To support widespread electrification, New England likely will need more than 40 GW of solar resources by 2050. The supporting pathways analysis for the 2025/2030 CECP found this amount would exceed the total area of available rooftops in the region. To further assess the siting considerations for solar development, DOER initiated a Technical Potential of Solar Study in 2022. The study will help to identify suitable sites for solar development and educate the public about the need to foster solar growth in Massachusetts while protecting our important natural and working lands.

The deployment of solar resources faces two significant challenges: interconnection of distributed energy resources and impacts on natural and working lands. Further policy will be needed to ensure sufficient solar deployment and to manage how such necessary development interacts with both of those systems.

- DOER, DPU, and MassCEC will continue to work with solar and storage developers and with the electric utilities and ISO-New England to remove or minimize any potential barriers in interconnecting new solar and storage resources.
- DOER will work closely with environmental protection agencies and stakeholders to ensure that the incentives provided to solar and storage projects do not unintentionally harm valuable natural and working lands and forests. In addition, DOER will continue to encourage deploying solar and storage projects on “built” landscapes.
- The Commonwealth has adopted the Energy Storage Initiative Target, which calls for 1,000 MWh of storage by 2025. 300 MWh of energy storage has been installed as of the end of 2021 and over 800 MWh is in the pipeline.
- Offshore wind represents one of the most 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. Massachusetts will work with neighboring states, federal agencies, and ISO-New England in developing a regional plan for offshore wind transmission.

No municipal action required.

STRATEGY E5: INCORPORATE DECARBONIZATION GOALS INTO DISTRIBUTION SYSTEM MODERNIZATION

- 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 optimize the integration of DERs. With input from DOER and other stakeholders, the DPU is currently reviewing the utilities' proposed Grid Modernization Plans

- The deployment of AMI is a key technology to enable flexible electricity load including shifting electricity demand away from peak periods that are the most expensive and highest emitting. Grid modernization includes using advanced data analytics to monitor and potentially control electricity usage and provide this information to customers.

No municipal action required.

STRATEGY E6: DRIVING A JUST CLEAN ENERGY TRANSITION

- To effectively integrate environmental justice and equity in the energy transition plan, the Commonwealth will need to undertake efforts including but not limited to: (a) ensuring that siting and permitting decisions consider the impact of energy projects on communities with EJ population, (b) incorporating the voices of those who have been traditionally underrepresented in policy and regulatory processes and decisions, and (c) ensuring that well-paying jobs and economic development benefits flow to those who have traditionally not benefited from those investments.

No municipal action required.

Greenhouse Gas Emissions from Non-Energy Sources & Industrial Use

STRATEGY N1: TARGET NON-ENERGY EMISSIONS THAT CAN BE ABATED OR REPLACED

- The Commonwealth will 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 SF6 used in gas-insulated electrical infrastructure switchgear.[19]
- Methane leaks from the natural gas distribution network are substantial but are being reduced significantly because of existing policies. 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.

[19] GWP stands for global warming potential.
HFC stands for Hydrofluorocarbon. HFCs include "any of several organic compounds composed of hydrogen, fluorine, and carbon. HFCs are produced synthetically and are used primarily as refrigerants." (https://www.britannica.com/science/hydrofluorocarbon)
SF6 stands for Sulfur hexafluoride. "(SF_6) is a synthetic fluorinated compound with an extremely stable molecular structure. Because of its unique dielectric properties, electric utilities rely heavily on SF_6 in electric power systems for voltage electrical insulation, current interruption, and arc quenching in the transmission and distribution of electricity. Yet, it is also the most potent greenhouse gas known to-date." (https://www.epa.gov/eps-partnership/sulfur-hexafluoride-sf6-basics)

- As a part of this 2025/2030 CECP, by the end of 2024, DPU will review and propose changes to the existing Gas System Enhancement Plans (GSEPs) for upgrades to leaky pipes that includes an economic evaluation of alternatives to full replacements in geographic areas with low anticipated natural gas utilization.

No municipal action required.

STRATEGY N2: IMPLEMENT BEST PRACTICES AROUND RESIDUAL NON-ENERGY EMISSIONS

- The major source of emissions from solid waste disposal is the seven municipal waste combustors (MWCs) operating in the Commonwealth.
    - the Massachusetts 2030 Solid Waste Management Plan (SWMP) articulates a commitment to the longer-term goal of reducing the Commonwealth's solid waste disposal to 4 million tons by 2030 and by about 90% (to 570,000 tons) by 2050 and diverting recoverable material from disposal to higher uses.
    - MassDEP will make a concerted effort to improve the performance of existing combustion capacity and analyze the potential approaches to reduce carbon dioxide emissions from municipal waste combustors, including capping the emissions from MWCs.
- Transitioning more residences from stand-alone septic systems to managed sewer systems would likely reduce methane emissions from septic tanks.
- 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. However, at this time, no additional policies are set in this plan to expand anaerobic digesters at WWTPs.
- For agricultural emissions, which are very small in Massachusetts, improved practices can contribute to emissions reductions or stabilization.
- Since 1990, GHG emissions from the combustion of fossil fuels for industrial energy demands have fallen significantly. Much of this reduction is due to background trends, such as increasing globalization that has left fewer facilities operating within the borders of the Commonwealth.

Proposed Municipal Action(s)

- **Request DPW and the Planning Board to assess opportunities to construct or expand managed sewer systems in place of stand-alone septic systems.**
- **If appropriate and acceptable to Wastewater Treatment Plant staff, request the wastewater treatment plant to monitor opportunities to construct or expand potential anaerobic digesters.**

Protecting our Natural and Working Lands

STRATEGY L1: PROTECT NWL (KEEP NWL AS NWL)

- The Commonwealth aims to double the state's current pace of Natural and Working Lands (NWL) conservation of ~10,000 acres per year to 21,000 acres per year.
    - By the end of 2023, EEA and associated agencies will review and update evaluation criteria of state land acquisitions and land conservation programs to **prioritize protection of forests vulnerable to development, carbon-rich forests, wetlands, and open space upstream of wetlands, including marsh migration corridors**.
    - EEA will seek to **increase the annual budget of land protection grants and programs through state and federal funding sources**
    - EEA may potentially seek additional state funding to **expand the Agricultural Preservation Restriction (APR) Program beyond its current model**
    - By the end of 2024, EEA will develop and seek to advance new legislation to support the goal of No Net Loss of Forest and Farmland. This will include amendments to the Chapter 61 and 61A
    - EEA will also **partner with municipalities, land trusts, and other conservation organizations to encourage additional NWL conservation** above and beyond the state conservation goals for 2025 and 2030, including the pace of conservation restrictions.
- The Commonwealth will look to provide incentives and pursue the regulatory changes described below that aim to decrease NWL conversion to development.
    - EEA will seek an increase in the Land Planning Grants annual budget that would provide expanded grant funding to municipalities and regional planning agencies to **enhance the adoption of Natural Resources Protection Zoning (NRPZ) and tree protection bylaws and incentives**.
    - By the end of 2022, the MEPA Office will deliberate with the MEPA advisory committee, which was formed to advise on MEPA's 2021-2022 regulatory review effort, the potential to add a review threshold in regulation that would **require projects engaging in a certain level of forest clearing to undergo an environmental review process**.
    - By the end of 2023, DOER will provide **guidance for future solar siting through the Technical Potential of Solar Study.** Such guidance is expected to help minimize environmental impacts and forgone carbon sequestration on NWL while meeting renewable energy needs for electrification of building heating and transportation.
    - By the end of 2024, MassDEP will investigate approaches to increase statewide protection of wetlands and, at minimum, the first 50 feet of the 100-foot wetland buffer zone.

Proposed Municipal Action(s)

- **Request the Conservation Commission to identify additional NWL conservation opportunities for 2025 and 2030 and propose a plan to increase municipal land protection.**
- **Request the Conservation Commission and the Planning Board to monitor and recommend how to implement additional NWL protection through the MEPA, solar siting, and wetlands buffer DEP programs that are under consideration for 2022-2024.**
- **Request the Planning Board to amend the Open Space Residential Design (OSRD) provision to a by-right process to help foster such developments, which help decrease development footprints and increase preserved open space.**

STRATEGY L2: MANAGE NWL

- A little over 200,000 acres of forests in Massachusetts—approximately 11% of all privately owned forest lands in the Commonwealth—are currently enrolled in the Chapter 61, 61A, and 61B tax programs, which allow privately owned forest lands to be taxed at the current use value of the property instead of the fair market or development value of the land. The goal is for 20% of privately-owned forests and farms to adopt climate smart management practices.
    - By the end of 2023, DCR will seek to **launch a new Forest Resilience Program** as part of the agency's Working Forest Initiative, which already offers cost-share payments for forest.
    - By the end of 2026, EEA will seek an amendment to the Massachusetts Forest Tax Law to modify the Chapter 61 and Chapter 61A programs or to **establish a new Chapter 61C program.**
    - Beginning in 2024, MDAR will seek to provide additional financial incentives to farmers through the MA Coordinated Soil Health Program for implementing healthy soils practices that increase carbon storage in agricultural soils.

Proposed Municipal Action(s)

- **Request the Conservation Commission to monitor and support DCR's new Forest Resilience Program, EEA's new Chapter 61C program, and MDAR's MA Coordinated Soil Health Program.**

STRATEGY L3: RESTORE NWL

- Completing at least 16,100 acres of riparian and urban tree planting will require significant expansion and pace of current tree planting programs in Massachusetts.
    - By the end of 2023, DCR will seek to **launch a Riparian Tree Planting Program** to significantly expand tree cover along rivers, streams, lakes, and ponds, as well as retain edge/transitional habitat along farm fields.
    - EEA will seek additional increases to the annual budget of the **Greening the Gateway Cities program** to accelerate urban tree plantings in EJ neighborhoods.

  - Beginning in 2024, EEA will dedicate at least $3 million per year in the Municipal Vulnerability Preparedness (MVP) Program Action Grant funding for greening and nature-based projects to lower heat island impacts and increase urban carbon storage.
- Achievement of no net loss of stored carbon in wetlands will require conserving not only the wetlands but also the land adjacent to and upstream of wetlands, as land management upstream and around the wetlands can significantly disturb and degrade the wetlands.
  - By the end of 2024, MassDEP will **implement a no net loss of stored carbon requirement** in the Bordering Vegetated Wetlands (BVW) General Performance Standards (310 CMR 10.55(4)(b)) and **a minimum of 2:1 replacement to loss ratio** to 310 CMR 10.05(10) to memorialize the longstanding requirement of projects seeking variance.
  - By the end of 2024, MassDEP and the MEPA Office will investigate and identify ways to **streamline permitting and environmental impact review for wetland restoration projects** that restore tidal wetlands, remove tidal flow restrictions, and restore salt marsh functionality.

Proposed Municipal Action(s)

- **Request the Conservation Commission and Shade Tree Commission to identify potential riparian tree planting locations.**
- **Request the Shade Tree Commission to identify potential EJ and heat island locations for additional tree planting.**

STRATEGY L4: INCENTIVIZE LONG-LIVED, DURABLE WOOD PRODUCTS

- While harvesting forests results in short term losses of forest carbon, careful planning and management can ensure Massachusetts' working forests can continue to sequester carbon while also storing carbon in useful wood products over long periods of time.
  - Starting in 2023, DCR will pilot a program to collect information on where wood harvested on privately-owned and state-owned forests in the Commonwealth is processed.
  - Starting in 2023, DCR will commission a mill recovery study to assess common end uses of timber harvested in Massachusetts.
  - Starting in 2023, DCR will commission a study to identify potential opportunities to support a local market for durable wood products in Massachusetts from sustainably harvested wood.
  - By the end of 2024, DCR will seek to **expand the Forest Viability Program** to fund technical assistance and financial incentives for increasing efficiency in timber processing and expanding the market for low quality wood to be used as durable wood products.

No municipal action required other than to follow these efforts and potentially adopt these programs as they take effect.

STRATEGY L5: EXPLORE ADDITIONAL CARBON SEQUESTRATION

- it will be necessary to develop regionally consistent sequestration measurement, accounting, and market frameworks that will allow Massachusetts to purchase additional, least-cost sequestration services from other states in the region to allow the Commonwealth to achieve net zero GHG emissions in 2050.
    - By 2025, develop an accounting framework for achieving net zero GHG emissions in state and with other jurisdictions outside of Massachusetts.
    - By 2025, develop a framework design of the necessary elements (e.g., eligibility, registry, measurement, crediting, monitoring, and enforcement) of a viable carbon sequestration market.

No municipal action required. However, as mentioned it Athol's 2022 decarbonization report, opportunities may exist for local carbon sequestration projects.

Notes from the Massachusetts Clean Energy and Climate Plan for 2025 and 2030 Supporting Documentation Report

Technical Pathways Modeling

1. The model assumes that the state installs low-cost ductless heat pumps not cold climate heat pumps through 2030.
2. Used vehicles includes vehicles more than five years old. Used vehicles are more predominant in rural areas in urban. 35% of passenger vehicles in urban areas are used vehicles. 71% of passenger vehicles in rural areas are used vehicles.
3. The base weather year for the model is 2011 weather data.
4. The model assumes that the Clean Energy Connection project (currently in court) is eventually completed after 2030. In addition, the model assumes that there will be load flexibility.
5. The report doesn't differentiate between how much solar PV comes from local solar as opposed to large scale industrial great solar.
6. The model suggests that the existing grid will be able to handle all proposed electrification through 2030. However, grid modification planning will need to start now. Most electrical grid investments will occur between 2030 in 2045.
7. Load flexibility has a huge transmission and distribution cost benefit.
8. Electricity prices are forecast to drop because of higher throughput.
9. Gas prices our forecast increase under all scenarios.

Clean Heat Standard for Massachusetts

1. According to “An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, which Governor Charlie Baker signed on March 26, 2021” (the 2021 Climate Law):
    a. Greenhouse gas (GHG) limits must be set every five years
    b. MassDEP is required to set sub limits for specific sectors
    c. The law requires numerical benchmarks and to track adoption solar thermal air source and ground source heat pumps and other non-thermal technologies
    d. The 2030 clean heat target is 49% below 1990 carbon emissions and 40% below 2020 carbon emissions
2. The 2025/30 Clean Energy and Climate Plan (CECP) preferred “phased” scenario proposed actions include:
    a. 130,000 whole-house cold climate air source and ground source heat pumps
    b. 380,000 supplemental air source heat pumps for fossil-fueled furnace systems in a partial building electrification setup
    c. 660,000 fossil fuel domestic hot water heaters replaced by electric resistance or heat pump domestic hot water heaters
    d. 230,000 buildings fully weatherized

   e. 4% per year until 2025, 5% per year between 2025 and 2030, 3% per year from 2030 to 2050 thermal decarbonization
   f. The report notes that early actions are more valuable to reduce climate change
3. CECP benchmarks and metrics - After this plan is released EEA will commence work to develop a web-based dashboard where these metrics will be posted and tracked.

Appendix B: Community Green House Gas Reduction Resources

Following are descriptions and internet links for several efficiency and greenhouse gas emission reduction-related programs and resources that may be useful to consider for community decarbonization efforts. The categories include Massachusetts program support resources, potential municipal program support resources, National Grid program support resources, and private sector technology resources.

Massachusetts Programs and Initiatives

Massachusetts Decarbonization Roadmaps and Legislation

Massachusetts formally acknowledged global warming and the need to reduce greenhouse gas emissions in 2008. The first major legislative act passed in 2008 was called the Global Warming Solutions Act. This act set target carbon reductions of 20% by 2020 and 80% by 2050 below 1990 carbon emission levels.

More recently in December 2020, Massachusetts approved and released its 2050 Decarbonization Road Map. The road map charts a "no regrets" path to by 2030 and 85% decarbonization by 2050. in March 2021, Massachusetts updated its greenhouse gas emission reduction targets for the state. The state's decarbonization targets are now 50% by 2030, 75% by 2040, and net zero by 2050.

- Global Warming Solutions Act: https://www.mass.gov/service-details/global-warming-solutions-act-background
- MA 2050 Decarbonization Road Map and supporting documents: https://www.mass.gov/info-details/ma-decarbonization-roadmap
- 2021 Act: *An Act Creating A Next-Generation Roadmap for Massachusetts Climate Policy*

Massachusetts Energy Efficiency Advisory Council (EEAC)

The Massachusetts Energy Efficiency Advisory Council (EEAC) was enabled by the 2008 Global Warming Solutions Act. EEAC is charged with monitoring the performance of and guiding the state's energy efficiency programs. EEAC's website is the best source of information for the direction, priorities, and funding levels for the state's energy efficiency and greenhouse gas reduction programs.

In its March 16, 2022, meeting, EEAC provided a Mass Save program performance (2019-2021) update and program forecast (2022-2024) presentation. The presentation states that Mass Save's efficiency and heat pump installation programs are going to accelerate over the next three years. In addition, the presentation states that Mass Save's program performance will be measured in greenhouse gas emission reductions instead of energy savings. Moving forward, Mass Save's programs will be designed and funded ($4 billion over 3 years) to align as closely as possible with the state's updated 2030 – 2050 greenhouse gas emission reduction goals and the financial investment required to achieve these goals.

- March 16, 2022 EEAC Mass Save performance and forecast presentation: https://ma-eeac.org/wp-content/uploads/Q4-Presentation-3.16.pdf.

Mass Save FY 2022-2024 Program Priorities – Residential

Mass Save is the state's primary resource for residential energy efficiency and heat pump-related energy information and financial support. For the 2022-2024 program approved by the MA Department of Public Utilities on January 31, 2022, EEAC (mentioned above) will be monitoring the following key residential performance indicators:

- Progress towards residential program design enhancements.
- Consideration and implementation of whole-home, performance-based retrofit program, or similar new approach to emphasizing the co-delivery of weatherization and heat pumps.
- Integration of home energy scorecards.
- Implementation of an all-electric new construction offer for the 1-4 unit market segment.
- Updates on the number of units enrolled in Passive House multi-family new construction offering.

Specifically for Low-income[20] eligible weatherization, EEAC will be monitoring:

- Electrification efforts for the Income Eligible sector, including installation of heat pumps for space and water heating.
- Efforts to increase installation of envelope measures.
- Enhanced strategy for serving small multi-family buildings including "naturally occurring" low-income housing.
- Development and implementation of a statewide computerized audit tool as recommended in the Low-Income Process Evaluation.
- Affordable multi-family decarbonization/deep energy retrofit offering.
- Development and implementation of a mixed income protocol for multi-unit buildings, including 5+ unit buildings.

Mass Save FY 2022-2024 Program Priorities – Commercial & Industrial

In addition to its residential initiatives, Mass Save is the state's primary resource for commercial and industrial energy efficiency and heat pump-related energy information and financial support. For the 2022-2024 program approved by the MA Department of Public Utilities on January 31, 2022, EEAC will be monitoring the following key performance indicators:

[20] "Low-income residents — defined as anyone who makes less than 60 percent of the state median income — can have the state cover 100% of the cost of efficiency-boosting home measures and appliances. If you receive a low income electric rate or food stamps, you likely fall into this category."
Moderate-income customers - "those who make between 60 and 80 percent of the state median income, qualify for the state's Income Eligible Program. That includes some free upgrades, as well as other savings. And residents whose income is 80 percent or more of the state's median still qualify for some savings plans." Source: https://acadiacenter.org/what-the-new-mass-save-rewrite-means-for-you/

- Development of strategies for municipal building participation in the deep energy retrofit offering.
- Launch of an all-electric new construction offering for the C&I sector.
- Pursuit of non-lighting measures in the commercial sector, especially HVAC, refrigeration and process controls, and operational savings given the PAs plans to not expand their SEM demonstration into a formal program offering.
- Efforts to increase GHG reductions in the C&I sector, including launch of the deep energy retrofit offering.

Mass Save Rebates and Incentives

- All residential rebate and incentive programs are available at: https://www.masssave.com/en/saving/residential-rebates
- All business rebate and incentive programs are available at: https://www.masssave.com/saving/business-rebates

Mass Save Heat Loan

Homeowners can request a 0% interest energy loan for up to $25,000 of energy-related investments. In partnership with Mass Save, the loans are processed through approved local lending institutions. Homeowners are only allowed to apply for a single heat loan so homeowners should include all the energy measures that they might be interested to finance in the application. Additional measures or loans will not be accepted.

- Mass Save Heat Loan website: https://www.masssave.com/saving/residential-rebates/heat-loan-program.

Mass Save ConnectedSolutions – Smart Thermostat and Battery Storage Program

Mass Save manages a residential and small business smart thermostat and battery incentive program called ConnectedSolutions. Homeowners and small businesses with qualifying smart thermostats and/or battery systems that have less than 50 kW peak output qualify for this program. Mass Save's website has more information about this program. Smart thermostats and battery storage equipment qualifies for Mass Save's 0% interest Heat Loan.

- Connected Solutions website: https://www.masssave.com/saving/residential-rebates/connectedsolutions-batteries

Mass Clean Energy Center (MA CEC)

The Mass Clean Energy Center (MA CEC) jump starts and oversees all Massachusetts clean energy initiatives. Early pilot programs sponsored by MA CEC have supported municipal group procurement programs including MA Solarize and MA HeatSmart. MA CEC has an excellent summary of clean energy incentives and programs that is available at the URL listed below. In addition, MA CEC has what it calls the Solarize/Heat Smart toolkit. This section of its website includes interviews and guidance from participants in earlier municipal group procurement initiatives.

- MA CEC summary of residential, business, and government/non-profit solar incentives and programs: https://www.masscec.com/get-clean-energy
- MA CEC Solarize and Heat Smart Toolkit: https://www.masscec.com/solarize-heatsmart-toolkit

Massachusetts Offers Rebates for Electric Vehicles (MOR-EV)

As stated on its website, "the Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program aims to provide air pollution emission reductions for the Commonwealth by increasing the use of electric vehicles." Current rebates for light duty vehicles are $1,500 for hybrid vehicles and $2,500 for battery electric vehicles. Current rebates for heavy duty vehicles are $7,500 - $90,000 depending on the weight class of the vehicle.

- Website: https://mor-ev.org

Municipal Programs and Initiatives

Cities and towns have several potential programs that they can enact to support the state's greenhouse gas reduction targets. Potential programs include approving property assessed clean energy financing, adding home energy scores in assessor data,

Property Assessed Clean Energy (PACE)

As described on the MA Development website, the idea behind property assessed clean energy (PACE) is "to finance energy improvements through PACE Massachusetts, a property owner agrees to a betterment assessment and lien on their property, which repays the financing. This approach enables owners to undertake more comprehensive energy upgrades with longer payback periods of up to 20 years. At property sale, the assessment stays with the property and is transferred to subsequent property owners."

Individual cities and towns must approve this financing mechanism before it can be used. Approval requires a majority vote by the City Council or Board of Selectmen. As of April 2022, 52 cities and towns have endorsed the use of PACE in their communities. This program is only available for commercial, industrial, and multifamily properties with more than 20,000 square feet and is often referred to as C-PACE (C stands for commercial). A residential program (R-PACE) is under consideration (as of April 2022) by the state legislature.

- Mass Development's website for more information about this program: https://www.massdevelopment.com/pace

Home Energy Scores

The US Department of Energy (US DOE) has created and supports a home energy score program designed for energy auditors and building assessors. The idea behind the energy score program is that building assessment data can provide accurate energy scores for single family homes. This program is an excellent potential resource for communities that would like to provide energy performance information for all households. In addition, with permission from each household, information collected as part of the energy score process can be used to inform the

town about the community's residential building energy upgrade needs. Future building assessments would be able to monitor the community's transition to lower residential sector carbon emissions.

The links below include more information about US DOE's Home Energy Score, a white paper regarding the legality of and opportunities for home energy scores tied to assessor databases, and an article that describes Newton's Home Energy Ratings assessor database initiative.

- US DOE Home Energy Score website: https://betterbuildingssolutioncenter.energy.gov/home-energy-score
- 2013 White Paper on Assessor databases and energy scores: https://d1o0i0v5q5lp8h.cloudfront.net/earadv/live/assets/documents/Publications/EnergyRatingsOnPropertyTaxRecords-%20FINAL-140203.pdf
- Newton, MA posts home energy scores on its assessor database. Here's an article written about it: https://village14.com/2020/10/31/home-energy-scores-now-available/

Regulation & Legislation

Massachusetts municipalities have enacted several binding and non- binding energy and greenhouse gas reduction bylaws and regulations. Following are a few examples:

- Acton, MA - Climate emergency - 0% GHG emissions by 2030 https://www.actonclimatecoalition.org/emergency/. Lexington has a similar proposal for Town Meeting with a 2035 0% emissions target.
- Bedford, MA Electricity aggregation – Offer more renewable electricity https://www.bedfordma.gov/home/news/bedford-community-choice-aggregation
- Boston, MA – Building Emissions Reduction and Disclosure Ordinance (BERDO). Reporting requirements for commercial and industrial facilities larger than 20,000 square feet. Greenhouse gas emission reduction requirements are in development and scheduled to begin in 2022. https://www.boston.gov/departments/environment/berdo-regulations-development
- Lexington, MA - Gas-powered lawn equipment ban approved in 2021. https://www.lexingtonma.gov/sites/g/files/vyhlif7101/f/uploads/motion_art_10_noise_landscape_revised_11.18.21_11.03pm_final.pdf.
- Lexington, MA – and other communities are voting locally to assess opportunities to require clean heating, cooling, and domestic hot water equipment for new installations. Home Rule for Clean Heat (2022) https://www.cleanheatlexington.org/resources/HomeRuleCleanHeat
- Lincoln MA - Town Facilities Energy Performance Standard (2011), a measure for new construction and major renovation energy performance criteria with a sliding scale net-zero fossil fuel target by 2030. https://www.lincolntown.org/DocumentCenter/Index/43
- Lincoln MA - Solar PV zoning bylaw (2016) http://www.lincolntown.org/DocumentCenter/View/26987/Solar-energy-bylaw-amendment-proposal-12212016?bidId=

- Wellesley, MA - and other communities are developing green zones for municipal land that comply with the American Green Zone Alliance (AGZA) https://theswellesleyreport.com/2021/02/wellesley-dpw-eyes-parks-as-green-zones/

National Grid

National Grid Commercial and Industrial Services

National Grid offers custom support small, medium, and large businesses and multifamily buildings (more than 5 apartments). All their programs are available at: https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/

National Grid is beginning to work with individual communities to develop nonbinding community energy efficiency initiatives. The MOUs list specific energy reduction targets over a set period – usually 3 three years. Newton has published its MOU with Eversource and National Grid at: https://www.newtonma.gov/home/showpublisheddocument/78256/637743892757170000

In addition, National Grid has several EV charger initiatives: https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/Electric-Vehicle-Charging-Station-Program

Appendix C: Renewable Energy Portfolio Standard (RPS) and Clean Energy Standard (CES)

A major variable in community decarbonization planning is the amount of renewable and clean energy that will be available from the electrical grid. Massachusetts has increased the amount of renewable energy and clean energy dramatically beginning with the Electricity Restructuring Act of 1997. Following is a summary of the state's legislative efforts to date as reported by MA DOER in its 2019 Annual Compliance Report (November 16, 2021)[21].

Legislation

"The Renewable Energy Portfolio Standard (RPS) Class I is a statutory obligation created by the Electricity Restructuring Act of 1997 and activated by regulations in 2002. The statute was first revised by the Green Communities Act of 2008, which added a second class of RPS, Class II, and the Alternative Energy Portfolio Standard (APS).

The RPS and APS statutes were further modified by the Competitively Priced Electricity Act of 2012, the Renewable Thermal Act of 2014, the Energy Diversity Act of 2016, the Act to Advance Clean Energy of 2019 [and *An Act Creating A Next-Generation Roadmap for Massachusetts Climate Policy* of 2021].

In 2018, the Clean Energy Standard (CES) was successfully introduced to complement the other standards. The CES is administered by the Massachusetts Department of Environmental Protection (MassDEP).

The Clean Peak Standard (CPS), part of An Act to Advance Clean Energy which was signed into law in August 2018, provides incentives to clean energy technologies that can supply electricity or reduce demand during seasonal peak demand periods."

Minimum Standards

"The RPS requirements began in 2003 with an obligation of 1% of total retail electricity sales and increased 0.5% annually until it reached 4% in 2009. From 2010 to 2019, the RPS Class I obligation has increased 1% annually. The RPS Class I minimum standard was 14% in 2019.

Since 2010, the RPS Class I minimum standard has included a SCO [solar carve out] obligation for in-state solar generation. The minimum standard obligation for the SCO and its 2014 successor program, SCO II, change annually by formulas set in regulation.

The RPS Class II renewable energy obligation changes annually per a schedule and formula set in regulation, with a cap of 3.6%. The RPS Class II waste-to-energy obligation is fixed at 3.5% annually. The APS obligation, which was 4.75% in 2019, increases by 0.25% per year. The total obligation for the CES was 18% in 2019, though it is inclusive of the RPS Class I minimum standard. Therefore, the additional obligation from the CES was 4% in 2019. The CES increases by 2% per year."

[21] https://archives.lib.state.ma.us/bitstream/handle/2452/855691/on1300228336-2019.pdf?sequence=1&isAllowed=y

Eligible Resources

"Eligible RPS Class I resources include post-1997 renewable generation units located in New England or in adjacent electricity control areas. Eligible resources for RPS Class II Renewable Energy include pre-1998 renewable plants (primarily small hydropower) located in New England or in adjacent electricity control areas. Eligible Class II waste-to-energy Generation Units must be pre-1998 waste-to-energy plants located in Massachusetts and meet certain MassDEP recycling requirements."

2019 Renewable Energy and Clean Energy Minimum Standards and Compliance

The table below summarizes the minimum standards and compliance by all Massachusetts utility companies and 64 supply vendors in 2019 as reported by MA DOER:

Summary of Minimum Standards, Certificates Used to Meet Obligation, and Alternative Compliance Payments in 2019 (Net of non-compliant Suppliers)

RPS/APS Class	Minimum Standard *	Total Obligation (MWh)	Certificates Used to Meet Obligations (MWh)	ACP Credits Used to Meet Obligations (MWh)	Alternative Compliance Payments
RPS CLASS I (NET)	8.4912%	3,796,084	3,723,951	9	$ 634
RPS SCO *	1.7455%	780,339	741,343	23,868	$ 9,642,672
RPS SCO II *	3.7633%	1,682,417	1,642,310	46,763	$ 15,572,079
RPS CLASS II Renewable	2.6884%	1,201,860	1,165,729	12,602	$ 364,324
RPS CLASS II Waste-to-energy	3.5001%	2,123,562	1,511,623	22,552	$ 262,289
APS	4.7501%	2,073,066	2,073,066	8,880	$ 208,864
CES **	3.2759%	1,464,505	1,406,167	23,675	$ 1,429,842
TOTAL***	**28.2145%**	**13,121,833**	**12,264,189**	**138,349**	**$ 27,480,704**

* Solar carve out requirements are subsets of the overall RPS Class I requirement of 14%
** CES total obligation is 18%. The RPS Class I obligation counts towards meeting the overall obligation making the Incremental minimum standard 4%.
*** Total number of certificates and ACP credits does not exactly match total obligation due to 1) rounding of individual obligations, and 2) the non-compliance of four suppliers (See Appendix Two: COMPLIANCE FILINGS, REVIEW, AND VERIFICATION) Certificates Used to Meet Obligations includes banked certificates from prior compliance years.

Appendix D: Table and Figure Sources and Assumptions

Following are descriptions of the sources and assumptions behind the information shared in this report. The primary source for greenhouse gas (GH emission information comes from the Metropolitan Area Planning Council's (MAPC) greenhouse inventory tool. MRPC filled out the necessary input information for Athol in February 2022. MAPC has a step-by-step instruction guide for the Excel spreadsheet at:

http://www.mapc.org/wp-content/uploads/2020/03/04102020_MAPC-Step-by-Step-GHG-Inventory-Guide.pdf

The guide includes descriptions of the source information that we have included below. In addition, MRPC generated its own spreadsheet to leverage the greenhouse gas information in MAPC's tool into the tables and charts that we've included in this report

Table 1 Greenhouse Gas emissions by community sector

Greenhouse Gas emissions for table 1 come directly from MAPC's GHG inventory tool that MRPC filled out in February 2022. "The Tool includes default annual emissions factors from MassDEP's GHG emissions reporting summaries."

Table 2. Energy use sources by community sector

Energy use information for table 2 comes from MAPC's GHG inventory tool that MRPC filled out in February 2022.

> **Electricity and Natural Gas –** "As of 2015, all of the investor-owned utilities ("IOUs") in Massachusetts have been publishing electricity and natural gas consumption data broken out by municipality online. MassSave Data provides community-wide kWh and therm usage by year. [The data is] broken out by **Residential and Low Income** and **Commercial and Industrial** customer segments."
>
> https://www.masssavedata.com/public/home
>
> **Other energy use** – Other energy use is estimated based on state and federal average use per home or per employee.

Tables 3 & 4. Residential energy use

The number of homes in specific housing types and the source of residential heating use comes from two tables in US Census Bureau data on household heating fuel from the American Community Survey. The number of homes by residential category type comes from the data table **Housing Tenure by Units in Structure, aggregated at the municipal level**. The percent of homes heated by specific fuel types comes from the data table **Housing Tenure by Fuel Type.**

Electricity and natural gas use per residential building category comes from dividing the total energy use by the number of homes listed for each residential building category.

Table 5. Total commercial building energy use

The number of commercial and industrial employees comes from Massachusetts Executive office of Labor and Workforce Development (EOLWD) Employment and Wages (ES-202) data.

"For commercial and industrial heating fuel oil use the Tool calculates a share of the statewide heating oil usage, based on number of businesses and industries located within the municipality."

electricity and natural gas use per commercial and industrial building category comes from dividing the total energy use by the number of employees listed for each commercial and industrial building category.

Table 6. Residential building estimated fuel conversion equipment costs

The residential fuel conversion equipment design load is calculated based on 35 Btus per square foot and 150% heat pump design condition efficiency. The design load is then multiplied by the cost per ton listed at the top of each column. The average design load assumes a significant investment in energy efficiency upgrades. The cost for the efficiency upgrades is not included in the conversion cost. The cost per ton figures are rough rules of thumb and will vary significantly for individual projects.

Table 7. Commercial building estimated fuel conversion equipment costs

MAPC's GHG Inventory tool doesn't have access to commercial and industrial total floor area. To calculate the commercial and industrial fuel conversion equipment design loads, we've used the total MMBtu to design heat pump output ratio for multifamily buildings and applied it to the commercial and industrial buildings. The design load is then multiplied by the cost per ton listed at the top of each column. The average design load assumes a significant investment in energy efficiency upgrades. The cost for the efficiency upgrades is not included in the conversion cost. The cost per ton figures are rough rules of thumb and will vary significantly for individual projects.

Table 8. Passenger and commercial vehicle miles & fuel use

The number of vehicles and associated miles and fuel use data are from Massachusetts Vehicle Census on MAPC's online Data Common resource. The most recent data is from 2014.

Table 9. Off-Road Carbon Emissions

According to MAPC's GHG Inventory guidebook, "GHG emissions from off-road mobile activities are categorized according to how they occur. There are two sources of off-road mobile emissions that are of primary concern locally – these are emissions from landscaping, construction, and manufacturing activities. These GHG emissions are included in the Stationary Energy sector because the combustion of fuel is localized and occurs off public roadways." The data was generated by US EPA and made available by MAPC.

> **Commercial, Industrial, and Manufacturing data** are derived from the U.S. Census Data Set "CB1700CBP" titled "All Sectors: County Business Patterns by Legal Form of Organization and Employment Size Class for U.S., States, and Selected Geographics: 2017"
>
> **Estimated landscaped area** square footage data on MAPC's online Data Common resource. The most recent data is from 2017.

County level carbon emissions data is from the MOVES emissions data on MAPC's online Data Common resource. The most recent data is from 2017. The GHG tool then reduces the county data to town data based on the percent of jobs or landscape area associated with the individual city or town.

Figure 2. Total Fuel Decarbonization

This chart reflects the net reduction in fuel-based energy use in MMBtus assume fuel-based energy use conversions to high efficiency electric equipment and vehicles at the 5-year conversion rates listed in the report.

Table 10. Renewable Energy and Clean Energy Portfolio Standard generation targets

See the detailed description of the Renewable Energy (RPS) and Clean Energy (CES) Portfolio Standards in Appendix B.

Figure 3. Projected electricity load and fuel mix

This chart assumes 5-year building and vehicle conversion rates of about 5% by 2025, 15% by 2030 and 2035, 20% by 2040 and 2045, and an additional 5% conversion in 2050 for a total conversion rate of about 90% by 2050. In addition, the chart assumes default electricity from National Grid. Building equipment electricity use conversions assume an average 250% equipment efficiency. Vehicle electric use conversions assume an average 40% gasoline engine efficiency, 45% diesel engine efficiency, and a 90% electric motor efficiency.

Tables 11 & 12. Solar PV area, output, and potential costs

We've used the National Renewable Energy Lab's (NREL) PVWatts online calculator to determine the estimated electricity output of potential solar PV installations: https://pvwatts.nrel.gov. Costs per peak kW are the range of recent solar PV solar projects that the author was able to identify.

Residential Solar PV – The total solar PV area estimate for all potential residential solar PV assumes 20% of the total floor area divided by 2 (floors) is available for solar PV.

Parking Lot Solar PV – Parking lot area is a target figure for preliminary discussion. Actual parking lot solar PV sites will need to be identified and total area confirmed.

Commercial Solar PV - Commercial-scale ground mounted lot area is a target figure for preliminary discussion. Actual ground-mounted lot solar PV sites will need to be identified and total area confirmed. The sites can be single 100-acre locations or multiple lots of 5-10 acres or more. We assume that these sites would be financed, and the electricity offered as part of a power purchase agreement (PPA) or community solar project.

Figure 6. Total carbon emissions reduction

This chart summarizes the total carbon emissions reduction impact based on all the assumptions and actions included in this report.

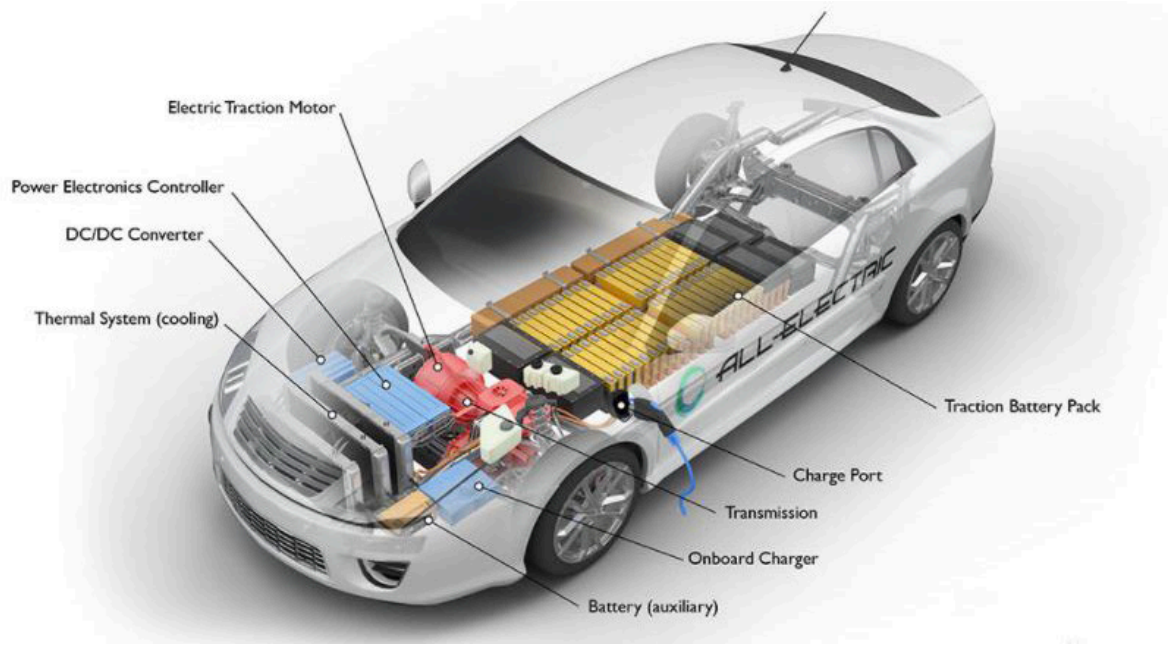
Appendix E: Electric Vehicles and Charging Stations

The evolution of lithium-ion batteries and concern regarding carbon emission-related climate change have inspired a major transition from internal combustion engine powered vehicles to high efficiency powered vehicles. This section provides a short description of electric vehicles (EV), EV charging stations and the current number of light duty, heavy duty, and off-road vehicles garaged in Athol.

Electric Vehicles and Charging Stations 101

Electric vehicles currently come in three forms, hybrid (HEV), plug-in hybrid (PHEV), and full battery (BEV). A hybrid vehicle generates electricity from the vehicle's internal combustion engine. A plug-in hybrid vehicle generates electricity from the vehicle's internal combustion engine and from an electric outlet. A battery electric vehicle receives energy exclusively from an electric outlet. Figure 1 below represents a full battery electric vehicle.

Figure 1. Battery Electric Vehicle [22]



PHEV and BEV cars and trucks require special electric plugs to charge their batteries. Figure 2 explains the most common types of electric charger connections and the charging speed for each charger type.

[22] U.S. Department of Energy. How Do All-Electric Cars Work, https://afdc.energy.gov/vehicles/how-do-all-electriccars-Work

Figure 2. EV charger connections and charging speeds [23]

	Level 1	Level 2	DCFC		
Description	120 volt (V) alternating current (AC) plug, single phase service 12-16 amp (A)	208/240V AC plug, single phase service 12-80A	208/480V AC circuit, three-phase service connection 50-200A		
Connector Type(s)					
	J1772 charge port Standard Wall Outlet	J1772 charge port	Combined Charging System (CCS)	CHAdeMO	Tesla
Typical Use Cases	Light-duty EVs; residential, workplace	Light and medium-duty EVs; residential, workplace, public charging, fleets	Light, medium, and heavy-duty EVs; public charging, fleets		
Typical Charge Time (for light-duty EVs, varies based on battery size)	2-5-miles/1 hour of charging PHEVs can be fully charged in 2-7 hours; BEVs in 14-20+ hours.	10-20 miles/1 hour of charging PHEVs can be fully charged in 1-3 hours; BEVs in 4-8 hours.	60-80-miles/20 min of charging BEVs can be fully charged in 30-60 minutes.		

Electric Vehicle Charging Stations in Athol

The challenge for Athol with EV charging stations will be to anticipate when to install and how to pay for, locate, and manage enough electric charging stations to serve all the town's vehicle owners and visitors. Athol will either need to purchase and place electric charging stations in convenient locations or support other public/private efforts to install electric charging stations and get approval to connect them to the utility grid.

We recommend that Athol develop a charging station plan for 100% community-wide electric-vehicle market penetration for the town. Athol can then work backwards to determine the location for Athol's first wave of electric charging stations. Rapid changes in EV vehicle technology combined with the investment in EV charging stations included in the recently approved Infrastructure bill will undoubtedly create a long-term need for more electric charging stations.

As part of its EV charging station deployment plan, Athol will need to develop a load management plan with National Grid with this information and coordinate a phased installation plan with the utility company. Charging multiple vehicles rapidly and concurrently will add significant electrical load to the existing utility distribution infrastructure. On a more positive

[23] U.S. Department of Energy. Developing Infrastructure to Charge Plug-In Electric Vehicles, https://afdc.energy.gov/fuels/electricity_infrastructure.html

note, connecting multiple electric vehicles with large batteries to the utility distribution system will also offer significant load management opportunities. Total electricity use will increase but the number of electricity generation sources may be possible to manage with smart EV charging practices and electricity storage.

EV Charging Station Needs

The four primary groups of vehicle use, and related EV charging needs include residential, workplace, municipal, and opportunity charging. Figures shows the residential, commercial, and industrial zoning districts in Athol.

Residential

Most residents will charge their electric vehicles at home. However, not every resident in Athol has access to off-street parking. Residents without off-street parking will need to find alternative means to charge their cars.

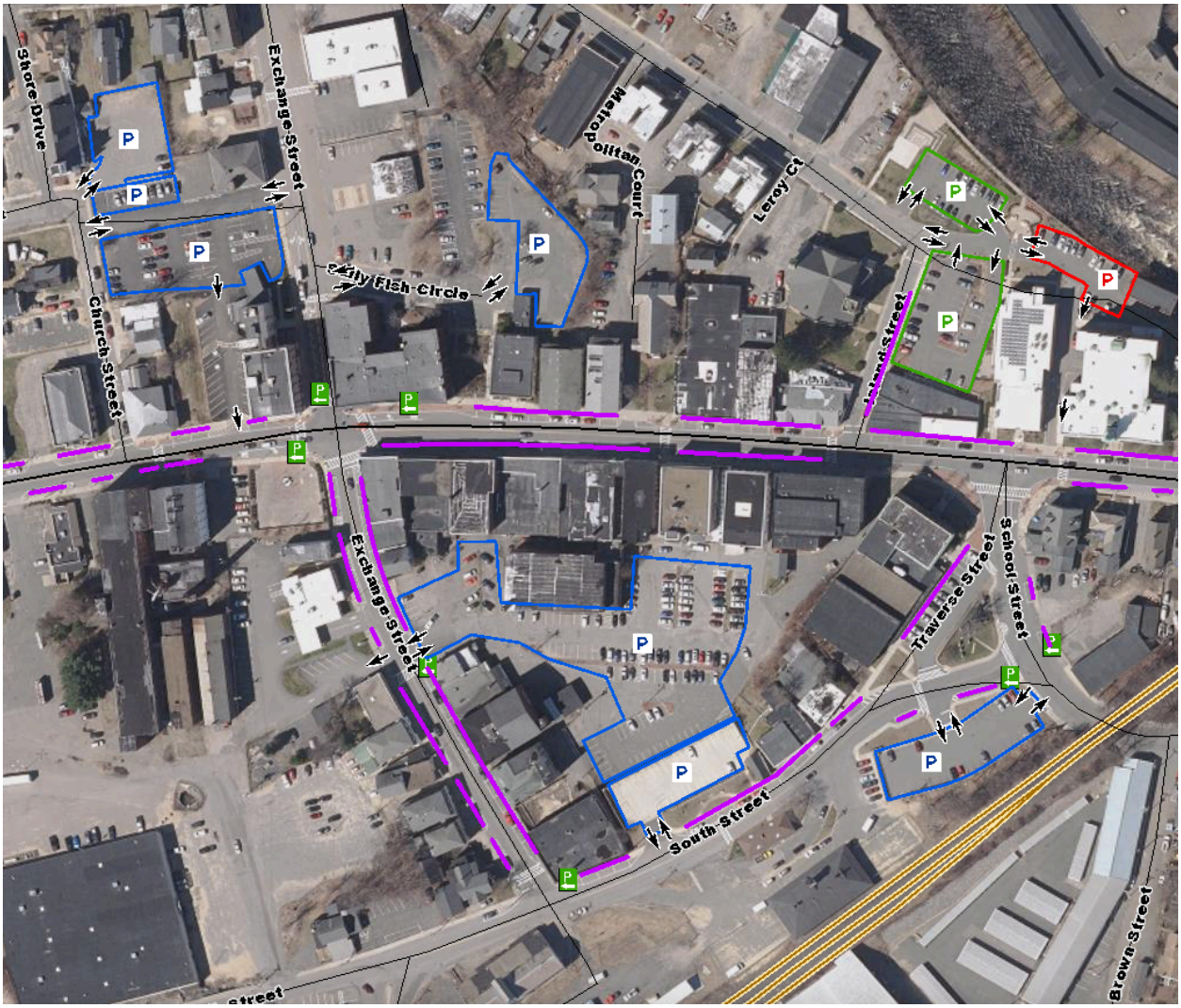
Figure 3 is a street view of Washington Street in downtown Athol. As the photograph indicates, the residences have both on-street and off-street parking.

Figure 3. Rindge Avenue on-street parking

Workplace

Workplaces offer electric vehicle charging opportunities for employees, visitors, and workplace-related vehicles and off-road equipment. Athol has several commercial and industrial zoning districts. Figure 4 includes the downtown Athol parking lots.

Figure 4. Downtown Athol parking



Municipal

Athol has its own fleet of vehicles to consider and transition to electric and other zero emissions vehicles. Concord, MA prepared an implementation study[24] for its municipal vehicles that can serve as an example how Athol can plan to install EV chargers for its municipal fleet.

[24] https://concordma.gov/DocumentCenter/View/36769/Concord-Electric-Vehicle-Charging-Infrastructure-Study-Final?bidId=

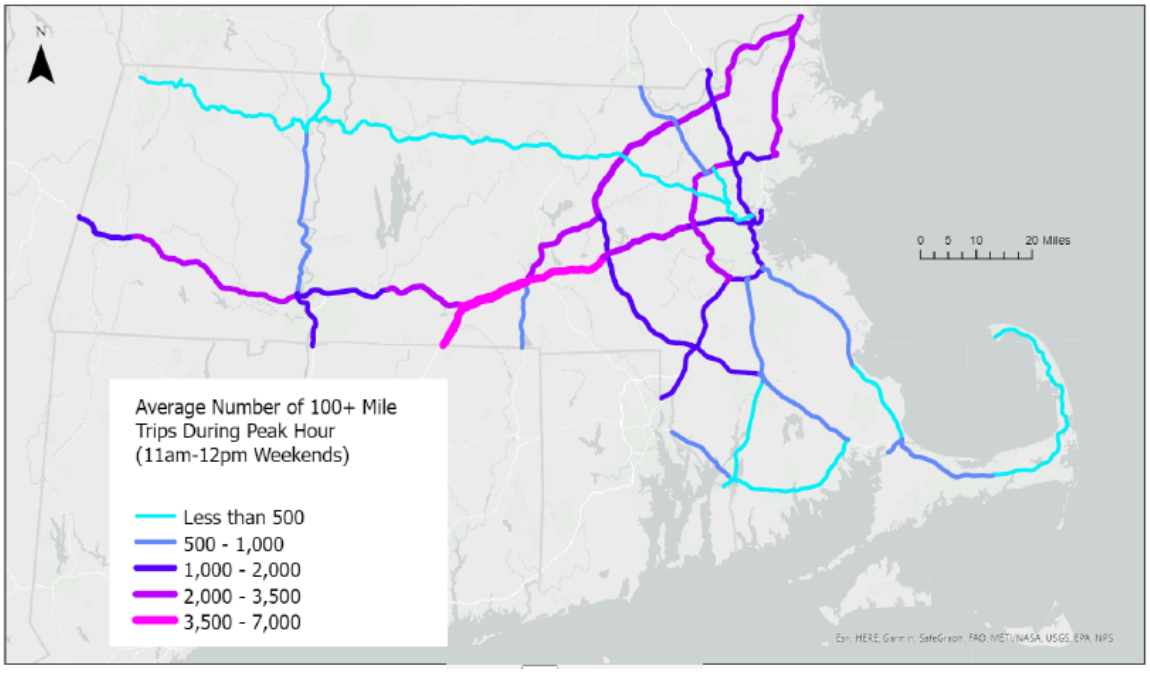
Opportunity

Athol is a destination point for tourists and other local and regional visitors. The town has already installed Level 2 EV charging stations in its municipal parking garage for visitors. In addition, Athol is strategically located on the I495 and I95 and transportation corridors. Level 2 chargers will offer short term visitors a slight increase in their electric vehicle range. However, Athol will require more robust level 3 chargers to meet the in-transit needs of fully electric vehicles.

Figure 5 indicates that Athol is in an area next to I95 with a high number of 100+ mile trips during peak weekend travel hours.

Figure 5. [25]

Figure 12: AFC Network Corridors by Volume of Long-Distance Trips



Source: StreetLight Analytics and MassDOT

Community EV Charging Station Planning and Criteria

From a project management and public acceptance perspective, Athol may want to augment broad, even EV charger distribution with concentrated support for individual neighborhoods and businesses that offer to step forward and accelerate electric vehicle adoption. The goal of this approach would be to accelerate the path to 25% EV market penetration for individual neighborhoods and the associated tipping point of full electric vehicle acceptance.

[25] https://www.mass.gov/service-details/deployment-plan-for-massachusetts

Financial Assessment

The economics of EV charging remains challenging. The three categories of EV charging stations include Level 1, Level 2, and Level 3. Figures 6 & 7 includes graphic representation of these three levels of charging and the associated charging range per hour that each charging level offers.

Figure 6. Examples of Level 1,2,3 charging stations

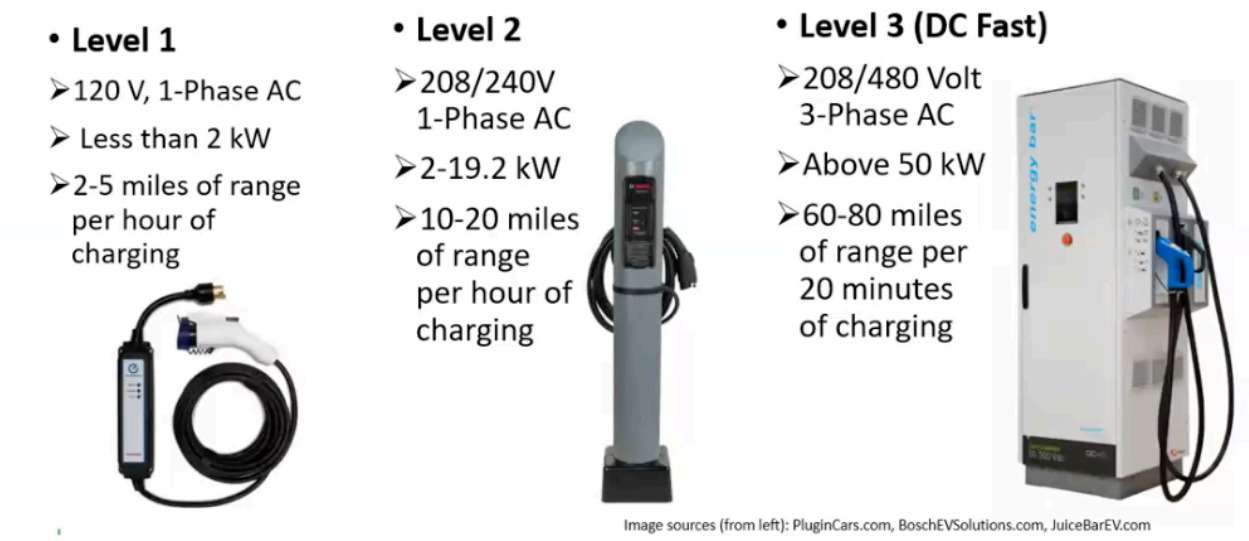


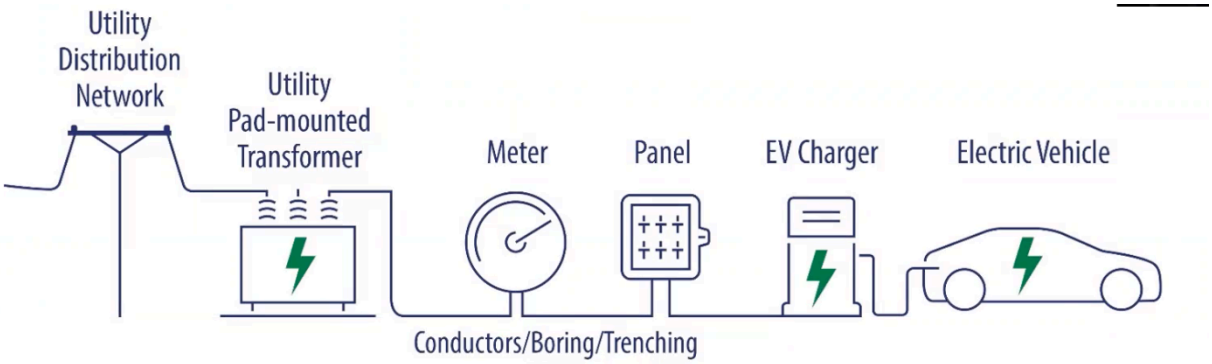
Figure 7. 2020 EV charger cost estimates

Item	Minimum Cost Estimate (Per EVSE)	Maximum Cost Estimate (Per EVSE)
Level 2	$400 (Residential), $2,500 (Commercial)	$6,500
DCFC (50 kW)	$20,000	$35,800
DCFC (150 kW)	$75,600	$100,000
DCFC (350 kW)	$128,000	$150,000

EVSE = electric vehicle supply equipment

In addition to charger procurement costs, EV charger stations have utility-related and vendor installation costs. Figures 8 & 9 include these cost considerations.

Figure 8. Utility company costs for EV chargers



Unit Cost Estimate for a 25 kVA Transformer	Unit Cost Estimate for a 2500 kVA Transformer
$3,853	$164,550
Minimum Cost Estimate for Reconductoring	**Maximum Cost Estimate for Reconductoring**
$260 per foot	$780 per foot

Figure 9. 2020 EV charger installation and miscellaneous equipment and service cost estimates

Installation Costs

Item	Minimum Cost Estimate	Maximum Cost Estimate
Level 2 Charger Installation	$600/EVSE (Residential)	$6,650/EVSE (Commercial)
DCFC Installation	$20,000/EVSE	$94,000/EVSE

Misc. Equipment and Services Costs

Item	Minimum Cost Estimate	Maximum Cost Estimate
Data Contract	$84/year/EVSE	$240/year/EVSE
Network Contract	$200/year/EVSE	$250/year/EVSE
Credit Card Reader	$325/unit	$1,000/unit
Cable Cost	$1,500/unit	$3,500/unit

The other financial consideration is the cost that EV drivers pay to charge their cars. The Boston Globe recently highlighted cost increases and differences in charging rates for Level 3 chargers in Massachusetts.[26] The authors found wide discrepancies in the rate that EV Charger owners charged customers and the mechanism for charging customers. We assume that charging rates

[26] https://www.boston.com/news/the-boston-globe/2023/03/27/electric-vehicle-charger-pricing/?p1=hp_secondary

will be an ongoing work in progress but should be something that the town should keep an eye on for potential communications or municipal action.

Policy Assessment

Massachusetts has three key strategies to expand the number of electric and alternative fuel vehicles in the state that Athol should be aware of:

1. The Commonwealth's goal is to follow California's lead and require 100% passenger EV's by 2035. ZEV Truck sales begin in 2025.
2. The Commonwealth will reform and expand its electric vehicle incentives.
3. The Commonwealth will implement programs to electrify vehicles for hire and local delivery services.

Simply put, Massachusetts intends to have as many electric vehicles as possible on the road as soon as possible. In addition, Massachusetts has strategies to build electric vehicle charging stations and encourage smart charging.

- The Infrastructure Investment and Jobs Act (IIJA) provides approximately $60 million over five years to Massachusetts to fund fast charging stations along major highway corridors. The IIJA also provides the Commonwealth with competitive grant funding opportunities to support community-based charging locations.
- Massachusetts will encourage private investment through competitive bids for community-based DC current fast charge stations with pilot grants. EEA and DOER will leverage pairing charging stations with solar PV and electrical storage systems.
- EEA and DOER will develop a model building code for municipalities that requires make-ready charging in all new commercial and residential buildings.
- The DPU recently approved[27] $400m for electric utility companies to pay for all or most of the cost to install EV charging stations in public and many private locations.

Athol should and can anticipate a surge in electric vehicle use soon and should adopt municipal regulations to support this transition. In addition, Athol should communicate directly with residents in support of the state's efforts to increase electric vehicles. Potential Municipal Action(s) include:

- Assign a task force with representatives from the Planning Department, DPW, Energy Committee, and National Grid to assess and recommend a municipal-wide EV charging station plan. MVPC may be able to assist as well with its regional EV charger planning tool. The task force will review options to accelerate multifamily, community-based fast charge DC stations, fleet EV stations, and managed home charging stations.
- Request DPW to solicit private sector bids for community-based DC fast charge stations paired with solar PV and electrical storage systems.
- Adopt MassEEA and MassDOER's model building code that requires make-ready charging in all new and major renovation commercial and residential buildings.

The StanCOG study offers the following additional suggestions:

[27] https://blog.greenenergyconsumers.org/blog/400-million-for-electric-car-charging-in-massachusetts

- Develop supportive parking and zoning bylaws.
- Streamline permitting of EV charging equipment.

Further afield, the UK[28] offers these observations and municipal policy suggestions:

- Local authorities are responsible for overarching planning policies in their areas, including street alternations and parking.
- In Great Britain, they also own lampposts and bollards, which can be adapted to incorporate public charging, as already demonstrated in many areas.
- Many local authorities also own local car parks, which can be adapted to include local charging infrastructure.
- Importantly, local authorities understand the transport needs of their local population, which they should be considering as part of transportation planning.

Sample municipal language is available at:

- Southern Main Council of Governments model municipal bylaws:

  https://www.mainecleancommunities.org/municipal-ev-toolkit

- Cape Cod Commission model municipal bylaws

  https://www.capecodcommission.org/our-work/model-municipal-electric-vehicle-bylaw

Athol should be aware that EV charging station issues do arise and sometimes require follow up attention. Vandalism is a potential concern, network system failures occur, and multiple charging station ownership can lead to poor EV Charging station interoperability. These issues should resolve themselves over time, but the EV charging station industry is still early in its development.

Creative EV Charging Solutions

While researching information for this report, we identified several promising and creative EV charging solutions. They include telephone pole-mounted EV charging stations, bollard-stye EV charging stations, and vehicle-to-grid EV charging stations.

Pole-mounted EV charging stations

National Grid and Melrose, MA piloted a good example of telephone-pole mounted EV chargers.

[28] https://www.gov.uk/guidance/electric-vehicle-charging-infrastructure-help-for-local-authorities

Figure 10 includes a photograph of one of these EV charging stations.

Figure 10. Melrose pole-mounted EV charger

From a utility company's perspective telephone-pole mounted EV chargers are an obvious choice to bring offer municipal EV Charger programs. The equipment is installed close to power lines that it owns and on poles that they either own or share ownership. The equipment is less vulnerable to vandalism but can still be accessed by standard electric distribution system equipment. The installation cost is predictable and repeatable and faulty equipment can be swapped out easily.

From a municipal program perspective, handing over ownership and servicing to a utility company provides an easy solution for communities that are not equipped to handle these services. Communities can also offer these services on municipally owned telephone poles with a third-party provider. Examples of this opportunity include telephone poles located in municipal parking lots or other municipally owned land.

Streetlight and Bollard-style EV charging stations

Municipal streetlights and bollards offer another opportunity for cities to install EV charging stations. In the UK, Siemens Energy has worked closely with an EV Charging company called

Ubitricity to install charging stations in municipally owned streetlights and bollards. In this example, Ubitricity installs charging equipment in existing streetlights or bollards. Residents scan a QR code on the pole, connect their own cable provided by Ubitricity to their car and the pole charger, and then lock their car. Charging stops when the resident unlocks their car. In this model, Municipal electric accounts cover the cost of the EV charging electricity and are reimbursed through Ubitricity's network service.

Figure 11. Ubitricity EV charging station[29]

In another example based in Brooklyn, NY, Itselectric is rolling out bollard-style EV charging stations that offer a similar service to Ubitricity.

Figure 12. Itselectric charging station[30]

[29] https://cleantechnica.com/2020/03/24/siemens-brings-street-light-ev-charging-to-london-neighborhood/
[30] https://theevreport.com/brooklyn-based-itselectric-raises-2-2m-to-offer-curbside-ev-charging-for-cities

Residents sign up for Itselectric's service, plug their cars into outlets on privately owned bollards using cables provided by Itselectric, and are billed directly by Itselectric. However, in this case, private building owners host a separate electric submeter that Itselectric installs on their electric account. Itselectric reimburses the building owner for the electricity used to charge cars and provides an incentive fee for hosting the system.

Vehicle-to-grid charging stations

Large battery systems and/or large numbers of battery systems in vehicles offer an important opportunity to serve as energy storage resources for buildings in addition to the vehicles. This concept is called vehicle to grid EV charging or "V2G" for short.

Ford offers this technology for its F-150 Lightning pickup truck. Ford has developed a fully integrated V2G system for homeowners who upgrade their electrical service and install Ford's V2G charging system. Using this technology, homeowners can run their homes electrical system for several hours when the power goes out by plugging into their truck.

On a larger scale, school buses offer an excellent opportunity to provide similar V2G services for school districts and municipalities. School buses require very large batteries (100-300kW) and usually operate for short durations at very predictable times of the day and during the year. Athol can shape how this opportunity is deployed with its school buses under a direct ownership or contracted service model.

Figure 13. Durango, Colorado school bus V2G installation [31]

[31] https://www.durangoherald.com/articles/durangos-electric-school-bus-is-like-a-huge-battery-on-wheels/

EV Charger Installation Implementation

StanCOG offers eight steps required for municipalities or private entities to install EV charging stations. StanCOG's study provides additional detail and guidance for each of these implementation steps:

1. Site Prioritization: Agree on top priorities for new charging sites.
    - Review high potential sites cross-referenced against available funding programs
    - Check with utilities and charging companies for nearby planned sites
    - Secure agreement from site owner to host charging station
    - Check with site owners and other stakeholders to agree on a set of sites
2. Set budgets
    - Estimate equipment, installation and operational costs
    - Determine additional site needs (e.g., signage, security)
    - Consider including estimate for future needs (e.g., additional chargers, more power)
    - Identify funding sources and apply for funding
    - Determine business model and operational roles (e.g., site owner, government owner, charging company owner)
3. Contract vendors
    - Issue Request For Proposal(s) for site(s)
    - Consider grouping multiple sites for cost advantages
    - Choose vendors for equipment, installation, and (potentially) operation
4. Obtain permits
    - Obtain appropriate permits (e.g., building, electrical, right of way) as needed
5. Install charging stations
    - Vendors install stations
    - Coordinate with utility for infrastructure upgrades as needed
6. Inform public
    - Publicize availability of new (and existing) charging stations
    - Review Education and Outreach section of this report for guidance
    - Confirm the station is included in the Alternative Fueling Station Locator
7. Monitor utilization
    - Track utilization of sites through network providers
    - Consider adding chargers to stations as station utilization nears 50%
8. Update priorities
    - Periodically coordinate with stakeholders to assess adequacy of public charging, determine needs for additional chargers, and prioritize sites

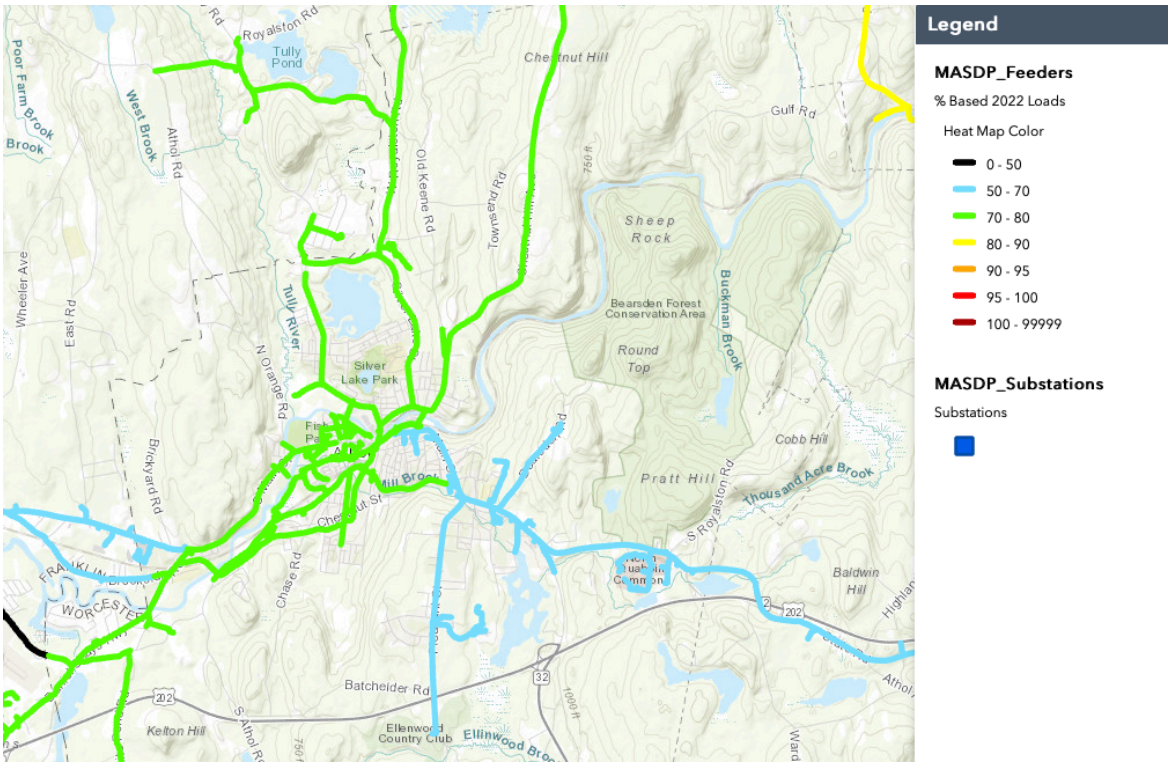
Appendix F: Electrical Grid Considerations and Resources

National Grid has two important electric grid maps that are available online[32]. The first map is located on a tab called “heat map”. Figure 1 is the heat map zoomed in to Athol. The heat map identifies each major electric distribution “feeder” line that runs from National Grid’s substations into each community. The substations are indicated by blue squares. Athol receives electricity from four substations.

The feeder lines are color coded to represent how heavily each feeder line is loaded during peak summer electrical load conditions. Feeder lines that are black or green have room for more electricity use. Feeder lines that are yellow, orange, red, or purple are getting close to or are extended beyond their design capacity. The electrical capacity of the feeder lines in Athol looks good except for the neighborhoods on the south side of the town which are starting to reach their capacity limits.

From a planning perspective, National Grid cannot assume that electrical storage or backup generator systems will be available during a peak draw period. Another consideration is that under current regulations, the customer who requests additional electrical service (e.g., for new heating/cooling equipment or EV chargers) that pushes electrical system needs over the limit of the existing electrical system capacity must pay for the full cost of all system upgrades. Many utility regulations are under review with a target completion date of 2025.

Figure 1. National Grid feeder line capacity in Athol

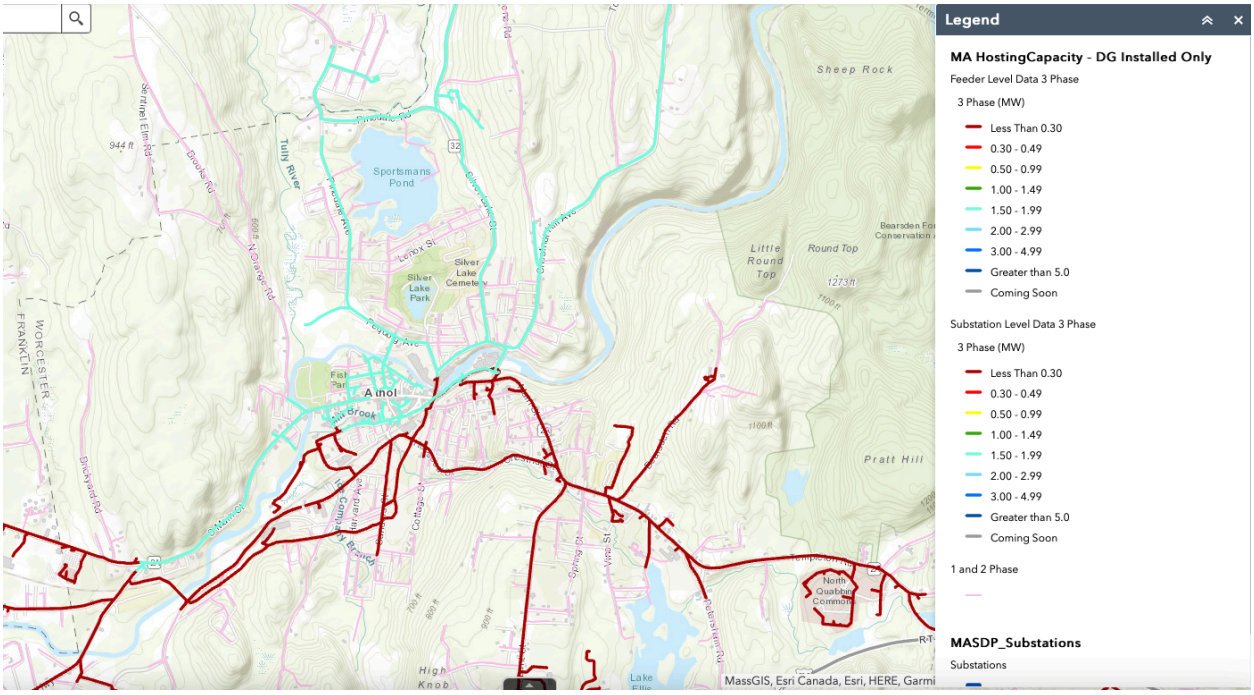


[32] https://systemdataportal.nationalgrid.com/MA/?_gl=1*1u3uges*_ga*ODEyODc2Mjk5LjE2ODAzNjU5OTc.*_ga_FH50R0D4B4*MTY4MDM2NTk5Ni4xLjEuMTY4MDM2NjAyMi4zNC4wLjA.

The second map is located on a tab called “hosting capacity”. Figure 2 is the hosting capacity map zoomed in to Athol. This map identifies all the electrical distribution lines in Athol. Pink lines are 1 and 2 phase electric service lines. 1 and 2 phase electricity lines can support small scale solar PV installations that are less than 15 kW. Larger solar PV systems require 3 phase electrical service. Like the heat map, each feeder line is color coded to suggest the potential amount of capacity that is available on each feeder line for new solar PV installations. Blue lines identify feeder lines with more capacity. Green, yellow, and red lines identify feeder lines with less capacity. Athol has several 3 phase feeder lines that could support additional solar PV installations.

For both the heat map and the hosting capacity map, National Grid recommends contacting the company directly before proceeding with any major electrical projects. There is significant engineering analysis and evaluation associated with keeping the lights on and meeting high power quality requirements for all customers. Additional energy analysis and evaluation may be required for future electrical projects.

Figure 2. National Grid hosting capacity for solar PV electricity generation



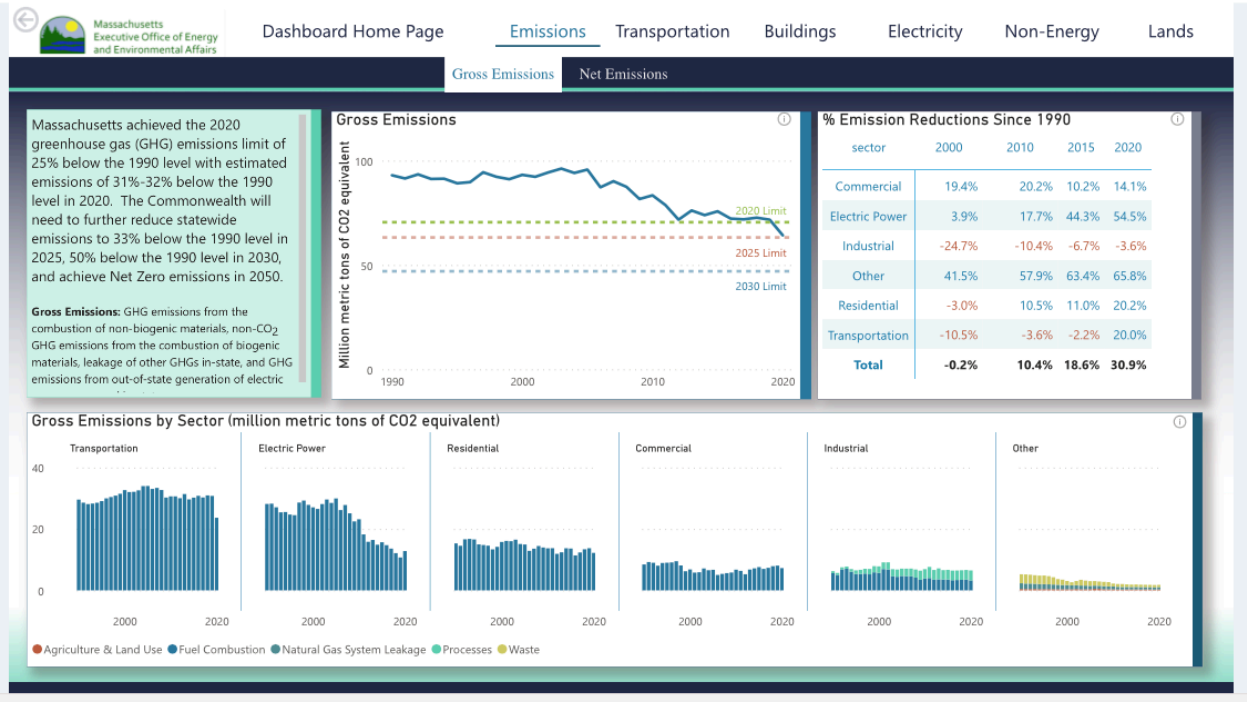
Appendix G: Decarbonization Reports

Monitoring decarbonization progress will be an important task for each community. The State has developed a clean energy dashboard to report progress at the state level. Individual residents and businesses can use tools that are available online to monitor their own decarbonization efforts. Cities and towns can monitor municipal facility and vehicle information is on MA DOER's MassEnergyInsight tool or other online resources. Community-wide monitoring is a little more challenging.

State GHG emissions

MVPC recommends that communities monitor the state's decarbonization progress using MA EEA's GHG emissions dashboard annually.

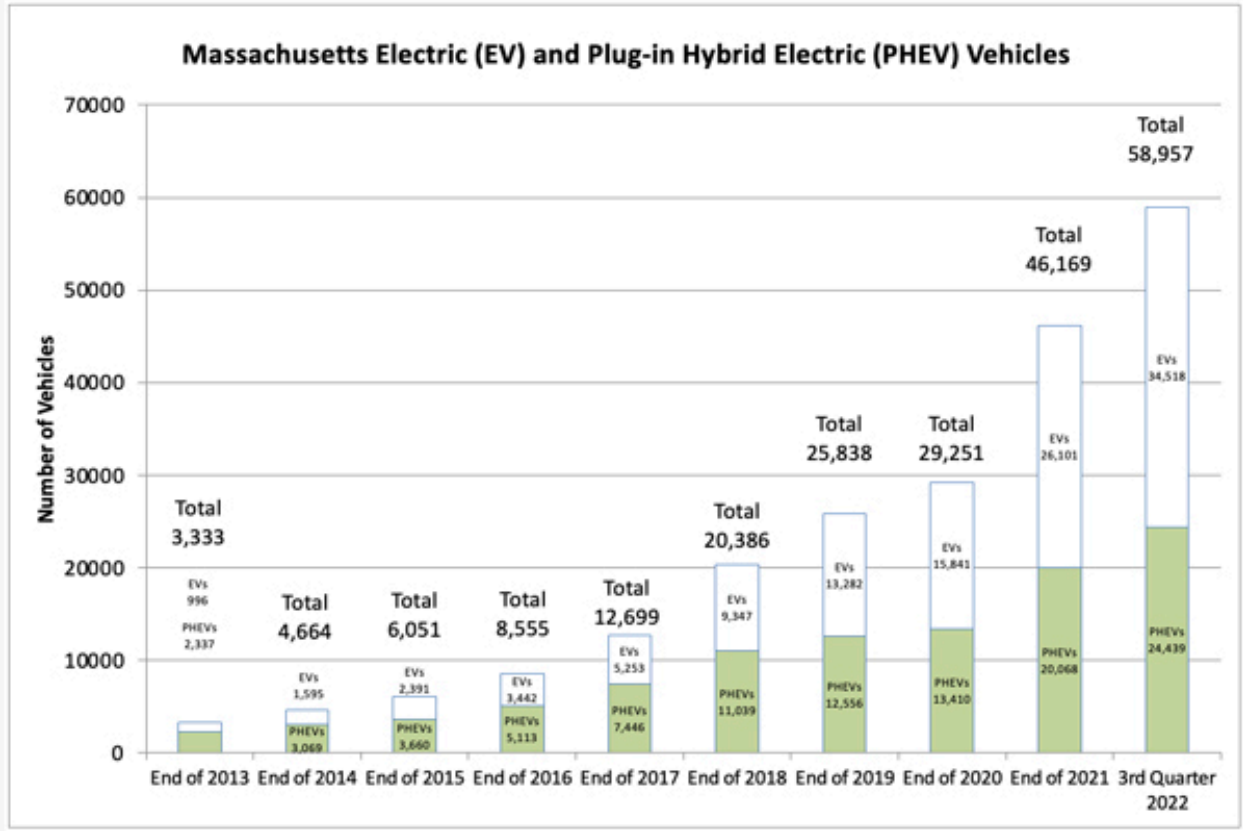
Figure 1. MA EEA's GHG emissions dashboard



https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-metrics

The Massachusetts MOR-EV program also publishes data on incentives received, by both county and zip code: https://mor-ev.org/program-statistics. Note: this is at best a proxy because not all vehicles qualify and not everybody applies for a rebate. But it's still a helpful point of comparison.

Figure 2. MA MOR-EV rebate requests

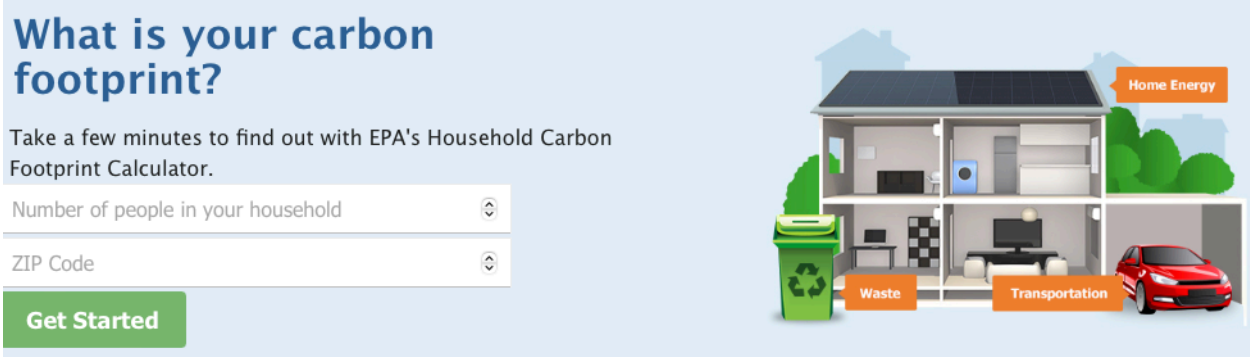


https://www.mass.gov/how-to/apply-for-massevip-fleets-incentives#:~:text=MassEVIP%20Fleets%20is%20a%20MassDEP%20rolling%20grant%20program,depend%20on%20vehicle%20type%20and%20means%20of%20acquisition.

Residential and Commercial GHG emissions

Individual residents and businesses can calculate their own carbon emissions using one of several online resources. Figure 3 includes a screen-print of US EPA's carbon footprint calculator.

Figure 3. US EPA's carbon footprint calculator

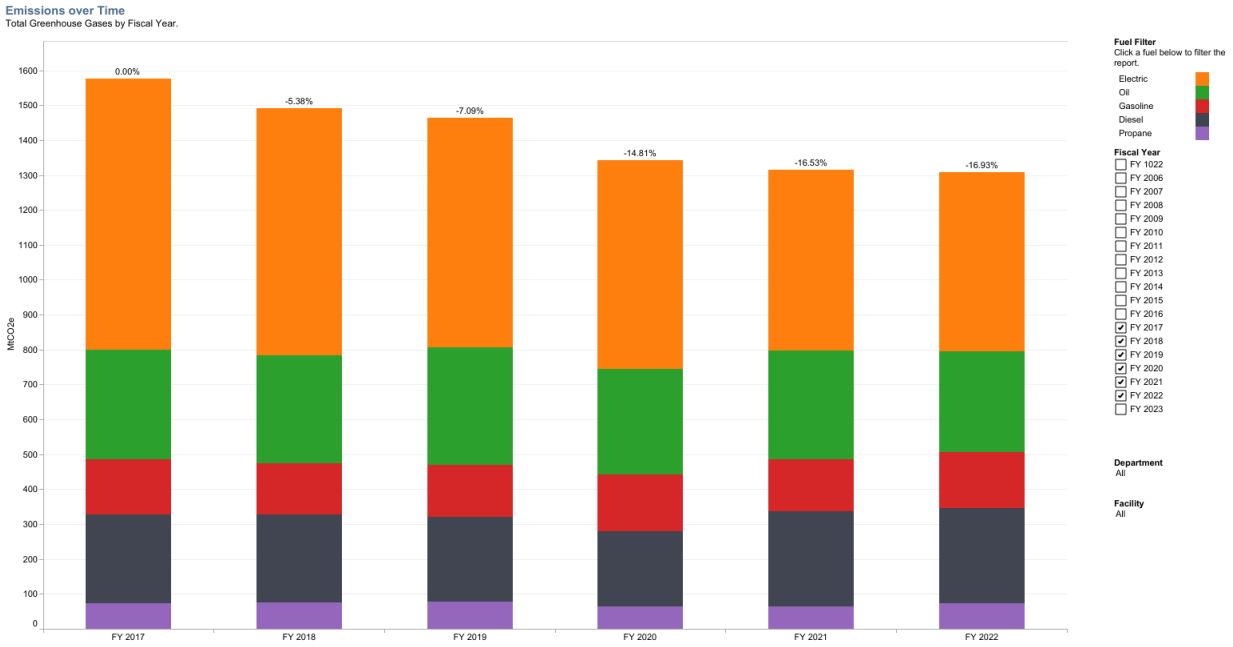


https://www3.epa.gov/carbon-footprint-calculator/

Municipal GHG emissions

Figure 4 is a report from MA DOER's MassEnergyInsight tool for Athol's municipal facility and vehicle carbon GHG emissions reduction from FY2017 to FY2022.

Figure 4. MassEnergyInsight Municipal emissions over time report



Community GHG emissions

As mentioned earlier, community wide GHG emissions monitoring is a little more challenging. Following are graphs that MVPC has produced for Athol that summarize GHG emissions by major category using readily available information. The categories include electricity and natural gas, residential and commercial heat pumps, electric vehicles and EV charging stations, and renewable electricity. The graphs include actual updated information when it was available from Athol's 2017 base year through 2022 and proposed or potential 2025 and 2030 target levels.

Data Sources

- Electricity and Natural Gas community wide information is available from the MassSave Data portal.
- The number of residential and commercial heat pump installations should be available through National Grid and MassSave. This is a work in progress. The other potential source for heat pump installations is the town's assessor department. The type of heating system and fuel source is one of the property characteristics recorded as part of a home or commercial property assessment.
- Electric vehicle data is available from MA DOT and will be even more accessible when MA DOT finishes its vehicle census dashboard:

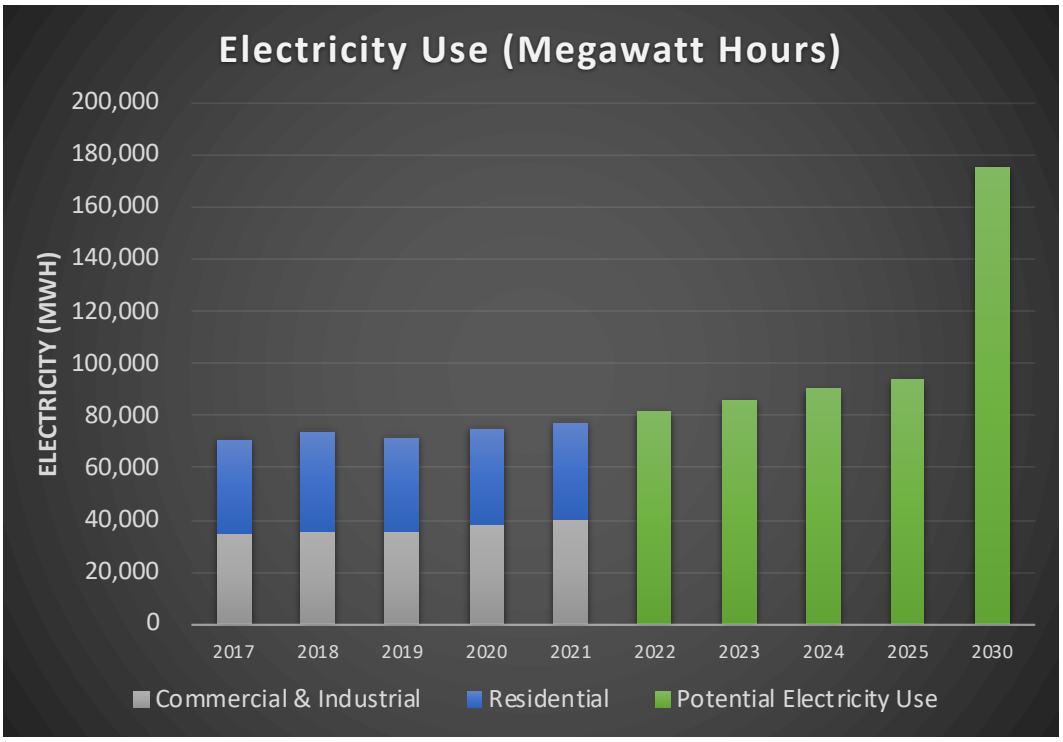
Liz Williams at MassDOT OTP (liz.williams@state.ma.us) has access to a data dashboard that provides counts of registered vehicles by fuel type at the municipal level. These are only the current active registrations, On 3/3/23, Liz added via email that:

> "we are in the final stages of developing the first iteration of the Massachusetts Vehicle Census (MVC) which sounds like it would meet your needs. The MVC will initially release municipal-level data reflecting total counts of registered vehicles as well as opportunities to filter by fuel type, use type, and vehicle type. Odometer readings will be available in the first release, but at this time I am not sure if we will have the heavy vs light duty breakdown or vehicle age in there. In the future we hope to really expand the vehicle attributes that we're able to include, and also include lower levels of geography, down to the census block group. The data will be updated at least annually.
>
> This first iteration of the MVC will be released on or around June 30th, barring any issues."

- EV charging station information is available online using MVPC's tool or other similar EV charging station location tools.
- The baseline electric supply generation fuel and renewable energy source data is mandated by state legislation. The required increase in clean and renewable energy is listed in this report. The town will need to add or estimate additional renewable energy procured through an electricity supply aggregation initiative or by individual customers separately.
- The number of residential and commercial solar PV installations is available through MA CEC. This is a work in progress.

Electricity and Gas Use

Figure 5. Residential, commercial, and industrial electricity use



Residential and Commercial Heat Pumps

Figure 6. Residential Heat Pumps.

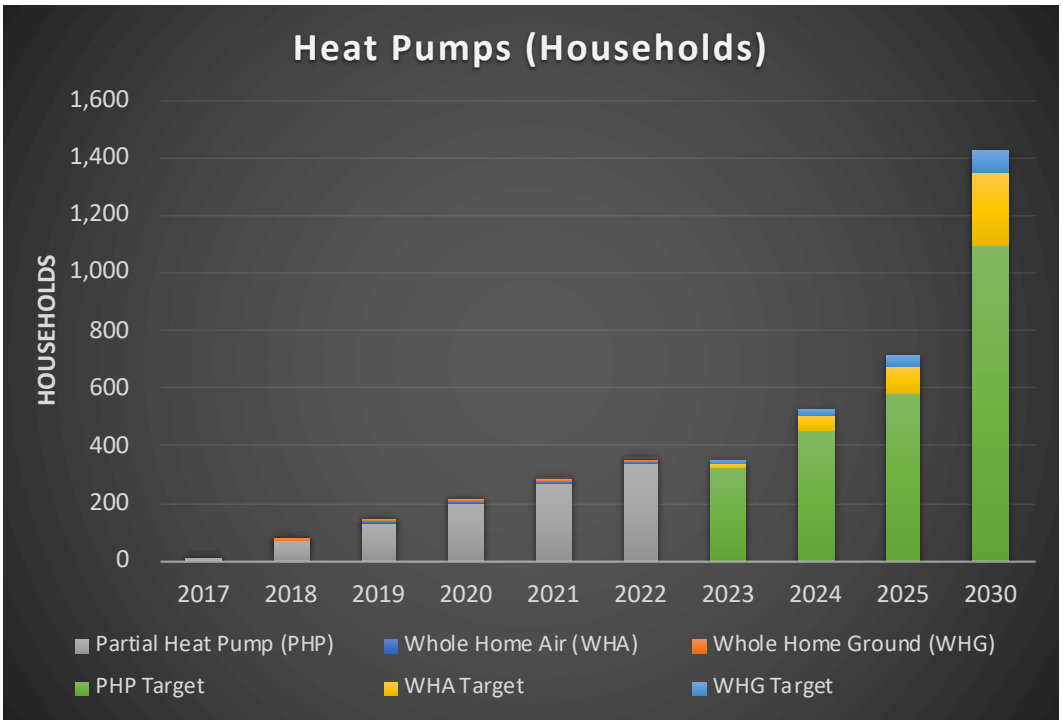


Figure 7. Commercial Heat Pumps.

(pending)

Electric Vehicles and EV Charging Stations

Figure 8. Electric Vehicles

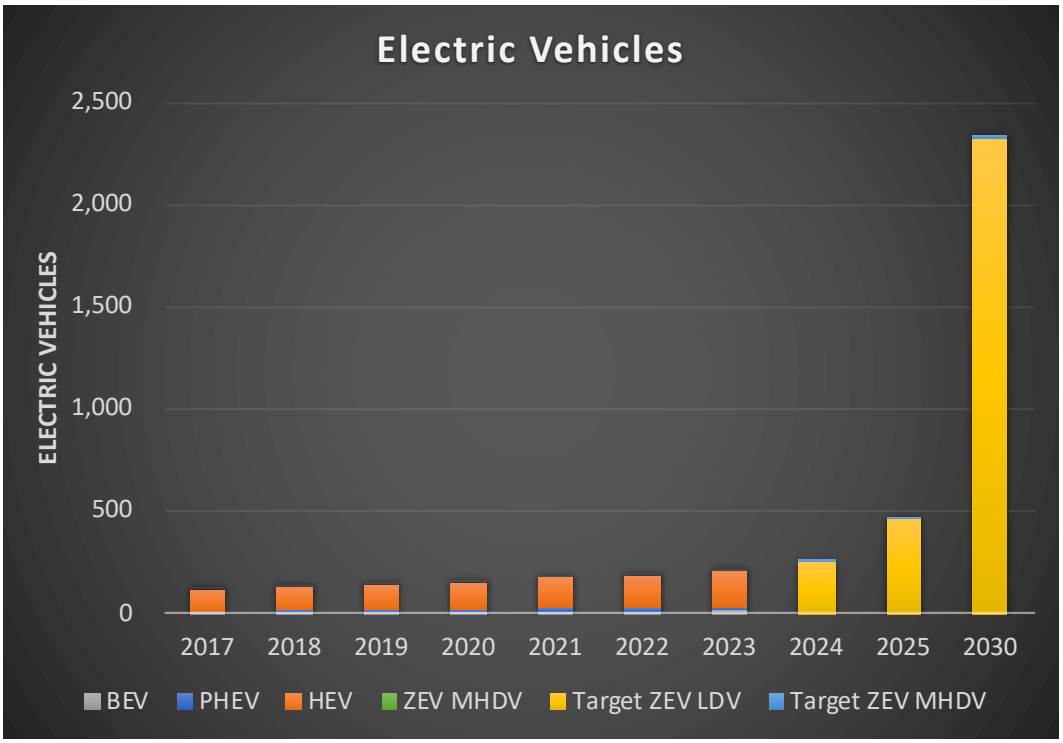
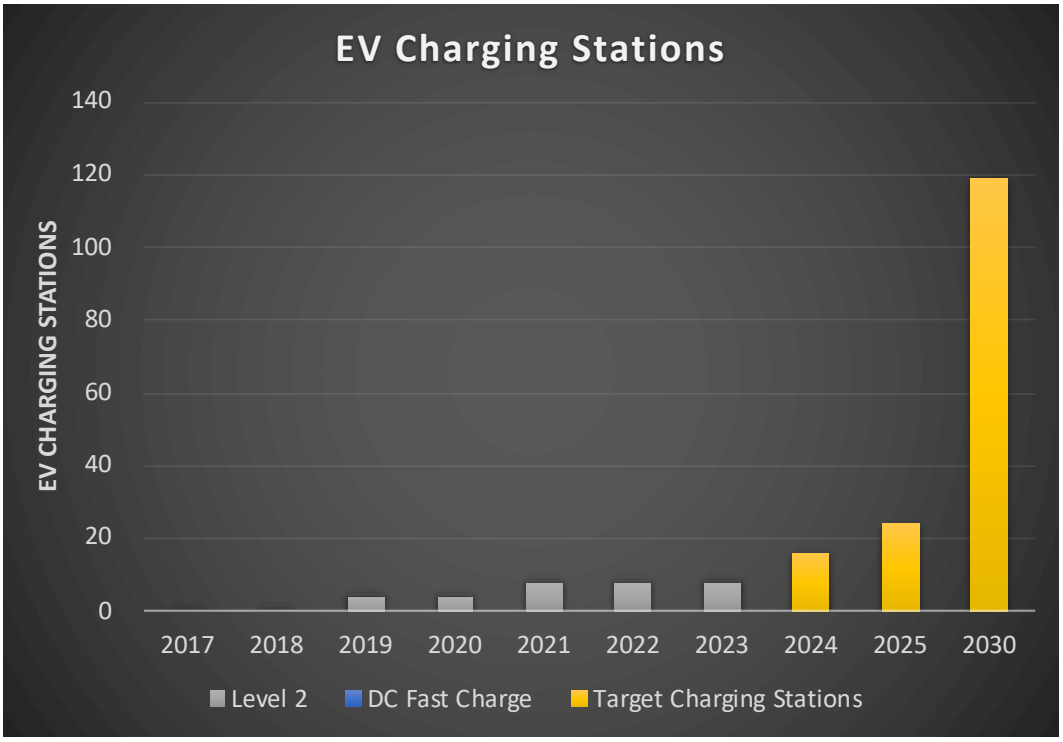


Figure 9. EV charging stations



Renewable Electricity

Figure 10. Electricity energy source

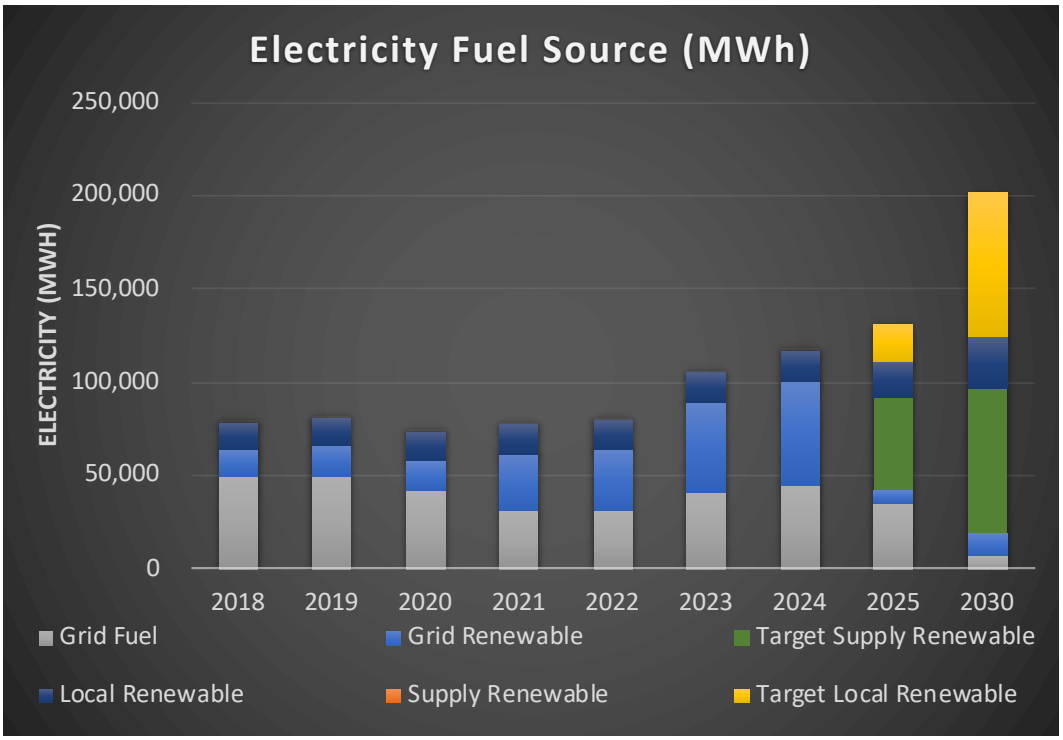
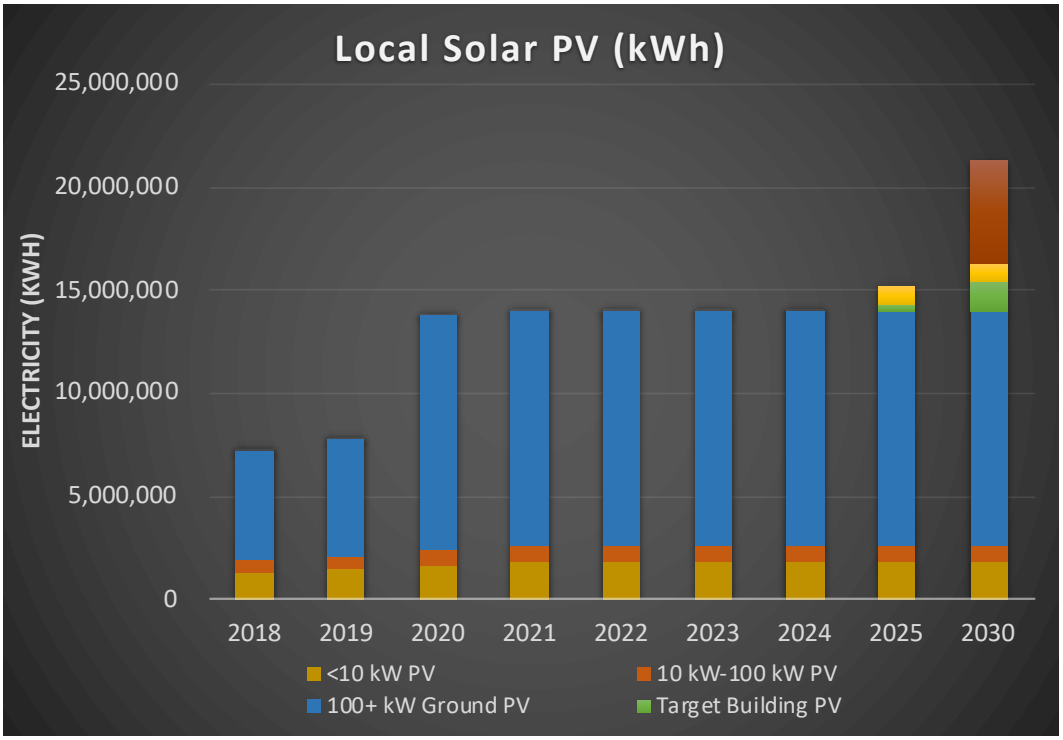


Figure 11. Local solar photovoltaic (PV) annual electricity output



Appendix H: Carbon Emission Costs and Investment Approaches

Carbon Emissions

As authors Kenneth Gillingham and James H. Stock note in their Journal of Economic Perspectives article *The Cost of Reducing Greenhouse Gas Emissions*[33]:

"Climate change is a long-term problem, and the focus of policy must be on long-term solutions. To make major progress on climate goals, like 80 percent decarbonization by 2050 in the United States, will require new technology deployed on a vast scale. Even if each technological step is evolutionary—cheaper electric vehicle batteries, connecting the grid to harness the wind potential in the Midwest, reducing the cost of offshore wind, developing and commercializing low-carbon fuels for air transport—the overall change will be revolutionary. If a price on carbon is not politically feasible—and arguably even if it is—these long-term considerations need to be incorporated into our short-term policy tradeoffs. From the perspective of the cost calculations in this paper, one clear implication is that choosing low-cost interventions without a future, including ones that lock in fossil fuel infrastructure, can result in too much emphasis being placed on what is cheapest to do today."

The authors noted that the Obama administration set the societal cost of carbon reduction at $46/mTonCO2e (in 2017). More recently, Massachusetts set the set the social cost of carbon at $393 per ton.[34] While the societal cost of carbon can be debated, we can use the concept of cost per ton of carbon to help focus attention on the most cost effect new technologies "that need to be deployed on a vast scale."

Figure 1 represents Athol's total building, vehicle, and electricity GHG emissions.

Figure 1. Athol community building, vehicle, and electricity carbon emissions

Total Carbon Emissions

Year (Fiscal)	Buildings Carbon Emissions (mTonsCO2)	Vehicles Carbon Emissions (mTonsCO2)	Electricity Carbon Emissions (mTonsCO2)
2017	25,914	46,459	16,479
2025	23,323	41,705	2,057
2030	**14,253**	**25,429**	**2,463**
2035	10,366	18,370	1,692
2040	6,478	11,310	946
2045	3,887	6,555	1,704
2050	**1,295**	**1,799**	**1,584**
Emission reduction	24,619	44,660	14,895
Estimated years	15	15	20
Lifetime emissions reduction	369,278	669,900	297,891

[33] https://pubs.aeaweb.org/doi/pdf/10.1257/jep.32.4.53

[34] https://acadiacenter.org/massachusetts-proposed-three-year-energy-efficiency-plan-would-deliver-record-setting-benefits-for-a-modern-energy-economy/

Figure 2 takes these GHG emissions and divides them by potential incremental costs to install heat pumps, buy electric vehicles, and procure renewable electricity. The net result is a range of potential investment decisions that the town of Athol and its residents and take to reduce the town's GHG emissions.

Figure 2. Cost per metric ton of CO2 equivalent to install heat pumps, procure electric vehicles, and renewable electricity

Heat Pumps (tons)		22,737
Lifetime GHG emissions/ton		16
	Incremental Cost	15 year Cost/mTonCO2e
If incremental cost/ton is:	$1,000	$62
	$5,000	$308
	$10,000	$616

Vehicles (#)		8,222
Lifetime GHG emissions/vehicle		81
	Incremental Cost	15 year Cost/mTonCO2e
If incremental cost is:	$10,000	$123
	$20,000	$245
	$30,000	$368

Electricity (2017 kWh)		70,764,000
Lifetime GHG emissions/kWh		0.0042
	1 year Cost/kWh	20 year Cost/mTonCO2e
If incremental cost/ kWh is:	$0.00	$0.00
	$0.02	$95
	$0.04	$190

For example, the most cost-effective measure that Athol can take based on these calculations is to procure 100% renewable electricity if it is the same price as the current supply electricity price. Even at an additional cost of $.02/kWh, procuring renewable energy is a cost-effective carbon reduction investment. At this moment, procuring renewable electricity should be Athol's top carbon emissions reduction priority.

According to findmyelectric.com[35]:

> "Currently, most estimates put the average price of a new EV somewhere around $64,000, which is slightly lower than the average price in the spring and summer of last year (2022). For comparison, the average price in 2023 of a new car of any kind in the US is around $48,000."

The additional $16,000 cost for an EV is equal to just under $200 per mTonCO2e.

As a rule, replacing new equipment with low carbon emission equipment makes less sense than replacing old equipment that's due to be replaced. From a societal perspective, any of these investment that is less than $393 per ton is cost effective. The incremental cost to install high efficiency low/no carbon emission equipment over new fossil fuel driven equipment is often below $393 per ton. Athol can use the charts in Figure 2 to estimate the cost/mTonCO2e benefit from any potential heat pump, vehicle, or renewable energy investment. These calculations do not consider other potential benefits such as lower maintenance costs or other high-performance benefits.

Investment Approaches

The most prudent first step is to plan for future carbon reduction investments. Major building and vehicle investments often occur with short notice. The more planning that can be done in advance, the more likely it will be that the right equipment or vehicle decision can be made.

Immediate actions to take include procuring renewable electricity and requesting a quote to install building efficiency measures. Buying renewable electricity will provide an instant carbon reduction benefit. Requesting a quote to install building efficiency measures will give you an idea how much this will cost. In addition, it will potentially lower the building's energy use if the measures are installed and potentially reduce the size of the new high efficiency heat pump system that will get installed. Step one includes:

1. **Organize and review one year of utility bills**
2. **Procure renewable electricity**
3. **Review electric vehicle replacement options and costs**
4. **Review high efficiency electric heat pump heating/cooling/domestic hot water options**
5. **Request a MassSave (or other) energy audit and a quote to install building efficiency measures**

The second step is to review the timing and financial details behind these potential investments. Timing variables include the building and equipment condition and age, potential renovations scheduled, backup power and related climate resiliency considerations, and vehicle age. Financial variables include potential State and Federal economic incentives, current cashflow considerations, and potential low interest loans or property-based financing opportunities to help defray the potential higher upfront cost of new high efficiency equipment and vehicles. Step two for homeowners includes:

[35] https://www.findmyelectric.com/blog/electric-car-prices/

1. **Review MassSave building efficiency and high efficiency equipment incentives, related electric vehicle incentives, and off-road landscaping equipment and vehicle incentives.**
2. **Review options for a low-interest energy loan through lenders identified by MassSave.** If your site is suitable, consider including renewable energy, battery storage, and EV charging measures in the loan package. This has been a one time only program. If this is still true, it's worth installing as many measures as possible in the loan package.

Step two for municipal facilities and vehicles includes:

1. **Develop a municipal facility renewable energy procurement plan**

   Procuring 100% renewable energy for the town's municipal facilities is the single fastest and easiest step that Harvard can take to reduce its carbon footprint. Options include but are not limited to procuring 100% renewable electricity directly from a solar PV developer, joining a 100% renewable electricity procurement offered by Power Options, or including the Municipal accounts with a town-wide 100% renewable electricity procurement.

2. **Develop a municipal facility and municipally owned land solar PV development plan for Select Board and Town approval**

   As part of the Inflation Reduction Act (IRA) passed earlier this year, Municipalities may be able to receive direct incentives for solar PV installations. The details for this piece of the IRA legislation is still being developed. Regardless of the financial details, the Advisory Council should initiate a more detailed assessment of the town's facility, parking lot, and ground-mount solar PV installation options.

3. **Develop a municipal electric vehicle (EV) procurement plan for Select Board and Town approval**

   National Grid is providing technical assistance for town's to develop detailed electric vehicle procurement plans. The advisory council should request this assistance from National Grid and work closely with National Grid's vendor to prepare an EV procurement plan for the town.

4. **Develop a municipal facility efficiency and high efficiency electric conversion procurement plan for Select Board and Town approval**

   Developing a municipal facility efficiency and high efficiency electric conversion procurement plan requires the most steps to complete. The steps include:

   a. Review and confirm the town's facility and technology preferences
   b. Select the first facility(s) and vehicles to upgrade
   c. Request META grant support for a facility assessment
   d. Present and submit the facility's decarbonization budget proposal to Select Board and Town for approval
   e. Submit grant assistance and related financial support requests proposed to the Town
   f. Prepare and advertise specification and construction management RFQ
   g. Review and approve construction specifications

h. Advertise construction RFP and award contract
i. Complete construction and hand off to town staff
j. Select the next facility and repeat the process following the Town's proposed decarbonization timeline.

Municipal facility energy assessments

Facility assessments will play a key role in the transition from business as usual to lower GHG emissions in municipal facilities. MA DOER offers assistance with facility energy assessments under its META grant program. Following are MVPC's recommendations for questions that should be included and addressed as part of a comprehensive facility decarbonization assessment.

1. Which facility renovation path does the town plan to follow?
    a. New construction
    b. Major rehab, or
    c. Ongoing maintenance
2. What renewable energy sources are available for the facility?
    a. Onsite or local generation
    b. Before or after the meter
    c. Own, lease-to-own, or host and purchase
    d. State, regional, or national procurement
3. Potential sources of energy use increases?
    a. Short-and long-term climate change impacts
    b. Additional air conditioning
    c. Additional mechanical ventilation, filtration, or other air quality management
    d. Potential indoor temperature changes
    e. Potential facility use and schedule changes
    f. Future equipment (landscaping and other) charging
    g. Future light duty vehicle charging
    h. Future heavy duty vehicle charging or fueling
4. Utility rate analysis
    a. Potential energy use increases or decreases
    b. Potential energy demand changes
    c. Potential utility rate category changes
5. Electrical system review
    a. Backup power and electrical load management requirements
    b. High efficiency electric equipment requirements
    c. EV charging equipment requirements
    d. Utility side of meter electrical distribution system upgrade requirements
    e. Energy monitoring

6. High efficiency heating
    a. Reuse or replace the existing distribution system
    b. High temperature or low temperature system required
    c. Centralized or decentralize
    d. Air source, ground source, or VRF heat pump?
    e. Other renewable heat source?
    f. Partial or whole facility replacement
    g. Service/maintenance provider availability
    h. Major component replacement timing and costs
    i. Projected annual service costs
7. High efficiency domestic hot water
    a. How much is needed?
    b. What temperatures are needed?
    c. Where is the hot water needed and when?
    d. Heat pump or solar?
    e. Instantaneous or storage?
    f. Central or distributed?
8. Load reduction opportunities
    a. Generator
    b. Battery
    c. Thermal
    d. Equipment shutdown
9. Control system
    a. Open or proprietary system
    b. Control and equipment hardware upgrades
    c. Software upgrades
    d. Integration with individual equipment control
    e. Service provider availability and contract specifications
10. EV charging impacts
    a. Level 1 charging
    b. Level 2 charging
    c. DC Fast charge
    d. Networked?
    e. Bidirectional?
    f. EV charger rollout schedule

Municipal Financial Resources

To date, municipalities participating in MA DOER's Green Communities program have leaned on project expediters to identify, write grant applications for, and install energy efficiency measures. Expediters have walked through facilities to identify measures for potential grant funding as a cost of doing business. This process has served cities and towns well to install measures to meet the State's 20% energy use reduction targets.

However, the scale of investment needed to decarbonize municipal facilities and vehicles is much greater than multiyear energy efficiency investments. Municipalities will need to expand the scope of potential grant applications and financial tools to pay for critical decarbonization investments. Municipalities will need to strike a balance between planned project investments and opportunistic investments driven by grant funding availability.

As the carbon cost analysis above indicates, the most cost-effective time to invest in decarbonization measures is during "trigger events," times when related events are already planned like equipment or vehicle replacement. In all cases, it will be critical to have a strategic analysis of potential decarbonization investments in hand to either support a targeted funding opportunity or inform planned equipment or vehicle replacement.

The primary funding sources for municipal decarbonization investments will be State-initiated programs that align with the state's legislated 2030 and 2050 carbon reduction goals. These will be in the form of standard incentives and rebates and discreet grant funding opportunities. MA DOER's regional managers and Green Community newsletters will be the best resources for updated grant opportunities.

Additional funding will be available from the Federal Bipartisan Infrastructure Law (BIL). Funding from this federal bill has already started to flow directly to states and is beginning to flow to individual projects through competitive funding opportunity announcements. A summary of all the BIL programs that Congress approved is available at:

https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

Common requirements across all funding for BIL includes a cost share, environmental justice considerations, community benefit plans, and made in America criteria. Federal BIL funding will continue for about 5 years.

Applying for larger-scale State and Federal funding will require additional support to develop cost estimates, write grant concept papers and full grant applications, manage project reporting, and manage construction bids, construction, and close out.