Newton Citizens Climate Action Plan

Acting Now to Secure Our Sustainable Future

August 2019

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Prepared for:

The Citizens of the City of Newton,

The Newton City Council, and

The Honorable Ruthanne Fuller, Mayor of the City of Newton

Newton Citizens Commission on Energy
Newton, Massachusetts

About the Newton Citizens Commission on Energy

The Commission was established on October 24, 1979 by city ordinance, which reads, in part:

Sec. 2-302. Purpose, powers and duties. (a) The commission shall develop a city-wide energy plan to encourage energy conservation and the use of alternative energy forms, and provide a plan to coordinate state and federal experts to provide for energy needs and emergencies.

(b) The commission's powers shall include the following:

The commission shall encourage energy conservation in Newton and may investigate methods of conservation and disseminate information thereon; may apply for and receive grants; act as a liaison between Newton and the state on energy matters; act as a clearing house for car and van pooling; conduct citizen education programs including programs regarding the availability of "peak load" pricing differential rates; make recommendations to the mayor and the board of aldermen [sic]; report on its activities to the mayor and the board of aldermen when so requested or on its own initiative; file legislation before the board of aldermen; and publicize programs and methods of energy conservation; provided that no expenses may be incurred by the commission without the prior approval of the mayor and the board of aldermen.

BY-LAWS

The Newton Citizens Commission on Energy, noted in these By-Laws as Commission, is established in accordance with City of Newton, Massachusetts, Board of Alderman Docket item #519-75 and article -XXIII of the Newton City Ordinances, enacted October 24, 1979.

ARTICLE I. Membership

Section A - Members

Regular members of the Commission are as established by Ordinance, and are hereinafter referred to as members.

Section B - Associate Members

Associate Members shall be persons whose interests are in the field of energy and conservation or related areas, and are hereinafter referred to as associates.

ARTICLE II. Officers

Only regular members may be elected officers of the Commission. The officers and their duties are as follows:

Section A - Chairman

1 - Preside at all meetings.

2 - Represent the Commission and act as official spokesman.

Section B - Vice Chairman

1 - Assume the duties of the Chairman in his absence.

Section C - Recording Secretary

1 - Keep recording of all meetings.

2 - Record all votes.

3 - Prepare a written summary of each meeting for distribution to members

4 - Receive requests for agenda items.

5 - Prepare and send a written agenda to members five days in advance of each meeting.

Acknowledgements

This plan was developed by the Newton Citizens Commission on Energy, NCCE, a nine-member body appointed by the Mayor, City Council, School Committee, Newton-Needham Chamber of Commerce, and League of Women Voters.

Members	Halina Szejnwald Brown, Chair James Purdy, Vice Chair		
	Michael Gevelber	Jonathan Kantar	Puja Vohra
	Stephen Grody	Jonathan Klein	Ann Berwick (ex-officio)
	Asa Hopkins	Ira Krepchin	
Associate Members	Cory Alperstein	Edward Craddock	Philip Hanser
	Fred Brustman	Brant Davis	

These Newton residents have donated their time, talent, and treasure to produce this plan. As a group, the authors offer decades of experience in many facets of the energy/environmental field, including teaching environmental science and policy and mechanical engineering at the university level, and covering regulatory and policy analysis, design/build skills for high performance buildings, transportation planning, data analytics, and community activism.

The Commission would like to thank former NCCE Chair Eric Olson and Newton High Performance Building Coalition member Peter Barrer for work they did to establish a baseline inventory of Newton's greenhouse gas emissions. We also thank Commission Associates Cory Alperstein, Edward Craddock and Philip Hanser, for their generous contributions of time, ideas and knowledge.

We are grateful to Councilor Deb Crossley for helping us to better understand the policy and political contexts of this plan, for her valuable technical advice regarding the building sector, her unwavering support for our cause, and for her feedback on various drafts.

The Citizens Climate Action Plan also benefitted from the exchange of ideas and data with the staff of the Metropolitan Area Planning Council, who were concurrently preparing a five-year plan under contract to the City. The NCCE received helpful advice from Newton's Planning Department staff members Jennifer Steel, James Freas, and Claire Rundelli, and valuable data from Newton Accessor James Shaughnessy.

Finally, the Commission thanks Jane Hanser for her editing of the final Citizens Climate Action Plan document.

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Executive Summary

According to the United Nations Intergovernmental Panel on Climate Change (IPCC), avoiding climate change's most catastrophic effects requires eliminating greenhouse gas emissions by 2050. Business as usual is not an option at local, state or national levels.

The Newton Citizens Commission on Energy (NCCE) concludes that it is technologically and economically feasible to meet the IPCC targets in Newton, and that the City should adopt them as its climate policy goals. This Citizens Climate Action Plan (CCAP) provides a 30-year roadmap for achieving these targets, emphasizing actions that must be taken during the next two years as well as interim goals. It outlines the roles of Newton's residents, businesses, government, and institutions. The Plan focuses on the three sectors responsible for nearly all of Newton's GHG emissions: transportation, and buildings—residential and commercial. The Plan's underlying principles are:

1. By 2030, Class 1 renewable sources in New England provide 100 percent of Newton's electricity
2. Electrify 100 percent of transportation and heating systems, and power them with 100 percent Class 1 New England renewable sources.
3. In the residential sector, reduce energy consumption for heating by 20 percent.
4. In the transportation sector, reduce vehicle-miles traveled and energy consumption by 15 percent.
5. Use natural asset replacement cycles (home heating systems, renovations and additions, and vehicles) to increase efficiency and electrify with minimal incremental costs.
6. Motivate major employers to develop and implement their own CAPs.

Of the more than three dozen specific recommendations in the Plan, we identified ten that should be immediately implemented. These are:

1. Create and fund Energy Concierge Office to help residents and businesses reduce energy use and electrification (heat pumps and electric vehicles (EV's). Allocate staff.

2. Transition, in stages, to Passive House (PH) energy-use standard in all new buildings: Require PH and all electric for all special permits. Revise Criterion 5 in special permit review process.
3. Require HERS rating, energy costs and car charger to be disclosed for all home sales. List in Assessor's database. Benchmark and publish the energy performance of all new large commercial and mixed use buildings.
4. Require that electric option is considered for all heating systems installations.
5. Adopt the Real Estate Efficiency Program (REEP) as a financial incentive for residential and small business energy retrofits.
6. Establish free preferential parking for electric vehicles (EVs) at municipal lots.
7. Introduce a marketing campaign for EVs.
8. Sign an MOU with National Grid and Eversource about collaboration and additional resources for implementing energy conservation actions recommended in the Plan
9. Establish Green Leadership Council, led by the Mayor, for large commercial property owners, jointly with National Grid and Eversource.
10. Require transportation plans for all large new commercial developments.

Figures 1 and 2 summarize the cumulative impacts of these recommendations. The implementation cost will be borne almost entirely by Newton residents, businesses and institutions. But the City will need to provide incentives, outreach, technical support, and engage in partnerships. We call on the City to provide the human resources necessary to perform this job.

Figure 1: Impact of Electric Vehicle Adoption Rate on GHG Emissions

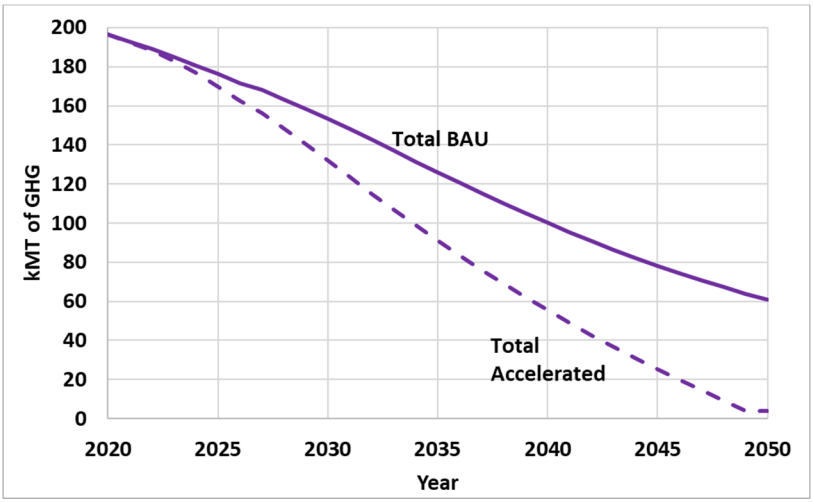
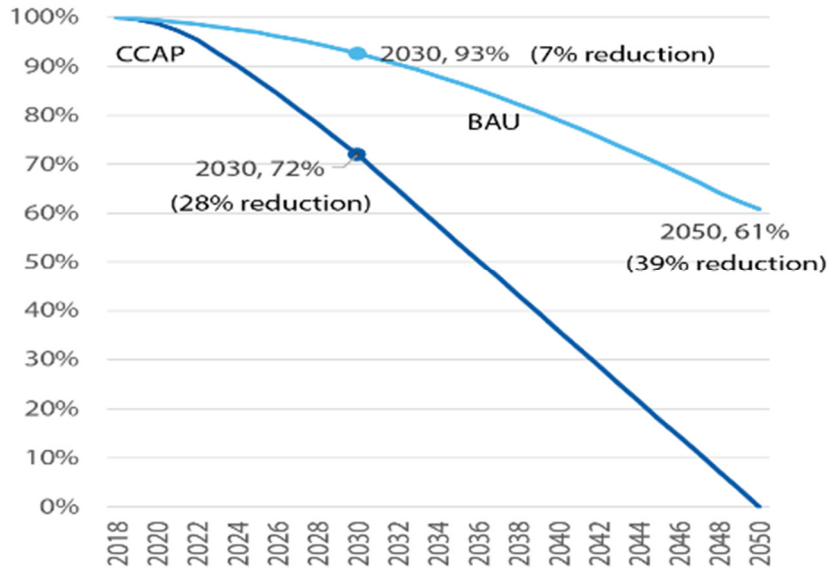


Figure 2: Decrease in GHG Emissions in the Housing Sector



Origins of CCAP

Recognizing the critical importance of climate change and its impacts on the City of Newton and the world at large, Mayor Ruthanne Fuller, in her inaugural speech in January of 2018, called for the preparation of a Climate Action Plan (CAP). A group of volunteers (known informally as vCAP) met with the Mayor in March 2018. This meeting led to efforts to produce two documents: a five-year Climate Action Plan (CAP) prepared by the Metropolitan Area Planning Council (MAPC) staff working under contract to, and in cooperation with, the City; and this 30-year Citizens Climate Action Plan (CCAP), prepared by the Newton Citizens Commission on Energy. There was coordination between the two efforts, and their recommendations are generally consistent with each other.

The key differences between the two plans are in scope, planning horizon, goal-setting, underlying analysis, and implementation plan. In contrast to the MAPC-City Plan, the CCAP Plan is based on extensive quantitative research, analysis, and modeling specifically for Newton conditions; it sets quantitative targets for 2050, with interim quantitative targets; it recommends top priority actions; and it performs technology assessments. It also, in contrast with the MAPC effort, focuses only on the transportation, residential and commercial sectors which are together responsible for 88 percent of all GHG emissions in Newton. It leaves out municipal operations, waste disposal and natural gas leaks, which together comprise 12 percent of emissions. The Citizens Climate Action Plan can be viewed as a prioritized roadmap, for implementing many of the recommendations in the MAPC-city CAP, with long term goals and short-term interim milestones.

The NCCE discussed preparation of the Citizens Climate Action Plan at monthly meetings in 2018 and began writing the plan in Fall 2018, with completion of a draft plan in March/April 2019. In addition to the standing monthly Commission meetings, the authors of the plan met countless times in informal working sessions and in a variety of member-configurations: in the Newton Public Library, private homes, local cafes, and Newton City Hall.

The NCCE member authors designed the plan to come as close as possible to meeting the recommendations in the International Panel on Climate Change Special Report (fall 2018), which requires carbon neutrality by 2050, with substantial progress toward an interim milestone by 2030. This goal is also consistent with the Massachusetts Global Warming Solutions Act.

1
Introduction

The Global Challenge. Scientific evidence is mounting that the current rates of energy consumption and associated emissions of greenhouse gases (GHG) are leading to profound changes in climate that, left unchecked, will lead to devastating consequences.

It is hard to overstate the urgency of the threat facing the world community, including the City of Newton. According to the Intergovernmental Panel for Climate Change, IPCC, the world authority on climate, to ward off the worst impacts of climate change will require reducing emissions by 60 percent from current levels by 2030 and 95 percent by 2050. In order to meet this enormous challenge, the use of fossil fuels must be rapidly eliminated in favor of renewable non-carbon sources; and the demand for energy must decline.

The Local Solution. This Citizens Climate Action Plan (CCAP) addresses the following two questions:

- What will it take for Newton to meet the recommended IPCC reduction targets for GHG emissions from direct energy use (60 percent from current levels by 2030 and 95 percent by 2050)?
- Are the necessary actions feasible to implement?

It is the opinion of the NCCE that it is technologically and economically *feasible* to significantly reduce the energy used in Newton and to eliminate its GHG emissions by 2050. The necessary technology is largely there in the building and transportation sectors, and further technological improvements are rapidly materializing. The *NCCE recommends that the City of Newton adopt the IPCC targets for its climate action planning*. This document presents a roadmap for achieving these goals, with emphasis on actions that must be taken during the next two years or so; and outlines the roles of its government, residents, institutions, and businesses in setting various actions in motion. While reaching the IPCC goals is feasible, it will require tremendous political leadership and an

active, informed citizenry to implement policies and modify behavior to reach our goals.

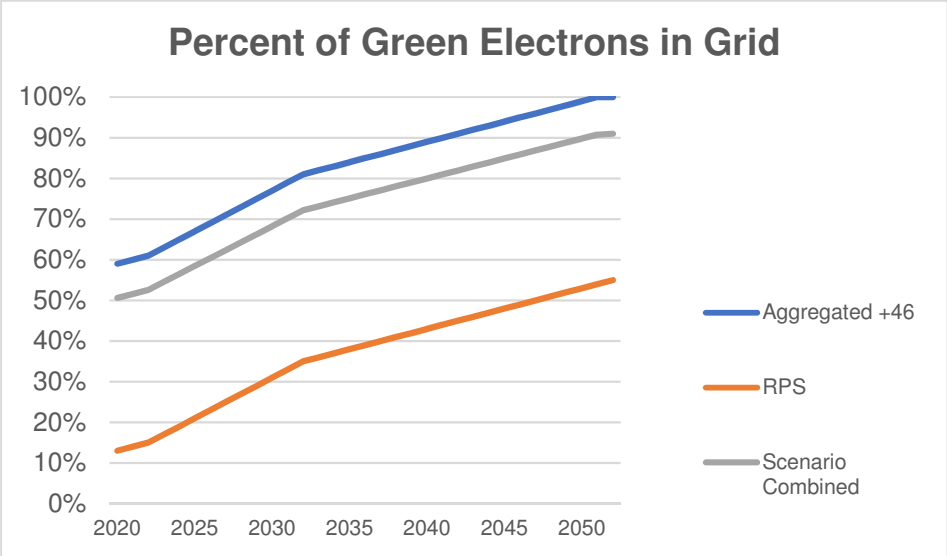
At the same time, it is clear that IPCC targets can only be achieved through a *two-pronged approach:* significant reduction in the demand for energy in the private and commercial sectors; and near-complete replacement of fossil fuels with electricity generated from renewable sources. Neither of these approaches is sufficient in and of itself, but applied together they may enable the world to avoid the worst consequences of climate change. There are three key reasons why energy demand reduction must accompany the transition to clean electricity:

- Clean electricity is a scarce commodity and will continue to be so in the foreseeable future. We cannot waste it on inefficient houses, cars and appliances.
- Increasing the thermal performance of our buildings and hot water systems will allow us to decrease our need for energy, permitting us to more effectively use electric heat pumps instead of fossil fuel-based alternatives;
- Clean electricity is not carbon free. At present, the manufacturing of wind turbines and solar panels requires a great deal of fossil fuel energy—to mine and smelt the metals, manufacture plastics and other parts, transport, and manage the end-of-life of the equipment.

The Role of Cities. In the U.S., in the absence of national climate protection policies, states and cities have taken the initiative. Cities are in fact better equipped than states and the federal government to undertake certain necessary actions. For example, cities can mobilize citizens – through incentives, outreach, mandates, and the removal of local barriers – to upgrade the energy performance of their homes, to switch to electric vehicles, and to consider less car-dependent lifestyles. Cities are also well positioned to advance the use of renewable electricity through community aggregation and to plan local land use and transportation toward reduced use of fossil fuel-based energy.

Newton has already taken a number of climate change actions. Through its Power Choice Program Newton has become a leader in Massachusetts by purchasing 60% of its electricity from Class 1 New England generated renewable resources (Figure 3).

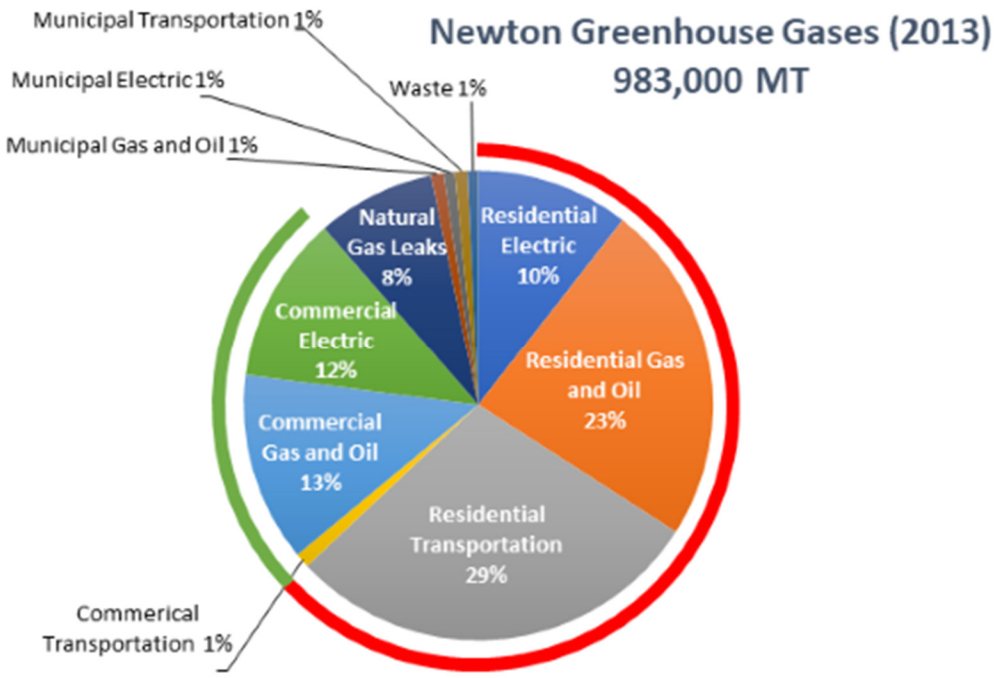
Figure 3: Clean Electricity in Newton



The State's Renewable Portfolio Standard calls for continuous growth in the amount of renewable energy supplied to the electric grid. Combined with Newton's Power Choice Program, which calls for the purchase of 46 percent of its electricity from local renewable sources, in addition to the state mandated 14 percent, that trend will lead to the use of 100 percent green electricity in Newton by 2050.

This Is a Community Plan. Approximately 88 percent of GHG emissions in Newton result from meeting the energy demand in the private and commercial/institutional sectors for buildings, electricity, and transportation (Figure 4). The remaining 12 percent comes from municipal operations (3 percent), natural gas leaks (8 percent), and waste disposal. This Plan focuses on the three sectors which are responsible for the great majority of emissions: residential buildings (both new and existing), transportation, and commercial buildings. In the past decade the City has made significant progress in reducing energy demand and GHG emissions from its own municipal operations and we trust that this trend will continue under the current leadership. Additionally, natural gas leaks and solarization of roofs are being addressed through several state-level initiatives and in coordination with the City.

Figure 4: Sources of GHG emissions in Newton (2013)



Almost 90 percent of the GHG emissions in Newton come from the energy consumed in building and transportation in both residential and commercial/institutional sectors.

Much of the work of achieving the goals of this CCAP will have to be undertaken by Newton residents, institutions and businesses. It will require capital investments up front, replacing the traditional building methods with new ones, getting used to different cars and alternative modes of mobility, and prioritizing consideration of the impact on GHG emissions of our daily practices, including what we eat, what we consume, and what and how we dispose of waste. Fortunately, much of the capital investments will be paid back over time in reduced energy use costs, increased durability (longevity), and better health and comfort. Investment in low carbon alternatives, whether better building envelopes, electric heating equipment, or electric vehicles will impart competitive advantage for early adopters who embrace such actions.

Between now and 2050, with or without the CAP, almost every resident and commercial facility will have to spend money to replace their heating equipment and the vehicles that they drive, and upgrade or replace built structures. The questions we are facing are these: *Will we continue with conventional choices which have gotten us to the dangerous climate threats in the first place? Or will we choose the alternative trajectory: reduced energy use and a shift to electric heat pumps and electric vehicles powered by renewable energy sources?* These are the profound questions of our time.

City government can make a significant impact on how easily and quickly we, the citizens and businesses of Newton, can change our GHG trajectory and find the path to decarbonization by 2050. The City can influence our choices and help Newton residents and businesses in a variety of ways:

- Persuade, Educate, Lead:
  - Provide incentives
  - Reach-out via educational programs
  - Improve access to information and resources, provide logistical support
  - Lead by example
  - Organize and facilitate
- Advocate:
  - Within the City and in various City communities (business, residential, village centers, etc.
  - At the State level regarding legislation and building codes, and various issues affecting GHG reduction strategies
- Develop Energy Concierge Services throughout the various departments of City Hall, which are aimed at empowering residents to make smart, informed choices regarding GHG reductions, whether it is securing and acting on a Mass Save audit, replacing a heating system, or considering the size, shape, and characteristics of a new home, addition, or renovation.
- Require consideration of GHG impacts in reviewing of all major initiatives and projects across City departments. A review by the Sustainability Office will be appropriate.
- Provide necessary resources and personnel
- Effect institutional changes aimed at incorporating the topic of GHG emissions and energy use in all major projects and ordinances, and in the daily operations of the executive branch.
- Regulate
  - Benchmark energy performance, require accountability
  - Adopt ordinances and rules to support efforts of this plan
  - Institute zoning changes to encourage GHGe reduction strategies
- Reduce barriers
- Provide logistical support

Strategy for Meeting the Goals. In the residential sector, our goals by 2050 are 1) Reduce energy use for heating in homes by 2050, 2) Reduce total vehicle miles traveled by private cars by 15 percent; and, 3) Totally replace internal combustion engine cars (ICEs) with electric vehicles (EVs).

We have identified a multi-element strategy for meeting these goals.

Reducing per capita energy consumption by 20 percent will require:

- Adopting very low energy use requirements for new construction
- Upgrading the energy performance of the existing housing stock by 20 percent
- Increasing the number of smaller and denser dwellings
- Transitioning to electric vehicles (which can be powered with clean electricity and which also happen to use less energy to operate).
- Improving the public transit system and biking/walking infrastructure.

Phasing out fossil fuels in Newton will require that all:

- Vehicles be powered by electricity
- Buildings be heated via electricity (electric heat pumps)
- Other natural gas uses, such as cooking and clothes drying, be replaced with electricity-powered equipment

And all the electricity powering these systems will have to be generated by renewable sources located in Newton and elsewhere in New England.

Underlying Analysis. This Citizens Climate Action Plan concerns itself with the three sectors that in aggregate contribute to 88 percent of GHG emissions in Newton: Residential, Transportation, and Commercial/Institutional. In contrast to the 2005 Newton Energy Action Plan, which provided broad ideas for reducing GHG emissions, the recommendations presented in this Plan are very specific. They are based on extensive research and quantitative analysis conducted over the past six months. The underlying research focused on:

- The characteristics of the housing stock and commercial/institutional buildings
- The likely trends in the growth and rate of building replacement and ownership change
- The current and forecast adoption rates of electric vehicles
- The demographic characteristics of Newton's population
- The relative contributions of the proposed actions to reducing energy use and GHG emissions
- The availability, performance, projected changes and the financial aspects of energy technologies used in the building and transportation sectors.

- The feasibility of potential actions, including the City's jurisdiction, the institutional aspects of Newton governance, and the anticipated public acceptance

Tracking Progress. The ultimate outcomes of the actions recommended in this plan will be decreases in energy use and GHG emissions. However, tracking the progress of each action in terms of GHG reductions may be impractical. This is because within each sector – residential, transportation, and commercial – multiple actions need to be taken simultaneously to achieve significant combined progress in GHG reductions, and therefore the outcomes cannot be linked to any specific actions.

For these reasons, progress needs to be tracked by following the *outputs* related to specific recommendations for action. At the same time, the annual update of the GHG emission inventory needs to continue. It will give us an overall assessment of progress toward the 2050 goals, provide feedback on the effectiveness of actions underway, and create the basis for course corrections.

To account for population growth or decline in Newton over the next 30 years, we recommend using *tons of GHG emissions/capita as a common metric.*

Long Term Success, Immediate Actions. Achieving the above targets will require undertaking initiatives on many fronts. Some initiatives will yield results quickly; others will produce results gradually over extended periods of time. Most of the recommendations in this plan will require immediate attention during the next two years or so if we are to meet the 2050 targets. The enabling ordinances, mandates, incentives, outreach programs, and other essential initiatives that are the bedrock of this plan must be put in place expeditiously. It is these immediate actions – the essential investment in the future – that constitute the essence of the Newton Citizens Climate Action Plan.

The trajectory toward carbon neutrality will neither be smooth nor straight, and will certainly require course corrections along the way. A lot will change over the next three decades in the technology, costs, infrastructure, demographics, social norms and national and state policies. However, we provide here a 30-year plan that provides the basis for our actions now and which allows us to keenly focus in on the imperatives for the next one (1), two (2) 2 and five (5) years. And as we implement this plan, we must measure, monitor, and assess our progress, making adjustments along the way but remaining mindful of our goals. To aid in our prospects of success, this plan provides milestones, interim goals, and progress assessments at shorter time intervals.

Addressing Other GHG Emission Sources. Newton's GHG emission inventory, on which this Climate Action Plan is based, counts only direct use of

energy in the geographic area of Newton, that is, electricity and fuels in the two key sectors of buildings and transportation. It does not include the energy used for producing and transporting the material goods we use in Newton, the travel we do outside of Newton, or the food we consume (consumption-based emissions). The GHG emissions associated with these aspects of Newton life are significant, estimated at between 30 and 100 percent of the impacts included in the Newton GHG emission inventory. We recommend that the next iteration of this Climate Action Plan take into account these consumption-based emissions.

Investing in the Future. In 1984 the Commonwealth undertook a massive and extraordinarily successful project to clean up Boston Harbor, the Charles River and other metropolitan region water resources. The cost of the project that spanned over 30 years was $5-6 billion, and it raised the water bills in the Boston Metropolitan area to among the highest in the country, with businesses and households carrying that burden. It was well worth it, however. The current estimates are that the benefits of the cleanup for the local economy are approximately 20 times higher than its cost.

Unlike the Boston Harbor Cleanup, the Newton plan to electrify its cars and buildings is unlikely to have a dramatic impact on electricity bills. But like the Boston Harbor project, the benefits from implementing the Newton plan will be greater than the costs. The benefits will include: reduced energy bills to home owners and businesses, higher home resale value, the creation of well-paying jobs in connection with building upgrades, quieter streets, cleaner air, reduced traffic congestion, higher quality housing stock, and a significant contribution to preventing the disruptions from climate change.

2
Conclusions & Recommendations

According to the Intergovernmental Panel on Climate Change, IPCC, to avoid the most catastrophic effects of climate change requires essentially eliminating carbon emissions by 2050, with the greatest reductions coming in the early years (60 percent from current levels by 2030 and 95 percent by 2050). Business as usual is not an option, whether on the local, state or national level. For that reason, this *Citizens Climate Action Plan (CCAP)* addresses the following two questions:

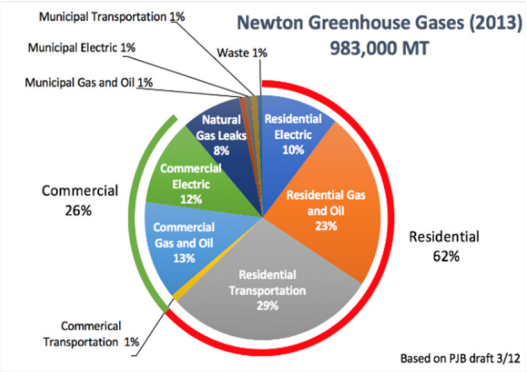
1. What will it take for Newton to meet the recommended IPCC reduction targets for GHG emissions?
2. Are the necessary actions feasible to implement?

Based on extensive research, analysis and modeling, the Newton Citizens Commission on Energy (NCCE) concludes that it is technologically and economically *feasible* to meet the IPCC targets, and that the City of Newton should adopt them as its climate policy goals. The required technology is currently available, most of the recommended actions are within the City's control, and the dividends that will accrue in addition to helping to slow down climate change—personal savings on energy bills and higher home resale values, higher quality housing stock, quieter streets, cleaner air, and less traffic congestion—outstrip the investments required.

The plan focuses on eliminating the GHG emissions from the sources documented in the 2013 Newton Emissions Inventory (Figure 5). The inventory calculated emissions associated with direct use of energy – electricity and fossil fuel. It did not include the so-called *embodied energy* associated with production of food and material goods purchased by Newton residents, and energy associated with manufacturing and transport of construction materials for their houses, and with personal and business travel. These consumption-based emissions are substantial, comparable in magnitude to emissions from direct energy use. The next iteration of this Strategic Plan will need to account for these emissions.

The CCAP presents a 30-year roadmap for achieving the IPCC targets, with emphasis on actions that *should be taken during the next two to five years*, and provides interim goals at various time intervals between now and 2050. It outlines the roles of its government, residents, institutions and businesses in setting various actions in motion. The Plan focuses on the three sectors that are responsible for 88 percent of Newton GHG emissions: residential buildings (both new and existing), transportation, and commercial buildings.

Figure 5: Newton Emissions Inventory (2013)



Much of the work of achieving the goals of this Plan will be undertaken by Newton residents, institutions and businesses. It will require capital investments up front, replacing the traditional building methods with new ones, upgrading the current housing stock, and getting used to different types of cars and alternative modes of mobility.

The City has an essential role to play in making these actions successful. These include:

- Providing financial incentives for residents, developing regulations, educating the public
- Reducing barriers to adopting GHG emission reduction measures
- Improving access to information, providing subsidies, incentives, resources, and logistical support
- Adopting new ordinances and modifying existing ones
- Measuring and monitoring progress; holding people accountable
- Advocating at the community, regional, and state levels
- Adapting administrative procedures and conduct within the daily business at City Hall, including: building permitting; interactions with homeowners; planning and development operations
- Requiring consideration of GHG impacts when reviewing all major initiatives and projects across City departments

- Providing necessary resources and personnel to develop and manage the efforts discussed herein. We estimate that implementing this plan might cost approximately $10 M per year. Approximately 10 percent of the spending will come from the City itself, which represents 0.25 percent of its annual operating budget
- Affecting institutional changes aimed at incorporating the topic of GHG emissions and energy use in all major projects and ordinances, and in the daily operations of the executive branch

2.1 The Strategy

This Plan was developed by applying the following six principles.

1. Reduce energy consumption in the residential sector by 20 percent through energy retrofits, high performance construction, and directing the growth toward smaller, compact dwellings in mixed-use settings.
2. Reduce energy consumption in the transportation sector by 15 percent through reduced miles travelled to, from, and in Newton.
3. By 2030 all electricity in Newton will come from Class 1 renewable sources in New England.
4. Electrify 100 percent of our transportation and heating systems, and power them from 100 percent Class 1 New England renewable sources.
5. Take advantage of natural asset replacement cycles (home heating systems, building renovations and additions, and vehicles) to increase energy efficiency and electrify with minimal incremental costs.
6. Work with major employers and property owners to motivate them to develop and implement their own Climate Action Plans in the commercial/institutional sector.

2.2 A Path to Carbon Neutral Newton

When translated to a wide range of specific actions recommended in this Plan, and fully implemented over the next 30 years, this strategy will produce the reductions in energy use and GHG emissions in the residential and transportation sectors shown in Figures 6 and 7.

Figure 6: Impact of Electric Vehicle Adoption Rate on GHG Emissions Comparing Business-As-Usual with Accelerated Scenarios

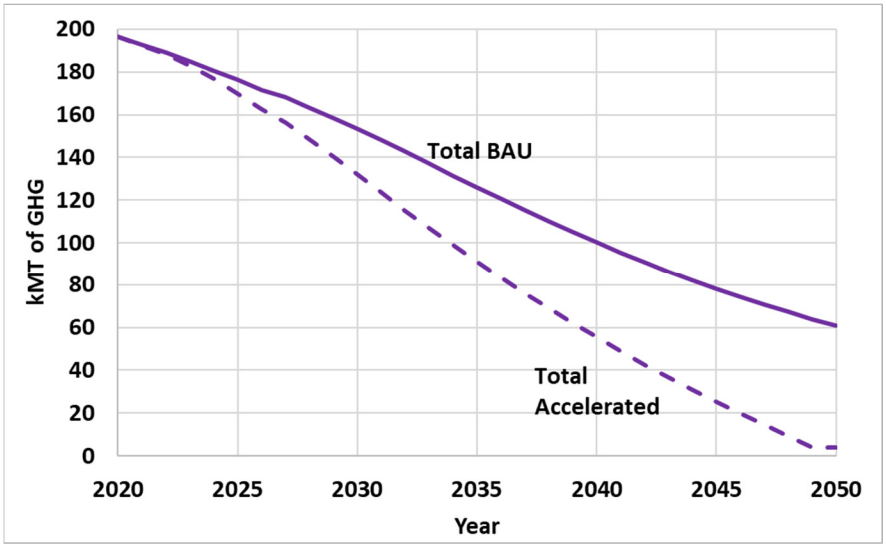
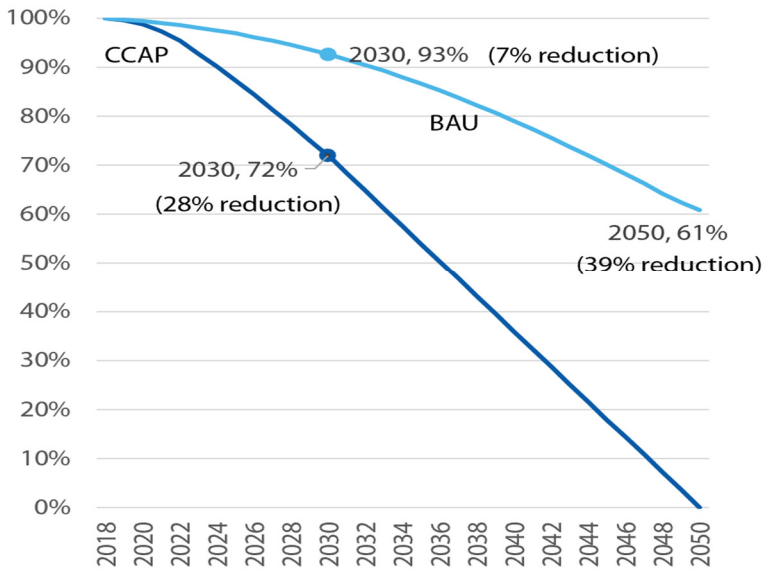


Figure 7: Decrease in GHG Emissions in Housing Sector vs. BAU



During 2019 the City should develop a detailed implementation plan. In order to set that plan on a trajectory toward carbon neutrality, we identified eight top recommendations which should be implemented immediately, based on their estimated magnitude of GHG reductions, technical feasibility, ability to be widely adopted, and their importance in setting a groundwork for further major impact activities.

Below we summarize the eight points, each of which is developed more fully within this report.

1. ***Create an office of Energy Concierge Services*** to help residents, construction professionals, developers and businesses to access information about best practices, costs and benefits, technological options, navigating permitting requirements, government subsidies, and emerging new trends and technologies in the areas of buildings and electric vehicles. Allocate the necessary staff.
2. ***Transition in stages to requirements for all new construction to meet Passive House and full electrification performance standards.*** Starting in 2019 require all new construction that calls for special permits to be 1) performed at a Passive House standard for energy efficiency, and 2) to be fully electrified. Revise Criterion 5 of special permit review to facilitate the Passive House requirement. Advocate at the state level for stricter building codes toward the Passive House requirement.
3. ***Begin immediately with publishing all HERS ratings*** on file since 2010 in assessor data base records. Require HERS rating, energy costs, and special features such as EV charger or electric heating to be disclosed at all real estate transactions. List these data in the assessor data base. Benchmark and publish the energy performance of all large commercial and mixed-use buildings. This will build awareness of energy costs to drive owners and buyers toward homes that cost less to operate.
4. ***Require that electric option is considered for all heating system installations.*** Train contractors and building professionals to understand, stock and install electric heating systems. Require that contractors present the electric option to their customers in order to educate the homeowners and allow them to make informed choices.
5. ***For the residential sector, adopt a powerful financial incentive for energy retrofits and electrification in the form of a green property tax initiative such as the Real Estate Efficiency Program***. This initiative will reward homeowners who achieve lower-than-average energy use with a credit on their property tax bill, at no cost to the City (see Appendix A for details).
6. ***Eliminate parking minimums***; ***Make it easier to park electric vehicles*** Provide preferential free parking for EVs at all city lots and curbs in high density residential and business locations.
7. ***Form an EV taskforce to conduct a city-wide marketing/outreach campaign to promote the benefits and encourage the purchase of EVs***. The campaign would cover the economic, environmental and quality of life benefits of EVs, such as low maintenance, low cost of driving,

quieter streets, and others. The City would partner with grassroots organizations to host educational events and test drives.

8. ***Sign a Memorandum of Understanding with National Grid and Eversource*** about collaboration and additional resources for implementing energy conservation actions recommended in the Plan. The MOU might include the following topics: Accelerating the rate of home retrofits; Setting numerical goals & metrics for energy conservation; Training of contractors and building professionals; Co-branding a joint campaign for efficiency measures; Financing Energy Concierge Services; Providing enhanced incentives for Commercial users beyond MassSave; and others.
9. ***For the commercial sector, create a Newton Green Ribbon Commission*** composed of the largest property owners in the City. Encourage them to develop their own CAPs and to share best practices, learn the state-of-the-art, set measurable and ambitious targets on a path to carbon neutrality by 2050, measure their progress, disclose and benchmark energy performance of their properties, and hold each other accountable.
10. ***For all new large commercial and mixed use developments require transportation plans that support CCAP goals.***

The implementation cost of CCAP will be borne almost entirely by Newton residents, businesses and institutions. But the City will need to provide incentives, outreach, technical support, and engage in partnerships. We call on the City to providing the human resources necessary to perform this job. For the immediate future, we recommend that the City engage: an organizational consultant to recommend how to organize and staff the implementation; and a communication consultant to develop a campaign to drive EV adoption.

Between now and 2050, with or without the CCAP, owners of almost every residence and commercial facility will have to spend money to replace their heating equipment and the vehicles they drive, and upgrade or replace built structures. The questions we are facing are: *Will we continue with conventional choices which have gotten us to the dangerous climate threats in the first place? Or will we choose the alternative trajectory – reduced energy use and a shift to electric heat pumps and electric vehicles powered by renewable energy sources?*

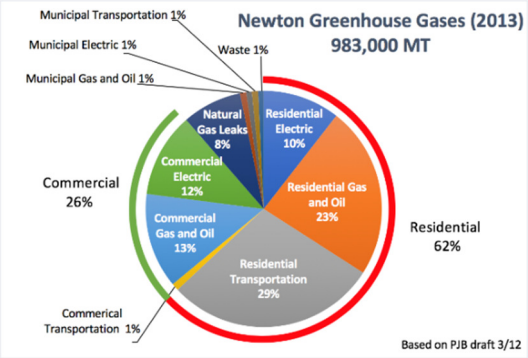
These are the profound questions of our time. It is our hope that the City government, using this Plan as a guide, will be a major force leading our beautiful city to take the alternative path.

3
Residential Sector

At 23 percent, residential consumption of gas and oil is the second largest (after transportation) energy-use category and GHG emitter in Newton (Figure 8). To eliminate those emissions from residential buildings, we've developed a plan that covers both new construction and existing buildings and that requires participation from residents, developers, contractors, and the City. Elements include education and outreach, incentives, and regulations. The result will be the elimination of the use of fossil fuels for home heating, and a decrease in per capita energy demand of 20 percent.

The analysis and recommendations included in the present chapter partially overlap with the Commercial Sector chapter, which includes large residential buildings in the definition of Commercial. The two sets of recommendations are consistent with, and reinforce, each other.

Figure 8: Sources of GHG Emissions in Newton (2013)



The burning of gas and oil to heat homes is the second largest energy use category in Newton according to a 2013 study.

3.1 Goals

An ambitious plan to reduce energy demand and GHG emissions from the residential buildings sector by 2050 calls for the complete replacement of fossil

fuels with electricity generated from renewable sources; and for a 20 percent reduction in the energy demand for residential heating (Table 1). This plan covers the current 32,000 residential households in 25,700 buildings in Newton. About 77 percent of these structures were built before 1960 and many have poor energy performance. Over 99 percent are heated by fossil fuels.

Table 1: Decreasing Per Capita Energy Consumption

Year	Reduction of energy consumption through energy efficiency improvements	Reduction of GHG emissions and use of fossil fuels
2025	3%	7%
2030	8%	27%
2040	14%	64%
2050	20%	100%

Caption: CCAP strategies and tactics will help reduce energy consumption by 20% and eliminate the use of fossil fuels for home heating—all by 2050.

Our analysis shows that it is not only possible to replace the burning of fossil fuels with renewable sources of energy and cut demand by 20 percent, but also that these goals are within reach in a fiscally responsible manner. This conclusion is based on an analysis of the housing stock in Newton and the City's demographics; the current and future estimates of the replacement rate of the current housing stock; the rate of home sales; assumptions about the increased rate of energy upgrades of existing homes; an assumed rate of electrification of heating; a push toward high performance standards for all new construction in Newton; and the assumption that future growth in the number of households will mostly be in large building complexes rather than single-family homes.

Meeting these goals will require the efforts of residents, developers and contractors, as well as City- and State-level participation. Newton citizens will have to invest in energy upgrades for their houses to a much greater extent than in the past; and developers and contractors will have to develop expertise in applying state-of-the-art building methods according to Passive House principles, and learn how to implement state of the art HVAC technologies. The City leadership will need to provide strong financial incentives and mandates; eliminate barriers, including the barriers in the state building code; and engage in a program of educating contractors and homeowners about the low carbon options for renovations, additions, and equipment replacement. State-level incentives will also help accomplish these goals.

While the burden of capital investing in the housing stock will fall mostly on residents and developers, the City will need to lead and support this transition through education, outreach, and legislative actions, all of which will require additional staff time.

3.2 Newton's Housing Stock

The strategy for dealing with residential buildings builds on an understanding of the Newton housing stock and its inhabitants. The relevant features include:

- 53 percent of households are in single family houses and 33 percent are in condos and two-family houses (in equal measures).
- About 34 percent of single-family houses are smaller than 1,850 sf, which, when located on large lots, may make them attractive candidates for tearing down and replacing with much larger structures.
- About 90 percent of houses in Newton were built before 1970, and more than half were built before 1930. Many of these houses exhibit poor energy performance.
- About 100 homes are torn down annually and replaced with new construction. The new houses average about 4048 sf. At that rate by 2050 about 20 percent of houses will be replaced while 80 percent of today's stock will still be in use.
- Approximately 650 homes change ownership annually[1]. At this rate, most houses in Newton will have changed hands by 2050.
- Because about 25 percent of Newton residents are over 65 years of age, the number of sales and replacements may increase in the future.
- Based on the current proposals for developments at Washington Street, Newton Upper Falls and Riverside, it is likely that further absolute growth in the number of dwellings will be in large multi-unit buildings. These units are much smaller (average 960 sf) than new 1-family (4048 sf) and two-family houses (avg 2275 sf per dwelling).
- Approximately 250-300 homes per year are retrofitted with additional wall insulation[2]. This represents a 20-25 percent rate of follow up after Mass Save home energy audits.

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[1] From Assessor's Office

[2] Data from National Grid

3.3 Strategy and Outcomes

The characteristics described above, along with regulatory possibilities, lead to a multi-pronged strategy for meeting Newton's climate action goals. The elements include:

- Taking advantage of the ongoing teardowns and gut renovations to partially replace the old housing stock with a much more durable and efficient one, using electric heat pumps for heating and electricity for cooking;
- Requiring that all new construction in Newton, including teardowns and gut renovations and regardless of type (from single-family to mixed use large buildings) perform at the energy efficiency level of Passive House;
- Treating each new construction project that exceeds the building code performance as a demonstration project and as a precedent-setter for a new baseline against which other projects will be judged (ratcheting effect);
- Increasing the rate of retrofits by a factor of 2-3 over the current rate;
- Taking advantage of the periodic necessity to replace fossil-fuel powered heating units in existing housing to shift toward electric heating;
- Taking advantage of purchase and sale events to incentivize retrofitting and electrification of existing homes;
- Incentivizing upgrades in the housing stock through additional measures beyond the current Mass Save subsides, which have proven to mobilize only a small fraction of Newton residents. Below we propose two such programs: a revenue-neutral property tax system; and public disclosure and vigorous dissemination of energy performance data for all houses[3];
- Eliminating barriers to energy upgrades through revisions in the zoning ordinance.

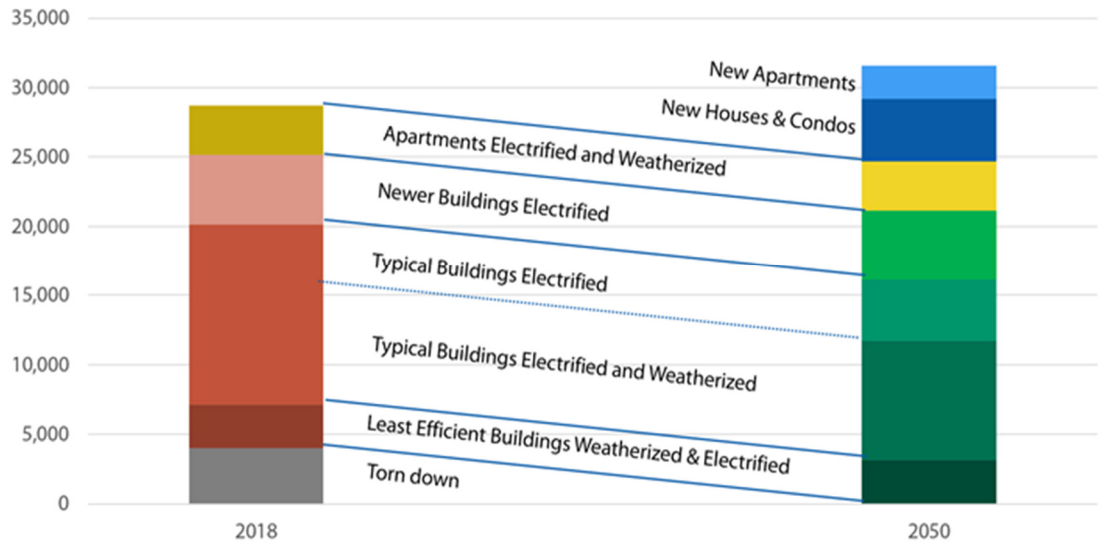
When fully implemented, by 2050 this strategy (with the specific tactical recommendations listed below) will produce a housing stock somewhat different from the current one (Figure 9), reduce energy consumption for space heating by approximately 20 percent (Figure 10), and eliminate GHG emission from Newton's residential housing sector (Figure 11)[4]. Although the number of housing units in Newton will increase by 2050, GHG emissions will decrease

[3] See Appendix A for details

[4] See Appendix B for model assumptions

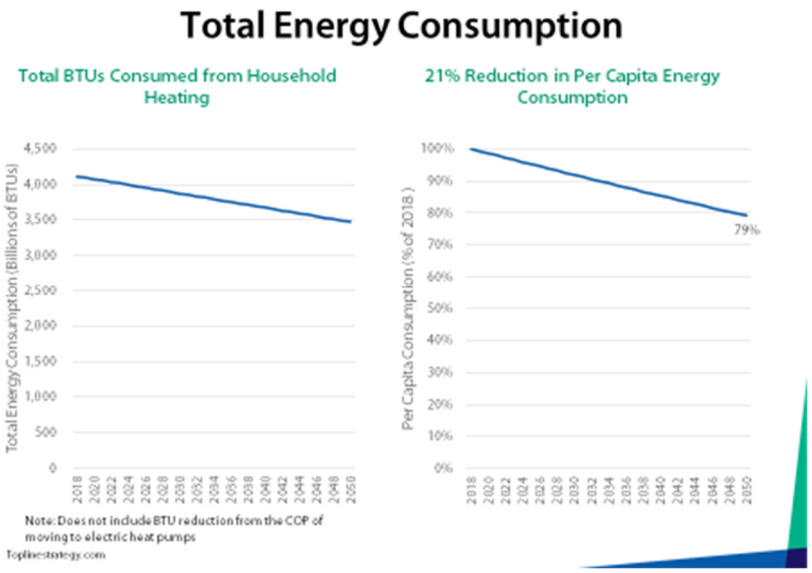
thanks to the adoption of electric heat pumps and improvements in home efficiency. Figure 11 compares estimates of GHG Emissions in the residential sector with a business-as-usual scenario.

Figure 9: Composition and Transformation of Housing Stock (2019-2050)



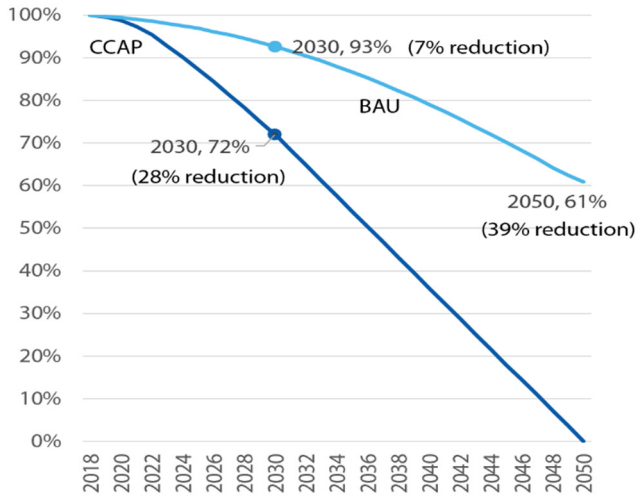
Current trends, boosted by the CCAP strategy, will lead to a new distribution of housing types in Newton.

Figure 10: Estimated Decrease in Energy Consumption From Energy Efficiency Improvements



Energy consumption in Newton will decrease by 20 percent according to modeling done for the CCAP.

Figure 11: Estimated Decrease in GHG Emissions in Residential Sector Compared with Business-As-Usual Scenario



Implementing the CCAP strategies can eliminate GHG emissions and the use of fossil fuels by Newton's housing stock by 2050. Under the Business-as-Usual Scenario decline in GHG emissions will be driven primarily by market forces, though technical support services will be needed to help contractors and homeowners choose the heating systems appropriate for their homes (See Appendix B for details of the model)

3.4 Specific Recommendations

A number of specific recommendations have been developed for the implementation of the residential sector strategy of the CCAP for new construction and for existing structures. The recommendations will require City staff time to design and implement. As the first step we strongly recommend that the City establish a full-time position or equivalent (for example, through engaging consulting services) for that purpose. The responsibilities of the position will be to interface with various city departments (i.e. Assessor, Permitting, Inspectional Services, Planning, Sustainability co-Directors, and others) and with the relevant committees on the City Council; to keep track of the state-of-the-art developments in building energy technologies and their financing, and energy policies in Massachusetts and beyond; and to assist with policy making and, especially, the implementation of this plan. These functions will become part of the responsibilities of the Energy Concierge Services (See Chapter 6, Implementation).

In this recommendation we take cues from Santa Monica, CA, a leader in sustainability policies and a city of similar size of population, socioeconomic profile, and average home prices to Newton. With an annual budget of about $800B (twice that of Newton), Santa Monica has a large Office of Sustainability and Environment, with more than two dozen employees[5].

3.4.1 New construction and gut renovations

A variety of recommendations covering education, training and regulations can help transform new residential construction practices to help achieve CCAP goals.

Education/training, Outreach. For new construction, implementation begins with education/training and outreach:

- Institute vigorous and comprehensive education and training for developers, contractors and homeowners about high efficiency options for construction, renovations and engineering systems, and about low embodied energy options in construction. *Embodied energy* refers to the energy used in manufacturing and transporting the materials used in a structure. The City should take advantage of such programs on the state level and learn from other cities that have done them.
- Put into place a marketing campaign to communicate that high-performance construction and renovations can be achieved at low or no extra cost.

[5] https://www.smgov.net/departments/ose/

Today's construction is much more energy efficient than in the past. An average new home built to code in 2018 has a HERS rating of 55, compared with a rating of 135 for homes built three or four decades earlier (the majority of Newton homes). Facilities built to Passive House (PH) standards, considered a costly luxury only a few years ago, can now be built at a cost of no more than 1-2 percent above the standard construction built to code[6]. This means great financial savings for the occupants through the life of the building, starting on day one. At least one home in Newton has already been built to PH standards – a 3,900 sf home called Newton Net Zero[7] – and more examples are elsewhere[8].

Newton can learn from and follow the example of Santa Monica, California, which put in place an extensive outreach and education program for building professionals to accompany its new green building code requirements[9].

The outreach program would include a web-page on the City website linking homeowners with information to help organize and fund home energy improvements and to better understand the potential returns on investments in high performing buildings and HVAC and lighting systems.

Drive the adoption of PH-standard of performance for all new construction. Given the volume of new construction expected, the City should drive the adoption of PH-standard of performance for all new construction through the following measures:

- Starting in 2022 adopt the requirement that all built-by-right houses perform to the Passive House standards and that they not use fossil fuels. In the interim, between 2019 and 2022, at the permitting step for built-by-right homes, provide information about cost-neutral options available for building envelope and HVAC systems, including high efficiency electric heating (heat pumps). Require the contractor to *consider* building to the PH standard and with electric heating, including price comparisons for the PH and non-PH construction. Charge significantly higher permit fees for construction that does not meet these standards.
- Starting immediately, use the special permit process to require PH performance levels and no use of fossil fuels for all new construction that requires such special permit.

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[6] Communication from Fred Gordon, developer and owner of a 28-unit PH in South Boston

[7] https://zeroenergy.com/newton-net-zero

[8] https://www.greennewton.org/advocacy/10655-2/

[9] https://www.smgov.net/Departments/OSE/Categories/Green_Building/ZNE_Guide_for_New_Construction_-_Residential.aspx

- Revise criterion 5 for granting a special permit to explicitly require a minimum number of measures to reduce energy use and increase efficiency:

  In cases involving construction of building or structures or additions to existing buildings or structures, if those proposed buildings or structures or additions contain individually or in the aggregate 20,000 or more square feet in gross floor area, the site planning, building design, construction, maintenance or long-term operation of the premises will contribute significantly to the efficient use and conservation of natural resources and energy.

- Adopt the Green Buildings Principles developed by Green Newton as criteria for evaluating merits of for large development projects seeking special permits[10].

At the state level, where lies the authority for setting performance requirements and building specifications for all construction, the push for PH-level performance and electric heating is gaining strength. Until such a building code is adopted by the Bureau of Building Regulations and Standards, BBRS, Newton can drive its implementation through education, incentives and other legal means. An electric heating system will simply be part of the central air-conditioning, which is a standard feature of all new construction.

A look at the potential for new construction shows how powerful a high-performance requirement can be. In the period of 2016-2018, on average about 107 new homes were built annually in Newton, most of which replaced existing homes. Of these, about 85 percent were single family homes. As the population of Newton continues to age and moves out of single-family dwellings, the rate of such replacements might increase. 34 percent of all single-family homes in Newton are 1850 sf or less in size—a size that often leads to tear-down-and-replace development.

Assuming an average rate of 125 teardowns per year over the next 30 years (which is somewhat higher than the current rate of about 100), approximately 4000 homes dwellings in Newton (about 12 percent of total household) will be replaced. Those replacements provide an opportunity to facilitate a transition to the high-performance building stock of tomorrow.

The last three bullet points above are most appropriate for large mixed-use developments, such as the Riverside and Upper Falls proposals by, respectively, Mark Development and Northland Investment. We estimate that most of the growth in the number of dwelling units will be in such large developments.

[10] https://www.greennewton.org/advocacy/10655-2/

Demanding high-performance standards for these buildings is an opportunity not to be missed.

We follow the example of the City of Somerville, MA, in the above recommendations. which in its zoning overhaul plan (released in October 2018) created a designation of Net Zero Building. The designation applies to smaller and denser dwellings with the gross floor area per dwelling unit at 850 sf (a change from either 1,500 or 1,125, depending on lot size). The definition of net zero includes the requirement that there be no on-site combustion for heating or cooking, and an EUI that is 25 percent below ASHRAE 90.1 2010, or meets stringent requirements such as those in the PH standard[11].

Require disclosure of energy performance ratings. Drive the disclosure of energy performance rating (HERS or EUI or cost of heating and cooling) at the point of sale. Require its publication in the Assessor's property tax records if the legal department considers it within the City's authority.

Public disclosure of energy performance and operating costs of buildings provides strong financial incentives for building to the PH-standard. Newton can facilitate its adoption on a voluntary basis. Home buyers are increasingly interested in the energy performance of houses and are willing to pay more for them[12].

The public utilities in Massachusetts support the energy performance disclosure[13] and we expect that it is only a matter of time before energy performance becomes a standard attribute of all buildings and HERS score and EUI become the metrics used by homeowners, contractors and developers.

Under the Commonwealth of Massachusetts' 2010 Stretch Code for energy efficiency, all new construction and major renovations in Newton receive a HERS rating. The City can support this trend by requiring the public listings of HERS ratings, where available, in the Assessor's database. That requirement may encourage other homeowners with well insulated homes to obtain a HERS rating and post it. That action will, in turn, put pressure on the owners of poorly insulated homes to upgrade them.

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[11] See page 45; http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/10/20181016-SZO-V3-Overview.pdf

[12] https://www.washingtonpost.com/realestate/study-finds-that-energy-efficient-homes-often-command-higher-prices/2012/07/19/gJQAF4MiwW_story.html?noredirect=on&utm_term=.7a31c2267015

[13] http://ma-eeac.org/wordpress/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no bulk.pdf

Encourage smaller dwelling-units, close to public transit. The City can promote the construction of smaller units in proximity to public transit and other services by:

- Encouraging construction of more detached Accessory Dwelling Units (ADUs) on existing residential properties.
- Supporting construction of large multi-family residential and mixed-use buildings in appropriate locations.

Multi-unit residential homes are generally more energy-efficient than single family dwellings of comparable size. Multiunit residences are, in addition, generally smaller than single family homes, which means they require less energy and also represent less embodied energy in construction materials and furnishings. Driven by this logic, the state of Oregon has in place a successful program to encourage ADUs (less than 800 square feet). In addition to reducing the energy consumption per capita ADUs might provide affordable housing for seniors who want to downsize[14].

Encouraging the construction of large mixed-use residential buildings in Newton will drive the new housing stock toward more compact and energy-efficient buildings. In addition, higher population density in mixed use settings (that might include commercial and cultural enterprises and public amenities) also reduces the need for driving. Large residential projects also present an opportunity to implement advanced high efficiency construction methods, electrical space conditioning, and the installation of solar panels.

Regarding ADUs, Newton should follow the example of the Somerville Zoning Overhaul plan, which permits an accessory building type by right with the following qualifiers:

- *One (1) permitted per lot, excluding triple deckers*
- *Similar size to a Cottage "principal" building type*
- *Only 1 or 2 stories in height*
- *Must be setback 60 ft from the front lot line*
- *Must be separated from Principal Building by 10 ft*
- *Site planned and constructed with life safety considerations*[15]

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[14] https://www.portlandoregon.gov/bds/36676

[15] See page 18; http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/10/20181016-SZO-V3-Overview.pdf

3.4.2 Existing houses

Existing one and two-family homes, where about 80 percent of Newton residents will continue living between now and 2050, present *the most difficult challenge for reducing energy consumption and GHG emissions.* Understandably, upgrading these houses to higher efficiency and switching to electric heating is intimidating to many and can be costly. However, we see a path to success through a mix of the right incentives, education, and leadership.

Disclosure of energy performance ratings. Drive the disclosure of energy performance rating (HERS or EUI or cost of heating and cooling) at the point of sale. Require its publication in the Assessor's property tax records.

According to the Assessor's Office, approximately 600-650 homes change ownership each year without major rebuilding or total replacement. That means that over the next 30 years almost all one-, two- and three-family houses that are not torn down will change owners. Changing ownership presents an opportunity to encourage energy upgrades: improvements in building envelope, HVAC and electrification. With the right incentives and publication of a home's HERS rating we can greatly encourage upgrading these homes. Until HERS is mandated, a vigorous campaign for its voluntary disclosure for recently upgraded properties, and adopting the practice of listing in the Assessor's database (if within the legal authority of the City), may provide such an incentive. The resulting increase in the sale price of a home of about 2-3 percent would generate enough capital to install insulation and electrify the house[16].

Our model estimates that increasing the rate of retrofits over the current one by a factor about 3, when combined with electrification of heat and PH standards for all new construction, will allow Newton to meet its 2050 GHG goals.

Require comparison of upgrade alternatives. Require that contractors present to homeowners a cost benefit analysis of alternative technologies and building envelope improvements, including replacement of fossil-fuel with electric heat. This can be done as part of the Mass Save program for energy assessments and retrofit projects.

Energy audits and current subsidies through Mass Save are an effective tool for modest upgrading of the energy performance of existing houses. They can also be a starting point for more substantial retrofits. During the 2017-2018 two-year period, 2115 energy assessments were conducted in Newton under the Mass Save

[16] https://www.washingtonpost.com/realestate/study-finds-that-energy-efficient-homes-often-command-higher-prices/2012/07/19/gJQAF4MiwW_story.html?noredirect=on&utm_term=.7a31c2267015

program. There is no direct data on the follow-up of these assessments. But based on data provided by National Grid (for 2017 and 2018) homeowners in Newton implement 200 insulation jobs, and 280 improvements in heating systems annually (we do not know what types). A typical insulation work costs $3200, of which the homeowner pays only 25 percent ($800) while the rest is covered through the Mass Save program. It is an incredible value. Able Home Performance Inc., a Mass Save-approved contractor, estimates that wall insulation reduces energy consumption by up to 15 percent while air sealing (which is free to Mass Save customers) reduces it by 5 percent. A replacement of a 30-year-old furnace with modern high efficiency equipment (required to qualify for subsidies) reduces energy consumption by 20-25 percent. The homeowners who currently implement these projects through Mass Save should be encouraged, during the permitting process, to commit to more advanced insulation work and to switching to heating with electric heat pumps.

In short, increasing the current rate of insulation projects by a factor of 2 or 3, and using them, as well as furnace/boiler replacement as opportunities for switching to electric heat and installing more advanced insulation, will go a long way toward meeting the goals of the Citizens Climate Action Plan.

Provide strong economic incentives for retrofit projects. The transition to air heat pumps faces two challenges: the up-front capital costs of installation and the cost of electricity, which is higher than natural gas (although the much greater efficiency of heat pumps, and their dual functions as heating and air conditioning partly offsets these costs). In addition, some weatherization projects may be more costly than the generous Mass Save subsidies provide for. For these reasons, we need powerful economic incentives to mobilize Newton citizens to retrofit their homes. Based on the documented low rate of weatherization at the current time, the Mass Save incentives are clearly insufficient to increase the rate of retrofits by a factor of 2 to 3 as the goals of this Plan require.

We propose that Newton adopts such an incentive in the form of a revenue-neutral program. The proposed *Accelerated Real Estate Efficiency Program* initiative would reward homeowners who reduce their greenhouse gas emissions at no cost to the City. A full write up of the proposal can be found in Appendix A. At its core, it would provide a financial incentive large enough to encourage the transition to electric heat and to significantly upgrade the building envelope. The advantages of the REEP initiative include:

- ✓ Its economic impacts on homeowners, though highly visible and mobilizing to action, are small;
- ✓ It is cost neutral to the City;

- ✓ It is performance based: homeowners can choose their path toward reducing energy consumption

Another financial incentive for switching to electric heat pumps comes from the 2019-2021 energy-efficiency plan, mandated every three years by the Green Communities Act, developed by the Massachusetts utilities, and approved by the Department of Public Utilities on Jan. 29, 2019. It provides new tools for Mass Save and will give homeowners incentives to switch from oil and propane furnaces to electric heat pumps.

Education/training, outreach. Vigorously reach out to contractors and homeowners to generate awareness of the energy efficiency and low embodied energy materials and practices readily available to them. Facilitate access to all available State, Federal and utility incentive programs. These points are discussed in the first two bullet items in the new construction section.

By-right energy-saving improvements. Allow, *by-right,* the installation of energy-saving home improvements, such as vestibules, insulation wraps, solar installations, high efficiency heat pumps, and other measures.

Under the current zoning ordinance some energy-related improvements conflict with existing rules. Examples include the set-back requirements that may prevent adding vestibules to existing structures or adding exterior insulation to building envelope; or restrictions on roof solar installation in historic districts. Special permits required in such cases are a barrier to implementing these projects, and should be removed.

Newton should adopt an ordinance that allows energy saving home improvements under $15,000 to be installed. This recommendation is modeled on Somerville Zoning Overhaul[17].

Limitations on additions to existing homes. Require that additions that would increase the total area of a home do not increase the total energy use of the building. Require a HERS score of 25 or less for renovations and additions that add more than 250 sf to the house, and which require a *special permit.* In addition, require that total energy demand of the home does not increase, as measured by HERS score.

Newton homeowners add over 120 substantial additions to their homes every year. Because of the added floor space, and the associated added energy use,

[17] See page 50; http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/10/20181016-SZO-V3-Overview.pdf

under current practice these additions are moving the city *further away from its goals* of reducing energy use and GHG emissions.

Substantial home additions are an opportune time to improve the building shell of the existing home; update and electrify the home's heating, cooling, and ventilation systems; and optimize the energy performance of the new addition itself. Additions are also a time when homeowners have access to expert advice (from their engineers, architects, and contractors) and financing, and when the City has regulatory permit authority.

For these reasons, the City should require that the net impact of additions on the total energy consumption of the dwelling should not be greater – and preferably smaller – after the completion of the addition project. Any increase in the energy use resulting from the addition should be compensated by energy-efficiency improvements elsewhere in the structure.

Concentrate on the lowest performing homes. Focus on the homes with characteristics that suggest they are among the worst energy use performers. Reach out to those homeowners to encourage them to conduct energy audits followed by upgrades through the Mass Save Program. Help through education and analysis of available technologies, programs, subsidies, and cost-benefits. Provide staff to assist homeowners with options, analysis, and decision-making resources.

3.5 Recommendations in Action

Ultimately, the goal of these recommendations is to make it easy and cost-effective for homeowners to switch to electric heat and undertake energy-efficiency projects. The following scenarios demonstrate how the individual recommendations come together to achieve these goals.

3.5.1 SCENARIO I

When their gas furnace fails, the owners of a typical Newton home call the HVAC company who has been servicing their furnace for the last 10 years. Upon inspection, the furnace repairman tells the owners that the furnace can be repaired, but the fix will be temporary and the furnace will need to be replaced very soon.

Not knowing much about furnaces, the homeowners google "replacing our furnace, Newton, MA" and one of the first listings that comes up is the City of Newton's site – "Replacing Your Furnace." After reading through the information on the site, the homeowners still have questions, so they call the

phone number provided on the site and a trained City representative schedules a call with them for the next day.

One of the major recommendations of that discussion calls for the homeowner to get a home energy audit before making a purchase because the size and cost of the furnace and the ongoing costs of fuel can be reduced by as much as 25 percent through weatherization. A list of approved energy auditors makes it easy for the homeowner to move ahead with this. For these homeowners, the energy auditor finds that the house is in good shape overall, but by simply plugging air leaks they can reduce energy usage by 8 percent. The total cost for the project would be $2000, but Mass Save would pick up $1,500 of the total, meaning that the homeowner would pay only $500 for work that will save $200/year in energy costs.

With their newly retrofitted home, the homeowners go to the City website that will help them research and find a reliable, trustworthy electric heat contractor. They find that their current HVAC company is one of those listed and ask the company for a proposal. In accordance with the Newton ordinance that an electric heat option must be considered as part of the permitting process to replace a furnace, the HVAC company, which has undergone training by the City on electric heat and installed several systems, provides two proposals, one for a gas furnace and the other for an electric heat pump.

The proposals themselves provide the homeowners with a complete picture of the costs of both systems including the installation costs, ongoing fuel costs, and the incentives and tax savings that the homeowner can expect from going electric.

Strictly based on the installation costs and the ongoing fuel costs, the gas option would be less expensive, costing $10,000 to install and $2,000 a year in fuel vs. $15,000 and $2,800 for the electric option. However, the estimated $900 annual property tax reduction due to GHG reductions (see Appendix A, Real Estate Efficiency Program) and other incentives make the electric option slightly less expensive. Furthermore, in addition to providing heat, the central heat pump can also replace the home's central air conditioning system. With one less piece of equipment to install and maintain, the decision to go electric becomes obvious.

3.5.2 SCENARIO II

A developer purchases an older, unrenovated 1,900 sf single-family home on a ½ acre lot in Newton Highlands for $970,000 with a plan to tear it down and replace it with a 3,900 sf. high quality modern home. With similar homes selling for $2.2M and estimated construction costs of $700,000 ($180 per sf), the developer can potentially make a profit of over $500,000.

Over the last several years, the developer has successfully built over a dozen homes in the area. Not wanting to change what has been a winning formula, she asks her regular architect to design a home for the property that is similar to the previous ones, including the use of gas heat and conforming to the Massachusetts HERS standard of 55.

The developer submits the plans to the City who, after reviewing them, meets with the developer to show her that, under the City's new green building plan, the developer can actually make a little more money by changing the house to use electric heat and meet the Passive House standard.

The City's Plans Examiner explains that over the last year, nearly 20 new homes had been built to the Passive House standard (HERS 25) and outfitted with electric heat. While building to the PH standard added about 7 percent to the construction costs, the price premium these homes sold for more than made up for the difference.

In total, the electric heated Passive House would save the homeowner about $3,000 per year in energy costs:

- With City's property tax plan, an emissions-free home would pay $2,300 per year less in property taxes.
- The annual cost to heat and cool a Passive House would come to under $1,000 vs. $1,700 for a HERS 55 house, a savings of $700 a year.

With the HERS rating, energy costs and property tax rates disclosed as part of the purchase process, the buyer could easily calculate that they could pay up to $70,000 more for the electric heated Passive House and still save money when compared to a similar HERS 55 property with gas heat.

With the house selling for $70,000 more and the Passive House only costing $50,000 more to build, the developer pockets an extra $20,000.

3.6 Unresolved Issue

This plan does not address the issue of increasing house sizes, which is pertinent to reducing GHG emissions. As shown in Appendix B, the average size of newly constructed houses in Newton has been increasing every year for several decades. Anyone driving though our city, especially through the southern part, will be struck by the growing number of 4000-5000 sf houses. The operating energy demand increases with house size, and so does the amount of carbon embodied in the building materials, so these mega-houses take us further *away* from the goals of this Plan.

Some may see the efforts to slow down or reverse this trend as an infringement on individual freedoms and consumer autonomy. We recommend that for the next update of this Plan the Newton community engages in a conversation about this issue.

4
Transportation

As this document is being written in early 2019, transportation technology is undergoing rapid transformation, including the mainstreaming of electric vehicles for public and private use, the application of information technology to improve public transit, the introduction of autonomous vehicles, and the expansion of ride sharing opportunities. The lifestyle preferences and practical needs of younger people are also shifting toward less driving and less car ownership. It is therefore impossible to plan for the next 30 years with any measure of certainty. For that reason, this chapter, while keeping its gaze on the year 2050, makes recommendations initially for the next five years. We hope that five years out great strides in the electrification of all forms of transportation, and serious investments in new technology, make it worthwhile to revisit best practices and expectations for reductions in the transportation sector as a contributor to GHG emissions. In the near-term our strategy is to reduce car-trips to the extent possible and encourage the adoption of electric vehicles (EVs) for the rest. The conversion to EVs offers the greatest potential to reduce the City's carbon footprint from transportation.

4.1 Goals and Rationale

At 31 percent and nearly 300,000 tons of GHGs, private transportation is the largest single source of GHG emissions in Newton. Newton residents own nearly 58,000 cars,[18] on average 1.7 cars per household. A typical Newton household

[18] The number of Newton vehicles (56,661) and the average gas mileage, is obtained from MAPC Newton Vehicle data set 2011-2014. This data set was filtered for only those cars registered to a Newton address. The number of annual new car purchases (6300 vehicles per year) was based on an average of values obtained from the Newton's Assessors office. The average new car gas mileage was calculated from the fleet average mileage reported in the MAPC data base, considering that the change year to year was due to an increase in the mileage (e.g. mpg) from the new cars bought that year. The average car ownership period (9.2 years) is calculated from the total number of vehicles divided by the annual new car purchases.

drives over 40 miles per day.[19] This number has been relatively constant over the past six years. A large percentage of cars in Newton are gasoline-powered SUVs. In 2018 close to 70 percent of all vehicles purchases in Massachusetts were SUVs, light trucks and vans and most likely Newton is no different. These statistics explain the low average fuel economy in Newton: 23 miles/gal.[20] According to MAPC approximately 5 percent of cars in Newton are hybrids (including plug-in hybrids) and 1 percent are battery electric.

The overall transportation goals for 2050 include:

- Replace most private, commercial and city vehicles powered by internal combustion engines (ICE), with electric vehicles (EVs), which will be charged with electricity generated by renewable sources. As we will show, the conversion of most vehicles to EVs is both feasible and the easiest and most cost-effective way to reduce greenhouse gas emissions from Newton.
- Reduce vehicle miles travelled (VMT) by private cars in Newton (and the associated energy consumption and GHG emissions) by 15 percent;

4.1.1 Reducing Vehicle Miles Traveled

The first goal for the Transportation Sector—reducing Vehicle Miles Traveled (VMT)—will require the city to remove current subsidies for driving alone as well as to incentivize the use of public transportation and active mobility, such as walking and biking. The 2017 transportation strategy *Newton in Motion* provides a plan for achieving this goal[21].

According to *Newton in Motion*, by 2040 Newton aims to reduce the percentage of car trips *by commuters* from the current 73 to 53 percent of total trips (Table 2).[22] This amounts to a 27 percent reduction in vehicle miles travelled (VMT). This reduction will be achieved by increasing the number of trips by public transit from 13 to 23 percent, biking from 4 to 9 percent and walking from 1 to

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[19] These estimates are based on Massachusetts Registry of Motor Vehicles mileage data from odometer readings during annual inspections: they include cars and other vehicles registered at Newton addresses. Through-traffic on the Massachusetts Turnpike, Route 128 and Rte. 9 is not included.

[20] The exact percentages of SUVs, EVs and hybrids in Newton will be available from MAPC later in 2019. Current MA new and existing car vehicle distributions by type obtained from a compilation of data reported by Auto Alliance [https://autoalliance.org/in-your-state/MA/]. The mileage for new EV's is obtained for models currently being purchased by Newton residents obtained from the MOR-EV data base.

[21] http://www.newtonma.gov/gov/planning/lrplan/transportation_strategy.asp

[22] Commuting trips are typically less than half the total number of trips a household makes, although they tend to be the longest trips that people take; data for local trips are not available.

6 percent. The *Newton in Motion* plan calls for improved public transit and biking/walking infrastructure, and for better information for Newton residents on the available options for individual trips. Pointing the way forward, many Newton residents already use alternative means of transportation.

Newton in Motion envisions an increase in walking, biking and using public transport, and a decrease in private car trips by commuters.

Table 2: Reducing Car Use in Newton

Commuting Mode	2017	2040
Automobile trips	73%	53%
Use Transit	13%	23%
Walk	4%	9%
Bike	1%	6%

Source *Newton in Motion* page 1-15

Newton in Motion included only commuter trips, because that is what the US Census measures.

However, we estimate that more than half of the miles travelled within Newton each day are *not* associated with commuting, but rather with the mobility needs of everyday life: driving children to school and activities, shopping, visiting doctors, socializing, other leisure activities, and so on. Better benchmarking of these trips is critical to achieving a lower VMT for them. This will require the city to make a small investment in technology and to allocate some of its annual census to asking about trips for social, shopping, school and other errands.

Assuming that less than half of the 40 miles driven daily by an average Newton household are associated with commuting, we conservatively estimate that implementing the *Newton in Motion* recommendations will reduce total VMT in Newton by approximately 10 percent between now and 2050. With innovations in information technology and new types of public transport, we estimate that this number will go up to about 15 percent by 2050.

Nationally, 40 percent of Americans' trips are less than three miles. Newton is more compact and better served with transit than most of the U.S., so we believe that total VMT can be reduced significantly, and that the goal could be as much as 50 percent by 2050. We recommend that in four to five years progress of the implementation of this plan is rigorously evaluated, aiming for a more ambitious goal of VMT reduction.

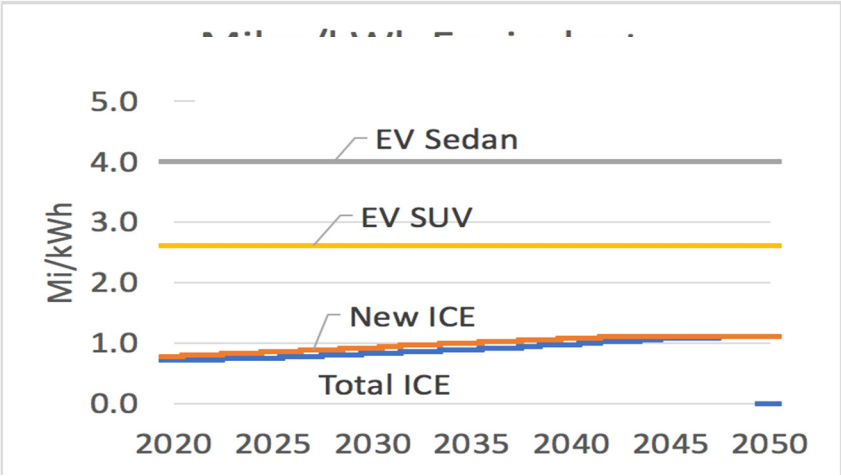
Reducing VMT at that level will make Newton residents healthier, richer and more resilient. The City will need to use several strategies to simultaneously encouraging and enabling non-auto trips and discouraging solo driving. These strategies include changing land use patterns, robust Transportation Demand Management, and removing subsidies for driving alone, particularly low-cost or free parking.

4.1.2 Transition to EVs

The second goal -- the transition from internal combustion engines (ICE) to electric vehicles (EVs), which includes plug-in hybrids (PHEVs) and battery driven cars (BEVs) -- **has the greatest potential to reduce the City's carbon footprint from transportation, with significant progress by 2030.** The reasons are:

- Electric vehicles are approximately four to six times more efficient than Vehicles with IC engines (Figure 12), depending on vehicle type.
- This electric energy can be supplied from non-fossil-fuel-based, non-GHG-emitting sources of electricity (see Chapter 1, Introduction)

Figure 12: Comparison of Energy Efficiency of EV vs. ICE engines

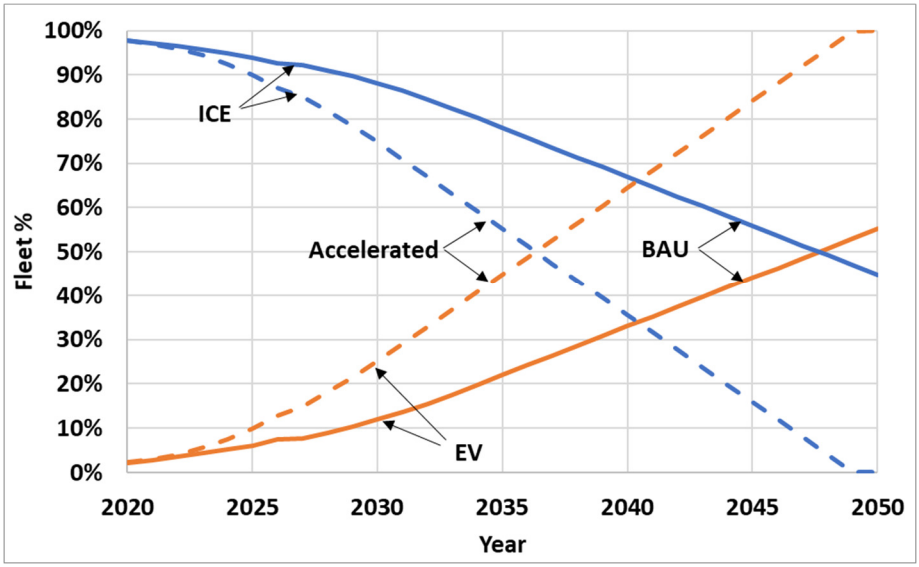


Since the efficiency ratio of EV to ICE declines over time from approximately 6 to 3, the ratio used above is 4 for sedans and 2.7 for SUVs. For ICE it is assumed that fuel economy increases owing to federal regulations.

Switching to Electric Vehicles (EVs) and Plug-in Hybrids (PHEV) can significantly reduce energy consumption and carbon emissions in the

transportation sector, as shown below. Figure 13 shows the projected adoption rate of EVs between 2019 and 2050 under two scenarios: Business as Usual, (BAU) and Accelerated adoption of EVs. Figure 14 shows the GHG emissions from cars in Newton under the same two scenarios. The BAU scenario assumes that the adoption rate of EVs is driven only by overall market forces. In the accelerated scenario adoption of EVs is accelerated by adopting the recommendations in the Plan. Both scenarios build on the car purchasing behaviors of Newton residents (see Appendix C for details).

Figure 13: Estimated Adoption Rate of EVs in Newton [as percent of private vehicles]

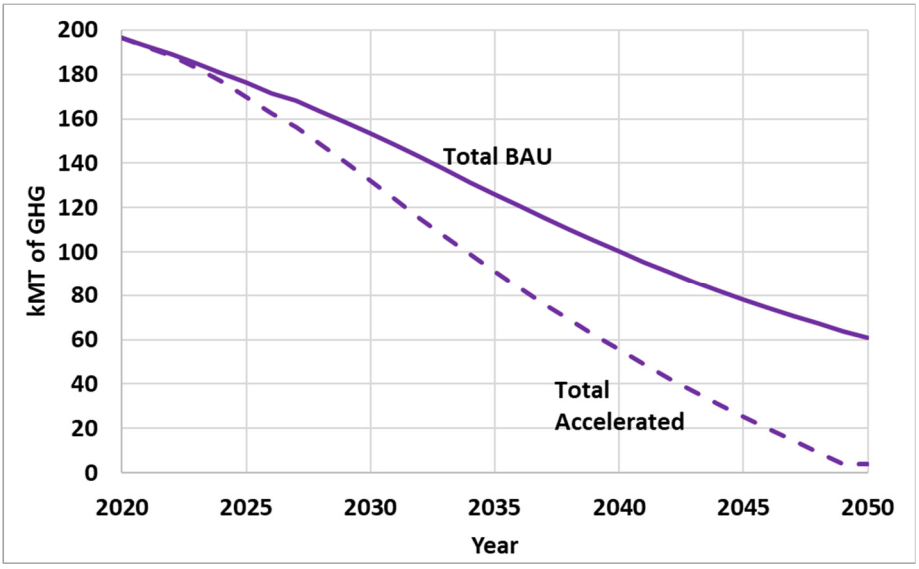


In the BAU scenario, between 2020 and 2027, one percent of total fleet is replaced with EVs each year, and after that 3 percent of total is replaced with EVs each year. In the Accelerated scenario, between 2020 and 2024, 1.5 percent of total fleet is replaced with EVs each year, and after that 4 percent of total is replaced with EVs each year. These two figures show that in the Accelerated scenario, between 2025 and 2028 EVs will represent between 10 and 20 percent of Newton cars. They also show that in 2035 the Accelerated scenario will lead to 60 percent drop in GHG emissions, which is in accordance with the IPCC goals.

We estimate that the "critical mass" in adopting EVs is between 10 percent and 20 percent of all Newton vehicles. Until that point mostly the early adopters will purchase EVs. The early adopters are the individuals who are technology- or social standing-conscious residents, and for whom the current price differential between EVs and ICEs is not an obstacle. Most likely, the EV will be a second or third vehicle in that household. Once the critical mass is reached (between 2025 and 2028, as shown in Figure 13) most residents in Newton will become sufficiently familiar with EVs to consider buying them. These second-tier

adopters are sensitive to the price differentials between ICE and EVs, which will decrease or possibly disappear by 2025.

Figure 14: Impact of EV Adoption Rate on GHG Emissions



In the Business-as-Usual scenario the market forces drive the transition to EVs, without interventions from the City (See Appendix C for details of the model).

The task of transitioning to an all-electric fleet in Newton is made easier by the following factors:

- Newton residents replace their automobiles about every 9.2 years [more often than average for the US (approximately every 12 years)]. Each year 11 percent of Newton vehicles are replaced. Each purchase event opens an opportunity to consider an EV. Between 2019 and 2050 all the private cars in Newton will be replaced more than 3 times.
- There are substantial federal tax credits (up to $7500, depending on the model) and state rebates ($2500) for EV purchases. Although their future is uncertain at the time of March 2019, strong support for these subsidies from car manufacturers, electric utilities and state government suggest that some types of subsidies will continue.
- Conversion to an EV can provide an economic benefit to consumers because of the greater EV efficiency, which could cut the cost of driving and maintaining the vehicle by half. Because vehicle charging often takes place during off-peak hours, the benefits are greatest if the utility charges less during off-peak hours. The economic benefits will depend on the relative prices of gasoline and electricity.
- The cost of EVs is trending downward and their travel range is increasing to the point where an EV's driving range is comparable to that of a car with a full tank of fuel. Between 2010 and 2018 EV prices have gone

down by 80 percent and by 2021 it is estimated that the cost will go down by 90 percent of the 2010 price[23,24].

- The technology of EVs is improving very rapidly. It is widely forecast that technological changes in EVs during the next decade will greatly exceed those made during the preceding twenty years. This will result in longer driving range and continuing price declines.
- The variety of available EV models is rapidly increasing, and includes electric SUVs that are coming to the market at the time of this writing. Since 70 percent of current new car purchases in Newton are SUVs, light trucks and vans, the availability of these types of models will be crucial.
- EV charging is becoming easier as the supportive infrastructure (charging stations, repair garages) are being put in place. Electric utilities are actively involved in this process. EVs can be fully recharged overnight on a home's 120-volt/15-Amp circuit. With the more advanced charging technology currently available at Mass Turnpike plazas, the charging time can be shortened to 20 minutes.
- The interim technology in the form of plug-in hybrids (PHEV) is widely available and time-tested to alleviate concerns among more cautious drivers about new technologies, such as BEVs. At the time of this writing a minivan Chrysler Pacifica PHEV exemplifies the new model of large, fuel efficient, comfortable family car with an electric plug-in option.
- The trends and forecasts for EVs, nationally and internationally, indicate a robust growth in the adoption of EVs, (an upward curve rather than a linear trend). Some estimates predict that globally the market share of ICEs will go down from 70 percent in 2025 to 40 percent in 2030.
- Massachusetts state policy on transportation will emphasize de-carbonizing personal vehicles. The Governor's Commission report The Future of Transportation in the Commonwealth recommends the goal of ending the sale of fossil-fuel cars and light trucks after 2040, and sets the stage for continued incentives for EV purchase. It also recommends a "Cap and Invest" plan modeled on the Regional Greenhouse Gas Initiative (RGGI) with a fee collected on gasoline and invested in sustainable transportation, including EV charging and incentives to purchase EVs[25]. These state level policies will greatly help Newton in phasing in EVs.

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[23] https://www.forbes.com/sites/energyinnovation/2017/09/18/the-future-of-electric-vehicles-in-the-u-s-part-2-ev-price-oil-cost-fuel-economy-drive-adoption/#67192870345c);

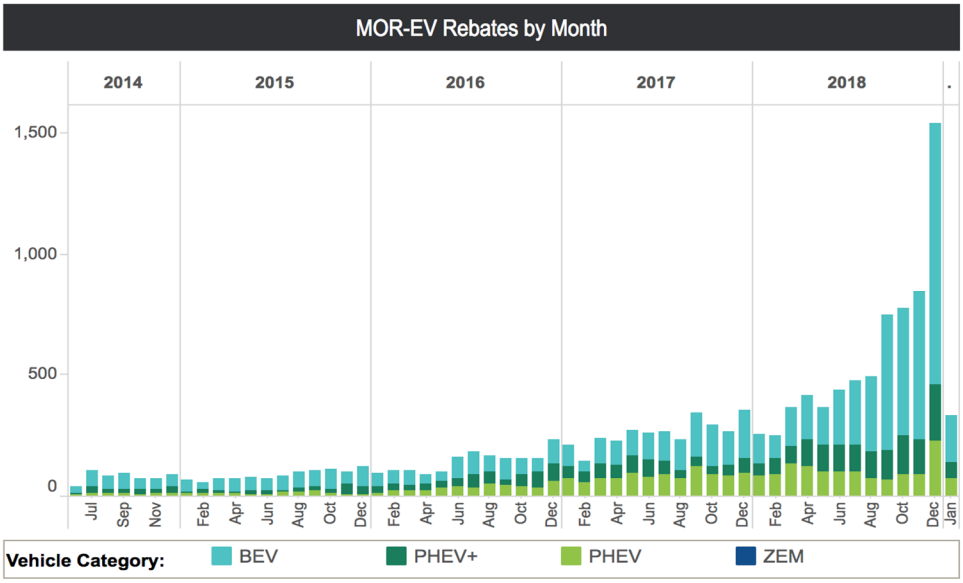
[24] https://about.bnef.com/electric-vehicle-outlook/

25 https://www.mass.gov/orgs/commission-on-the-future-of-transportation

Figure 15 shows the number of purchases of EVs and two types of PHEVs in Massachusetts between mid-2014 and early 2019. The growth rate for BEVs has been the fastest, especially in the second half of 2018. Based on the state's MOR-EV incentive program, there is evidence that EV purchases are now "turning the corner" of the curve. This indicates that the strategic considerations described below are at a point where EVs will rapidly become acceptable by more than early adopters.

An indicator of the growing interest in EVs in Newton is the number of EV license plates. These license plates are voluntary "vanity plates", so the actual number of EVs is most likely higher. The value of this data is that it shows the rate of growth, which is increasing (Figure 16).

Figure 15: EV Purchases in Massachusetts

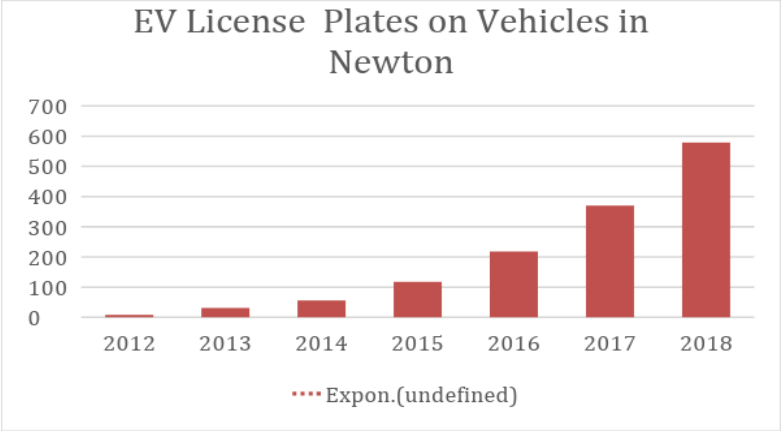


EV purchases in Massachusetts have accelerated since 2014, with BEVs leading the way. Growth is expected to continue to accelerate[26,27]

[26] Source: Massachusetts, Department of Energy Resources, Center for Sustainable Energy

[27] https://mor-ev.org/program-statistics) (PHEV and PHEV+ refer to the battery capacity: <10kWh and >10kWh, respectively)

Figure 16: EV License Plates in Newton



The number of EV plates issued in Newton is on the rise. Because these plates are voluntary plates the actual number of EVs is most likely higher than the numbers shown (Source: Newton Assessor's Department)

4.2 Strategy for EV transition

The conversion of most vehicles to EVs is both feasible and the easiest and most cost-effective measure to reduce greenhouse gas emissions in Newton. And there are many factors that can turn the current very low rate of EV ownership into a high one. But there are also formidable *barriers* to this transition.

4.2.1 Barriers

- Newton households, like the rest of Massachusetts and the country, like large, heavy and energy demanding vehicles, and may not be attracted to the electric versions of these types of vehicles.
- At the present time most consumers are cautious about purchasing EVs, which are more expensive than ICE-powered vehicles and do not give the same driving range and ubiquitous and quick opportunities to refuel.
- Ownership of EV requires changes in daily routines.
- While dealers and car companies have developed greater market awareness, for many reasons, they do not have significant incentive to push for strong growth of EV's (since there is a smaller amount of service business which is a major profit center for dealers, and the sale engagement is more complex, reducing the benefit to sales staff).

For these reasons, in order for the transition to proceed at a rate necessary to meet the 2050 goals this process will require over the next 5 years a strategically designed facilitation on the part of the City and the activist community to accelerate EV/PHEV adoption.

4.2.2 Elements of the strategy

The Newton Citizens Climate Action Plan calls for the following strategy to accelerate the transition to EVs:

- Take advantage of the periodic replacement of personal vehicles approximately every 9.2 years to encourage households to shift toward EVs and PHEVs.
- Incentivize conversions by advocating for rebates and tax credits at the state and federal level; and by favoring EVs for choice parking spots;
- Outreach and educate Newton residents by informing them about the tremendous potential of EVs to reduce GHG emissions in Newton, about EV technologies, prices, and availability of various subsidies.
- During the first several years of the EV campaign, focus on the following households: those with cars that are 7+ years old (using the Assessor's data base); those that own hybrids, and owners of "sporty," expensive, and technologically advanced cars.
- Negotiate with utilities to provide incentives for home charging stations, and possibly special rates (both in terms of distribution charges and energy charges, possibly through Newton's municipal aggregation program).
- Remove the constraint posed by insufficient EV charging facilities away from home and in multifamily buildings by providing public charging stations and making the provision of charging facilities a condition for receiving special permits for new multifamily and commercial developments.

These efforts should be done in concert with a number of other cities and organizations. For example, the Green Energy Consumer's Alliance (https://www.greenenergyconsumers.org/) has arranged special purchase rates with a number of dealers, and updates pricing available on a monthly basis. Other towns (Belmont, Weston, Wayland) have developed outreach programs that can be leveraged such as Mass Energize[28]. NGO's have also developed programs such as those by Sierra Club, and Plug in America (https://pluginamerica.org/).

4.3 Specific Recommendations for EV Transition

We have developed a detailed set of recommendations to help implement the EV strategy.

[28] https://www.massenergize.org/

Make it easier to charge and park EVs and PHEVs. The City can do the following to ease difficulties parking and charging electric vehicles:

- Provide preferential parking for EVs at city lots and curbs in high density residential and business locations
- Expand the number of charging stations, placing them in highly visible location.
- Incorporate charging facilities into all new City managed solar canopies on municipal properties. Charging facilities should be incorporated in at least 15 percent of spaces beneath the canopies and parking in these charger-equipped spaces limited to EVs.

The City should not let cost stand in the way of installing charging stations. The free-standing charging facilities currently installed in Newton cost $26,000 each; they were financed with the money from the Volkswagen settlement. The marginal cost of adding charging facilities to the solar canopies will be similar per charging station. The City should pursue grant money for this purpose, but should also expend the resources necessary to reach an advantageous number of charging facilities.

- Require charging stations to be installed in all multi-unit residential buildings and large commercial buildings, enough to serve all the occupants. The City can use the special permit process for buildings 20,000 sf and larger as an implementation tool. In that respect, we follow the example of Somerville, MA, which, in its 2028 Zoning overhaul plan has provisions for greater access to charging stations.[29]

Lead by example. The City can set a good example by converting the municipal fleet to EVs as soon as possible. Members of Newton Citizens Commission on Energy should do the same.

Identify financial incentives for EV ownership. The current cost incentives for buying/leasing an EV or PHEV need to be extended at the state and federal level

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[29] http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/10/20181016-SZO-V3-Overview.pdf

Accessory parking structures used for accessory parking must provide electrical capacity capable of supporting Level 2 EVSE to at least twenty-five percent (25%) of parking spaces, rounded up to the next whole number.

Parking structures used for commercial parking must provide electrical capacity capable of supporting Level 2 EVSE to at least fifteen percent (15%) of parking spaces, rounded up to the next whole number, and at least five percent (5%) of parking spaces, rounded up to the next whole number, must have an operational Level 2 EVSE installed.

EVSE capable of simultaneously charging two (2) vehicles is counted as two (2) Level 2 EVSE.

until the market will no longer need to be assisted. Newton should advocate strongly for these incentives to be continued.

Encourage EV conversion through campaigns, partnerships, advocacy and outreach. To encourage the adoption of EVs the City can pursue a variety of cooperative ventures including:

- Partnerships with auto dealers to identify deals for EVs specific to City residents. Massachusetts Green Energy Alliance has negotiated such deals in the past. [add link] Partnering with EV manufacturers should also be explored by the City. Nissan, which currently offers a $5,000 rebate per vehicle if the City joins in their promotion, is an example to consider, but the downside of joining with a single manufacturer or dealer may not be advisable—being tied to one manufacturer can limit available choices and may weaken the City's bargaining position.
- Partnerships with large employers, retailers and institutions to install charging stations
- Partnership with Green Newton to campaign for EVs and to organize an annual EV drive.
- Working with utilities to provide financial incentives to residents for fast charging stations, and discount electricity price for EV charging. A program of "giving back to the community" in exchange for greatly increased use of electricity should be explored.
- Conducting a city-wide marketing campaign to promote the benefits of EVs (economics, environmental and quality of life in Newton, such as quiet streets. Focus on the following households: those with cars that are 7+ years old (using the Assessor's data base); those that own hybrids, and owners of "sporty," expensive, and technologically advanced cars.
- On an ongoing basis, offer training, webinars, and workshops to increase the immediate impact of EVs.
- Advocate with the state legislature to extend and increase the state federal subsidies and incentives for buying EVs.

Track the progress of the EV transition. The City can monitor progress through the database of vehicles registered in Newton, which identifies the make, model, and year of each vehicle for assessing the excise tax.

4.4 Strategy for Public Transport and Active Mobility

The key to the goal of reducing VMTs is reducing single occupancy automobile trips.

4.4.1 Change Land Use Patterns to Minimize the Need for Transportation

Land use and development patterns of the last sixty years have increased the use of vehicles and created significant traffic congestion. We can create livable neighborhoods in Newton that require just a short walk to places people frequent – such as pharmacies, grocery stores, restaurants, parks, and coffee shops. This will significantly reduce vehicle usage and support other city goals such as increasing housing options and furthering economic development. Newton businesses will be better able to attract and keep employees who do not own cars or want to drive.

Priorities:

- Build more housing near transportation hubs
- Infill with needed retail and services to support residents
- Create commercial development near transportation hubs
- Design streets near the increased density of housing, retail and commercial to prioritize mass transit and non-vehicle traffic.

4.4.2 Stop Subsidizing Driving

Owning a car is expensive, but after one is purchased and maintained, the costs are invisible, because they are "sunk"—i.e. in the past. By contrast, transit requires an up-front payment for each use. The decision to use a car therefore "seems" cheaper. There are several factors that further encourage driving—the most effective of which is low-cost or free parking and low price of gasoline (relative to, for example, Europe)

In addition, the creation of parking lots and structured parking has a direct effect on the cost of doing business, of housing and on the vibrancy and walkability of our villages and city centers

Priorities:

- Eliminate parking minimums and consider parking maximums near villages and transit
- Require a daily charge for commercial parking and a monthly charge for residential parking
- Allow shared parking
- Create convenient, protected bicycle parking
- Advocate for the ability to toll municipal roads, higher gas and excise taxes. Advocate that these funds be invested in lower carbon transportation modes, such as the T.

4.4.3 Transit

For commuters to Boston, Brookline, Cambridge and Waltham, Newton has transit options that many cities in the U.S. could only dream of: two (2) light rail lines (MBTA's B and D lines), numerous express buses, and the commuter rail Framingham/Worcester line. Yet the use of MBTA public transit by commuters is limited by:

- The convenience and perceived low-cost of driving
- Unfamiliarity with transit of many of our citizens,
- Distance from home to a transit stop, which for some residents is too large for walking.
- Bus stops that lack shelters to provide basic comforts, such as seating, and protection from wind, rain and snow
- Limited access to the stations and express bus stops owing to unsafe bicycle and pedestrian connections.

Convenient and reliable north-south service would be a major improvement in the ability of Newton residents to commute inbound on the Green Line and other MBTA services.

These transit improvements would also serve some local trips, e.g. from home to village centers for dining and some shopping.

Strategy. The strategy for increasing use of public transit features two key elements:

- The pursuit of policies that increase the share of trips by public transit. That effort will require improving public transportation, transit stops and active mobility infrastructure for *commuters* and *non-commuters* alike. It will also require better subsidies (see TDM below) and outreach.
- Keeping track of, and taking advantage of, technological advances in mode-share direction mapping (google maps, but better), communications, logistics, and vehicle technologies in order to implement radical innovations in non-private car mobility.

4.4.4 Walking, Biking, Micromobility

Newton is fortunate to have many paths and off-road connections to and through our transportation nodes and villages. But decades of designing for vehicle speed and throughput have degraded and broken many of these. By continuing to implement the city's Complete Streets policies, prioritized by the popularity of the destinations (schools, villages, transit, etc), active transportation can be much more attractive, safer and healthier.

Municipalities around the world are creating safe, protected networks of low-stress routes for pedestrians and cyclists that increase that mode share by 400 percent or more.

Strategy:

- Continue to expand the network of low-stress and protected bicycle (or micromobility) lanes.
- Reduce vehicle trips to schools via policy (underway in the School Department) and services (school buses should be electric asap)
- Incentivize bike share participation by offering free rides to transit during rush hour

4.5 Specific Recommendations for Public Transport and Active Mobility

The specific recommendations for implementing the public transport strategy build partly on the *Newton in Motion* strategy prepared by the City and its consultant, completed in 2017 after extensive analysis and public outreach (Figure 17). Some of the recommendations listed below draw on that document.

Provide more transportation options

Priorities:

- Establish new level of service metric for evaluating road work and development based on people not vehicle throughput.
- Redesign streets to create more space for walking, biking, mass transit, trees, commerce, gathering spaces, etc.
- Create a low stress network for walking and biking. Safe and pleasant routes should connect people to village centers, schools, parks, and transit. The network can be routed along greenways, through public parks and on low volume streets to provide safe and pleasant routes.
- Work with neighboring communities to continue transit routes such as, bike paths and bus lanes, across City lines

Expand programs for seniors.

Evaluate and consider expanding the mobility programs for seniors, which the City is implementing at the time of this writing as *NewMo*, to all Newton residents. This new service provides an on-demand micro-transit service. Seniors can book a trip in real time with an app on their smart phone, by email or with a phone call. The system will create a route to pick up multiple passengers along the way. Prices are affordable owing to municipal subsidies. Eliminating current

subsidies for driving in Newton will generate a revenue stream, part of which can be used to subsidize the on-demand micro transit.

We recommend that all the vans used for this service be EVs, with an eye for adopting future technological advances. For example, it is possible that in several years these vehicles will be autonomous, thus saving a great deal of money for the city and making them widely accessible for all Newton residents.

Eliminate the first/last mile barrier

Partner with employment centers to eliminate the "first" and "last mile" barrier to using public transportation by commuters: the challenge of getting commuters close to their destination to avoid having to drive. Boston is currently developing a plan for reducing the number of car trips entering the city, and should work with the surrounding communities with public transit connection to Boston to solve the "last mile" problem.

Improve local MBTA service on existing routes.

The key to increasing the use of public transportation is better connections, more regular service, service that extends into the evening and better stops

The 59 bus stops at all the inbound rail and transit routes as well as village centers (Upper Falls, Newton Highlands, Newtonville, and Nonantum), shopping and restaurants on Needham Street and Four Corners, and the Newton City Hall and Newton Free Library. In addition, the 59 serves three major developments that are intended to be transit-oriented: Austin Street, Washington Place, and Marshall's Plaza on Needham Street.

The 52 bus serves Newton Centre and provides Green Line connections there.

The MBTA announced in January 2019 that route changes on the 59 bus route would be improved by consolidating split routes, resulting in better service on Needham Street where there is large potential ridership from apartment buildings and businesses. However, the overall schedule for the 59 Bus does not add service. Research shows that a 20-minute frequency is needed to induce more ridership. Beyond the tons of GHG directly saved, acceptably frequent bus service would – together with improvements that are planned on the Green Line – make transit ridership an important segment of all trips in Newton, and this allows independent travel by people who do not or cannot drive.

The City should negotiate with the MBTA to provide 20-minute service on the 59 and 52 buses for their full length in Newton, and to extend service hours beyond 6:30 pm. This will capture a larger share of commuter trips, including

both trips by employees working in Newton and Newton residents commuting to Boston and other inbound destinations.

The Express Buses—already provide excellent commuter connections east and west. The city should encourage the MBTA and MassDOT to create a bus-only lane for rush hour on the MassPike to make the bus competitive with driving.

Commuter Rail—the stations need to be accessible. The trains should provide travel both east and west as well as frequent, T-level service (one of the "big ideas" from the Washington Street visioning process). The city should work to leverage such improvements to this service.

Accessible Stations—The Green Line is undergoing track and signal work to allow for faster service and higher capacity cars. Ensuring that all residents can access the stops is the next step.

Connect Auburndale and Riverside—A train track exists, but service needs to be added to allow for reverse commuting and better connection of the Green Line and the Commuter Rail.

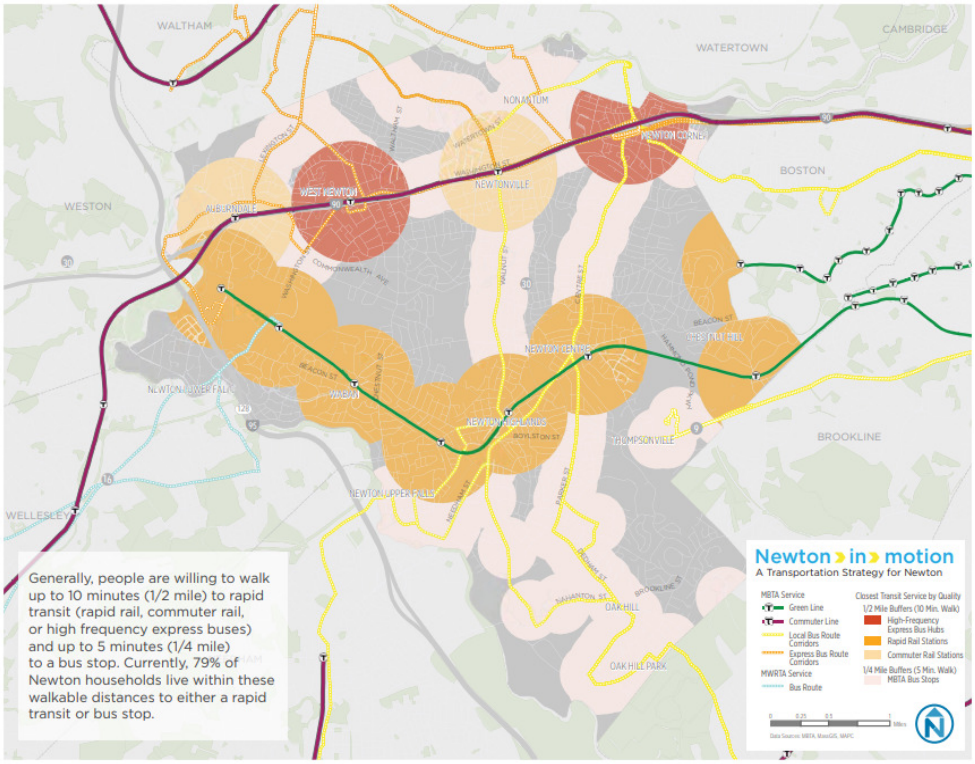
Expand local services.

Expanded local services, through both the MBTA, the City, and public private partnerships will help increase ridership.

- **Expand local MBTA bus routes**. Beyond improved service and longer hours on the existing MBTA bus routes, local service needs to be provided in other parts of the City like Auburndale and West Newton. *Newton in Motion* addresses these needs.
- **Consider an on-demand ride service**. A demand-responsive door to door service would be ideal, but would be very expensive for the City to operate. Some examples exist (like Acton's MinuteVan shuttles that serve the commuter rail station and school campus), but they depend on grants and funding sources other than the municipal budget. As another example, The Ride, MBTA's complementary paratransit service, is mandated by the Americans with Disabilities Act, but it costs approximately $40 per trip on average. But a compromise scenario that should be explored is a public/private partnership offering on-demand ride pooling that might stop at main intersections, allowing access within walking distance of homes, and a wider range of destinations around Newton.
- **Add fixed and flexible route shuttles** extending service into underserved parts of Newton, such as Auburndale. In this recommendation we follow the example of Lexington, MA which has five fixed route shuttle loops connecting with the town center.

WALKING DISTANCE TO TRANSIT

FIGURE 24 PROXIMITY TO TRANSIT BY TRANSIT TYPE



Outreach, Education & Motivation

Getting people to use non-automobile modes requires information and promotional outreach: uncertainty about these modes is a barrier to using them. The City has recently added a web page to Newtonma.gov that provides detailed information on public transportation. This page includes a description of all the public transportation routes that go through Newton; links to information about programs such as Park 'n Pedal; information about bringing your bike on public transportation; and links to realtime apps such as *Moovit*, *Get T-Alert*, and more.

The City has also recently added a web page to Newtonma.gov that provides information on bicycling. It provides links to download a guide of the city's road markings for bicycle and pedestrian safety; there are links to information about Lime bike share, Map My Ride, which provides maps with elevation guides to many routes within and around Newton that can be downloaded onto an app. safe and most popular cycling routes; bike clubs and organized rides; and much more.

A web page with information on walking could also be added as we plan and improve school accessibility and intersection redesign to lessen pedestrian crossing distances and improve safety and pedestrian visibility. It could possibly provide information on local walking clubs, both formal and informal.

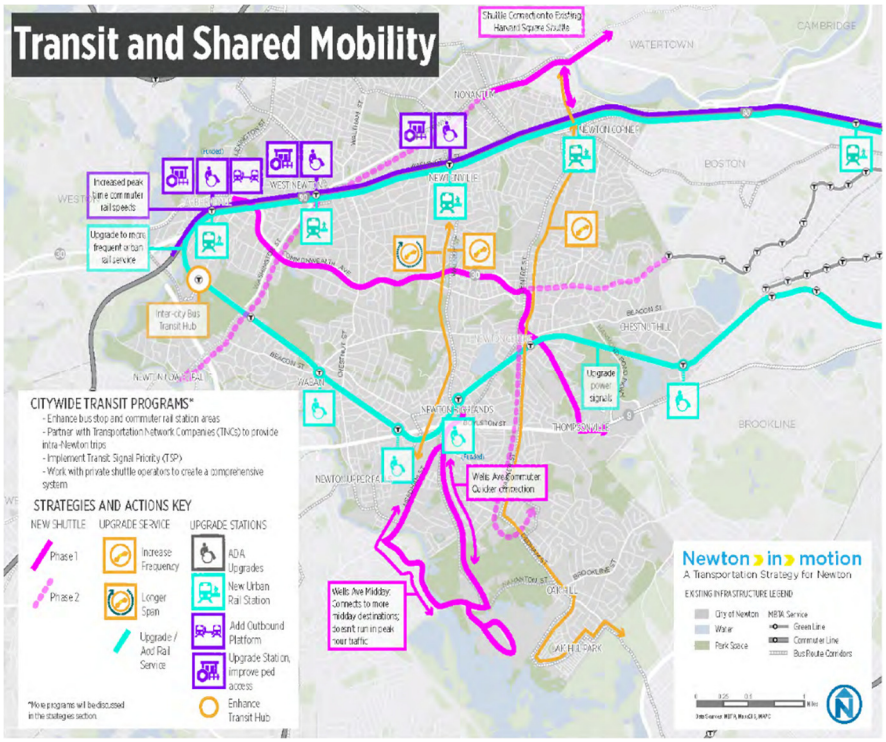
Trip planning tools such as Google Maps and apps such as Cowlines that allow travelers to plan using multiple modes were unavailable only a few years ago and now provide excellent information, not just for automobiles but also public transportation and walking. The MBTA schedule explorer allows the user to choose the best service to get to a destination at the desired time. The walking mode provides distance and time estimates. The MBTA has and endorses several transit apps to show the real time location of buses and trains and their arrival time at your stop and estimated time of arrival at your destination.

The City can promote increased use of these tools, and can provide regular travel training at venues like the senior center and schools. An ongoing effort is needed to inform and encourage Newton residents to use public transportation, to bike and to walk. Online and phone information resources should be made available by the City in the same manner that resources are dedicated to solid waste and recycling, but sharing information alone will not overcome barriers. Targeted outreach and incentives are necessary as well, with convenience an important consideration.

Continue and Expand Transportation Demand Management

The city is using Transportation Demand Management (TDM) to reduce trips from new, large developments. This expanding suite of tools, including many cited in *Newton in Motion* and this document, sets a number of vehicle trips allowed per year and moves that number downward in pace with the city. This tool should be adopted as soon as possible in City and School departments to reduce vehicle miles traveled by our own employees as well as school children. A Transportation Demand Coordinator should be added, and should be made available, once school and city trips are covered, to aid residents, small businesses and nonprofits who want to reduce their VMT.

Figure 17: Summary of recommendations from *Newton in Motion*.



Evaluate the economic tradeoffs

The costs of transportation are distributed and include indirect costs to the environment that are undervalued. Our current transportation system encourages overconsumption and is unsustainable. Using total cost analysis will enable better transportation planning.

Strategies:

- Assess the full cost of transportation by mode, as well as the costs of transportation to the city and residents.
- Use economic incentives to motivate change. Fees can be a very effective way to discourage driving, especially congestion pricing, and can be used to pay for improvements to public transportation and to create infrastructure for walking and biking.
- Determine the cost benefit of depaving, tree planting, curbs, sidewalks, and other changes to streets.
- Evaluate how Newton's commercial and retail property value stems from existing transportation options and travel times. Use evaluation data in assessing development projects and capital spending projects, including debt exclusion or override proposals. Decide how that relates to our

willingness as a community to invest in maintaining or improving that value.

4.6 Unresolved Issues

This plan does not address the difficult yet very pertinent issue of SUVs. SUVs, which across the board have low fuel economy, represent approximately 70 percent of new car purchases in Newton. As a result, Newton's average fuel economy is only 23 miles/gal. Replacing SUVs with sedans (preferably electric) would significantly reduce energy consumption, but to call for it might be viewed as an infringement on consumer autonomy.

We recommend that for the next iteration of this plan Newton conducts a community-wide conversation about large vehicles like SUVs.
We recommend that for the next iteration of this plan Newton conducts a community-wide conversation about large vehicles like SUVs

5
Commercial Property Sector

This Chapter of Newton's Citizens Climate Action Plan focuses on top priority strategies to pursue in the commercial sector in Newton. This chapter also lays out an implementation plan to support those strategies.

5.1 Overview/Background

Newton's commercial buildings are responsible for 25 percent of its greenhouse gas emissions. Of these emissions, about half are due to electricity use and half are due to fossil fuel combustion in the buildings. These fuels are used primarily for space and water heating, as well as cooking.

In this section, we primarily address the choices that commercial building owners and builders make that impact on-site energy use and emissions. Therefore, the primary actions that Newton's commercial and institutional building owners and developers can take and where the City should focus its efforts relate to energy efficiency and fuel choice in Newton's buildings. The goal of this plan is to get building owners and builders to create well-sealed, well-insulated buildings with efficient zero-emission heating systems.

For the purposes of this chapter, we define commercial buildings, in accord with the International Energy Conservation Code, as anything that is not a detached one- or two-family dwelling, townhouse, or other residential occupancy three stories or fewer in height. That category includes *large apartment or condominium buildings, commercial, institutional and municipal buildings are all included in this chapter.* By using this definition, our analysis and recommendations partially overlap with the Residential Sector chapter, which includes large apartment or condominium buildings. The two sets of recommendations are consistent with and reinforce each other. The present chapter provides a more detailed implementation plan regarding large residential buildings.

By addressing commercial vehicles' transition from being powered by internal combustion engines to being powered by electric motors, the present chapter

also partially overlaps with the recommendations and implementation plan in Transportation chapter. The two sets are mutually consistent and reinforcing.

Newton is home to approximately 935 commercial buildings. Of these, over 800 are less than 50,000 square feet in size. However, just 31 of the city's largest buildings and property owners cumulatively control half of the commercial square footage (Figure 18).

Figure 18: Histogram of Newton Commercial Building Sizes

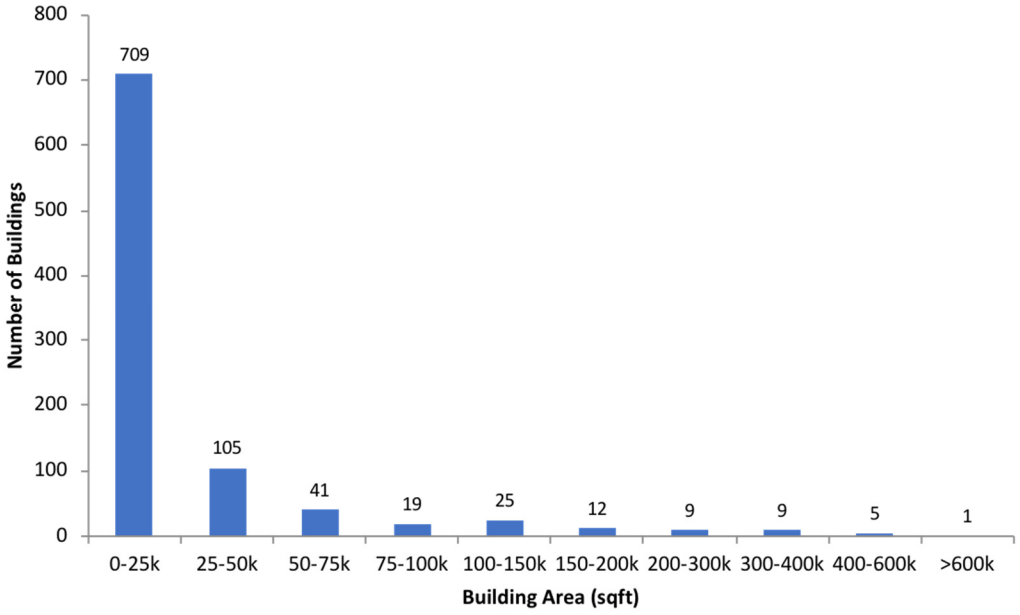


Table 3: Newton Employers with the Largest Building Areas

	Area [million ft^2]	**Number of Organizations**	**Portion of large building area**
Large For Profit	6.2	23	47%
Large Nonprofit	6.0	7	45%
City (large bldg.)	1.1	1	8%
Sub-total	**13.3**	**31**	**48% [of total commercial building area]**
Total Commercial	27.6		

New commercial construction will likely generate the largest differences in Newton's built environment within the next two decades. Developments at

Riverside, along Needham St., and along Washington St. could produce the lion's share of Newton's additional housing units and commercial and retail space. These developments are not yet set in stone. Therefore, establishing expectations soon regarding the performance of these buildings will help to keep new buildings' owners, and the City, from locking in infrastructure that would be out of date and need to be retrofit within a decade or two.

5.2 Strategy and Outcome Overview

This Plan calls for the following strategies for reducing energy demand and GHG emissions in the commercial sector:

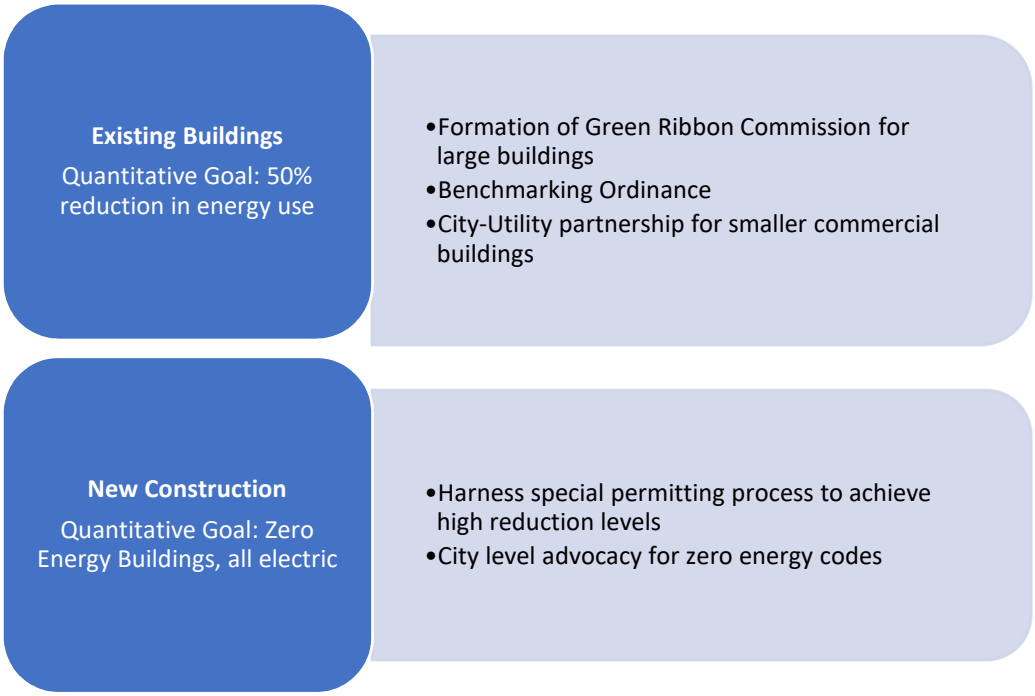
- For all existing building stock:
  - The City should set a goal of reducing emissions from existing commercial buildings by 50 percent or more by 2030;
  - The City, led by the Mayor and with the assistance of the NCCE and our electric and gas utilities, should convene as many of the large property owners as possible into a "green ribbon commission" or other process to share best practices, learn the state of the art, set measurable and ambitious targets, measure their progress, and hold each other accountable;
  - The City should establish a building energy benchmarking and disclosure program so building owners, tenants, and the public at large can evaluate the energy performance of Newton's existing commercial buildings;
  - The City should facilitate building owner and tenant participation in utility energy efficiency programs.
- For all new construction and gut renovations:
  - The City's planning and zoning staff should use the special permit process to encourage developers to build structures that are very efficient and all-electric. The City Council should set policy expectations that the goal is Passive House standards, with the very low energy use intensities published by the model Zero Code[30] as fallback levels.
  - The City Council should harness the ongoing zoning reform process to build a consistent and compatible vision for Newton that reduces building and transportation emissions, encourages the use of public transit and other modes that reduce traffic and congestion, and aligns with the city's values.

[30] The **ZERO Code** is a national *and* international building energy standard for new building construction that integrates cost-effective energy efficiency standards with on-site and/or off-site renewable energy resulting in zero-net-carbon buildings.

- The City Council should establish an expectation that no new buildings constructed after 2025 will use fossil fuels on-site.
- The Mayor, NCCE, and City departments should work with the state government and partner cities to advance a state building code that is compatible with and enhances these goals.
- The above strategies reflect the Green Building Principles developed by Green Newton as criteria for evaluating the merits of large development projects seeking special permits. The City should formally adopt the Guidelines as a framework for negotiating with developers.

The strategies and goals for the commercial sector are summarized in Figure 19 and Table 3.

Figure 19: Summary of Commercial Buildings Goals



5.3 City-Utility Partnership

Many cities engage directly with their utilities to improve the delivery of energy efficiency programs to their residents and businesses and to support their sustainability initiatives. This contact can benefit both cities and utilities. Cities gain additional resources to help meet their energy goals, while utilities

achieve greater customer satisfaction and higher program participation and energy savings to further their policy objectives. The options for these partnerships range from formal funding agreements to informal marketing and outreach promoting energy efficiency programs. In addition to providing financial support for community efforts, utilities can offer access to energy usage data, technical expertise and support for energy management strategies, and support for the development of an energy efficiency workforce.

The City of Newton should work collaboratively with Eversource (for electric) and National Grid (for gas) to create a formal partnership through a signed MOU that covers the following aspects of the CCAP goals as described in the table below:

- Enhanced energy efficiency in commercial buildings
- Transportation
- Data sharing needs

Table 3: Strategies for City-Utility Partnership

Strategy	Type of Support
New Buildings	Align special permitting resources with more stringent energy efficiency targets going beyond code that match with utility incentives. Work closely with utility to minimize documentation to support city permit and utility incentives
Small Existing Buildings	Prioritize, using utility data, community level targeting. Work closely with chamber of commerce/utility for joint programs.
Green Ribbon Commission support for large existing buildings	City and utility to identify top buildings to participate in green ribbon commission. Utility to develop individual Memorandum of Understandings (MOUs) with each large participating building and identify energy reduction goals. City staff to keep track of all partnerships and progress.
Benchmarking Support	Work with utility data to target and evaluate energy efficiency initiatives. Reward commercial owners who receive the most efficient ratings. Identify cost sharing for 'training' city staff and commercial facility managers to input benchmarking data.
Marketing	Create joint education materials with utility to promote EE and EVs in City of Newton.
Improve Access to Utility Data	Leverage existing data sharing platforms to provide digital energy data and develop clear guidelines for data sharing between city and utility. Engage in joint efforts to provide aggregated whole building data to owners for better energy targeting.
Electric Vehicles	Work closely with Eversource to align its EV goals with the City's goals for EVs. Work together to identify what type of support Eversource can provide in terms of charging stations and enhanced incentives to residents for EVs

5.4 Specific Recommendations for Existing Buildings

In order to meet the City's emission reduction goals, emissions from Newton's existing commercial buildings must be reduced 50 percent or more by 2030. That will require both increases in efficiency and a transition to efficient electric heating options. While new construction will be more efficient than Newton's existing buildings, most of the commercial buildings that will exist in Newton in 2050 are already built—and even more-so for 2030. Therefore, Newton must engage with the owners of the city's commercial and institutional buildings and help them make the right decisions as they invest to increase the performance and upgrade the heating systems in these structures to achieve the 50 percent goal.

5.4.1 Green Ribbon Commission 'lite'/2030 District

Newton's existing commercial and institutional building owners range from small businesses that own a single building, to large institutions and real estate firms that own and operate entire campuses or portfolios of commercial and multi-family real estate. A small number of building owners control a majority of Newton's commercial building square footage. The City must engage with these building owners to improve the energy performance of their buildings. By 2050, these buildings should be zero-emission buildings, but interim targets and a collaborative approach can accelerate actions. We recommend that the Mayor convene representatives from each of Newton's large building owners (including the City itself) and challenge them to cut GHG emissions from their buildings in half, or more, by 2030. The City should provide technical and administrative support to a collaborative of these building owners to share best practices, learn from leaders, and challenge each other to do better.

This effort could take the form of an ongoing and active "green ribbon commission" as is being used in Boston (The Boston Green Ribbon Commission) and Newton could also create a "2030 District" to tap into a private-sector led national network of commercial building leaders. As stated on the 2030 District web site[31]:

> *2030 Districts are led by the private sector, with local building industry leaders uniting around a shared vision for sustainability and economic growth – while aligning with local community groups and government to achieve significant energy, water, and emissions reductions within our commercial cores.*

[31] http://www.2030districts.org

Analysis of Newton's commercial properties over 100,000 square feet in size, reveals that 31 organizations account for 50 percent of the commercial area (Table 4).

Table 4: Breakdown of Large Properties

	Area [million ft^2]	**Number of Organizations**	**Percent of Total**
Commercial	6.2	23	22%
Non-profit	6	7	22%
City	1.1	1	4%
Sub-total	13.3	31	48%
Total Commercial	27.6		

A more detailed breakdown of commercial and non-profits reveals possible subgroups that are likely to face similar issues (Table 5).

Table 5: Detailed Breakdown of Large Properties

Use Type	**Area** [million ft^2]	**Number of Organizations**
Academic	5.1	5
Office	3.0	11
Apartments	1.3	5
Retail	1.4	5
Newton City (4 largest bldgs)	1.1	1
Hotel	.5	2
Other non-profit	.9	2

One way to divide these areas up might be in 3 clusters (Table 6).

Table 6: Breakdown by Building Types

Cluster	**Percent of Large Buildings**	**Number of Organizations**
Academic	40%	6
Office	20%	11
Apartment & Hotel	15%	9

The Mayor should begin this process by inviting the leaders of these organizations to participate; and to designate individuals from their organizations who will be responsible for building performance to attend a

kickoff meeting. Even if participation is not universal from the beginning, the first set of participants can develop the group's framework, set goals, and share best practices. The City should ask each organization to set goals consistent with the City's climate targets and identify the funds they will use to meet those goals. Combined with the benchmarking and disclosure recommended below, the group can identify leaders, and those requiring more assistance in meeting their goals. Two organizations with a large presence in Newton, Boston College and the parent organization of Newton Wellesley Hospital, are already part of the Boston Green Ribbon Commission, so might be willing to share what they learned in that process.

As this group evolves, it should also develop partnerships with utility efficiency programs (for which it serves as a promising environment to identify program participants), as well as other business organization such as the Newton-Needham Chamber of Commerce and Innovation District.

Implementation Plan for the City

- 2019: Mayor's office to convene a formal 'green ribbon commission' with at least the city's top 10 largest commercial property owners.
  - City and NCCE to finalize the list of large commercial properties to target
  - NCCE and City to conduct kick-off meeting with utility and top commercial owners
  - City and NCCE to develop preliminary partnership goals with utilities. Use 2030 District standards as a model to develop group goals
- 2020-2025: Keep track of progress through quarterly meetings with utility and participating owners. Provide guidance to financing tools to enhance deeper savings.
- City to develop an internal tracking system to track progress, coordinated with the benchmarking and disclosure program.
- Annually: Generate rewards for top performing properties. Identify additional properties to invite to join the commission.

5.4.2 Benchmarking and Disclosure

Newton's commercial building owners and tenants should be able compare the energy performance of their buildings with similar buildings in Newton and elsewhere. To that end, Newton should require commercial buildings over a certain size threshold to report their energy use through EPA's Energy Star Portfolio Manager. The size threshold for mandatory annual reporting should start high (e.g. 50,000 square feet in a single building or campus) and fall on

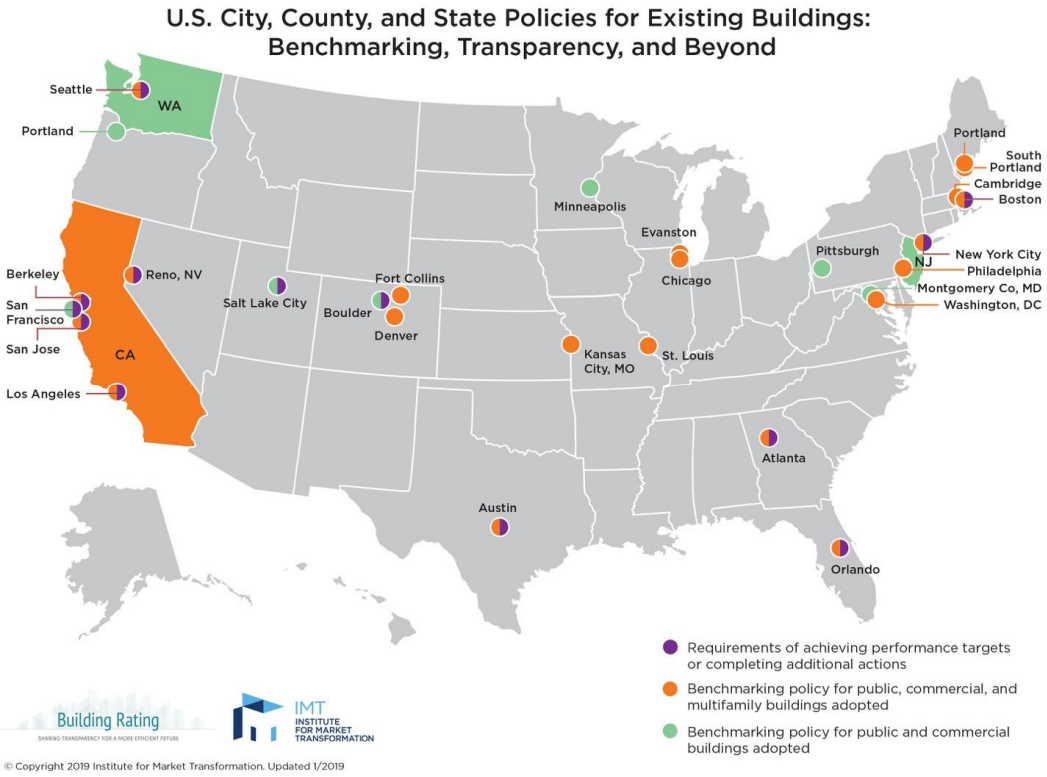
a known schedule until energy use in all buildings over 5,000 square feet is regularly reported and benchmarked. This kind of annual benchmarking and reporting requirement has been used in cities across the country (Figure 20), and is creating a national dataset for benchmarking and comparison.

US Department of Energy (DOE) funding is currently available to support local governments on benchmarking initiatives through the local Northeast Energy Efficiency Partnerships (NEEP) in the following ways:

- Meeting with city government officials or key stakeholders to understand the community's vision and needs
- Providing presentations to the different stakeholder groups (community members, town government officials, etc.) on topics including overviews of other city policies, impacts benchmarking policies have on the community, what to do with the data, and others.
    - See the benchmarking dashboard for impacts of policies around the region.
- Drafting of model policies tailored to the specific needs of a community
    - Example: South Portland's policy is specific to a business district in the City and will be rolled out to the entire community in the future
- Developing "How to Comply" guides or other supporting materials for the community, building owners, and others.
- Assisting with fitting benchmarking policies into the broader landscape of a town's energy/carbon reduction goals.

As part of the benchmarking effort, the Mayor should present annual awards to the best performing and most improved buildings in the City. The City and utility efficiency programs could also use the benchmarking data to identify buildings in particular need of assistance.

Figure 20: Institute for Market Transformation Inventory of Government Policies



Implementation Plan for the City

- 2019: Lay the groundwork:
  - NCCE and City staff work with NEEP and city stakeholders to craft a benchmarking and disclosure ordinance tailored to Newton's needs;
  - Pass the ordinance by late 2019;
  - Apply for DOE funding to support development and implementation.
- 2020:
  - Budget for the remaining funding required to launch the program;
  - Require energy use reporting from buildings over 50,000 square feet;
  - Mayor awards first "City Star" awards to top performing large buildings.
- 2021-2025:
  - Expand requirements to smaller buildings;
  - Annual awards for highest performance and most improved buildings.

5.5 Specific Recommendations for New Construction and Gut Renovations

For new buildings and gut renovations, the City can take advantage of permitting and zoning processes on the local level; and advocate for more stringent energy codes at the state level.

5.5.1. Use the permitting and zoning processes to encourage very high performance in new buildings

Newton has the authority to require developers to meet certain conditions in the context of special permits. Developers require special permits if they will be building a structure that is not allowed by right. According to the City of Newton website, special permits are always required for multi-family housing and larger commercial projects.[32] Newton should assertively use the special permit process to achieve conditions that get all new buildings and gut renovations as close as possible to the goal of Passive House levels of energy use, and meet that demand with all-electric systems. This goal may not be achievable for all new buildings today, although it is already achievable for most. There are numerous regional examples of multi-family all-electric Passive House buildings that offer quiet, high indoor air and environmental quality and very low energy and emission intensity.

To the extent that Passive House performance is not achievable, City staff should at least strive to ensure that all buildings that require special permits meet the energy use intensity targets established for our climate zone in the model "Zero Code". The Zero Code is a recognized national and international model code that sets achievable levels of performance for buildings such that the remaining demand can credibly be met with affordable renewable energy, to produce net zero buildings. Part of this code establishes a set of required performance factors that take the form of building-use-specific improvements over the energy use intensity performance of a baseline building that meets the ASHRAE Standard 90.1-2016. In our climate, the required levels are about a 40 percent improvement over the baseline building.

The energy requirements of Newton's special permitting process should not be used to discourage development here; rather, this process should also seek conditions that lower transportation energy use through reduced parking and greater walkability and connections to public transit. New construction that is

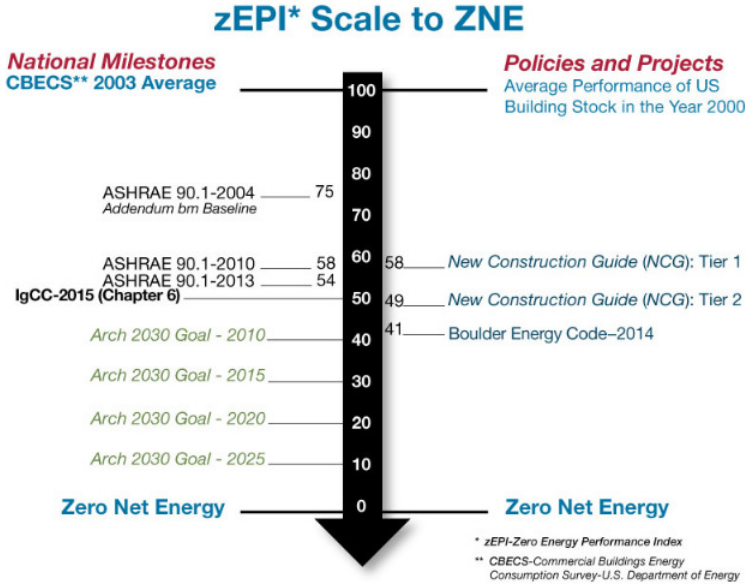
[32] http://www.newtonma.gov/gov/planning/current/sppermits/default.asp

accessible by transit in Newton generally displaces construction further out in Boston's sprawl that is not as transit-accessible.

To ensure that buildings are actually built to the level required and that they perform at that level over time, Newton's Buildings Department should ensure that all new buildings track and report their energy use to the benchmarking and disclosure system in order to get their Certificate of Occupancy. This data will enable Newton to explore the use of an "outcome based" or "performance-based" approach to building energy requirements.

To prepare the construction industry in Newton and surrounding municipalities for the need to build very-high-performance buildings, eventually achieving Passive House across all building types, Newton should establish an official trajectory of increasingly stringent expectations. A three-year cycle of tighter and tighter expectations would coincide with the three-year cycle on which the model International Energy Conservation Code is updated, and on which Massachusetts updates its state code. Newton could model its approach on the Zero-Energy Performance Index (zEPI) scale to gradually build toward net zero standards (Figure 21).

Figure 21: Zero Energy Performance Scale



(Source: Modified 2015 International Green Construction Code (IGCC), https://shop.iccsafe.org/2015-international-green-construction-coder-igccr-43415.html)

Any new buildings constructed with fossil fuel infrastructure will require extensive, and potentially expensive, retrofits to meet necessary emissions goals. While nearly every commercial or residential building designed and

built today could cost-effectively achieve zero on-site emissions through all-electric construction, it may be premature to require such an approach today. However, Newton should set developer and building owner expectations today to plan for a fossil-fuel free future—by 2025, no new commercial building in Newton should be built with fossil fuel infrastructure, like natural gas connections and combustion heating systems.

It is already technically and economically feasible to heat many types of new commercial buildings with all-electric systems. Many commercial buildings require more cooling than heating capacity, even in our climate, due to internal loads from computers, lights, and occupants. Variable refrigerant flow (VRF) and other types of heat pump systems provide heating and cooling, and can even move heat from sources within buildings (like server rooms) to other places in the building that require heating, without drawing on the outside air.

The northeast and other cold climates have seen numerous examples of high-performance electrically-heated offices, schools, multifamily housing, and restaurants built over the last 15 years. These buildings can use either ground-source or air-source heat pumps.

By setting a future date certain, Newton allows building developers, architects, building trades, and potential tenants to develop the skills and familiarity with technologies and building and design practices necessary to build all-electric buildings.

Implementation Plan for the City

- 2019:
  - The City Council should adopt an explicit goal of Passive House and all-electric construction for new buildings to guide City staff as they negotiate with those seeking special permits. City Council should pair this goal with a trajectory of energy use expectations, beginning with the Zero Code levels and updating every three years toward net zero by 2030.
  - The City should use its ongoing zoning update process to maximize the beneficial energy and climate benefits of developments in Newton. It should link requests for new gas line connections to special permitting and the trajectory of the code cycle in future, with 2030 as end goal.
- 2020:
  - Buildings Department should require new buildings to participate in the City's benchmarking and disclosure program in order to get a Certificate of Occupancy.

5.5.2. Advocate for a stringent state energy code

The City of Newton has the authority to adopt its own building code. However, that code would need approval from the Commonwealth of Massachusetts, which would be difficult to obtain and would likely not be worth the effort. Instead, Newton should advocate for the commonwealth's baseline and energy Stretch Codes to be as aggressive as possible, as soon as possible. For example, Massachusetts' Stretch Code should require net-zero-carbon construction for all new commercial buildings by 2030. Newton should also work together with other municipalities and advocates to push for state approval of a model net zero or all-electric energy code that these cities and towns could adopt if the Massachusetts Department of Energy Resources (DOER) does not move quickly enough toward a zero net carbon requirement in its Stretch Code.

Implementation Plan for City

- 2019:
  - City staff and Commission members should participate in the voting process for the update to the International Energy Conservation Code.
- 2020-2021:
  - City leaders should advocate to their state counterparts for a stringent state building code and Stretch Code for the 2022 cycle.
  - If state leaders are reluctant to lead, NCCE and City staff should identify partners in other municipalities to join in advocacy and consider developing a separate code to bring to the state building authorities for approval.

6
Implementation

There is no magic bullet for reducing GHG emissions. Neither carbon pricing nor building large windfarms in New England, while absolutely necessary, are enough to facilitate a transition to a different housing stock, to different institutional and commercial buildings, and to alternative mobility modes and technology. Cities are in the best position to foster these kinds of changes because of their ability to interact with, and provide incentives for, the affected citizens.

The CCAP lists more than three dozen recommendations for actions, described in Chapters 3 to 5 of this report. They will, *in aggregate,* lead to significant reductions in energy demand and GHG emissions from the residential, commercial and transportation sectors in Newton. Such a large number of actions is necessary because of the complexity of the challenge. It will take a variety of incentives, rules, and outreach, partnerships, education programs, and technical support to help Newton residents and businesses retrofit their buildings, transition to electric homes and cars, and to leave their cars at home. It will take a variety of incentives, rules, outreach, education programs, partnerships, and technical support to help contractors and developers adopt cutting edge construction methods and equipment. In this section we envision the future that successful implementation will bring; highlight the highest priority items, which should be implemented immediately to achieve that vision; outline the City's role; discuss the necessary resources and their sources; and recommend a way to start the process.

6.1 Envisioning Newton's Future

Newton is not acting in isolation to combat climate change. Our City is part of a region that is generally committed to preventing the worst consequences of climate change. Our future vision is not that of living in dark cold houses or chasing the construction industry away. Rather, it is a vision of a thriving city

with high quality housing stock, less traffic congestion, quiet streets, cleaner air, and civic pride in what we will have accomplished together.

At least once over the next 30 years, every family in Newton will change their heating system, replace the family car two or three times, replace a roof, and in many cases paint their house, change siding, build an addition or remodel. When these moments of taking action come, two choices are before us: one is to continue business as usual and stay on the current trajectory of increasing GHG emissions and climate catastrophe. The *other choice is to forge a new trajectory* that has a reasonable chance of bringing us to carbon neutrality by 2050. Our extensive research and analysis, conducted over the past six months, suggests that the alternative path is entirely feasible. Once we are on that trajectory, the decisions about the heating system, roof, addition, car, place to live, will become self-evident.

Newton needs to achieve a culture-shift, both within the City operations and in the community, which will make it feasible to meet our goals during the timeframe required. This is no small task. We cannot simply dictate what will happen; individuals will be called upon to set different priorities and embrace change. A robust ongoing communications campaign will move us forward, and the City of Newton will need to invest the resources and expertise to bring this about by drawing on advanced methods of communication, including social media.

Our Citizens Climate Action Plan calls for residents and businesses in Newton to make substantial upfront investments for a carbon-free future. Over time, these investments will pay for themselves in savings on energy bills, higher building resale values, and a better business environment. The overall improvement in the quality of life in Newton will also take place. With electric vehicles and reduced vehicle miles travelled the streets will be quieter, less congested and less polluted with such unhealthy air contaminants as ozone, nitrogen oxides, carbon monoxide, and fine particles; indoor air quality will also improve when the combustion of natural gas for cooking is eliminated. Individuals with asthma will greatly benefit from these changes. And over time the likelihood of accidents such as the 2018 gas explosions in Lawrence and Andover will disappear.

Achieving carbon neutrality will not always be smooth or straight-forward, and will certainly require course corrections along the way. But without having the ultimate goal before us at all times, we will never achieve it. For that reason, *there is no such a thing as 5-year or 10-year plan.* There is only a 30-year plan with milestones and interim goals at shorter time intervals. But *the next two years are critical* for setting the right course and preparing the groundwork for the next ten years.

6.2 Priority Actions

During 2019 the City needs to develop a detailed implementation plan. In order to set that plan on a trajectory toward carbon neutrality we identified nine top recommendations that should be implemented immediately. These were selected by applying the following criteria:

- ✓ Magnitude of GHG emissions reduction
- ✓ Technical feasibility
- ✓ Market adoptability: likelihood that residents, businesses, and stakeholders can be mobilized to adopt necessary changes and take action
- ✓ Importance in laying the groundwork for further major impact activities

These recommended actions are meant to be applied *in tandem*. For example, putting incentives for homeowners to implement energy retrofits in place needs to be combined with the technical support that the Energy Concierge Service (see below) is intended to provide. In another example, establishing preferred parking spaces for electric vehicles needs to be combined with a campaign for electric vehicles which will help Newton residents to make their EV purchases.

The top ten recommendations are listed below, with a brief description of each:

1. ***Create an office of Energy Concierge Services*** to help residents, construction professionals, developers and businesses to access information about best practices, costs and benefits, technological options, navigating permitting requirements, government subsidies, and emerging new trends and technologies in the areas of buildings and electric vehicles. Allocate the necessary staff.
2. ***Transition in stages to requirements for all new construction to meet Passive House and full electrification performance standards.*** Starting in 2019 require all new construction that calls for special permits to be 1) performed at a Passive House standard for energy efficiency, and 2) to be fully electrified. Revise Criterion 5 of special permit review to facilitate the Passive House requirement. Advocate at the state level for stricter building codes toward the Passive House requirement.
3. ***Begin immediately with publishing all HERS ratings*** on file since 2010 in assessor data base records. Require HERS rating, energy costs, and special features such as EV charger or electric heating to be disclosed at all real estate transactions. List these data in the assessor data base. Benchmark and publish the energy performance of all large commercial

and mixed-use buildings. This will build awareness of energy costs to drive owners and buyers toward homes that cost less to operate.

4. ***Require that electric option is considered for all heating system installations.*** Train contractors and building professionals to understand, stock and install electric heating systems. Require that contractors present the electric option to their customers in order to educate the homeowners and allow them to make informed choices.
5. ***For the residential sector, adopt a powerful financial incentive for energy retrofits and electrification in the form of a green property tax initiative such as the Real Estate Efficiency Program***. This initiative will reward homeowners who achieve lower-than-average energy use with a credit on their property tax bill, at no cost to the City (see Appendix A for details).
6. ***Eliminate parking minimums***; ***Make it easier to park electric vehicles*** Provide preferential free parking for EVs at all city lots and curbs in high density residential and business locations.
7. ***Form an EV taskforce to conduct a city-wide marketing/outreach campaign to promote the benefits and encourage the purchase of EVs***. The campaign would cover the economic, environmental and quality of life benefits of EVs, such as low maintenance, low cost of driving, quieter streets, and others. The City would partner with grassroots organizations to host educational events and test drives.
8. ***Sign a Memorandum of Understanding with National Grid and Eversource*** about collaboration and additional resources for implementing energy conservation actions recommended in the Plan. The MOU might include the following topics: Accelerating the rate of home retrofits; Setting numerical goals & metrics for energy conservation; Training of contractors and building professionals; Co-branding a joint campaign for efficiency measures; Financing Energy Concierge Services; Providing enhanced incentives for Commercial users beyond MassSave; and others.
9. ***For the commercial sector, create a Newton Green Ribbon Commission*** composed of the largest property owners in the City. Encourage them to develop their own CAPs and to share best practices, learn the state-of-the-art, set measurable and ambitious targets on a path to carbon neutrality by 2050, measure their progress, disclose and benchmark energy performance of their properties, and hold each other accountable.
10. ***For all new large commercial and mixed use developments require transportation plans that support CCAP goals.***

6.3 Tracking Progress

The ultimate *outcomes* of the actions recommended in this pla*n wil*l be decreases in energy use and GHG emissions. However, tracking the progress of each action in terms of GHG emissions reductions may be impractical. That is because within each sector — residential, transportation, and commercial – – multiple actions need to be taken simultaneously to achieve significant progress in GHG reductions, and therefore the outcomes cannot be linked to any specific actions. Furthermore, during the first 5 years the GHG reductions will be rather slow, very much within the error margin of the GHG emission inventory.

For that reason, progress in the CCAP needs to be tracked by following the *outputs* related to specific recommendations. Examples of such outputs include: adoption rate of electric vehicles, adoption rate of Passive House building Certifications, number of Mass Save energy audits completed and energy reduction recommendations implemented; number of fossil fuel heating systems replaced with electric heat pumps powered with renewable energy.

At the same time, bi-annual updating of the GHG emissions inventory needs to continue. It will give us an overall assessment of progress toward the 2050 goals, provide feedback on the effectiveness of actions underway, and create the basis for course corrections. To account for population growth or decline in Newton over the next 30 years, we recommend using *tons of GHG emissions per capita as a common metric.*

6.4 The City's Role

The CCAP is a community plan: residents, businesses and institutions have the primary responsibility for making changes in their mobility modes, homes, and buildings. The role of the municipality is *to help Newton residents, businesses and institutions to get off the current business-as-usual trajectory and adopt a new path* leading to carbon neutrality. The City can do that by:

- Providing financial incentives for residents, developing regulations, and educating the public;
- Providing the necessary resources and personnel to develop and manage the efforts discussed herein;
- Reducing barriers to adopting GHG emission reduction measures;
- Improving access to information, providing subsidies, incentives, resources, and logistical support;
- Adopting new ordinances and modifying existing ones;
- Measuring and monitoring progress and holding people accountable;

- Advocating at the community, regional, and state levels;
- Adapting administrative procedures and conduct within the daily business at City Hall, including: building permitting; interactions with homeowners; planning and development operations;
- Requiring consideration of GHG impacts when reviewing all major initiatives and projects across City departments;
- Affecting institutional changes aimed at incorporating the topic of GHG emissions and energy use in all major projects and ordinances, and in the daily operations of the executive branch.

6.5 Resources

The overwhelming majority of the cost of implementing CCAP will be borne by the residents, institutions, and businesses in Newton. The cost to the City will be primarily in the staff time for the technical support provided by the Energy Concierge Service and for developing several new policies and procedures we recommend. The job ahead will require more work to be carried out than can be handled by the current two co-directors of Newton's Sustainability Office. We call on the City to match the investments made by Newton residents, institutions and businesses by increasing the human resources necessary to perform this job.

Newton may consider following the example of the City of Cambridge to generate the necessary additional funds. In its electricity aggregation contract Cambridge has an "adder" of 0.2 cents per kWh toward energy conservation projects. This "tax" generates $1.2 million annually. When Newton's Power Choice contract comes up for renewal in 20 months the City may consider following the Cambridge example. Newton has also been very successful in obtaining grants for various climate-related projects, and we trust that the City will continue with these efforts. Finally, it is worthwhile to discuss with the utilities some form of partnership and cost sharing for the Energy Concierge Service.

In addition to the above financial resources, Newton has access to non-material resources: the experiences and creativity of other communities also addressing the climate issue, both in Massachusetts and beyond. These are priceless resources that expand and grow richer every day, from cooking parties on convection stoves, to new techniques for retrofitting houses, to ordinances requiring solar installations on all large commercial roofs, to ordinances that leverage the investments homeowners often make before putting their houses on the market (currently under consideration in Cambridge). The new staff members in the Sustainability Office should keep track of these developments and learn from them.

6.6 How to Begin?

We have developed a set of recommendations that, when implemented can achieve our GHG emission reduction goals. To begin the process, we recommend that over the next three months the City engage the services of an organizational consultant who will translate our ideas and recommendations into a work plan within the context of Newton's governance system and organizational chart. The consultant will investigate the internal capacity of City departments and City leadership, and make suggestions on how best to organize and use the existing talent. The consultant will write a job description for the leader of the overall climate implementation plan, and will make recommendations for additional staffing.

We also recommend engaging the services of a communications consultant to develop, as soon as possible, a plan for driving the adoption of electric vehicles in Newton and to help the Newton community to come together around the implementation of this plan.

These small immediate up-front investments will have a huge payback, paving the way to meeting our goals and improving the overall quality of life in Newton.

APPENDICES

A
Real Estate Efficiency Program Initiative

Newton has opportunities to encourage Newton property owners both to make their buildings more energy efficient and to use them in more self-sustaining ways. This appendix presents a homegrown initiative, called the "Accelerated Real Estate Efficiency Program (REEP)". Its primary objective is to encourage private investments in efficiency totaling $100 million or more during the next 10 years.

Overview

The NCCE recommends that a specific Newton initiative, the Accelerated Real Estate Efficiency Program (REEP), be adopted *by ordinance* in order to create strong financial incentives for Newton residents to upgrade the energy performance of their homes. The program extends Newton's current tax invoicing procedure by further adjusting the annual calculation of the amount due per parcel to reward each resident-owned property for achieving ever greater energy efficiency.

Under existing authorities, REEP mathematically derives a distribution of all properties' measured energy consumption and offers a graduated schedule of financial credits to owners emitting the lowest amount of greenhouse gases (GHGs). Since credits are earned relative to all other Newton properties in a given year, the incentives are self-adjusting as owners achieve improvements. NCCE anticipates REEP will encourage private investment of between $100 million and $125 million, during the next ten (10) years, in improvement projects designed to reduce domestic residential energy consumption.

NCCE believes this initiative can be accomplished with no increase in cash costs incurred by the City of Newton and requiring nothing from the Commonwealth. NCCE models predict that REEP impels enough change to achieve or exceed the CCAP goal of 20 percent reduction in energy consumption in the residential sector by 2050.

Background

Sub-par Average Quality: New household formation in New England is slower than in the rest of the United States[33]. Anecdotal and broad statistical data[34] suggest that the quality of existing housing stock and structures in retail and light industry use in the Northeast is older and renovated less often than elsewhere in the United States. Employers have had to compensate both for the perception of and fact of lower quality of available housing stock and the fact of higher expenses, when seeking to attract skilled workers to the region. And at least the perception of under-investment in the upkeep of existing properties contributes to and drives the eventual rate of tear-down and replacement building on the same site.

Obscured Distinctive Value: In general, sellers and buyers of properties are free to transact purchase and sale agreements fairly. When weighing alternatives, buyers increasingly inquire about the energy efficiency of a building and its annual heating and cooling costs in price negotiations. One of the recommendations of this Plan (chapter 3) is to elevate this key piece of information by driving for a disclosure of energy efficiency of the house at the point of sale. However, in Newton the energy efficiency of a building can be both difficult to determine and to compare to other properties for sale. Per project or per property case studies are used by successful proponents of more efficient real estate purchases[35]. Even then, however a consistent metric of building efficiency is not readily available to buyers, nor is it available for use by sellers in promoting the virtues of structure(s)/dwelling on their properties. And while the calendar age of a building may serve as a proxy for such missing-but-otherwise-measurable data, this is imprecise, at best.

These factors weaken the incentives for home owners to upgrade the energy performance of houses.

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[33] http://nahbclassic.org/generic.aspx?genericContentID=194717 and Figure 3 in the report 5-years prior https://www.nahb.org/en/research/housing-economics/special-studies/archives/how-long-buyers-remain-in-their-homes-2009.aspx and http://www.jchs.harvard.edu/sites/default/files/harvard_jchs_2017_remodeling_report_chap5.pdf

[34] Interview of former Vice Chairman of the Federal Reserve Bank, Alan Blinder, see the last paragraph of https://www.marketwatch.com/story/the-fed-is-not-in-the-mood-for-ferocity-says-former-vice-chairman-blinder-2018-04-24

[35] https://static1.squarespace.com/static/5447046ae4b0a3095e84ecec/t/5ace499c70a6adb3539a2ba7/1523468703538/CF_Fort+Hill+finalfinal.pdf

The primary objective of the initiative is to encourage private investments into energy efficiency totaling $100 million or more during the next 10 years.

Previous Improvements & Attempts: Outside the United States, some local and national governments have mandated that real estate available for sale include a standardized house energy (efficiency) rating (a "HER" rating) in their marketing materials[36]. The existence of those country laws is credited to a European Union *Energy Performance of Building Directive*, dated December 16, 2002. In the Spring of 2018, similar legislation was introduced to the Commonwealth of Massachusetts but that bill[37] neither advanced out of committee nor was reintroduced in a subsequent session[38].

Enough time has elapsed and experience accumulated that economic analyses have measured the response to standardized efficiency ratings. For example, buyers and sellers in U.K. and Denmark[39] enjoy better information and realize higher real estate prices for more energy efficient properties[40].

In the United States, housing buyers similarly see energy efficiency as important to their purchase decision-making[41]. But because the raw information is not properly collected and standardized, no similar economically sound evidence is readily available.

First Principles: Property ownership affords rights and freedoms to the holder of a real estate parcel. Property owners and possessors also undertake responsibilities, duties, and obligations. These include obligations to the local community for the care, upkeep, and condition of their property(s). These can also include responsibilities for the effects of actions taken on-premises or inactions on the part of an owner possessor. And these can also include responsibility to entities located off-premises.

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[36] Example discussion, see Koo, Han, Lee, Park; Development Of A New Energy Efficiency Rating System For Existing Residential Buildings, https://doi.org/10.1016/j.enpol.2013.12.068 (https://www.sciencedirect.com/science/article/pii/S0301421514000032)

[37] https://malegislature.gov/Bills/190/H4371.html

[38] https://www.masslive.com/news/index.ssf/2018/06/panelists_mass_home_energy_sco.html

[39] https://www.copenhageneconomics.com/dyn/resources/Filelibrary/file/9/39/1490357966/copenhagen-economics-2016-do-homes-with-better-energy-efficiency-ratings-have-higher-house-prices.pdf

[40] https://www.repository.cam.ac.uk/bitstream/handle/1810/246914/ENEECO-D-13-00679_main_doc_FF%20%282%29.pdf

[41] http://eyeonhousing.org/2013/02/what-do-home-buyers-really-want/

Often, local governments have an enforcement right to seek corrective action from a property owner and to impose costs on such an owner, when there is a harm or a potential for harm to the public. As with enforcing local zoning ordinances, enforcement may be called for when a property's condition is less than a locally-defined quality standard.

A consensus and case law exist that a residential owner's obligations are enforceable where physical injury occurs to an abutting property or person. Regarding the effects of greenhouse gas emissions and pollution at a distance, The United States Supreme Court decided[42] that Massachusetts had standing regarding emissions arising in Rhode Island and that the EPA's "refusal to regulate greenhouse gas emissions presents a risk of harm to Massachusetts that is both 'actual' and 'imminent.'" Continuing, the Court found "Nor can EPA avoid its statutory obligation by noting the uncertainty surrounding various features of climate change and concluding that it would therefore be better not to regulate at this time" and concluded that "EPA has offered no reasoned explanation for its refusal to decide whether greenhouse gases cause or contribute to climate change. Its action was therefore 'arbitrary, capricious, . . . or otherwise not in accordance with law.'"

Citizens might reason by analogy that an individual property owner has standing and an interest in the regulation of greenhouse gases emitted by other Newton property owners. And, the City of Newton has a duty and should seek to regulate or effect such emissions.

Why Undertake Any Initiative, and Which One: Based on its current understanding of Climate Change, Commonwealth legislators, local elected officials, and the Newton citizenry desire government initiatives that can help reduce unnecessary emissions of Greenhouse Gases (GHG).

One could argue that a real estate market with credible and timely energy efficiency information available to potential buyers and sellers would be both market efficient and in a government's interest to ensure. While many agree, the timeframe for such market efficiency is long, measured in decades for same-house sales. The rate of new household formation and the rate of material reconstruction of existing households/housing stock[43] suggest that the

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[42] See *Massachusetts, et al., Petitioners v. Environmental Protection Agency et al.*, Decided: April 2, 2007, first in Section IV, then in Section VII of Justice Stevens' Opinion of the Court https://www.law.cornell.edu/supct/html/05-1120.ZO.html

[43] http://www.jchs.harvard.edu/research-areas/remodeling/lira

average energy efficiency of Newton's residential real estate will not improve enough, for example, to meet a "carbon emissions neutral" standard by 2050.

Accelerating the already market-efficient decision-making in the Newton housing market appears to be a societal good, in the public interest of Newton citizenry, and a reasonable use of governmental authority. Examples of such acceleration exist, variously by legislative initiatives such as Community Choice Aggregation (CCA)[44] in the Commonwealth; by Federally-backed state programs such as Property Assessed Clean Energy (PACE)[45] lien programs in California and 30 other states; and by government-business partnerships[46] for more targeted sectors.

The REEP program proposed in this paper gives the municipality an opportunity to initiate potentially highly impactful action in the area where it has a jurisdiction and power.

Newtonian Pragmatism: The REEP has the following underlying characteristics:

- **Voluntary participation**: Requiring no mandate that a property owner or any agent thereof perform any new procedure, acquire any new license or permit, nor newly present to City government any information not currently made or to be made commonly available to the City. Compliance as to the particulars of participating and any consequences of participating or not may be specified; however, whether or not to participate shall remain voluntary.
- **Net-Revenue Neutral**: The City should neither enjoy new revenues nor have its revenues diminished by this program, as is necessary to remain compliant with Proposition 2½ (Mass. Gen. L. c. 59, § 21C). Similarly, no override shall be required of, nor enjoyed by, the City as a result of this program.
- **Net-Expenditure Neutral**: Requiring low-to-no additional expenditures in the City's capital or operating budgets
- **Within Existing State Authorities**: Requiring no enabling legislation from Beacon Hill, nor unblocking decision from the Supreme Judicial Court

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[44] https://www.massclimateaction.org/community_aggregation

[45] https://www.housingwire.com/blogs/1-rewired/post/35857-pace-loans-are-energy-efficient-improvements-financially-worth-it

[46] https://dnrec.alpha.delaware.gov/energy-climate/efficiency/energy-efficiency-investment-fund/ Energy Efficiency Investment Fund (EEIF) for commercial and industrial users

Table 7: Overview of Newton's Real Estate Tax Administration Procedure

Item	Current	Proposed
Total Amount of City Revenues Required in Fiscal Year+1	Set by Vote of Council	
Real Property Value Assessments as of Calendar Year-1	Assessor's Office	
Shifting of Property Tax Obligations from Residential Properties to Commercial Properties	Set by Vote of Council[47] (e.g., Commercial properties weighted as 175% of Residential in FY2017[48])	
Adjustment: Tax Assistance Programs[49] for Various Eligible Taxpayers in Furtherance of Commonwealth Law	Administered by Board of Assessors by Citizen Application	
Adjustment: Tax Assistance Programs[50] for Various Eligible Taxpayers in Furtherance of City of Newton Ordinances	Administered by Board of Assessors by Citizen Application	
Adjustment: **New** Real Estate Efficiency Incentive Program	*None*	Administered by Board of Assessors, Analytic Oversight by Citizens Commission on Energy
Net Adjustments Recalculate Effective Tax Rates for Properties Not Adjusted	Board of Assessors (e.g., Commercial-Residential effective rates weighting of 191.27% in FY2017 and 190.57% in FY2018[51])	
Receivable Posting, Billing & Collections	City Treasurer's Office	

[47] Classification Hearings. See http://www.newtonma.gov/gov/assessor/tax_class_booklets.asp

[48] http://www.newtonma.gov/civicax/filebank/documents/86065

[49] Chapter 59, Section 5 (M.G.L. c. 59, § 5) Clauses 17D (Disabled Veteran: Tax Exemption), 18 (Age & Infirmity & Financial Hardship: Tax Exemption), 22 (Elderly Surviving Spouse, Minor Child), 37A Blind Persons: Tax Exemption), 41C (Older Citizens: Exemption) or 41A (Older Citizens: Tax Deferral). See http://www.newtonma.gov/gov/assessor/programs.asp

[50] City of Newton ordinances including Property Tax Work-Off Programs, Newton Elderly and Disabled Taxation Aid Fund, and Newton Water and Sewer Discount Program. See http://www.newtonma.gov/gov/assessor/programs.asp

[51] http://www.newtonma.go–v/gov/assess–or/taxrate.asp

The Proposal

Purpose: The "Accelerated Real Estate Efficiency Program" (REEP) is a City of Newton initiative designed to financially reward property owners, through modifications in real estate administrative procedures (Table 7), for making the buildings on their properties become more efficient consumers of energy and for using them in ways that emit fewer or no Greenhouse Gases (GHGs). The plan is designed to help property owners do better than average for themselves, for their neighbors at large, and for everyone who comes afterward.

Eligibility: For residential properties, REEP is available to natural persons who maintain their primary residence in the City of Newton. For commercial properties, REEP is available to legal persons who maintain their primary residence or place of business in the City of Newton. Persons exempt from state income or property taxes are ineligible. Properties owned, in whole or in part, by a beneficial recipient of a property tax exemption, reduction, deferral or financial aid, other than a Veterans' benefit, are ineligible and are set aside in REEP calculations.

Participation: Participation is voluntary. Eligible property owners may opt-in to the program, or later opt-out, by completing an online form or filling-in a checkbox on a remittal form portion of their quarterly real estate property tax bill when making tax payment. Only participants will be eligible for the benefits described herein.

Prerequisites: To participate, property owners will opt-in and both submit and keep current a list of vendors for their chosen supplies of all variety of energy delivered to the property, or otherwise brought onto the premises, and converted to use thereupon. Annually, owners will declare the measured amount of usage by source or provide billing account numbers and an assignment of a recurring right to access billing data or right to receive secondary billing information directly from their vendor. Such declaration is meant to be all inclusive (within the limits of administrative costs the City is willing to bear for the program). The categories of vendors that shall be included will be no less than those shown in Table 8.

Table 8: Vendor Categories and Examples

ENERGY SOURCE & USE CATEGORIES	EXAMPLE OF VENDORS MAKING DELIVERY IN NEWTON
HEATING – **NATURAL GAS (PIPELINE)** – **PROPANE GAS (TANK)** – **OIL** – **WOOD PELLET**	NATIONAL GRID DEVANEY/HUGHES, PERFECTION PROPANE, KERIVAN-LANE BIGELOW, DEVANEY/HUGHES, KERIVAN-LANE HOME DEPOT, LOWES, NATIONAL LUMBER
LIGHTING & APPLIANCE – **ELECTRIC**	EVERSOURCE (NSTAR ELECTRIC/BOSTON EDISON)
AIR CONDITIONING – **ELECTRIC**	EVERSOURCE (NSTAR ELECTRIC/BOSTON EDISON)
DISTRIBUTED GENERATORS – **PROPANE GAS (TANK)** – **SOLAR (NET METERING)** – **AGRICULTURAL**	KEYES NORTH ATLANTIC EVERSOURCE (MassCEC PRODUCTION TRACKING SYSTEM) OTHER (MassCEC PRODUCTION TRACKING SYSTEM)

Basis of Comparison: The data reporting the amounts of each energy source used at each property[52] will be handled so as to calculate a mathematical distribution of properties using two measures[53], as the bases for awarding incentives. Every participating property will automatically be eligible for an incentive award according to reported performance on either or both measures.

- **Incentive Measure #1: The Energy Consumed Per Square Foot** – The amount of each energy source used will be restated using a common unit of measure (e.g., BTUs), totaled, and be called "The Sum Total Energy Consumed" for each property. For comparison across all taxable properties in the City of Newton, The Sum Total Energy Consumed will be divided by the number of square feet of livable space

[52] Where gross metering of energy consumed at a property would result in an amount which, by kind, would unfairly bias a property's place in the distribution, e.g., at properties with electric charging stations for vehicles when more the exception than the rule, such non-standard use(s) may be declared and separately metered readings may be provided in each reporting period and may be relied upon in program calculations

[53] A single incentive measure may be calculated, from the data element components cited, and used initially if implementation is constrained by data quality, availability or undue cost

above ground at all of the buildings in use at each property. The resulting quotient will be called the "Energy Consumed Per Square Foot". (Note that basements are excluded. Attics and garages are treated[54] as in the Assessors Database.). For year-to-year comparisons, the Energy Consumed Per Square Foot may be adjusted by the number of degree days (e.g., hourly ambient temperatures below 65°F for heating and above 75°F for cooling) in the reporting period, and then called "The Energy Consumed Per Square Foot Adjusted".

- **Incentive Measure #2: The Most Modest Emission of Greenhouse Gases Per Resident** – The type and amount of each energy source will be multiplied by an average amount of Greenhouse Gas byproducts resulting from use of that source[55] to become a common measure of Greenhouse Gases (GHG) emitted on premises by source, and then summed. The resulting total will be called "The Greenhouse Gas Emission" of the property. When divided by the number of Newton residents living at the property for some or all of the year the resulting amount will be called the "The Greenhouse Gases Emitted Per Resident".

Minimum Standard for Awards: As called for elsewhere[56], the City of Newton will make its best professional effort to measure or estimate the total carbon dioxide output attributable to the residents of Newton and publish the results in a timely fashion. The portions of that published amount attributable to Commercial or Residential heating, cooling, and electricity will be the initial basis for the REEP's calculation of a City-wide mean value for the Incentive Measure #1 and Incentive Measure #2 amounts. Incentive awards may be made only for properties performing better than average. Properties owned by program-eligible non-participants will be treated as if their performance on Incentive Measure #1 and #2 were at or greater than the mean for all properties in Newton.

Awards Available: A schedule ("Schedule of Incentives Available") will be posted listing the property efficiency incentives available under this program for those participants that document achieved energy performance on Incentive Measure #1 and Incentive Measure #2 that is statistically and significantly better (i.e., a lesser amount) than the mean for properties participating. An Incentive Award is expressed as a whole integer percent of the participant's property tax obligation net of adjustments under Massachusetts General Laws

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[54] assuming no living or income-producing space is there, though space may be included on request if heated.

[55] https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

[56] http://newtonclimateaction.org/newton-report-card/

and City of Newton ordinances other than those that may pertain to the Accelerated Real Estate Efficiency Program itself ("the Pre-Incentive Per Property Tax Obligation").

The REEP administrator(s) shall use its discretion in applying the Schedule of Incentives Available to the classifications of or any aggregations of classifications of properties in the City, except that there will be no classification of property for REEP purposes that does not also exist as a classification in documents presented to City Councilors at the Classification Hearing in preparations for levying taxes in a given fiscal year.

The actual financial amount (the "Incentive Awarded") under this REEP is computed for a property by multiplying the Pre-Incentive Per Property Tax Obligation for a resident or owner by the Incentive Award percentage. The total financial incentive earned under this program will be the sum of the amount of an Incentive Awarded for Incentive Measure #1 and of an Incentive Awarded for Incentive Measure #2.

In the first 5 years of this program, the "mean for properties participating" may be estimated[57] from indirect data sources or aggregates[58], in which case the standard deviation[59] used in awarding incentives will, by convention, be set at one-third of an estimated mean value. After 5 years, or whenever the number of participating properties will have exceeded 20 percent of the total inventory of properties in an eligible property class, or whenever 250 or more property owners will have opted-in and both effectively and completely provided the energy source usage data required for participation, whichever may first occur, this "mean for properties participating" and the corresponding standard deviations shall be calculated directly from the source energy usage data available per property, and previously used estimates will not be used.

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[57] For example, https://shop.bsigroup.com/forms/PASs/PAS-20702013A12014/

[58] http://www.newtonma.gov/civicax/filebank/documents/91133

[59] N.B.: statistics notation often symbolizes a Standard Deviation with the Greek letter Sigma and makes use of the lowercase σ character (Unicode 03C3).

The initial schedule shall be as shown in Table 9.

Table 9: Schedule of Incentives Available

Variation from the Mean[60]	Incentive Plan Award Factor	
	After 10th Plan Year	1st thru 10th Plan Year
Below mean, yet above -¼σ	1.0%	1.0%
-¼σ or below, yet above -½σ	3.0%	4.5%
-½σ or below, yet above -¾σ	4.5%	8.0%
-¾σ or below, yet above -1σ	6.0%	11.5%
-1σ or below, yet above -1¼σ	7.5%	15.0%
-1¼σ or below, yet above -1½σ	9.0%	18.0%
-1½σ or below, yet above -1¾σ	10.5%	21.0%
-1¾σ or below, yet above -2σ	12.0%	24.0%
-2σ or below	12.5%	25.0%

The elected City Councilors may, at any time, replace a then-in-force Incentive Plan Schedule. A newly authorized Incentive Plan Schedule will become effective in the first Fiscal Year for the City of Newton following the date of the Councilors' vote unless a farther future date was specified in the passing vote taken.

Uses and Implications of the Incentive Plan: Citizens and property owners of Newton will be called upon to make improvements to their buildings and practices to improve their performance on each of the Incentive Measures and thereby enjoy a financial credit on their City property tax bill. The Incentive Plan intends that taxpayers will increasingly become aware of both the increase on their tax bill and the possibility that they might be rewarded for eliminating the reason for the increase.

To that end, the Mayor and Councilors shall be free to make public statements, from time to time, advocating and promoting that property owners can improve the efficiency of their holdings and enjoy an encouragement from the City when they do so. Similarly, City officials and employees shall be at liberty to

[60] a lowercase Sigma character represents one standard deviation. a minus sign indicates values below the mean.

similarly encourage property owners to invest in improvements in energy use and efficiency.

Public Aggregates, Private Source Data: Under this program, when a resident or property owner discloses data required for participation in the REEP, the City of Newton shall be considered a Custodian of the raw data so disclosed. Ownership of the raw data elements descriptive of the energy source vendor and usage data will remain with their respective owners. Put another way, participants in the REEP are not putting details from their utility bills into the public domain for all to see. Rather, participants are allowing the City a defined use of certain data.

The City of Newton will have access to and certain use rights to the data provided under this program, including the right to derive and calculate new information from the raw data in isolation and/or in combination with other data. The City of Newton alone will own such derivations of a participant's raw data.

Wherever energy usage information is to be published, for example as part of reporting on the program, information disclosed beyond those employees and advisors with a need to know will be anonymized so as to preclude a determination of which properties or which participants correspond, in the particular, with which information item or items disclosed. As part of its representation of the REEP, the City of Newton pledges that it will not sell, transfer or disclose to another party the raw data elements collected under the Incentive Program.

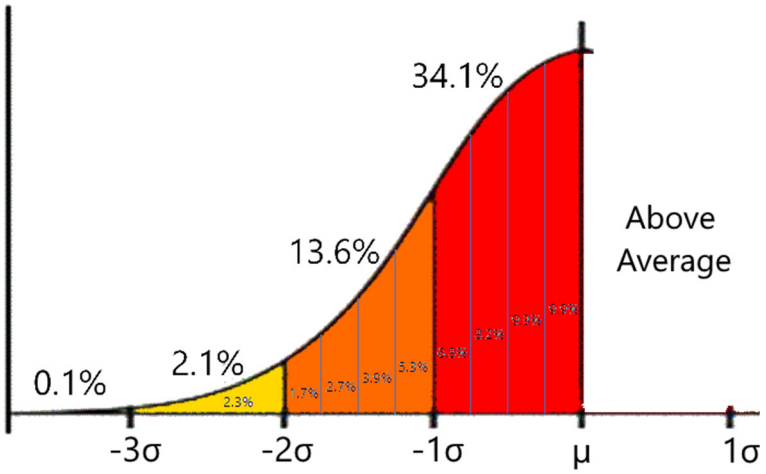
Term of This Program: This program will end after the end of the 30th fiscal year in effect or at the end of the City of Newton's Fiscal Year 2050, whichever shall occur first.

Estimate of Financial Impact of REEP on Taxpayers

This section broadly outlines estimates of the financial effects of the Incentive Plan and proposed Schedule of Incentives Available (here as "Schedule"). The estimation is sharply limited by the information available. A large collection of data describing per property consumption of energy in Newton is not available at this time. One benefit of adopting the REEP will be the availability of precisely that unavailable data; in its place, broad aggregates of energy use are used to make broad bounding estimates of REEP's impact. The actual effects will necessarily be different in amount.

This section estimates the number of participants over time and makes simplifying assumptions (e.g., the "evenness" of the distribution of energy performances for newly participating properties). The estimates, assumptions and Schedule are then multiplied to estimate the financial effects on individual taxpayers on average. Newton's actual results will differ from these calculations, necessarily, as actual participation rates, property energy performances, and the like would differ from the assumptions used in these estimations.

Simplifying, we calculate using the FY2018 average assessed property value for each eligible property in the City participating and not participating. There were 26,382 Residential properties and, using a tax rate of $10.82 per $1000 of assessed value, an expected tax levy on them of $273,422,446, equal to an average tax bill of $10,364. We calculate assuming a normal distribution of energy efficiency performance among those properties and among participants newly opting-in in each time period, and we calculate using the proposed Schedule:

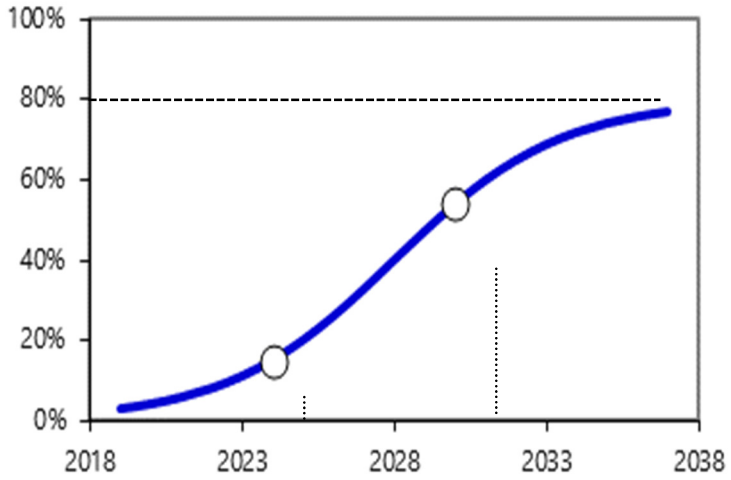


At 100 percent participation, the estimated Incentive Awarded for a participating property performing better than average on Incentive Measure #1 would be $1,035 on average and $825 for the median. An additional average Incentive Award of $1,035 is for those properties performing better according to Incentive Measure #2. Thus, a total of $2,070 could be awarded for both measures. A property performing better than average on one measure would enjoy an average incentive amounting to 11 percent of its current property tax obligation or 22 percent if performing better on both measures.

Since the Incentive Program intends that the City neither enjoy an increase in tax receipts under the plan nor be penalized for Incentives Awarded, an amount equaling the total of the awards granted is shifted onto and shared among the non-participating or participating though performing worse than average property owners ("Shifted & Shared Amount"). Thus, properties less efficient than the average on Measure #1 or consuming more energy per person on Measure #2 would see an average increase of $1,035 for the one and a total of $2,070 for worse than average performance on both measures.

However, most properties' performances would be somewhere in the middle and not at those extremes. An Incentive Awarded for a property on one measure would be offset to some degree by the Shifted & Shared Amount pro rata to that same property. At 100 percent participation, such an average award would be equal to the average offset, thus net to $0. However, 100 percent participation is not ever expected due both to participation being voluntary and to the churn in the ownership of properties from one year to the next. Short of 100 percent participation, the program is significantly less costly for non-participants and those not earning an award, while being fully positive for each award recipient under this plan; this is because the benefits under the plan accrue to individual award recipients while the costs of the awards are spread over all eligible owners not receiving an award, and the former number is less than the latter.

We use a Fisher Pry adoption curve to estimate reaching 10 percent program participation during the 3rd year, 50 percent program participation in Year 10, and an ultimate maximum participation ("saturation") of 80 percent of all property owners.



Consistent with the above described Incentive Awarded potential of $2,070 creditable per recipient property, the estimated average billed increase imposed on all other property taxpayers starts at $30 in the first program year and increases with the forecast of increased participation in the Incentive Program, reaching $927 in Year 10 (Figure 22).

Looking at the median award to a participant, that increasing effect of Shifted & Shared can be seen as a decreasing net amount of a median award (Figure 23).

Figure 22: Average Property Tax Invoice Increase for Non-Recipients

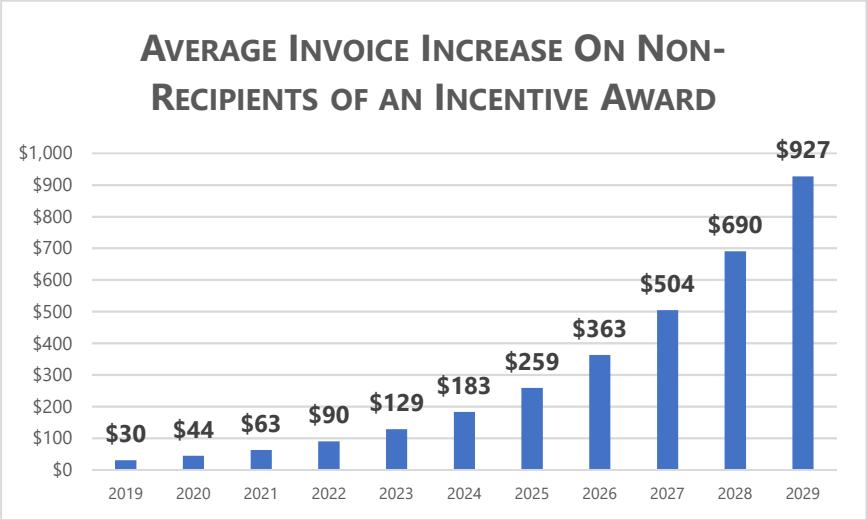
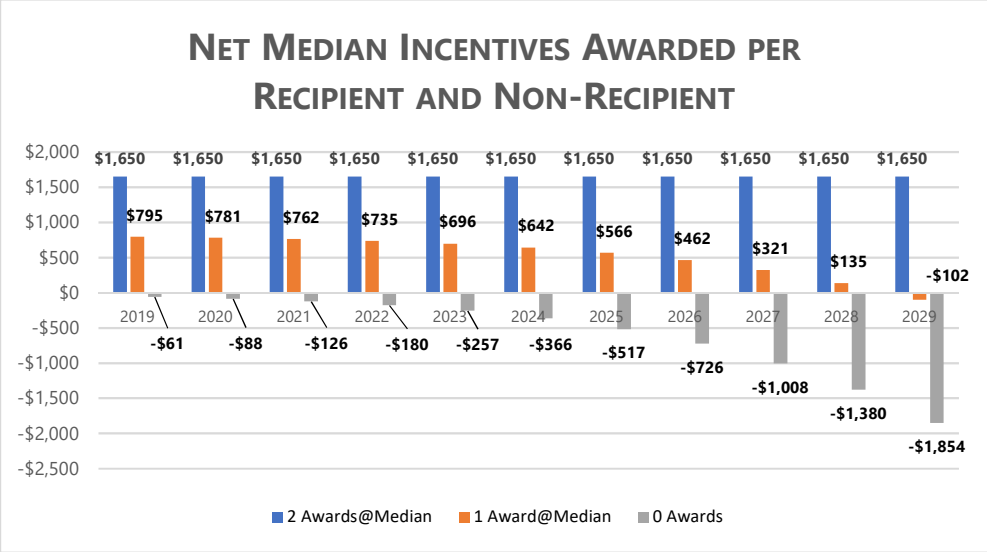


Figure 23: Median Property Incentive Award



The plan includes a provision to self-terminate at the end of Newton's fiscal year 2049 (i.e., June 30th of the calendar year 2050). In that eventuality, the total amount of Incentives Awarded in FY2050 would equal $0 and the total Shifted & Shared Amount would equal $0.

Answers to Key Questions Asked

1. **How Is the REEP incentive plan different from a National Grid Home Energy Report?**

First, there is no financial incentive in a Home Energy Report.

Second, information in and from the REEP incentive plan is better than Home Energy Reports for 4 reasons:

- The REEP incentive plan uses one basis of comparison for all Newton properties – that is everywhere more than a National Grid selection of "100 similar homes within approximately 1 mile" which differs from one customer to the next and time to time
- All energy sources and uses are included – which is more than just focusing on heating by natural gas
- The REEP incentive plan is adjusted for factors out of consumers' control: variations in square footage, ceiling height, age of each home, number of occupants, degree days, and the like can affect the usefulness of peer group of 100 comparisons
- Greenhouse gas emissions – homeowners might consider switching a kind of energy source used (e.g., on a hot water heater) to one or more alternatives, though such decisions may be harder to justify or take using only information from single source reports

Finally, by organizing energy use information specific to individual properties into a readily-usable form, and by ensuring Newton planners and policy makers have analytic access to the information (which is not currently available), elected City officials and planners will be better able to act on behalf, of and to the benefit of Newton property owners and residents

2. **Do property owners have to do anything, and does the REEP Incentive Program impose any new deadlines?**

If property owners want to participate, they need to act to "opt in" to the REEP incentive program. Owners may exercise their choice at any time. Participation takes effect immediately going forward (though not retroactively). Financial incentives under the plan become available at the beginning of the property tax cycle for the next fiscal year.

No action means no participation in the REEP. No participation means property owners do not have to submit any forms or information or allow the City any right of access to data on energy sources and uses.

Non-participants still need to attend to their other responsibilities as a property owner or resident.

3. **If we choose to participate, how soon will we get an incentive payment from the City?**

Incentives available under this program are determined at approximately the same time as are property tax obligations for each fiscal year.

Incentive amounts are earned quarterly and applied to each quarterly property tax bill by the City of Newton; neither residents nor property owners receive a separate check or direct deposit in the amount of an incentive earned. The REEP does not include a "lump sum provision" which could change the date for receiving an incentive amount to another time or form of delivery other than as a credit on a quarterly property tax bill.

Participation is not transferrable from a seller to a buyer. As of the date of closing of a property sale, REEP participation by the previous owner and any award made to the previous owner will end. Acquirers are encouraged to participate by opting-in to the plan.

4. **If we choose to not participate, will our property taxes remain the same as if the REEP incentive program didn't exist?**

Initially, yes, they will remain the same. Gradually, however, the amount on your property tax invoice will increase. As the number of participants becomes sufficiently large, the incentives awarded to the Most Efficient Energy Consuming and Most Modest Emitting Properties will become large and noticeable, which may result in your property tax invoice increasing.

The suggested remedy for any property owner who is displeased with an increase in their property tax invoice, that might result from other property owners taking advantage of the REEP, is to:

a) participate in the program; and

b) invest in making their property more energy efficient so that it too might become better than average as measured by the REEP

5. **Doesn't Proposition 2½ (now Mass. Gen. L. c. 59, § 21C) protect above-average energy consumers and greenhouse gas emitters from having to pay higher property taxes?**

No. Proposition 2½ limits the amount of tax increase that a municipality can levy on its residents and property owners from one year to the next in the aggregate, excepting new growth and with various exclusions allowed. Its provisions apply to the collection of all properties in a municipality and provide no tax increase limit to any individual property or owner thereof.

REEP does not change the tax on a property which is still calculated in the normal way. REEP results in a credit or debit which the City reflects on the invoice used for collecting property taxes due.

The REEP neither uses nor relies upon any of Proposition 2½'s provisions, exclusions, or administrative procedures. The executive oversight and administrative procedures in place to affect Proposition 2½ remain unchanged. Proposition 2½ and this Incentive Program are wholly separate and independent of one another.

The REEP was specifically designed to *not* result in a net increase or decrease in tax revenue receivable by the City of Newton from owners of real property in Newton, either now or in the future.

6. What happens if we choose to participate but energy consumption on our property is greater than instead of better than average?

Program participants who consume more than the average amounts of energy, according to Incentive Measure #1 and Incentive Measure #2, will not receive a financial benefit resulting from their participating in the REEP. Such participants may enjoy any non-financial benefits from the program, including the information value and insights possible with comparative analyses from a well-understood peer group using clear and relevant metrics. There is no financial cost or penalty resulting from such property owners participating.

In the early years of the program, the worst-case property tax levied on a participating property would be no more than were that property not participating in REEP. In later years, program designers anticipate that such a participating property may be slightly more advantaged financially than were that property to have never participated in REEP from the start.

And a property may be improved, consume less than average, and earn an incentive award in succeeding years, though it not receive an incentive award in any one year due to consuming more than average.

So, it pays to participate.

7. Isn't the program unfair because it creates new burdens for residents who aren't wealthy or who are no longer gainfully employed?

No.

The Incentive Program is focused on encouraging attention to be paid to the responsibilities that every property owner has. Less-affluent or older property owners are, at least in terms of the rights and responsibilities derived from their property ownership, no different than their more affluent or younger neighbors.

8. Do the incentives disproportionately benefit owners of larger properties?

No.

The Incentive Program benefits owners who have invested in making their properties more energy efficient and more modestly emit greenhouse gases. We all may, over time, come to understand that owners of larger properties have been faster in deciding and sponsoring improvement projects. Or we all may come to understand that it is the owners of the smaller properties that have been the fastest in reducing energy consumption and greenhouse gas emissions. At this point, no one knows. Either way, the plan provides incentives for responsible action, then allows the benefits to accrue to whoever chooses to act on behalf of greater efficiency and lower greenhouse gas emissions.

The REEP rewards an owner's investment choices rather than the size of her/his castle. And, everyone benefits when our neighbors waste less energy and emit fewer greenhouse gases.

9. Do the incentives disproportionately benefit owners of newer properties?

The incentives disproportionately benefit property owners who have more recently invested in the upkeep and improvement of energy-related systems in their properties. Some newer homes were built with the latest and most efficient systems available on the market, and so enjoy the advantage. Some owners of older homes have been regularly investing in upgrading their properties to take advantage of the latest and most efficient systems, and so enjoy the advantage.

New construction, pre-existing house, or a "moldy oldie", each property has its own unique history and moment in its lifecycle. The REEP is intended to reward the efficiency achieved by owners investing in energy-relevant updates and to encourage other property owners to likewise invest in making systematic improvements to their buildings.

10. Will the Incentive Program increase the number of tear downs in Newton?

The REEP does not, in and of itself, seek to shorten the useful lifetime of buildings on taxpayers' properties. The REEP does not, in and of itself, seek to shorten the house-as-home holding period. It will and is intended to shorten the renovation investment cycle by encouraging residents and owners to invest sooner, rather than further defer energy-related property update investments.

There is ample evidence that sales in the Real Estate Market respond positively to a prior owner's investments in energy efficiency. Economic research outside Newton has shown that more efficient buildings attract higher sale prices, all other things being equal.

There are no guarantees. Should owners choose to not participate in the REEP and choose to not invest in updating energy-related systems on their properties, real estate market demand or prospective buyers' willingness-to-pay-higher-prices for such less-attended to properties could "soften" or decline. And such a decline could be seen as shortening the useable life of any buildings on a property. To the extent true, that would be a result of an owner's decisions more than a direct result of the REEP, per se.

Proponents of the REEP anticipate that a decrease in the number of tear downs may result as an indirect byproduct of the program. The reasoning is that, on average, houses would be in better condition over a larger portion of their lifetime, in the eyes of both seller and buyer alike. With fewer houses that are "too far gone" due to a lack of upkeep, the number that should be torn down earlier in their potential lifetime could decrease instead of increase.

B
Residential Research & Discussion

Modeling Assumptions

Assumptions used in modeling energy use and GHG emissions from the residential sector: 2019-2050: Business-as-Usual and Accelerated Scenario. Where the assumptions in Business-as-Usual are different from Accelerated Scenario, they are indicated in **bold font** below.

Accelerated Scenario

1. The electricity supply in Newton gradually increases the renewable component, reaching 100 percent in 2030.

2. The entire residential housing stock (excluding apartments) is gradually electrified, reaching 100 percent in 2050 (for heating, cooking and other applications that currently depend on fossil fuels); **In the BAU all replacements of fossil fuel furnaces and boilers with heat pumps will be much slower but will proceed due to the acceptance of these new technologies. It will increase to 450 events per year by 2045 and will stay that way until 2050. At that time, there will be 450 events per year. It is possible that this transition will be slower than our techno-optimistic assumption, which will slow down the BAU decline in energy use and GHG emissions.**

3. The residential housing stock comprises three broad classes of houses: 10 percent are the worst performing (HERS 175), 70 percent are typical for Newton (HERS 125), and 20 percent are of better quality (HERS 75); The better quality buildings include houses built in the last 20 to 30 years and older homes that have undergone a major or gut renovations which brought their building envelope up to modern standards;

4. Between 2019 and 2050, the entire existing housing stock that is not replaced is electrified. In addition, all of the worst performing and about two-thirds of the typical homes go through an energy retrofit. In some cases, the electrification and energy retrofit occur simultaneously. In others, the home first undergoes a

retrofit and is then electrified later. An energy event is defined as a home being electrified, undergoing an energy retrofit or both simultaneously. In 2019, there are 270 energy events. This figure climbs linearly to 800 in 2023 and remains that level through 2050; **In the BAU scenario the rate of energy retrofits remains at the 2018 level of approximately 270 annually.**

5. A retrofit entailing insulation of building envelope reduces energy demand by 25 percent in the worst performing homes and by 8 percent in typical homes;

6. Between 2019 and 2050, 100 houses per year are torn down, another 25 undergo gut renovations, and 15 more net new houses are built. These 140 new structures are made up of single-family houses (59 percent), condos (34%), two-family homes (7%) and three-family homes (1%). The average size of the single-family houses is 4,048 sf; condos is 2,275 sf; two-family homes is 4,275 sf; and three-family is 5,173 sf, statistics based on the Newton data from the 2010-2018 period;

7. Three thousand additional household units are built: 2,400 apartments (average size 960 sf) and six hundred as a mix of single-family, two-family and three-family structures (average size 3,404 sf);

8. The HERS rating of new construction is 25 (similar to the Passive House performance), starting in 2019 for the construction requiring special permits and in 2022 for all other construction; **In the BAU scenario, the HERS rating of all new construction will decline more gradually, reaching 25 in 2040.**

9. Heat pumps operate at a COP of three (3) (i.e. three units of heat are produced for each unit of energy consumed). Gas furnaces/boilers operate at 95 percent efficiency (.95 units of heat are produced for each unit of energy consumed). Oil boilers operate at 85 percent efficiency.

General Discussion

Newton has approximately 32,000 dwellings, 89 percent of which are single family homes, condos and units in two- and three-family homes. Most of these structures were built before 1960 and many have poor energy performance.

Figure 24 shows the distribution of sizes of single-family homes in Newton. The average size of a single-family house is approximately 2,500 sf, with a wide variation ranging from less than 1,000 to 6,000 square feet or more. These may be likely candidates for tearing down and replacing.

Contrary to its image as a city of large single-family stately houses, 34 percent of single-family homes are below 1,850 sf. The average size of units in two-family and larger condominium-types dwellings is 1,400 sf. Upgrading the energy efficiency of these structures may present different challenges than for single family houses, owing to their ownership features.

Figure 24: Distribution of sizes of all dwellings in Newton

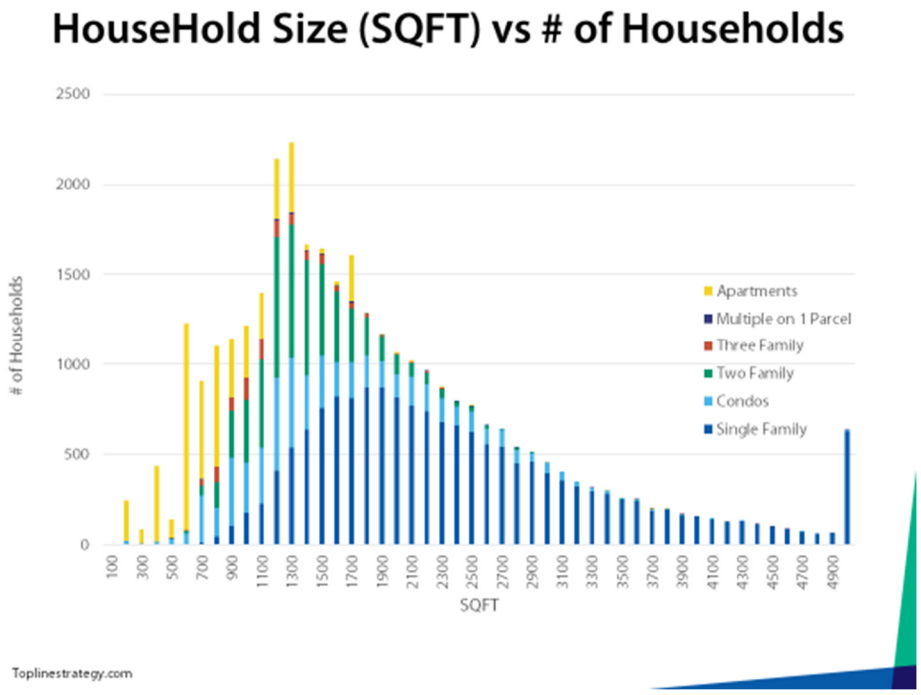


Table 10 shows that 33 percent of all dwellings are part of two- and three-family structures or are listed as condos.

Table 10: Newton Household Classifications

Newton Has 32K Households with 62.5M SQFT of Living Area,

	Type	Number of Buildings	HH/Building	Total HH		% of Households	SQFT Avg size
Homes (3 Family or Less)	Single Family	16,964	1.0	16,964	28,459	53%	42,311
	Condominium	5,143	1.0	5,143		16%	7,964
	Two-Family	2,726	2.0	5,452		17%	7,575,714
	Three-Family	270	3.0	810		3%	949,181
	Multiple Houses on 1 Parcel	45	2.0	90		0%	222,689
Apartments (4+ Units)	Small Apt (4 to 20 Units)	107	6.4	688	3,543	2%	627,054
	Large Apt (>20 Units)	25	67.6	1,691		5%	1,621,100
	Public Housing	88	4.7	413		1%	400,455
	All Other	332	2.3	751		2%	751,000
	Total	25,700		32,002		100%	62,423,437

Source: Newton Parcel Data from MAPC
All other includes apartments in a wide variety of different use codes such as multi-use properties that are primarily commercial but have some residential

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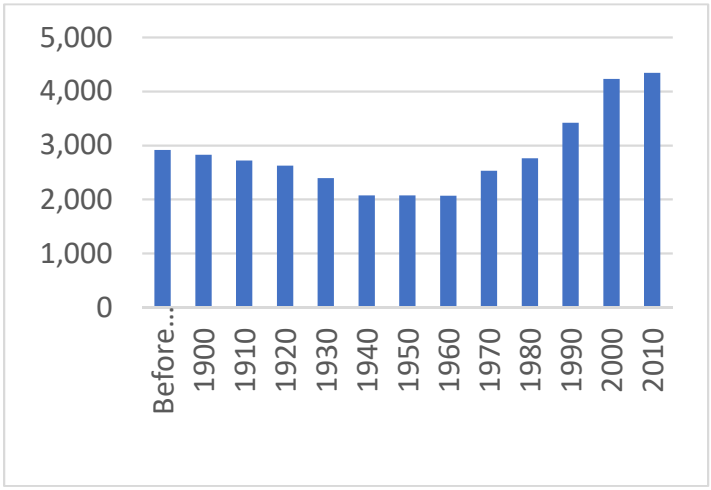
Age matters. Today's construction is much more energy efficient than in the past. An average new home built to code in 2018 has a HERS rating of 55, compared to well over 100 for homes built before 1980. Homes built to Passive House (PH) efficiency specifications, which was considered a costly luxury only a few years ago, can be now built at a cost of no more than 1-2 percent above the standard construction built to code. The enormous residential and commercial complex recently approved for Winthrop Square in Boston will in fact be built to the PH standard, a decision made by the developer, without any mandates from the City, thus demonstrating that PH construction has entered the mainstream. See also the Green Newton website for more examples[61].

The HERS rating is growing in popularity among developers and builders nationwide, and is being used to promote the attractiveness of new homes. It is only a matter of time before energy performance becomes a standard attribute of all buildings and HERS score and Energy Use Intensity (EUI) become metrics used by homeowners, contractors and developers. The City of Newton can support this trend by requiring public disclosure of HERS rating of all homes.

[61] https://www.greennewton.org/advocacy/10655-2/

The current trend of tearing down old houses and replacing them with new ones presents an opportunity to drastically reduce energy demand through highly efficient building envelopes and mechanical systems. In addition, replacing gas with electric air-source heat pumps opens an opportunity to reduce energy demand because a heat pump is about three times more efficient than a typical gas furnace. Finally, GHG emissions can be eliminated altogether by using renewable electricity.

Figure 25: Histogram of Newton Residences by Year of Construction



Size matters. Figure 25 shows that since the 1950s and 60s the size of new single-family residential homes have been increasing every decade, reaching approximately 4,300 sf in the 2010s, almost double the size of homes built before 1970. The energy used increases with the size of a building, which partially offsets the gains in efficiency that have been achieved over time. Table 11 illustrates this point using hypothetical examples.

The relative energy savings from decreasing the HERS rating, uses a 2,000 sf house as a reference (these are approximate numbers, used mostly for illustration). For a 2,000 sf home going from a score of 130 to 25 (approximately PH standard) reduces the energy demand by a factor of 5.2. But when this same 2,000 sf house (HERS 130) is replaced with a 4,300 sf new dwelling (HERS 25), the reduction in the energy demand drops to a factor of 1.4 (5.2/3.7).

This leads to two conclusions:

1) For Newton to make progress with an overall reduction in energy use, the energy performance of new construction must be very ambitious: to the PH level; and

2) From the energy perspective it will be much better if the teardown replacement structures are two-family houses rather than large single-family homes.

Table 11: Relative Energy Use by Home Size and HERS Rating

	HERS Rating		
House Size	130	55	25
4,300	9	3.7	1.7
3,000	7	2.9	1.3
2,000	5.2	2.2	1.0

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Replacement is an opportunity. It is reasonable to assume that over the next 30 years a significant proportion of Newton's smaller homes – especially those located on large lots – will be torn down and replaced with new construction.

In the period of 2016-2018 an average of about 107 new homes were built annually in Newton, most of them replacing teardowns. Of these, about 85 percent were single family homes and the rest were two- and three-family homes. As the population of Newton continues to age and chooses alternatives to single-family dwellings, the rate of teardowns might increase. Assuming an average rate of 125 home replacements per year over the next thirty years means that close to 4,000 homes (about 12 percent of total household dwellings in Newton) will be replaced. Based on the current statistics, the majority (about 85 percent of the new structures, e.g. 3,400) are likely to be large single-family dwellings of 4,048 sf average size. Approximately 15 percent of the teardowns (600 in total) will create 1,200 two-family condos. Based on the statistics since from 2010-2018 the average size of these new condos will be approximately 2,275 sf.

The energy performance of the replacement dwellings will be much higher than the buildings they replace. But the large size of the new structures (4,048 sf) partly offset these gains. From the energy use perspective, it would be more beneficial to replace the teardowns with two-family houses (or condos) than with single family houses. That would of course require in most instances a change in zoning in that particular street from single-family to multi-family. From a strictly

energy perspective, it would be beneficial to eliminates single family zoning altogether from Newton, as Minneapolis, Minnesota, has done in 2018 (in the latter case the reason was not energy but the desire to eliminate social exclusion and racial discrimination).

In short, the greatest opportunity for reducing energy demand in Newton through the house turnover process is to build very highly energy efficient houses.

Growth and large residential projects are an opportunity. This report assumes that 3,000 additional dwelling units will be created in Newton over the next 30 years to accommodate the growth of the population and to create more affordable dwellings. The minority of these (about 20 percent will be single-family houses and two- and three-family condos (averaging in size at 3,400 sf) while about 80 percent will be units in large multi-unit residential developments (such as: Avalon, Washington Place, Austin Street and, still in a discussion phase, Riverside and Newton Upper Falls). During the decade of the 2010s, 16% of newly created household dwellings in Newton were apartments in such multi-unit large buildings, 960 sf average size.

Multiunit residential homes are more energy efficient foot than single-family dwellings of comparable size. This, and their smaller size relative to newly constructed single-family dwellings (960 sf on average), means that the overall housing stock in Newton will tend toward being more compact and energy efficient.

Higher population density in mixed use developments, including commercial and cultural enterprises and public amenities, also reduce the need for driving. The City of Newton can encourage such construction in appropriate locations. Large residential projects are also an opportunity to adopt advanced high efficiency construction methods, electrical heating and solar panels, and to reduce the dependence on natural gas by not requiring new connections to the existing gas lines.

From a political perspective, the City has more leverage to push for high energy performance construction in such large projects through the special permit process, and by designating certain areas as overlay zoning districts for, for example, PH construction.

Not all construction is created equal. For practical reasons (of methodology and available data) Newton's GHG emission inventory covers only direct energy use in buildings: heating, cooling and electricity. But the building materials used for construction require a large amount of energy to be produced and transported: from mining of metals and minerals to cement production, to long distance

transport, to manufacturing of insulation and other construction materials. This energy is referred to as "embodied energy" and is an integral part of the climate impacts from all the goods we use: from clothes to electronics, to house furniture, and to roof and wall insulation in buildings.

Green Newton has recognized the embodied energy problem in house renovations and construction. Its Green Building Principles[62] specifically call for minimizing embodied carbon in the choice of construction materials. With that in mind, Newton should help contractors with the choice of insulation material.

Are we outsourcing our climate impacts? In 2018 the State Department of Environmental Quality in Oregon published a greenhouse gas emission inventory that included the embodied energy of all the material goods purchased by Oregonians: "Consumption-based GHG Emission Inventory"[63] (Figure 26).

When the results of the traditional inventory, such as the one performed in Newton (based on direct energy used in housing, transportation, commercial, etc.), were compared with the results of a consumption-based inventory it turned out that the consumption-based emissions were more than 60 percent higher. In other words, more than 60 percent of the emissions associated with Oregon's economy and the lives of Oregonians had until then appeared on the balance sheet of the localities where the goods are manufactured, not where they are used[64].

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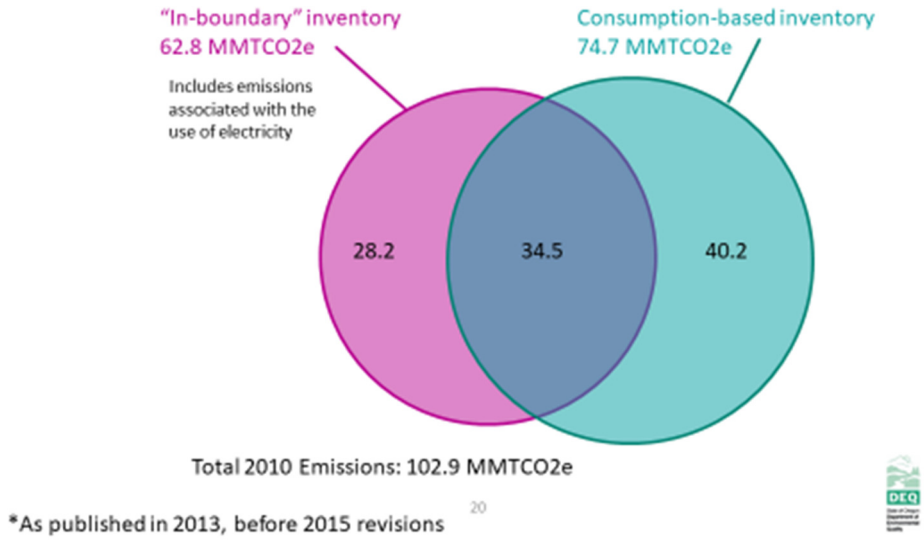
[62] Special reference to Principle 2: https://www.greennewton.org/advocacy/10655-2/

[63] https://www.oregon.gov/deq/aq/programs/Pages/GHG-Oregon-Emissions.aspx

[64] https://sustainableconsumption.usdn.org/climate/overview and https://www.portlandoregon.gov/bps/article/531984

Figure 26: Total Greenhouse Gas Emissions



A similar report about the need to include in the inventory the embodied energy of goods was published in 2018 by C40, a global alliance of cities working toward sustainability (of which Mayor Walsh of Boston was the chair in 2018). The report, *Consumption-based GHG Emissions of C40 Cities*[65] , showed that the embodied energy is a major contributor to the total GHG impact of all consumer goods, including houses, in most cities of the world.

Portland, Oregon, is a pioneering city that addressed consumption-based emissions in its 2011 Citizens Climate Action Plan[66]. Newton can learn a great deal from that excellent report. The organization Urban Sustainability Directors Network, of which Newton is also a member, developed a guide for helping their members to assess and mitigate consumption-based GHG emissions[67].

These reports underscore the magnitude of the impacts of ever larger houses in Newton on the city's GHG emissions. According to the research conducted by the Oregon DEQ the embodied energy of furnishings inside a house add approximately 30 percent to the embodied energy of the house itself; the larger the house the more of its material content. This energy consumption cannot be compensated by increasing the efficiency of the building envelope or the engineering systems.

Energy upgrades save money and reduce energy use. Assuming approximately twelve percent of the current residential housing stock will be

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[65] https://www.c40.org/researches/consumption-based-emissions

[66] https://www.portlandoregon.gov/bps/article/531984

[67] https://sustainableconsumption.usdn.org/climate/overview

replaced by 2050, that leaves 88 percent of homes which need to have reduced energy use and GHG emissions.

During the 2017-2018 two-year period, 2,115 energy assessments were conducted in Newton under the Mass Save program. The follow up rate on these assessments with insulation projects has been approximately 20-25 percent. But based on the data provided by National Grid (for 2017 and 2018) homeowners in Newton annually implement 250-300 insulation jobs, and 280 improvements in heating systems (we do not know what types). A typical insulation work costs $3,200, of which the homeowner pays only 25 percent ($800) while the rest is covered by the Mass Save program. It is an incredible value.

Able Home Performance Inc., a Mass Save-approved contractor, estimates that wall insulation reduces energy consumption by up to 15 percent, while air sealing (which is free to Mass Save customers) reduces it by 5 percent. A replacement of a 30-year-old furnace with modern high efficiency equipment (required to qualify for subsidies) reduces energy consumption by 20-25 percent. The homeowners who currently implement these projects through Mass Save should be encouraged, during the permitting process, to commit to more advanced insulation work and to switching to heating with electric heat pumps.

In short, increasing the current rate of insulation projects by a factor of 2 or 3, and using them, as well as furnace/boiler replacement, as opportunities for switching to electric heat and installing more advanced insulation, will go a long way toward meeting the goals of the Citizens Climate Action Plan.

Ownership change is an opportunity. A promising opportunity for motivating residents to upgrade their homes is a disclosure of HERS rating at the point of sale. On average, 800 single-, two- and three-family homes change hands each year. Some of these (about 100) are torn down and replaced. When teardowns are conducted by developers, two transactions are recorded with the Assessor's office—the initial purchase and the final sale. Assuming that 150-200 recorded sales represents replacements, that leaves 600-650 homes simply changing ownership each year without major rebuilding. *With strong incentives in place for installing insulation and new HVAC systems at the point of sale, over the next 30 years almost all houses could be upgraded.* Mandated HERS rating at the point of sale may provide such an incentive.

Another factor—Newton's population is aging. Currently about one out of every four Newton residents are over 65 years of age. We expect that over the next decade many of them will sell their homes and look for smaller and maintenance-free dwellings. That means that the number of dwellings changing hands is likely

to increase above the currently estimated 650. Establishing incentives for energy upgrades at the point of sale will increase in importance over time.

First principle for home renovations: Do no harm. Newton homeowners add over 120 substantial additions to their homes every year. Because of the added floor space, under current practice these additions are moving the city *farther away from its goals* of reducing energy use and GHG emissions.

Substantial home additions are an opportune time to improve the building shell of the existing home; update and electrify the home's heating, cooling, and ventilation systems; and optimize the energy performance of the new addition itself. Additions are also a time when homeowners have access to expert advice (in the form of their engineers, architects, and contractors) and financing, and when the City of Newton has regulatory permit authority. For these reasons, the City should require that the net impact of additions on the total energy consumption of the dwelling should not be greater – and preferably smaller – after the completion of the addition project. The increase in energy use by the addition should be compensated by energy-efficiency improvements elsewhere in the structure.

Remove barriers to energy upgrades. Under the current zoning ordinance some energy-related improvements conflict with existing rules. Examples include: the set-back requirements versus adding vestibules to existing structures or versus adding outside insulation to building envelope; and restrictions on roof solar installation in historic districts. The special permits required in such cases are a barrier to implementing these projects, and should be removed.

Electrify homes that have good efficiency performance. Electrification of homes, built on the assumption that electricity will be generated by 100 percent renewable sources, is the lynchpin of this Citizens Climate Action Plan. It is also the lynchpin of Climate Action Plans across the world. Some utilities are facilitating this transition, largely in response to the effective opposition to new gas pipelines. For example, Con Edison of New York announced on January 24, 2019, that as of March 15, 2019, it will no longer accept applications for new natural gas connections in the densely populated Westchester County north of New York City[68]. The future is clear: the housing stock in this area of the country will need to start transitioning to renewable electric heating.

We estimate that a rejuvenated housing stock will lead to a 20 percent reduction in energy consumption and associated GHG emissions, while the remaining 80

[68] https://www.coned.com/en/save-money/convert-to-natural-gas/westchester-natural-gas-moratorium/about-the-westchester-natural-gas-moratorium

percent of GHG reduction will be achieved through electrification. It would be wasteful to install costly electric heating in homes with very poor energy performance, for three reasons. First, the system will require large capacity (and thus be more costly); second, operation of the system will be more costly; third, in the foreseeable future 100 percent renewable electricity will be a scarce resource, which we cannot afford to waste. Therefore, the process of transitioning to electric heat should start with well-performing dwellings.

During the past decade the efficiency and performance of air-source heat pumps (functioning as both heating and air-conditioning units) have greatly improved. A heat pump of today has a Coefficient of Performance (COP) of about 3. COP is the number of BTUs delivered to the house per BTU of energy put in to run the unit. That means that a heat pump is about 3 times more efficient than a typical gas-powered furnace, which means that it can deliver three times more heat per unit of energy it takes to run. In addition, a heat pump also delivers air conditioning, thus eliminating the need to install costly central air-conditioning system. No doubt further improvements will take place in the future.

The financial side of heat pumps. At present, heat pumps are about twice as expensive to install as gas powered heating systems. Their operating cost per unit of heat is also more expensive: (about 1.5 times that of gas-powered furnace), partly because of the higher cost of electricity in New England. On the other hand, their greater efficiency - about three-fold relative to a modern furnace - and the elimination of a need for separate central air-conditioning system - reduce the capital and operating costs. On balance, the cost of heat pumps and gas-powered furnace are not much different. The REEP system described in Appendix A seeks to overcome the initial cost barrier of heat pumps as well as the costs of weatherization retrofits.

What gets measured gets managed. Home buyers nationwide are increasingly interested in the energy performance of their potential purchases. It is only a matter of time before energy performance of homes will become a standard consideration in purchasing decisions. The real estate agents in Massachusetts are responding on a volunteer basis by providing that information, when available, in the MLS listings. Standardized and legally mandated information, which we describe in the two paragraphs below, will do more than answer home buyers' questions: It will create strong incentives for the sellers to invest in the upgrades and then recoup the investment through the sale price.

Mandating the disclosure of a property's HERS rating in real estate transactions is the first of these two methods. Doing so is outside the Newton jurisdiction. However, the city can create a market demand for this information by listing the HERS ratings of the homes that have them in the assessor's database, and

educating residents and prospective residents. All homes built and significantly renovated since 2010 have a HERS rating, as required under the Commonwealth's 2010 Stretch Code.

The second method of standardizing information is the so-called "residential scorecard." In the 2019-2021 edition of their three-year energy efficiency plan, the Massachusetts utilities committed to rolling out this type of program called Home MPG (miles per gallon), in coordination with DOER by July 2019,. An enhancement to the Mass Save home energy assessment program, Home MPG is another way of displaying the energy efficiency profile of a house. Although not based on performance, as is a HERS rating, this is an important step toward engaging homeowners in thinking about the energy efficiency of their residences.[69]

The outstanding challenges. The current trends in new housing construction in Newton point toward 1) a continuation of the current process of replacing old inefficient single-family homes with mostly very large single-family houses and a smaller percent of more modestly sized two- and three- family dwellings; and 2) an increasing number of multifamily dwellings. These trends open an opportunity to create a *housing stock of the future* that has a much smaller per-capita energy consumption and GHG emissions than the current building stock. The special permit process allows the City, through criterion 5 of the special permit review, to require high performance standards (such as a HERS of 25 and full electrification) for all new construction requiring such permits, and should be adopted as a default condition.

The challenge is that outside the special permit process, Newton is legally prevented from requiring higher building standards than those specified in the Massachusetts Building Code, and as such it is therefore imperative for Newton leaders to actively participate in the state level initiatives aiming for higher energy performance of new construction. There are several such initiatives under way.

Another obstacle to creating high performing housing of the future is that many developers and contractors are not familiar with building to the PH performance standard without incurring cost overruns, or with the impacts of their choices of materials and design. Changing the standard practices in the conservative building sector – project management, choice of subcontractors, materials and

[69] http://ma-eeac.org/wordpress/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no-bulk.pdf

building techniques – is a formidable but not insurmountable obstacle. The City can lead by:

- Instituting a vigorous and comprehensive education and training program for developers and contractors;
- Treating each project that exceeds the building code performance as a demonstration project and as a definer of a new baseline against which other projects will be judged;
- Requiring the developers and contractors to consider alternatives with high energy efficiency when planning projects; and putting the *burden of proof on them* to demonstrate that they are unable to adopt such measures; and
- Developing other incentives, such as expedited approval, and high permitting fees for projects with undesirable features such as low energy efficiency, and the use of fossil fuels for heating and cooking.

Further research, resources and ideas

The research and analysis we presented in this chapter is not comprehensive. There are many programs around the country aiming to reach the same goals as the Newton Plan: to increase efficiency performance of existing and new residential buildings and to electrify heating. And the number is growing as the urgency for action is recognized by an increasing number of municipalities around the country.

We recommend that the implementation stage of the Newton Citizens Climate Action Plan include further review of programs being tried out around the country so that the steps that Newton will take are grounded in experience and learning while at the same time being most appropriate for the specific case of Newton.

Our research identified other municipalities with programs that merit further analysis. These are listed below by category.

General

- Two recent articles about State of California actions (spurred by passing legislation)[70]

[70] https://www.greentechmedia.com/articles/read/california-regulators-get-serious-about-building-decarbonization#gs.sqRvnBEi

https://www.vox.com/energy-and-environment/2019/2/15/18224470/california-climate-policy-decarbonize-building-sector

- A California roadmap to building decarbonization[71]
- Notably, the California Energy Commission's "Integrated Energy Policy Report"[72] leads with decarbonizing buildings through electrification.

Planning and Voluntary Programs

- Citizens Climate Action Plans that prioritize building and transportation decarbonization. These can be particularly useful if they set long-term, community-wide electrification targets and include analysis of the types of electrification retrofits that are suitable for the local building stock. (San Francisco, Emeryville, Richmond, Boulder CO, New York City, Washington DC, Boston MA)
- Incentive or rebate programs for air source heat pumps (ASHPs) and/or heat pump water heaters (HPWHs). (Burlington VT, Palo Alto CA, that may be developed instead of or in addition to state and/or utility programs, such as those offered by SMUD (Sacramento Municipal Utility District) and NYSERDA New York State Energy Research and Development Authority)
- Group purchasing programs or "thermalize" campaigns for ASHPs and/or HPWHs to help lower equipment and installation costs. (Somerville MA, Tomkins NY)
- Outreach and assistance on the part of the Energy Concierge Service focused on helping customers connect with qualified contractors to install ASHPs and/or HPWHs. (Boulder CO, Cambridge MA, Boston MA, New York City)
- Voluntary leadership program for prominent local real estate owners/developers to pilot strategies and develop best practice tools and resources for real estate professionals. (New York City, Boston MA, Salt Lake City UT)
- Commercial PACE financing to help amortize the long potential paybacks of heating electrification (New York City, San Francisco)

Municipal Buildings and Operations

- Design standard for all-electric buildings for municipal projects
- Decarbonization/Fossil Fuel scoring criterion added to Capital Improvements Program checklist and scoring (Oakland)
- RFP scoring criterion for creation/distribution of climate disinformation for city RFPs

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[71] http://www.buildingdecarb.org/resources/a-roadmap-to-decarbonize-californias-buildings

[72] https://efiling.energy.ca.gov/getdocument.aspx?tn=226392

Codes and Mandates

- Green Building Ordinance (specifically in CA, a Reach Code for electrification such as those developed by Marin County or Santa Monica)
- PEV Infrastructure or "all-electric ready" new construction requirements (Oakland, SF, Fremont)
- Electrification as a CEQA mitigation measure (Fremont)
- Energy or GHG performance retrofit requirement designed to encourage electrification (which could be developed through local building codes, the energy code, and/or the air code). (Washington DC, New York City)
- Ban or moratorium on new natural gas infrastructure development (could be accomplished by leveraging land use/zoning ordinances, utility franchise agreements, community activism, etc.) (Northampton MA, Easthampton MA, Amherst MA; New York City/Con Edison)

Additional Resources

HeatSmart seeks to increase the adoption of small-scale clean heating and cooling technologies in participating communities through a competitive solicitation process that aggregates homeowner buying power to lower installation prices for participants. The next round should be open at the end of 2019 https://www.masscec.com/heatsmart-mass

Commercial Solar Advisor https://www.masscec.com/commercial-solar

Mass Solar Loan Program- especially for seniors and homeowners below 80 SMI https://www.masssolarloan.com/-

Good solar PV cost info https://www.masscec.com/solar-costs-performance

MassCEC Internship Program- for clean energy companies in Newton and college students https://www.masscec.com/clean-energy-internship-program

Solar Hot Water rebates https://www.masscec.com/solar-hot-water

Mass Save Additions and Renovations Program https://www.masssave.com/en/saving/residential-rebates/renovations-and-additions/

DOER's MVP Program https://www.mass.gov/guides/home-mvp

Additional Ideas:

Mass Save Renovations and Additions program Provides up to $10K for homeowners renovating or adding space to include other house energy upgrades which they have a contactor in. https://www.masssave.com/en/saving/residential-rebates/renovations-and-additions/

The City could require anyone pulling a renovation or addition permit to get the Free Energy Assessment before the permit is approved. The recommended work would not necessarily have to be done, but then all would be informed of what is possible, incentives, payback, and 0 percent financing.

Commercial Solar Advisor Service. MassCEC has a free service for any commercial building owner to help them consider Solar PV. The service helps them get acquainted with approximate costs and opportunities for their roof, payback, financing options, what is a good price, who does commercial installs in their area, and help in comparing bids that may not always be apples to apples. The City of Newton could require anyone pulling a roof permit for a commercial program to have at least one phone call with the Commercial Solar Advisor before the approval of a roof permit. https://www.masscec.com/commercial-solar

Help push for legislation to allow submetering of VRF heat pumps. This is a big barrier to widespread use of VRF in commercial multi-family projects. In Massachusetts we are not allowed to submeter electricity, so an owner who installs a central VRF system is not allowed to submeter and bill tenants for the heating and cooling they use. (This is allowed regularly in many other states, most notably New York). City of Cambridge seems interested in pushing this idea.

C
Addendum to Transportation Chapter

EV Model

Model used to estimate the rate and effects of a transition from ICE to EV.

7. The total number of vehicles in Newton is 57,661 and on average, there are 6,300 new vehicles bought per year (and the same number retired). The average length of use of a car is 9.2 years before a replacement car is bought. The average miles driven per year for all Newton cars is 531 million, which has been relatively constant during the past several years.
8. The number of EV's is based on the percentage of new car purchases that are EV, when an existing car is traded in. According to the Massachusetts MOR-EV data base the number of EVs and PHEVs combined in Newton is 693. In 2018 the percentage of sales that are EV plus PHEV was 4.2 percent of new car sales, which represents approximately 265 cars (6300*0.042 = 265).
9. For the Business as Usual scenario, the model assumes that for 2019-2026, the growth rate of EV plus PHEV purchases increases by 0.75 percent each year, and starting in 2027, it increases by 2.25 percent for each year. For the first seven years, the sales percentage of EV/PHEV increases by 0.75 percent each year, and starting in year eight (8), increases by 2.25 percent for each year.
10. For the Accelerated Scenario, for the 2019-2022, the growth rate increases by 1.5 percent per year and starting in 2023 it increases by 4 percent per year.
11. In the U.S. average fuel economy for current new internal combustion (ICE) cars is 25, and is assumed to increase by 0.5 mpg per year, until new ICE cars reach 38 mpg, and thereafter will remains constant (based on the current product mix). The current Newton fleet has average fuel economy of 23 mpg. These figures are used to calculate the GHG emissions for non-EVs.

12. EVs are assumed to travel 4 miles per kWh. As such, they use 17 percent less energy than ICE vehicles at 23 mpg, and 30 percent less at 40 mpg.
13. Each car is assumed to have the same average use life as at present (9.2 years), and when traded in, it is replaced as per the percent sales of EV's/ICE in that year.
14. The reduction in GHGs depends on the percentage of electrical power coming from non-carbon emitting sources. This is currently being done through the Newton Power Choice aggregation program, which includes buying enough RECs to bring the total level of Class 1 renewable power to 60 percent in 2019. This percentage can be increased with each subsequent aggregation contract by adding 46 percent to the Massachusetts Renewable Portfolio Standard, which is 14 percent in 2019 and increases 2 percent per year until 2030 and 1 percent per year thereafter.
15. Forecasts and prices were publicly sourced:
    a. https://www.forbes.com/sites/energyinnovation/2017/09/18/the-future-of-electric-vehicles-in-the-u-s-part-2-ev-price-oil-cost-fuel-economy-drive-adoption/#44469986345c
    b. https://www.jpmorgan.com/country/CL/EN/research/electric-vehicles
    c. https://drivegreen.greenenergyconsumers.org/form_cars.php#allelectric

Better Bus Connections

The key to increasing the use of public transportation in Newton is cross-town bus service that connects with the MBTA services to Boston. This addition will reduce the barrier caused by insufficient parking at Green Line and Commuter Rail stations and express bus stops.

The MBTA will do a Better Bus network redesign starting in Fall 2019 that will include possible improvement of service frequencies on the 59 and 52 bus routes. Research shows that 20-minute frequency is needed to induce more ridership. Beyond the tons of GHG directly saved, acceptably frequent bus service would – together with improvements that are planned on the Green Line – help increase transit ridership as a percentage of all trips in Newton, and reduce vehicle miles traveled. Improved bus transit also accommodates independent travel by people who do not or cannot drive, for example older citizens, people with disabilities, and youth (who would otherwise be driven by parents).

As ridership grows, the City should work with the MBTA to extend service hours beyond 6:30 pm. This will capture a larger share of commuter trips, including

both trips by employees working in Newton and Newton residents commuting to Boston and other inbound destinations.

Improvements are also needed on express bus routes and commuter rail.

Just as cyclists vary in how much they ride and under what conditions, public transit riders vary from an occasional trip on the Green Line, to regular commuting by public transportation, to utilization of public transportation for most trips. Encouragement efforts should aim to get people to progress in their transit use.

The *WiseWays/Newton* transportation system for seniors that was announced by the Mayor in March 2019 uses shared-ride technology to bring people to healthcare and other facilities used by seniors, including transit stations. This service has the potential to provide first-mile/last-mile connections to MBTA radial transportation. It should be evaluated and potentially expanded to include all users.

Active Transportation

The City has been making steady progress on accommodating and encouraging biking and walking. Bike lanes have been added to Beacon, Walnut, and Centre Streets, and the MassDOT design for Needham Street reconstruction includes bike accommodation at sidewalk level. These efforts need to continue. These active (i.e., muscle-powered) modes are synergistic with public transportation, and together they make up a healthy lifestyle and a culture that makes driving a smaller part of our lives. Sidewalk improvements and sidewalk snow removal have also been City initiatives in recent years.

Traffic Management and Roadway Design

Traffic management and roadway design can further the goal of increasing the share of trips other than automobiles. Roadway design is an important element that is in the control of the City. Complete Streets are designed to share the cross-section with cyclists, pedestrians, and people who use wheelchairs. The *Newton in Motion* transportation strategy (2017) contains specific recommendations.

Travel Information

Getting people to use non-automobile modes requires information: uncertainty about these modes is a barrier to using them. The City has added a web page to Newtonma.gov that provides information on public transportation. Information on walking and biking should be consolidated with this page. Trip planning tools (e.g., Google Maps) that were simply unavailable a few years ago now provide excellent information, not just for automobiles but also public transportation and

walking. The information is updated continuously to reflect any MBTA service disruptions and a schedule explorer allows the user to choose the best service to get to a destination at the desired time. The walking mode provides distance and time estimates.

The City can promote increased use of these tools, and it can provide regular travel training at venues like the senior center and schools. Research shows that travel training can overcome a major obstacle to leaving the car at home.

D

Selected Non-Residential Property Owners

Owner Name	Square Feet	Use Category
TRUSTEES OF BOSTON COLLEGE	1,037,813	Academic
LASELL COLLEGE	615,679	Academic
HINES GLOBAL REIT	568,936	Offices
CHS COMMERCIAL OWNER LLC	407,078	Medical Offices
AVALON UPPER FALLS LLC	406,926	Apartments
UNIVERSITY OF MA BLDG AUTHORITY	396,300	Academic
ATRIUM WELLNESS CENTER II LLC	381,685	Medical Offices
BOSTON ACADEMY OF THE SACRED HEART INC	333,452	Academic
CHESTNUT HILL SHOPPING CENTER LLC	314,714	Retail
CHSP NEWTON LLC	300,109	Hotel
CHAPELBRIDGE PARK ASSOCIATES	296,263	Offices
AVALON AT CHESTNUT HILL INC	270,941	Apartments
THE MAY DEPARTMENT STORES CO	264,843	Retail
AG-JCM WELLS AVE PROP OWNR LLC	263,492	Offices
JCHE COLEMAN & GOLDA LP	229,240	Apartments
MALL AT CHESTNUT HILL LLC	228,483	Retail
NORTHLAND OAK ST LLC	202,431	Offices
K F REALTY ASSOCIATES	200,440	Retail
NEWTON-WELLESLEY HOSPITAL	200,400	Other Non-Profit
CHESTNUT HILL SHOPPING CENTER LLC	195,731	Retail
ABP BORROWER INC	187,452	Offices
300 NEEDHAM STREET LLC	181,975	Retail
TAURUS ONE NEWTON PLACE LLC	178,976	Offices
BH NORMANDY OWNER LLC	176,027	Hotel
JEWISH COMMUNITY CENTER	168,999	Other Non-Profit
KESSELER WOODS LLC	158,872	Apartments
MAURUURU PROPERTIES LLC	158,256	Offices
DIV WASHINGTON LLC	148,208	Offices
FESSENDEN SCHOOL	144,388	Academic
WHITE THOMAS J TRS	143,122	Offices

E
Glossary

ASHP Air-source heat pump

Building envelope The portion of a building that separates the interior from the exterior, consisting of foundation, roof, walls, doors and windows.

BEV Battery electric vehicle, operates only on electricity

Btu or **British Thermal Unit** A unit defined as the amount of energy required to heat 1 lb. of water 1 degree Fahrenheit. It is often used to compare energy-use from different sources (e.g. electric and gas).

CBEI Consumption-Based GHG Emission Inventory. The inventory of GHG emissions which includes both direct energy use in economic activities within particular geographic boundaries as well as embodied energy of goods and services used in that region. It includes goods, energy and services imported into the region and excludes goods, energy and services generated within the region but used for economic activities outside of it.

COP Coefficient of performance, a measure of the performance of electrically-powered heating and cooling equipment. It is defined as the ratio of energy output per unit of energy input.

EE Energy efficiency, achieved by such measures as weatherization and high efficiency heating systems

Embodied energy The energy required to produce, maintain and dispose of any material good through its entire life. It includes energy use to obtain and process raw materials (including metal mining), transport, marketing, sale, use and end-of-life disposal. Embodied energy may account for as much as 40 percent of a building's life-time energy consumption, with 60 percent going into operational energy[73] —heating, cooling, lighting etc.

EUI Energy use intensity, a measure of a building's energy efficiency, typically given in units of energy per square foot per year (kBtu/sf/year). This

[73] https://www.metropolismag.com/architecture/sustainability-glossary-embodied-energy/

is calculated by dividing the total annual energy consumption by the total floor area of the building

EV Electric vehicle, operates only on electricity

GHG or **Greenhouse gases** Gases having a potential to absorb radiation reaching the earth from the sun and warm up the earth's troposphere. The most common GHG is carbon dioxide, CO_2. Other gases, such as methane, with a different global warming potential per unit volume than carbon dioxide are normalized to CO_2's global warming potential and expressed as GHG equivalents.

Green Newton Building Principles Green Newton, a local environmental advocacy group has published a four-part set of Green Building Principles[74]: 1) minimize building operating energy; 2) minimize embodied carbon; 3) buildings must be all-electric and off the natural gas grid; and 4) minimize the carbon footprint for transportation to and from the building.

HERS Home Energy Rating System[75]. A nationally recognized measure of a home's energy performance—the lower the number the better. The HERS process includes measurements of air leakage, insulation effectiveness, and other variables. It results in a HERS score and provides the homeowner with a detailed report about energy problems in the house.

HPWH Heat pump water heater

ICE Internal combustion engine, used in most of today's conventional vehicles.

kWh or **Kilowatt-hour** The standard unit for measuring electricity use; a 100 watt bulb that is on for 10 hours would consume 1,000 watt-hours of electric energy, or 1 kWh. Electricity is billed in terms of $/kWh.

LCA or **Lifecycle Assessment** A scientific method for studying the impacts of producing, using and disposal of a material good or service through its entire life. It is used to estimate embodied energy, environmental pollution, and other desirable and undesirable effects.

PH Passive house refers to a defined set of principles and procedures for constructing ultra-efficient buildings, both residential and commercial structures. The concept originated in Europe and has been institutionalized in Germany through the Passive House Institute. To obtain PH certificate a building undergoes rigorous testing. In the US, the concept is disseminated through Passive House Institute US, PHIUS[76].

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[74] https://www.greennewton.org/advocacy/10655-2/

[75] http://www.resnet.us/hers-index

[76] http://www.phius.org/home-page

PHEV Plug-in hybrid electric vehicle – similar to a regular hybrid, but with a bigger battery pack that can be charged up by plugging in to a regular electricity supply.

VMT Vehicle miles of travel