The Problem: Greenhouse Gas Emissions

Background:

Scientists know with virtual certainty that increasing greenhouse gas concentrations tend to warm the planet. In computer-based models, rising concentrations of greenhouse gases produce an increase in the average surface temperature of the earth over time. The imbalance between greenhouse gas emissions and the ability for natural processes to absorb those emissions has resulted in a continued increase in atmospheric concentrations of greenhouse gases. Rising temperatures may produce changes in precipitation patterns, storm severity, and sea level. Collectively, this is commonly referred to as *climate change.*

The Massachusetts 2050 Decarbonization Roadmap aims to reduce the state's production of greenhouse gases. As stated in their Roadmap: The climate crisis is a generational challenge that, without decisive action, leaves residents and communities across the state on the front lines. Recognizing the urgency of this crisis, the Baker-Polito Administration listened to the science, and set Massachusetts on an aggressive path to Net Zero greenhouse gas emissions by 2050. Reducing emissions to achieve Net Zero by 2050 is the Commonwealth's primary and most important line of defense in preventing the significant threats presented by a changing climate.

Harvard's Role:

In 2020, a report of Harvard's greenhouse gas (GHG) emissions was conducted based on community wide activities of residents, businesses and municipal operations in the year 2018 . The findings also highlighted GHGs from agricultural activities as well as an estimate of the carbon sequestration benefit provided by forests, wetlands and other tree cover in the community.

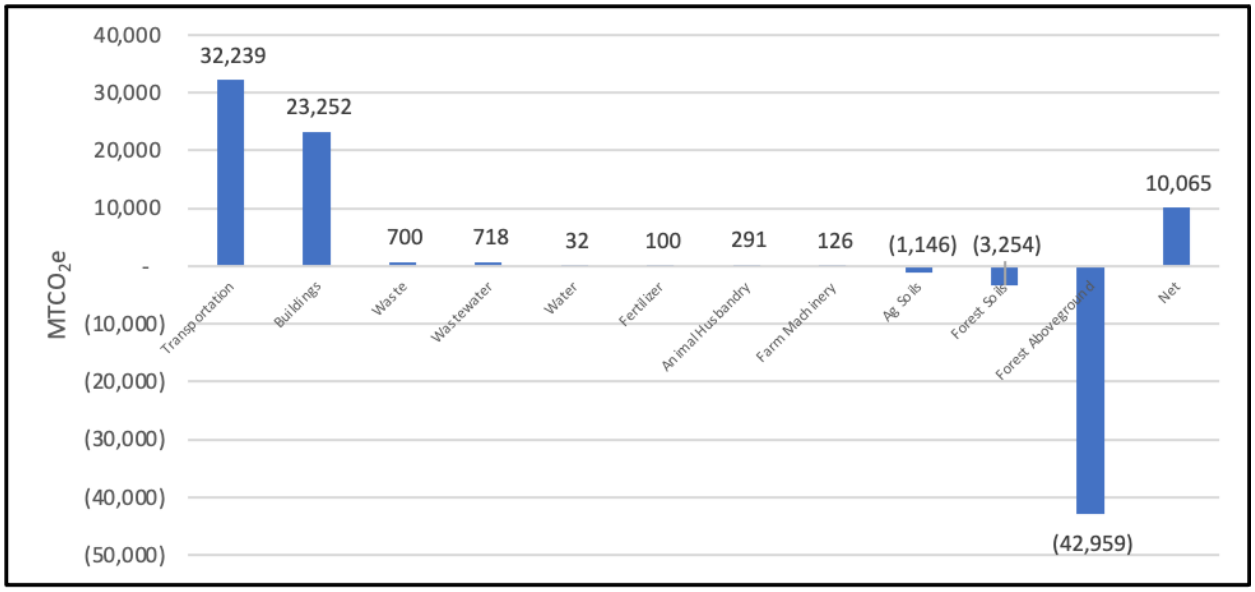
The inventory of GHG emissions for calendar year 2018 was the most recent year in which energy utility data was available. It considered three primary GHGs: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) and are presented in terms of CO_2e or CO_2.

Total greenhouse gas emissions for the Harvard community total 57,453 metric tons carbon dioxide equivalent ($MTCO_2e$) in 2018, primarily from **on-road transportation and building energy use.** Approximately 3% of those emissions are attributable to municipal operations. Agricultural activities are relatively small (< 1%) contributors to the GHG footprint of the community and come from unique sources related to fertilizer use, animal husbandry, and farm machinery use.

With 1864 households, this is approximately 25-30 metric tons per household, given there are few commercial enterprises that account for much of the total. The average metric tons per

household in the United States from several sources puts it at 20 metric tons. The average worldwide is 4 metric tons.

The figure below identifies the sources of GHGs in Harvard as well as the offsets of carbon from our forested areas.



Harvard benefits greatly from its extensive forested areas and other tree cover. These forested areas along with wetlands capture carbon from the atmosphere and is upwards of 80% of the Town's annual emissions.

But as fortunate as Harvard is to be so well forested, maps over the years show that these areas are shrinking due to development. The significant positive impact provided by trees and undeveloped land represents significant potential for release of carbon should the land be developed. On a per acre basis, the release of GHGs from development would create a significant increase in emissions of 403 $MTCO_2$ that would need to be overcome but also would permanently reduce the rate at which tree cover in Harvard sequesters carbon by 4.26 $MTCO_2$ per year.

Harvard also needs to reflect on climate justice. It has the good fortune of its forests but it also has a responsibility to help the state, country, and world by doing its part to reduce its impact by protecting its forests and addressing the greenhouse gases produced by its homes and cars. Reducing GHGs from its sources will require action on the part of residents to improve the efficiency of their homes, electrify their heating systems, drive electric vehicles, care for the land and take other actions both big and small to reduce GHGs.

Climate Impacts from GHG's

Climate impacts can be addressed in two major ways:

- ✓ Adaptation (also called resilience): how to adapt to or withstand the negative impact of climate change
- ✓ Mitigation (also called sustainability): how to prevent or reduce the adverse impact of climate change, usually be taking actions to reduce GHGs

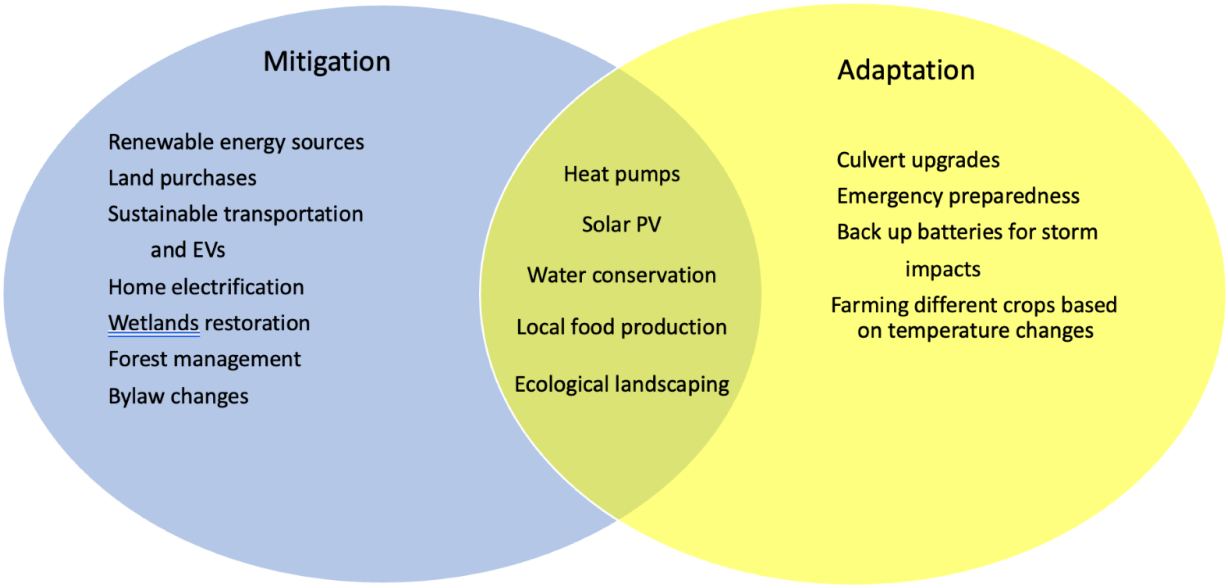
In order to address both adaptation and mitigation, the Town has sought input from residents, through workshops, surveys, and the establishment of several different committees who over time have been charged with developing plans to address climate change. These activities have led to the identification of what concerns residents: the problems brought on by climate change, now and foreseen, that need to be addressed.

Climate Action Plan Overview

Introduction

At the special town meeting in October 2021, the residents voted to adopt a resolution on climate change and part of that resolution is to create a climate action plan. The Harvard Climate Initiative Committee (HCIC) was formed with the charge to create the plan that would help guide the Town in meeting the Commonwealth of Massachusetts greenhouse gas emissions goals by 2050. The HCIC has framed this climate action plan around mitigation and adaptation.

This chart, is an example of mitigation and adaptation scenarios and the overlaps as to how the two elements of the plan come together.



With state funding, some of the work began in 2020. An agricultural climate action plan was released and the outline or framework of a comprehensive climate action plan was prepared. This work has led to the development of this plan: a goal setting and action plan that is attainable, that can reach the town's goals as outlined in the town resolution, and that will require municipal and resident participation and commitment. We believe Harvard will thrive to commit and act on these actions. That it will be a collaborative process, that it will require commitments from all parts of our municipal government and that it is an iterative process that will be ever evolving.

Page Break

Organization of the Plan

There is much the town and residents can do, but the goals and actions have to be realistic, implementable, timely and focused. For this reason, the plan targets six areas that reflect the Commonwealth's goals, the data on GHGs, the input the community provided to date and the desire to address both sustainability and resilience.

The areas include:

These six areas have one goal for municipal operations and one goal for residents and typically two action items per goal. As actions are completed, new ones will be added, thus making this a living document. It reflects the ability of the plan to be realistic in what can be accomplished and timely as actions are completed and new ideas emerge.

The plan, though drafted by the HCIC is not the work of HCIC but the outcomes of discussions, interactions, input and feedback received from town committees, municipal operations, and residents. It is the ideas of many, those most knowledgeable of what can be accomplished and the commitments they can make to meet the goals.

Some of the work has already begun due to the commitment of a key group of stakeholders in town. These accomplishments are noted and celebrated. Much of this work relies on the many volunteers who are so devoted to this work and to giving back to the community.

The following pages contain the substance of the plan:

- Introduction of the climate consideration being addressed
- Municipal Goal, Actions to Date, and Priority Actions to undertake
- Residential Goal, Actions to Date and Priority Actions to undertake
- Measurements for success criteria

Buildings

Climate Consideration:

Forty-one percent of greenhouse gas emissions in Harvard are due to its buildings – both municipal and residential.

Town buildings utilize fossil fuels. Harvard has 12 facilities with about 337,648 square feet that burn natural gas, oil, and propane for heat and domestic hot water (DHW). With Green Communities funds, energy efficiencies, such as heating systems improvements and maintenance and weatherization have improved the buildings' performance. However, to reduce greenhouse gases to the levels in the Commonwealth's roadmap, the buildings would need to be converted to non-fossil fuel sources.

Most residential buildings are heated by oil; a small percentage by natural gas, propane or electricity. Harvard homes are larger than the state average and thus emit more greenhouse gasses.

The HeatSmart program in 2017 provided incentives for air source and ground source systems. State data (which is assumed to be undercounting) notes 15 ground source systems installed between 2015 - 9/2020 and 80 air source systems between 2015 - 10/2019. This is a growing but insignificant number of homes that have been converted to non-fossil fuel systems.

Therefore, the following goals and actions are designed to be the most relevant and applicable to achieving this in Harvard.

Municipal:

Goal: Convert Harvard's municipal buildings from carbon-based fuel combustion to high efficiency electric heating and power production.

Actions to Date:

- Green Communities funding has supported the following climate mitigation actions:
    - Bromfield School - Lighting LED Retrofit
    - Public Library - Lighting LED Retrofit
    - Replacement of transformers in Bromfield heating system to improve efficiency
    - Weatherization of Bromfield and Public Library

Priority Actions:

1. Create a “x” year plan for replacement of municipal heating systems to fully electric options as part of the Capital Investment Planning Committee’s plans to be approved yearly at annual town meeting. [the time frame should probably follow the 85% decarbonization plan by 2050 timetable for budgetary reason)

Residential:

Residential buildings make up X% of Harvard’s building inventory and thus is the single largest area of focus for this plan and opportunity for carbon reduction.

Goal: Increase the number of homes that reduce their fossil fuel energy consumption by converting their heating and cooling systems to electric heat pumps

Actions to Date:

- HeatSmart program - A state grant program that provided incentives for home owners to convert to air source or ground source heat pumps with vetted contractors. 31 homes converted in 2018-19
- HarvardEnergize - a website has been developed that provides access to information and goal setting for households to undertake climate actions, including energy saving options. As of January 2022, a total of ___ Harvard households have joined HarvardEnergize.
- Harvard Climate Initiative website - events and resources(harvardsclimateinitiative.org)

Priority Actions:

1. Pass a general bylaw that requires all new residential homes be 100% fossil free for heating, cooling and hot water
2. Assist homeowners to evaluate air source and ground source heating and cooling systems specific to their homes’ design and needs
3. Implement incentives (?) for home conversions to electric heating and cooling systems

Measuring Progress:

Energy:

Climate Consideration:

Electricity that Harvard purchases from National Grid includes electricity generated from fossil-fuel and renewable energy. National Grid's electricity generation sources in 2021 were 82% fossil fuel (mostly natural gas) and 18% renewable energy. State legislation requires National Grid to increase the percent of renewable energy generation 2% each year. The rate of conversion to renewable sources through National Grid will not meet the targets set by the state.

Harvard has 12 municipal facilities with about 337,648 square feet that burn natural gas, oil, and propane for heat and hot water. Total energy use for these facilities in fiscal year 2019 was: Natural Gas – 133,878 therms, Oil - and Propane -

Harvard's use of electricity for its buildings, other structures, streetlights, and other services in fiscal year 2019 was 1,936,032 kWh or about 6,606 MMBtu.

For residential buildings, in 2019, the Town signed a contract for town-wide electricity (excluding municipal buildings) to be 100% renewable wind renewable energy credits (REC's) thus converting most of the residential buildings in town to this supplier, unless a family opted out of the program. As of 2021, 86% of households participate. This significantly reduces fossil fuel use, and thus greenhouse gas emissions for home electricity and for those with electric vehicles who charge their cars at home. Local renewable sources of electricity would provide more stability as these contracts are renegotiated every few years. Conversion of heating systems to heat pumps would accelerate the positive impacts of this renewable energy source.

Municipal:

Goal: Convert all electricity to renewable energy sources through solar installments and renewable energy supply contracts

Actions to Date:

- Hildreth Elementary School - Solar Power Purchase Agreement for a 245 kW photovoltaic rooftop array

Priority Actions:

1. Negotiate a 100% renewable energy electricity supply contract for all municipal buildings.
2. Increase the number solar installations on municipal buildings or surrounding grounds, either as ownership or PPA.

3. Add battery back-up to buildings with PV solar.

Residential:

GOAL: Increase the number of residential solar arrays and battery storage systems

Actions to Date:

- Solarize Harvard, as state funded program for residents, added approximately 200 solar installations on homes since 2000 through mid-2021.
- Harvard developed the first Community Solar Garden in the state with homeowners purchasing shares to offset their electricity use. These homeowners did not have suitable placement of their homes to individually benefit from a solar installation. Two gardens now have 60 participants.
- Community Choice Aggregation (CCA) - Town residents electricity supply converted to 100% renewable wind recs. 86% of town residents receive electricity from CCA

Priority Actions:

1. Provide education for residential installation of PV Solar and battery storage systems based on state and federal financial incentives.

Measuring Progress: