

Lexington's Renewable Future Getting to Net Zero Emissions Roadmap & Recommendations

August 21, 2018



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1. INTRODUCTION

1.1 Lexington's Renewable Future & Net Zero Emissions

Lexington's 25-year goal is to reduce fossil fuel and greenhouse gas emissions from the town's residential, commercial, and municipal buildings, which account for 66% of Lexington's total greenhouse gas emissions, and to achieve a transition to 100% renewable energy sources.

This report intends to answer the question: What would it take for Lexington to transition to a clean, healthy, sustainable, 100% renewable energy future?

Communities around the world are making serious commitments to achieving a 100% renewable future, as awareness grows of the serious health and climate change impacts caused by our current dependence on fossil fuels. The Town of Lexington is at the forefront of this movement, taking action at the local level to lower our fossil fuel emissions, reduce the catastrophic impacts of climate change all while improving air quality, public health, and quality of life for our residents.

In 2017, Lexington's Board of Selectmen voted unanimously to become the first town in Massachusetts to join the US Compact of Mayors (along with cities including Boston, Cambridge, and Somerville) in our commitment to the ongoing actions required to reduce our greenhouse gas emissions consistent with the Paris Climate Accord.

This Getting to Net Zero Emissions Roadmap is focused on Lexington's residential, commercial, and municipal built environment: reducing and ultimately eliminating fossil fuel emissions generated from heating, cooling and powering all our buildings. Fortunately, the cost of renewable energy has been plummeting as technologies like solar, wind, and energy storage have gone mainstream.

Solar panel prices plunged by 26 percent in 2017— despite having already dropped 80 percent in price in the previous 10 years and 99 percent since the late 1970s. In October 2017, the lowest bids for wind electricity were just 4 cents per kWh – a 24 percent drop in just six months.

The cost of batteries has followed a similar trajectory, dropping 75 percent since 2010. Bloomberg New Energy Finance expects the cost of energy storage systems will drop another 75 percent by 2030.

Lexington has taken advantage of these trends with the Community Choice program that was able to secure 100% renewable electricity for less than the cost of conventional electricity. Lexington's Community Choice program is currently reducing the community's emissions by 98 million pounds of CO₂ per year while saving Lexington residents \$1.4 million in its first twelve months.

Lexington's Getting to Net Zero Emissions roadmap integrates a set of strategies and programs designed to move the Town toward achieving net zero emissions in the built environment and improved air quality. The Getting to Net Zero Emissions Task Force's organizing principle outlines the general approach to achieving zero emissions across all sectors and building types: Report, Reduce, Produce, and Purchase.

The Sustainable Lexington Committee will coordinate initiatives in each of these areas with the Board of Selectmen, Town staff, Town Meeting, other relevant Town committees, boards and other stakeholder groups (as detailed in section 3). Lexington has already taken many significant steps on the path to net zero emissions. This report's objective is to outline the programs and priorities needed to close the gap needed to achieve a renewable future for Lexington.

1.2 Purpose of the Report

- a) Define the objectives and document the process of developing Lexington's Net Zero Emissions plan;
- b) Articulate the strategies and recommended supporting actions "the roadmap" to achieving net zero emissions;
- c) Develop a timeline to achieve the net zero emissions target.

Goal of the Task Force Process

The task force was formed to develop consensus and agreement among Lexington's stakeholders on a roadmap and timeline required to achieve a transition to 100% renewable energy sources for the built environment. This report builds upon energy and emissions baseline work developed by Peregrine Energy. Each recommended action was modeled to measure the projected impact and contribution towards achieving the net zero emissions target.

Figure A: Developing a Roadmap to Net Zero Emissions

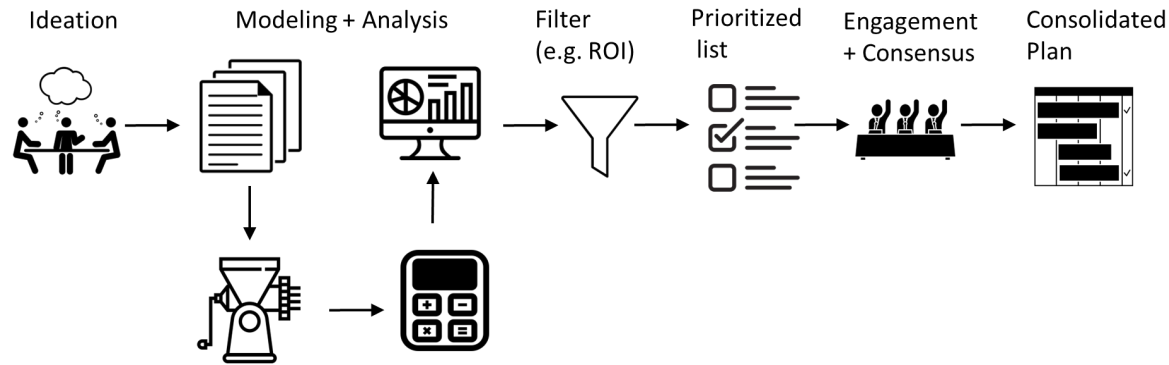


Figure A illustrates the steps taken in creating this roadmap and recommendations. The Task Force and the municipal, commercial, and residential working groups developed a long list of possible strategies to address energy efficiency improvements, fuel switching and generation of renewable energy for Lexington’s municipal, residential, and commercial buildings. The consultant team then modeled the potential impact of each of the suggested strategies. The list was refined based on impact, feasibility, and practicality. The resultant short list was then presented to the Task Force for review and endorsement, and finally, was adopted as the roadmap and recommendations included in this report.

The Getting to Net Zero Emissions Task Force

The Getting to Net Zero Emissions Task Force includes building owners, community leaders, and subject matter experts with experience in architectural design, historical preservation, building management, renewable energy, sustainability, environmental advocacy, local government, and education; and stakeholders representing residential, commercial, and municipal interests. The following is a list of Task Force members:

- Joe Pato, Lexington Board of Selectmen, Former Chair
- Jeanne Krieger, Former Chair, Lexington Board of Selectmen
- Paul Lukez, Architect & Author, Suburban Transformations
- Wendall Kalsow, Architect & Member Lexington Historical Commission

- Mike DiMinico, Sr. Director, King Street Properties
- Melanie Waldron, VP, Boston Properties
- Joseph Fulliero, Environmental Manager, Shire
- Janet Terzano, Real Estate Agent, Barrett Sotheby’s
- Alessandro Alessandrini, Chair, Lexington School Committee
- Melisa Tintocalis, Lexington’s Economic Development Director
- Lisa Fitzgibbons, Community Organizer, Mothers Out Front
- Mark Sandeen, Chair, Sustainable Lexington Committee

The Task Force met monthly in 2017 to develop and define the set of strategies, solutions, and recommendations that will best achieve the net zero emissions goal for Lexington’s particular building stock and energy use profile. We thank each of the task force members for their time, energy, expertise, and creative contributions to the success of this effort.

The initial meetings focused on ensuring that all task force members had a shared understanding of Lexington’s energy and emissions profile. This activity included reviewing the inventory of Lexington’s building stock, its energy sources, and the greenhouse gas emissions associated with each energy source. The Task Force also reviewed the set of actions taken by other leading communities working to achieve deep energy reductions, net zero emissions targets, carbon neutral, and/or 100% renewable energy objectives. These examples of best practices guided and framed the discussions of the range of possible actions in driving energy and emissions transformation at the community scale.

Working Groups

The Task Force convened working groups to explore solutions for three sectors: (1) commercial buildings, (2) residential buildings, and (3) municipal buildings. The working groups discussed potential policies, programs, incentives, and partnerships to support energy and emissions reductions in new and existing buildings, including fuel switching and renewable energy solutions that could be implemented to transform the supply of energy to renewable energy sources.

Modeling & Analysis

The working groups developed a long list of strategies that Lexington could potentially implement as a means of achieving the net zero emissions target. To refine the list of potential actions into a cohesive and comprehensive action plan, the consultants performed energy and emissions modeling and analysis to measure the impact of each potential strategy over time.

The energy and emissions planning model was customized using assumptions associated with the greenhouse gas emission impacts of the proposed actions when applied in Lexington. The consultant team used local data and multipliers, reflecting the building stock, rate of turnover of buildings, rate of renovation, fuel mix and related emission factors.

The consultants calculated the greenhouse gas impact of each individual strategy. The prioritization of the recommended strategies included consideration of:

- a) Feasibility of implementation
- b) Practicality of implementation
- c) Return on investment.

Based on the results of the modeling and filtering process, the consultants presented a refined list of recommended strategies that, if implemented together, will move Lexington toward achieving the net zero emissions target. This report presents the findings of the Task Force, refined and modeled by the consultant team. The proposed actions for residential, commercial, and municipal buildings are described in section 3.

2. THE SHIFT TO NET ZERO EMISSIONS

2.1 Targets and Strategic Approach

The Net Zero Emissions Task Force was formed to create a shared consensus and mutual agreement among Lexington's stakeholders on a roadmap toward achieving the target of net zero emissions in the built environment. An early task was to determine a suitable target year to achieve net zero emissions. The Task Force asked the consultant team to determine whether it would be possible to achieve a transition to net zero emissions by 2040. The consultant's findings are presented in this report, noting that according to their analysis, achieving net zero emissions is feasible in a shorter (17-year) time horizon.

Long-term Targets

- Target 1: Lexington's buildings are powered by 100% renewable energy sources by 2035¹
- Target 2: All new construction in Lexington is zero emissions by 2030
- Target 3: Lexington is home to a Commercial/Industrial District held up by others as an example of a successful zero-emission and climate-resilient neighborhood-scale development by 2030

¹ Not including emergency backup power generators

Net Zero Energy Strategic Approach

The organizing principle for our roadmap and recommendations is: Report, Reduce, Produce, and Purchase.

REPORT	The first step is to identify the range of building types and measure how Lexington's buildings perform from an energy use and emissions perspective. Building performance will be tracked and reported to show progress towards achieving emissions reduction goals on an annual basis.
REDUCE	There are two primary ways to reduce greenhouse gas emissions from buildings. The first is to use less energy by investing in energy efficiency retrofits, and the second is switching to cleaner sources of energy.
PRODUCE	The next step is maximizing the production of onsite renewable energy from rooftops and parking lots.
PURCHASE	After reducing energy use, shifting away from fossil fuels, and maximizing onsite renewables, the final strategy is to purchase renewable electricity to close the gap to meet the zero emissions objective.

Navigating the Sphere of Influence

Every city and town is unique in a number of ways, including climate, culture, building stock, energy supply mix, and policy levers. When it comes to energy system transition planning, local governments have varying degrees of ability to introduce energy system transition strategies. These strategies range from direct control, to limited influence, to no direct control or influence. The spheres of influence diagram (Figure B) illustrates these three categories. When local governments introduce new and ambitious planning processes, those involved in the planning process need to have a clear understanding of the boundaries of control, influence, and interest. This approach helps the community develop a clear picture at an early stage of what the specific challenges and opportunities may be in implementing a community-scale plan. It also helps to identify key partners and stakeholders that will be indispensable in terms of delivering the plan, and/or other government bodies with whom to pursue alignment.

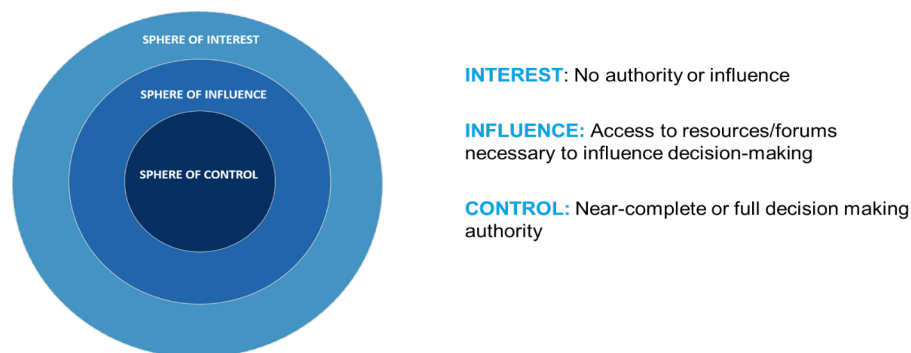
Lexington's Sphere of Influence

Lexington has limited regulatory authority over defining building performance standards, as the Commonwealth controls the building code. A number of strategies outlined in this report fall under the umbrella of advocacy, such as lobbying for changes to the building code. Lexington does have leverage by way of the Town's policy tools. For example,

zoning ordinances can be amended to promote production of renewable energy, or increased efficiency of new and existing buildings. Permitting is another point of leverage for the Town, in that information can be gathered at time of permit, and new requirements can be introduced as a condition of receiving a permit. Lexington's sphere of influence is a factor in the framing of each of the recommendations in section 3. As described above, the Strategic Approach to achieving net zero emissions will rely heavily on partnerships, promotions, and advocacy as fundamental tools for Lexington to increase its leverage in areas outside its sphere of control.

3. CONTEXT AND BACKGROUND

Figure B. Spheres of Influence



Lexington, MA, settled in 1641, is a relatively small community of 33,394 within 16.43 square miles. Its population has been increasing in recent years. With estimated growth of 6.4% from 2010 – 2015, Lexington has grown faster than the state as a whole (3.8%) during this period and faster than 6 of the 8 communities on its border (Arlington at 4.6%, Burlington at 5.8%, Woburn at 3.7%, Belmont at 3.5%, Waltham at 4.5%, and Winchester at 4.9%.) The legacy of this growth is a population density that, at 1,910 people per square mile, far exceeds the state average of 893 people per square mile.²

Lexington attracts and supports talented, financially successful people who move in and stay:

- Median household income is \$149,306 compared with \$67,846 for the state, and just 3.8% Lexington residents are below the poverty line, compared with an 11.5% poverty rate for the state.
- 77.5% hold a bachelor's degree or higher, compared with 40.5% for the state.
- Just about half of Lexington residents are of working age: 50.7% of residents are between the ages of 18 and 64, while 18.6% are aged 65 and older.
- 81.9% live in a house they own, and 91.5% lived in the same house one year ago.³

2012 data from the American Community Survey shows that “professional, scientific, and technical services” companies dominate Lexington’s commercial sector in number of businesses, though

“wholesale trade” comes a close second in value of business done, in spite of having only 29 such businesses.⁴

3.1 Lexington’s Buildings and Energy Profile (2016)⁵ Building Stock and Fuel Mix

The building stock in Lexington is primarily residential. The non-residential stock is dominated by three building types: office (32%), office/lab (27%), and school (16%) (see Figure D). Buildings in Lexington were responsible for nearly 218 million metric tonnes of CO₂e in 2015 (excluding federally-owned buildings). Electricity is responsible for the lion’s share of Lexington’s CO₂e emissions, accounting for 50% of the total, followed by natural gas at 34% and oil at 16%. Non-residential buildings were responsible for 48% of total CO₂e emissions.

According to the assessor’s database, the Town of Lexington is the single largest property owner in town, accounting for nearly 1 million square feet. Overall, ownership is concentrated in 17 large property owners, which together own more than half of the non-residential square footage. In many cases, those owners are not the businesses located in the properties, but a real estate firm or investment entity.

There are two unique building types to Lexington that pose unique challenges with regard to the net zero emissions objectives. A large proportion of buildings are historic, and thus can be more challenging from the perspective of both retrofits and installation of onsite solar PV. Secondly, there are a number of commercial buildings in Lexington with labs or manufacturing facilities, which by nature are highly energy intensive. There are specific recommendations targeted at developing a set of solutions for both historic buildings and laboratories, in collaboration with neighboring communities with similar building stock and use types.

Rate of Development

A review of residential building permits shows the rate of building construction and demolition in town. Over the last four years, the town has issued an annual average of approximately 75 new construction permits and 50 demolition permits. The building permit data shows that new homes are being added, and existing homes replaced, at very low rates—in both cases well below one percent per year. It should be noted, however, that the average size of new homes is over 4,700 square feet.

² http://www.census.gov/quickfacts/table/PST045215/2501735215_25

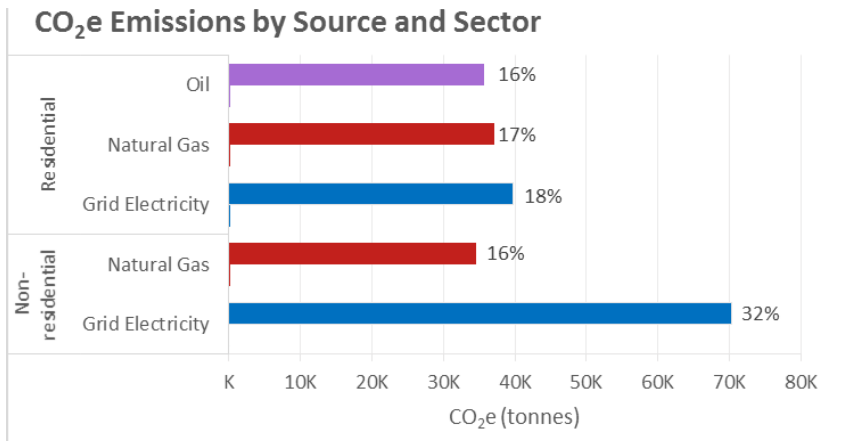
³ http://www.census.gov/quickfacts/table/PST045215/2501735215_25

⁴ http://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/00A1/E600000US2501735215

⁵ The data and figures in this section are credited to Peregrine Energy, excerpted from the Town of Lexington Energy Inventory prepared by Peregrine Energy for the Task Force on March 22, 2017.

One factor contributing to the low rate of turnover in Lexington is the high percentage of protected homes. Nearly 2,000 buildings in town are either located in an historic district or protected under the town's Demolition Delay bylaw.

Figure C: Lexington Building Related Greenhouse Gas Emissions by Source and Sector



*note natural gas figures include losses incurred due to gas leaks in transmission. The gas leak rate in Lexington (as of 2018) is estimated at 2.7%

Fuel Use

Electricity

According to data provide by Eversource, Lexington used nearly 310 million kilowatt-hours of electricity in 2015, excluding federal facilities located in Lexington. Non-residential electricity use dominated, accounting for approximately 66% of the total with residential use accounting for only approximately 34% of the total. This result indicates that Lexington will have to address non-residential electricity uses in order to achieve its emission goals. Looking across the years, it appears that overall electricity use in Lexington has been declining about 1% a year since 2008. This declining usage pattern is consistent with the experience of the state as a whole over the same time period.

Figure D: Emissions in Lexington, MA by building type (2016).

Natural Gas

According to National Grid, Lexington used 14.6 million therms of natural gas in 2015. Unlike electricity use, natural gas use is evenly split between residential and non-residential buildings. In 2015, residential accounts were responsible for 48% of gas use and non-residential accounts for 52%. Lexington's natural gas use has increased significantly since 2009. The reported natural gas use is also much more variable year to year than the electricity use. It should be noted that natural gas numbers account for both gas used to heat building and losses by way of gas leaks (leak rate is approximately 2.7%). National Grid has begun an initiative to address leaks by targeting super-emitters, the top 7% of leaks by volume, which account for 50% of the leaked gas. This program was intended to address almost all of the substantial emissions from this source by 2023, however the initial results from the pilot program have not met initial expectations. Figure E, on page 9, shows the projected impact this initiative will have on Lexington's GHG emissions.

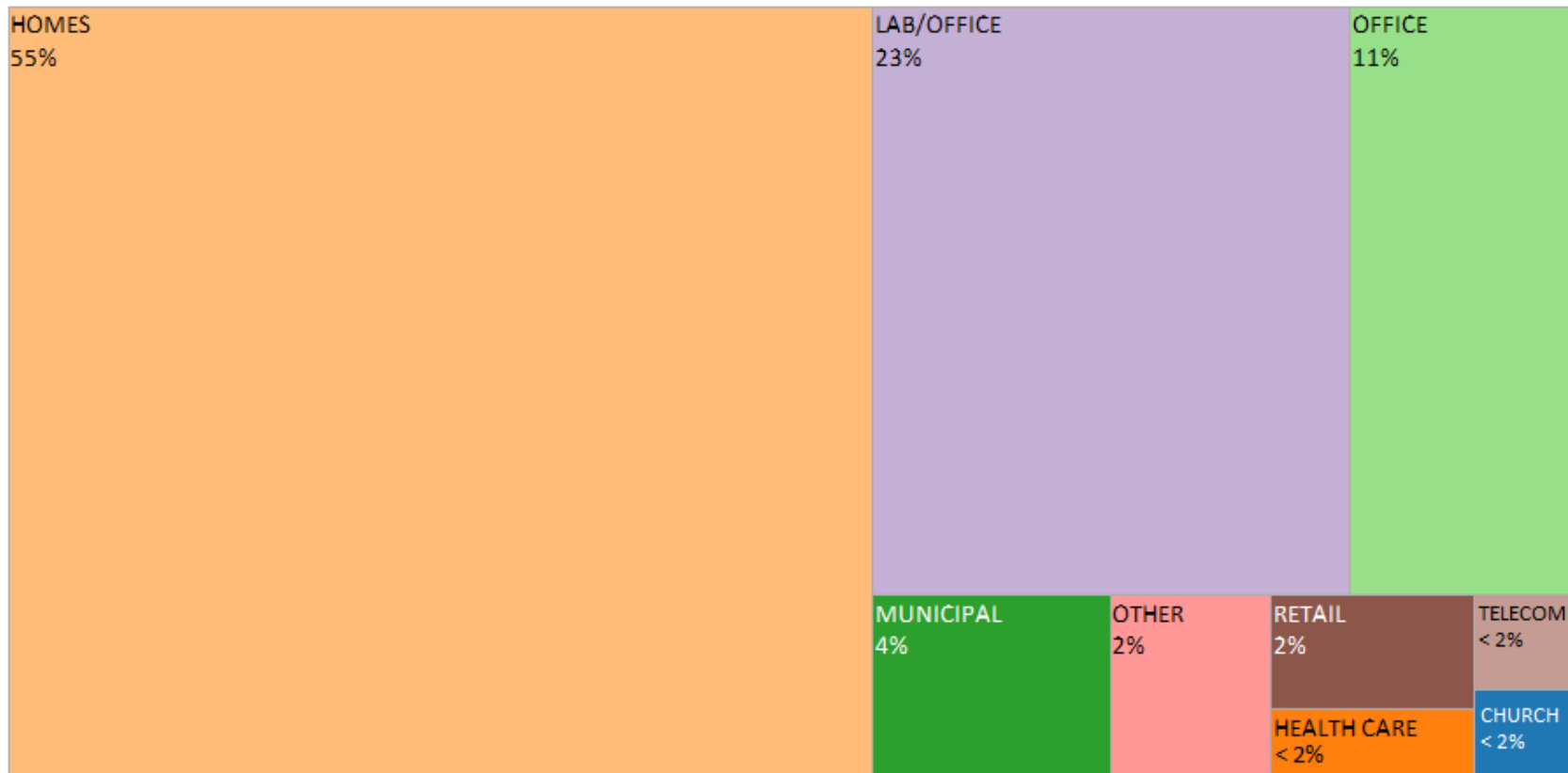
While both commercial and municipal properties use natural gas (and to a lesser extent diesel) to power emergency generators during power outages, eliminating that energy use is not included as one of the recommendations of this report.

Heating Oil

It is challenging to determine town-wide heating oil use. Unlike electricity and natural gas, heating oil has no regulated utility that serves all customers and is willing to provide aggregated use data. Instead, numerous private companies provide heating oil and they do not report the amount of oil consumed by their customers. As a result, heating oil use must be estimated. We estimated the total annual heating oil use at just under 3.5 million gallons per year. This estimate excludes non-residential use of heating oil.

Renewable Energy

Lexington has added a significant amount of solar photovoltaic generation in town, on residences (2.2 MW), schools (1.1 MW), and at the landfill (2.2 MW). Altogether, those systems will generate over 7 million kWh per year. The total production of the solar systems will equate to approximately 1.6% of Lexington's total electricity use.



3.2 Existing Energy Transformation Initiatives: Sustainable Lexington Committee

The Roadmap to Net Zero Emissions Lexington is by no means the Town’s first effort toward reducing emissions. The Town has celebrated many successes in recent years with regard to strategic emission reduction strategies. Lexington’s sustainability initiatives are driven in large part by the Sustainable Lexington Committee. The Committee, appointed by the Board of Selectmen, is tasked with enhancing the Town’s long-term sustainability and resilience in response to environmental resource and energy challenges. This scope includes recommending goals, implementation strategies, monitoring and measurement tools, and raising awareness among Lexington residents.

Current and recent⁶ Town of Lexington initiatives include:

⁶ As of December 2017

Lexington Energy Challenge: The Town was awarded a grant from National Grid in January 2017 to support home energy assessments, air sealing, insulation and installation of high efficiency HVAC systems in residential homes. In 2017, 947 home energy assessments, 226 air-sealing projects, 256 insulation projects, and 157 HVAC upgrades were completed.

Green Communities Grants: The Town of Lexington has received approximately \$745,000 in Green Community energy efficiency grants since becoming a Green Community. The Town has used those grants to implement lighting upgrade programs (among other projects) that have reduced the Town's annual electricity demand by 2.3 million kWh and provide estimated greenhouse gas reductions of 940 metric tons of CO₂ per year.

Solar: The 2.2 MW Solar Facility at Lexington Composting Facility on Hartwell Avenue comprises a 1.4 MW Ground mount system on 4.25 acres combined with two solar canopies with combined system size of 800 kW installed on Lexington's closed landfill site. This facility generates 30% of the Town's municipal electricity demand. The Town's 1.1 MW of rooftop solar installations on Lexington school and municipal buildings provide an additional 10% of the Town's municipal electricity demand. The two systems are expected to reduce Lexington's annual CO₂ emissions by 2,162 metric tons combined.

Residents in Lexington have added a further 1.1MW of solar installations through residential solarize programs making Lexington a leader in the generation of renewable energy on the east coast.

Community Choice Aggregation: About 10,250 customers were enrolled in the Community Choice program as of December, with expected annual electricity usage of 119 million kWh per year. This program will result in expected emission reductions of 47,000 metric tons CO₂ per year.

Natural Gas Super Emitter Gas Leak Pilot Program: The Town of Lexington engaged with National Grid and HEET to identify and repair the natural gas leaks of Lexington's highest emitting natural gas leaks in a pilot program. The pilot program has repaired the leaks, which is intended to result in CO₂e greenhouse gas emission reductions of 30,000 metric tons per year based on methane's GWP₂₀ of 86.

Net Zero Energy Schools: Hastings Elementary School is being designed as a net zero energy school, using a geothermal heat pump

system and solar + energy storage system to supply all energy needs for the 110,000 square feet school serving 645 students. Hastings will be the first fossil fuel free school in Lexington. The solar energy system is expected to generate 960,000 kWh per year and the building energy demand is expected to be about the same per year. Lexington Children's Place is also designed to be a net positive school, using air source heat pumps and solar + storage system to supply double the school's annual energy needs.

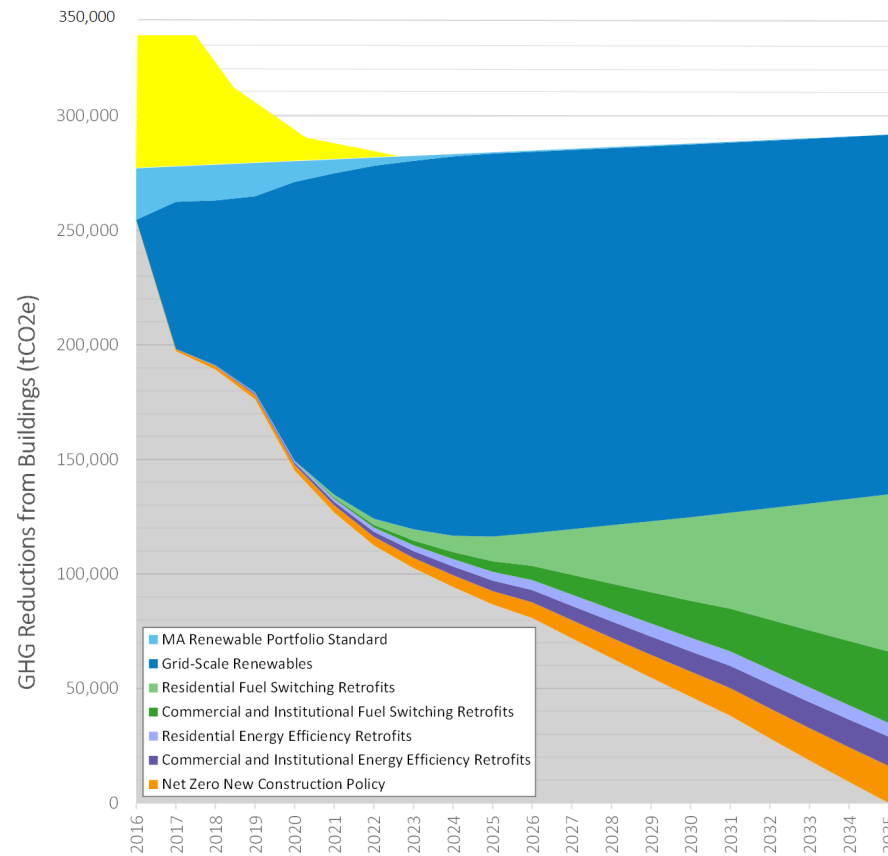
Hartwell Avenue Revitalization: As Lexington looks to the future and the chance to transform its building stock and infrastructure, existing commercial districts (like the Hartwell Avenue area) offer a great opportunity to create a sustainable and resilient zero emissions district, which if successful could serve as a model for other (overlay) districts in Lexington.

Using innovative zoning and urban design guideline strategies, multi-use districts can be developed in a way that works within reasonable zoning, FAR, and other design parameters, while achieving desired sustainability, resilience, and zero emissions goals and standards. These goals can be achieved using a mix of renewable energy systems and strategies, such as solar, geo-thermal, and energy storage.

Ideally, the zoning and urban design guidelines would be defined in a way that allows for innovative design and engineering solutions to be integrated while allowing a reasonable degree of flexibility in how the performance standards could be met over time within pre-defined design, zoning and other important planning parameters. Such a flexible process also allows for the ability to meet changing market conditions while integrating new renewable energy solutions and development strategies.

ROADMAP TO Net Zero Emissions in Lexington

Figure E: Projected GHG Reductions from Buildings (tCO₂e), by Strategy and Sector



- 19%** **Natural Gas Leak Reduction**
Systematic reduction of natural gas infrastructure leaks
- 44%** **Grid-Scale Renewables & Zero-Emission Electricity**
Impact depends on fuel switching to electricity
- 25%** **Fuel Switching Retrofits**
Target all fuel oil and natural gas and *align with energy efficiency*
- 6%** **Energy Efficiency Retrofits**
Implement an ongoing strategic deep energy retrofit program informed by BEUDO and similar data and *aligned with fuel switching*
- 6%** **Net Zero New Construction Policy**
Advocate for transition to NZE ready AND/OR zero-emission building codes by 2026

Roadmap to Zero: Overarching Strategies

Figure E illustrates the outcome of the energy and emissions modeling exercise. The model was used to predict and measure aggregate impacts of each recommended strategy over time, from 2018 through 2035. The modeling process works backward from the target of achieving net zero emissions by 2035. The team input data about the current building stock, building energy use, and contribution of renewables and, with the goal of

net zero emissions in 2035, applied projections around the rate of building turnover, projected uptake of energy efficiency retrofits, impact of improved efficiency of new construction, impact of fuel switching initiatives, and increased production and purchase of renewable energy incrementally over the duration between 2018-2035.

Figure E communicates the relative magnitude of each of the strategies or approaches. The ‘buckets’ of strategies with the exception of the already

outlined commitment by National Grid to address natural gas leaks (page 8) are described below.

Strategy 1: Grid-Scale Renewables & Zero Emission Electricity

While the Massachusetts Renewable Portfolio Standard will continue to deliver incremental reductions to Lexington's emissions footprint, over time, the recommendation is that Lexington transition all electricity customers to Community Choice Aggregation (CCA) or other suppliers of 100% renewable electricity. CCA purchase delivers 100% renewable electricity, as opposed to the current 13% offered through the Renewable Portfolio Standard (RPS). CCA additionally offers the benefit of more control over how and where the renewable electricity is produced. The Task Force recommends that the Town encourage uptake of the Lexington CCA using a staged approach, beginning with the biggest users (non-residential largest buildings), then smaller commercial, then residential customers over time

Impact: Approximately 155,000 tonnes, or 44% of total emissions reductions

Strategy 2: Fuel Switching Retrofits

Fuel switching in both the residential and commercial sectors is focused on (a) the elimination of the use of fuel oil as a heat source and (b) transition from natural gas to electricity. It is recommended that the Town undertake a survey of existing buildings that use fuel oil as a heat source, then strategically develop an approach of transitioning those buildings to electric heat (e.g. air source heat pumps). While the number of buildings using fuel oil is declining, the impact of the transition to a clean or zero emission electric source will be substantial, due to fuel oil's relative 'dirty' emissions factor. A second recommendation is to advocate that the Commonwealth explore and introduce measures to require transition to cleaner fuels; for example, mandatory switching at time of replacement, or incentives to subsidize the cost of electrical heating systems.

Impact: Approximately 88,000 tonnes, or 25% of total emissions reductions

Strategy 3: Energy Efficiency Retrofits

Achieving increased emissions reductions from existing buildings will require a suite of policies, regulations, programs, and incentives coupled

with strategic engagement, partnerships, and capacity building. Cities and towns are better positioned to target retrofits as the largest areas of opportunity (inefficient buildings) when they have access to data on building energy use. One of the Task Force's foundational recommendations is, therefore, for the Town to introduce a building energy use and disclosure ordinance (BEUDO) for commercial properties to complement the Commonwealth's Energy Scorecard program for residential properties. Scaling up retrofits (and tracking the impact of retrofits) in Lexington will be more effective with a BEUDO. The remainder of the proposed strategies supporting retrofits to existing buildings fall under the following categories: Advocacy; Promotion, Information, and Capacity Building; Programs and Partnerships; Requirements and Standards.

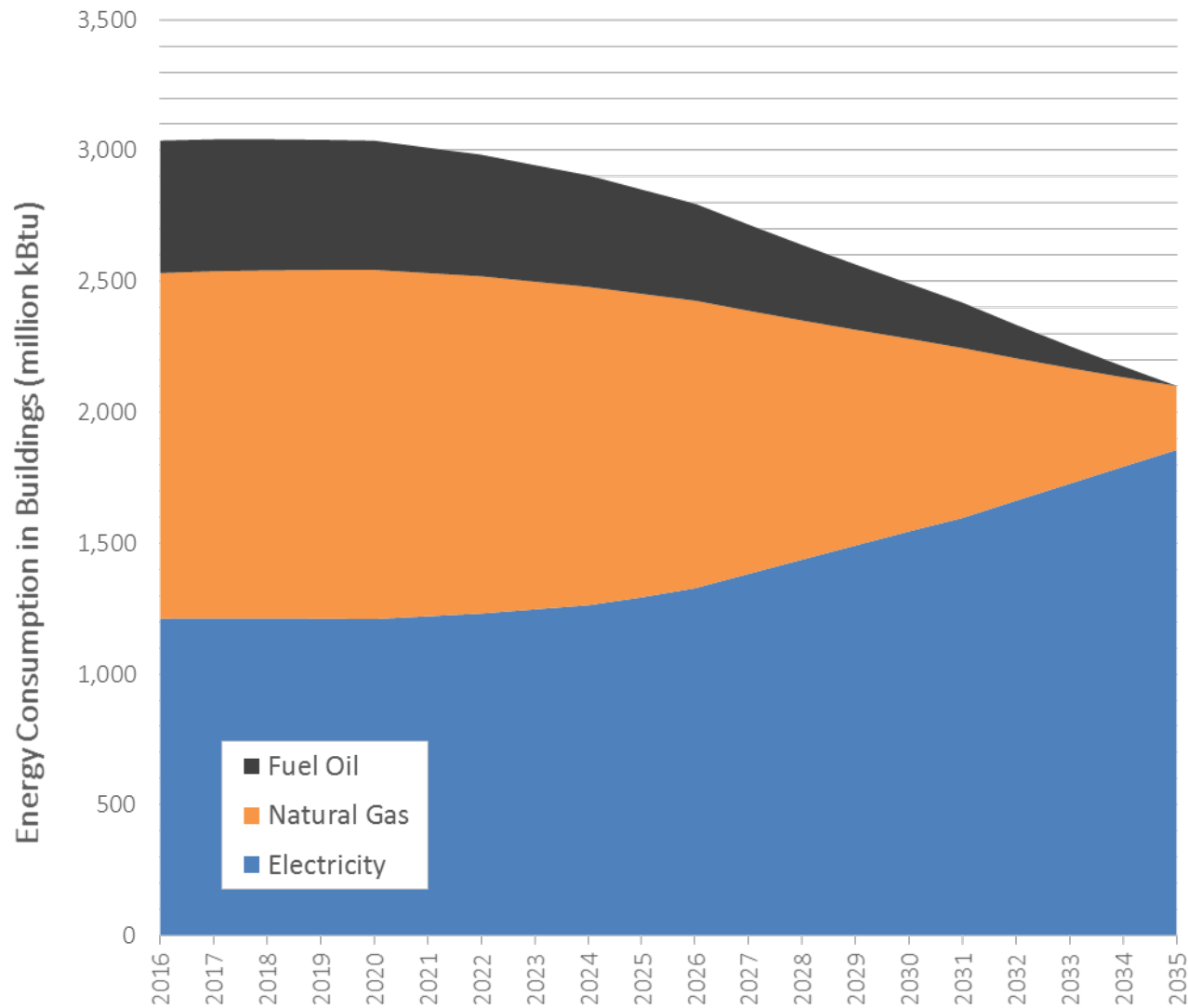
Impact: Approximately 18,900 tonnes, or 6% of total emissions reductions

Strategy 4: Net Zero Emissions New Construction Policy

Net zero emissions new construction is increasingly common, and acknowledged widely to be achievable during the time frame considered in this roadmap. From the perspective of policy-making, requiring a net zero emissions construction standard is less challenging and more feasible than requiring existing buildings to achieve the same target. In the case of Lexington, as with other communities with limited greenfield development potential, the impact of net zero emissions new construction efforts tends to be lower than the impact of retrofits to existing buildings because it relies upon the rate of replacement of inefficient buildings with net zero emissions buildings. There are several recommended measures to set the Town up for success in achieving a future where all new buildings are net zero emissions. There are a suite of strategies recommended under the following categories: State Advocacy (because the building code is defined at the state level); Planning and Zoning (using existing policy tools to require increasing levels of performance and renewable energy generation); promotion and partnerships (raising awareness and capacity building in the design and construction industries); and municipal leadership (Lexington leading the way in introducing a net zero emissions standard for its own new buildings).

Impact: Approximately 19,300 tonnes or 6% of total emissions reductions

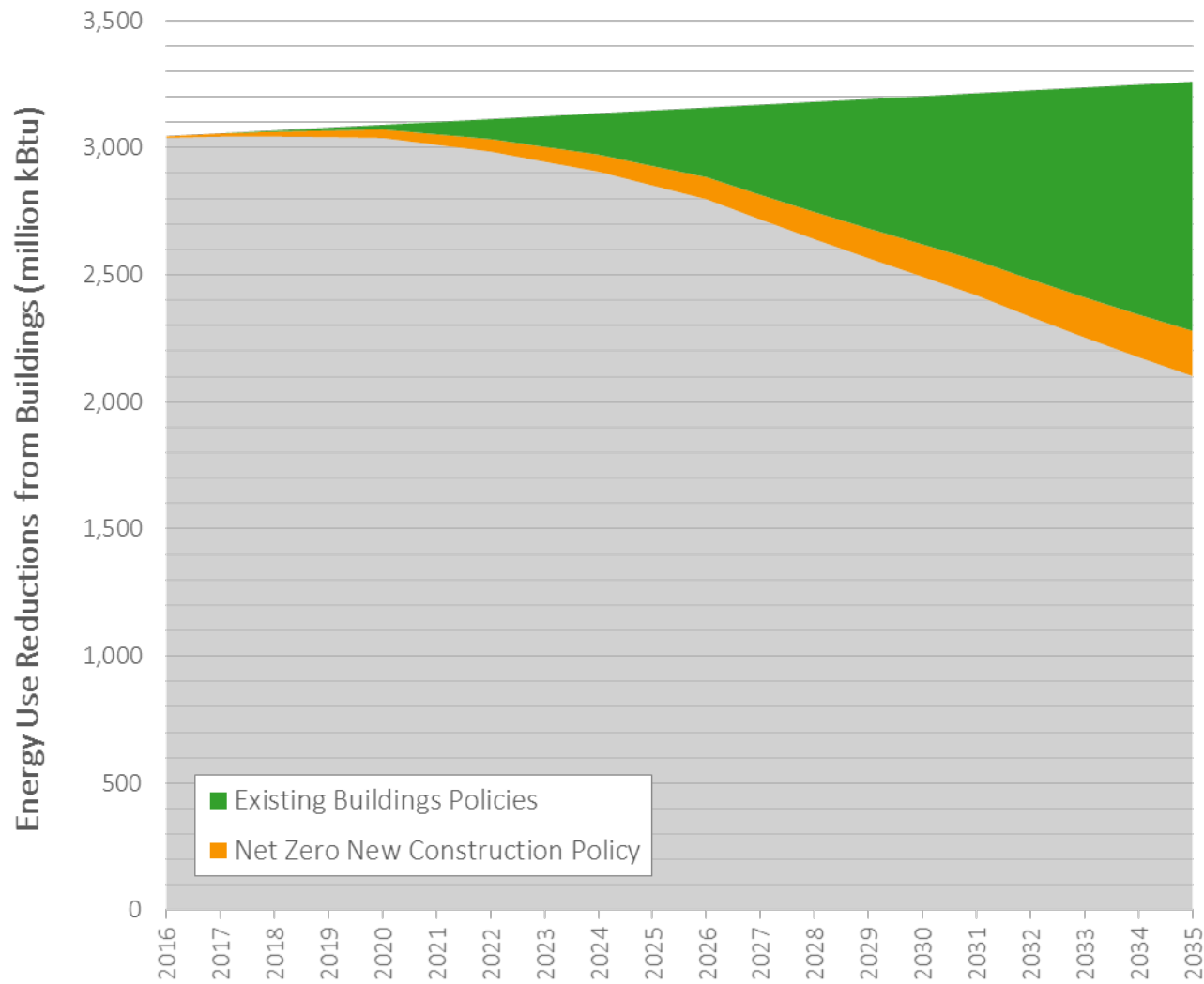
Figure F: Projected Energy Consumption in Lexington Buildings Over Time, by Fuel Type



Transition to Cleaner Fuel Sources

Figure F provides a close-up view of the projected outcomes of strategies that support fuel switching. The graph shows a gradual decline in total energy use in the years 2016 through 2035. Reduction in energy use reduces overall emissions in Lexington, thus contributing to the ultimate net zero emissions goal. While there is vast opportunity to reduce energy consumption in buildings by reducing heating, cooling, and plug loads; buildings will inevitably consume energy. As such, the net zero emissions strategy includes the three-pronged approach of energy use reduction, fuel switching, and increase in renewable energy production. Figure F shows the proposed shift in proportion of energy source. Notably, this plan calls for the use of fuel oil to be phased out entirely by 2035. A second fuel switching strategy is to encourage or require the shift away from natural gas in favor of electricity.

Figure G: Projected Energy Use Reductions: New and Existing Building Programs



Reductions from New Construction and Existing Buildings

Figure G is focused on the outcomes of recommended energy performance improvement in buildings. Improvements to buildings comprise 12% of Lexington’s total emissions reduction on the path to zero, with improvements to existing buildings resulting in 6% of savings, and new construction strategies contributing 6%. Retrofits to existing inefficient buildings will contribute twice the savings of strategies to encourage low-emission new construction, in part because Lexington is already built out to a great degree and the rate of new construction is resultantly low.

3.3 Getting to Net Zero Emissions: Tactical Approach

This section outlines the set of recommended tactics to be implemented in order to achieve the net zero emissions target. The tactics are organized by building sector: residential, commercial, and municipal. Within each sector the set of tactics are classified according to the nature of the tactic:

report, reduce, produce, purchase. The key actions for each tactic are outlined and the implementation timeline is indicated for each. An asterisk (*) is used to indicate which of the tactics are replicated in both the residential and commercial sectors.

3.4 Residential Buildings Roadmap

RESIDENTIAL BUILDINGS	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Residential: Report																		
Fuel oil survey & Fuel Switching Strategy																		
Consumer product incentive (in exchange for data)																		
Strategic Retrofit Plan																		
Residential: Reduce																		
Audits & Upgrade Requirements – Time of Sale or Renovation																		
State Advocacy: Fuel Switch																		
Bundled solar, retrofit, and electric vehicle offering																		
Historic building retrofit strategy																		
Promote available financial tools																		
Advocate for State zero emission building code																		
Audits and air-tightness testing																		
Promote electric heating in new construction																		
Residential: Produce																		
Promote bundled solar, retrofit, and electric vehicle offering																		
State Advocacy: Green Bank																		
State Advocacy: Requirements for solar, storage and EV																		
State Advocacy: Solar- and storage-readiness																		
Residential: Purchase																		
Community Choice Aggregation																		

	New Construction Strategies																	
	Existing Buildings Strategies																	
	Clean Energy Transition Strategies																	

3.5 Residential Strategies

REPORT

Fuel Oil Survey & Fuel Switching Strategy*

Conduct a fuel oil survey to identify buildings that use fuel oil as a heat source. (2018-2035)

- Switching from fuel oil to electric heat pumps will be increasingly advantageous as electricity becomes cleaner through Community Choice Aggregation.
- Analyze findings from data collection to develop a targeted and strategic approach to fuel switching retrofits for homes that use heating oil. These retrofits will specifically target conversions from heating oil to electric heat-pump technology. See New York City example⁷.

Consumer Product Incentive

Establish a program to provide customers with an incentive to provide access to single family and small multifamily utility data. (2018-2019)

- For example, homeowners who are willing to share ongoing energy use data may be offered free smart and adaptive thermostats.
- The result is twofold: Lexington will have a clearer picture of how single family residential buildings use energy and secondly, research shows that roughly 15-22% savings in energy use can be saved as a result of shifting to smart thermostats.

Strategic Retrofit Plan*

Develop a data-driven Strategic Retrofit Plan for existing buildings in Lexington. (2019-2020)

- Develop a direct marketing program targeting customers identified through the data analysis. Specifically, the data would be used to identify residents whose heating equipment is near end of life when it is most economical to switch fuels and heating technology. See Boulder, Colorado “Decarbonization” example.⁸
- This strategy is reliant on the success of procuring grid scale renewables, which would result in approximately 17% of all of the projected reductions in the road map, making it one of the most important proposals.

⁷ <https://www.nyccleanheat.org/content/incentives>

⁸ [https://www-static.bouldercolorado.gov/docs/Boulder_Thermal_Decarbonization_Final_Report_8.31.16_\(002\)-1-201702130943.pdf](https://www-static.bouldercolorado.gov/docs/Boulder_Thermal_Decarbonization_Final_Report_8.31.16_(002)-1-201702130943.pdf)

Building Energy Use and Disclosure Ordinance*

Implement a Building Energy Use and Disclosure Ordinance (BEUDO) and processes to periodically analyze data. (2018-2019)

- Absent of the state requiring something similar, introduce an ordinance for single-family homes to disclose energy use and pursue an EnergyStar label at the time of permit or sale.

REDUCE

Audits & Upgrade Requirements – Time of Sale or Renovation

Introduce a requirement for single-family homes to undergo energy audits at time of sale and/or renovation permit. (2019-2035)

- The Town can require energy audits at time of sale of a home and/or by way of the renovation permit process.
- Encourage homeowners to improve upon their HERS Index (Home Energy Rating System) or similar rating system to reach a desired energy performance improvement or threshold.

State Advocacy: Fuel Switch*

Advocate for the State to investigate and implement support for fuel switching, including approaches to mitigate potential increases in fuel costs. (2018-2025)

- The Massachusetts Department of Energy Resources offers generous incentives that support fuel switching to heat pumps. Lexington should encourage the state to go further. These efforts could take the form of regulatory measures (i.e. mandatory fuel-switch at the time of equipment replacement) or incentives to shift to cleaner sources of energy beyond heating oil. (e.g. subsidizing the cost of new equipment).
- Advocate for reallocation of natural gas pipeline maintenance funds to transition homes to all-electric, zero-emission heating systems.

Promotion, Information and Capacity Building: Promote available financing tools*

Promotion of Mass Save and other financial tools

- Continue to promote Mass Save offerings, including audits, incentives, and retrofits (2019-2035)
- Work with partners to promote and increase uptake of Mass Save offerings. (e.g. to large condo boards, high energy users)

Programs and Partnerships: Historic Building Retrofit Strategy*

Establish multi-city partnership of Historic District Commissions to develop a state-wide strategy and guide to historic building retrofits. (2019-2022)

- Facilitate collaboration between towns and cities across the state to develop retrofit guidelines for achieving GHG savings from historic buildings in a manner acceptable to Historic Building Commissions.
- Explore grant funding opportunities to support preservation and environmental performance improvements.

Advocacy: State Zero Emission Building Code*

Advocate for a roadmap to net zero emissions State building code before 2030 in partnership with other communities.

- Develop a coalition of cities and towns to advocate for a state-level roadmap to a net zero emission building code. (2018-2030)
- The objective of the code would be to introduce a stepped approach for increased energy performance requirements for new construction leading up to the ultimate requirement for net zero energy new buildings in 2030.

Commissioning and Air-Tightness Testing*

Promote audits and airtightness testing as a standard practice to reduce operating costs. (2018-2025)

- Build local capacity in airtightness testing and home energy audits in order to meet increased demand generated by advocacy and marketing programs.
- Promote the above as best practices, using research to demonstrate efficiency gains and costs savings associated with operating properly sealed and commissioned buildings.

Promote Transition to Electric Heat Pumps*

Promote the use of electricity over oil and natural gas in new construction. (2018-2025)

- Establish a campaign to raise awareness about the available incentive programs and the relative benefits of air source and geothermal heat pump alternatives over natural gas or fuel oil.

P R O D U C E

Bundled Solar, Retrofit, Electric Vehicle offering

Establish a partnership with a third-party provider to offer and promote bundled solar, retrofit, and electric vehicle offering. (2018-2019)

- Work with a third-party provider to develop a bundled offering of home energy upgrades, solar, and electric vehicles.
- Snugg Home⁹ is a replicable model (based in Colorado) offering a pilot program where an energy audit combined with lifestyle survey is translated to a customized bundle of offerings to homeowner, and a connection to bundled financing options. Offerings include air sealing, high efficiency heating and ventilation equipment, and solar panels.
- It is noted above that residential fuel switching retrofits are the largest source of projected reductions; this program is a part of that strategy.

State Advocacy: Requirements for solar, storage and electric vehicle charging*

Advocate for State building code requirements to support readiness for solar, storage, and EV charging in partnership with other communities. (2018-2025)

- Collaborate with other Massachusetts towns and cities to advocate for amendments to the State building code to require buildings to be solar-ready, solar storage-ready, and install electric vehicle charging capacity.
- Draft a model code based on codes and ordinances from other jurisdictions.

State Advocacy: Green Bank*

Advocate for the State to establish a green bank. (2018-2025)

The goal of a Green Bank is to increase investment and accelerate deployment of clean energy by removing the upfront cost of adoption, leveraging private investment, and increasing efficiency of public dollars.

P U R C H A S E

Community Choice Aggregation*

Continue promoting benefits of 100% renewable energy Municipal Aggregation option to eligible customers not currently enrolled. (2018-2035)

⁹ <http://colorado.snuggohome.com/about/>

3.6 Commercial Buildings Roadmap

COMMERCIAL BUILDINGS	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Commercial: Report																		
Implement Building Energy Use and Disclosure Ordinance (BEUDO)																		
Strategic Retrofit Plan																		
Analysis of BEUDO data																		
Commercial: Reduce																		
Advocate for State zero emission building code																		
State Advocacy: Fuel Switch																		
Develop local business capacity																		
Commissioning and air-tightness testing																		
Promote electric heating in new construction																		
Encourage zero emission large developments																		
Share best practices for laboratories																		
Promote available financial tools (PACE, incentives, and green leases)																		
Zoning amendments to encourage NZE construction																		
Implement a Building Energy Performance Standard (BEPS)																		
Commercial: Produce																		
State Advocacy: Green Bank																		
State Advocacy: Requirements for solar, storage and EV																		
State Advocacy: Solar- and storage-readiness																		
Microgrid Pilot Program																		
Commercial/Industrial District energy infrastructure overhaul																		
Commercial: Purchase																		
Community Choice Aggregation																		

 New Construction Strategies																		
 Existing Buildings Strategies																		
 Clean Energy Transition Strategies																		

3.7 Commercial Buildings Strategies

REPORT

Programs and Partnerships

Establish the Lexington Climate Accord to prompt and support action by sharing data, resources, lessons, ideas, and tools. (2018 – 2035)

- Encourage voluntary participation in the Lexington Climate Accord, a program modeled on the success of the Paris Climate Accord. Commercial property owners who are already setting their own sustainability and emissions goals consistent with the Paris Climate Accord, and measuring their performance against those goals, would agree to share their goals and performance against those goals with the Town as part of their responsibilities under the Lexington Climate Accord.

Building Energy Use and Disclosure Ordinance*

Implement a Building Energy Use and Disclosure Ordinance (BEUDO) and processes to periodically analyze data. (2018-2019)

- Introduce an ordinance to require owners of large buildings to report their building's energy use annually to the Town.
- Phase in the building energy use reporting requirement gradually beginning with larger buildings (>25,000 square feet), down to >10,000 square feet with the goal of capturing maximum floor area, and maximizing benefits of interventions.
- Provide an alternative means of compliance with any building energy use and disclosure ordinance for commercial organizations that have joined the Lexington Climate Accord. Commercial property owners who have joined the Lexington Climate Accord and set their own sustainability goals, would agree to share those goals and their performance against those goals in their own formats with the Town of Lexington.

Analyze data collected through the BEUDO annually. (2020-2035)

- Access to building energy use data will enable decision-makers to prioritize areas of greatest opportunity for reductions.
- Identify strategic and high-value retrofit opportunities to guide targeted promotion and programming.

Strategic Retrofit Plan*

Develop a data-driven Strategic Retrofit Plan for existing buildings in Lexington. (2019-2020)

- Combine permitting and BEUDO datasets to develop a timeline of building equipment replacements and retrofit intervention opportunities.
- Data will help identify worst performers (energy efficiency) and to predict the rate of renewal for heating appliances and mechanical equipment.
- This strategy is again reliant on the success of procuring grid scale renewables to aid in fuel switching, which would result in approximately 8% of all of the projected emissions in the roadmap making it the largest commercial proposal.

REDUCE

Advocacy: State Zero Emission Building Code*

Advocate for a roadmap to net zero emissions State building code before 2030 in partnership with other cities.

- Work with the Massachusetts Municipal Association, Massachusetts DOER, and municipalities as appropriate to advocate for a state-level transition to a net zero emissions building code. (2018-2030)
- The objective of the code would be to introduce a stepped approach for increased energy performance requirements for new construction leading up to the ultimate requirement for net zero energy new buildings in 2030.

State Advocacy: Fuel Switch*

Advocate for the State to investigate and implement support for fuel switching, including approaches to mitigate potential increases in fuel costs. (2018-2025)

- Support for fuel-switching could take the form of regulatory measures (i.e. mandatory fuel-switch at time of equipment replacement) or incentives to shift to cleaner sources of energy (e.g. subsidizing the cost of new equipment). Commercial stakeholders in the lab and manufacturing sector have noted a concern that transition to different fuels could have impacts on their processes that must be carefully considered especially with regard to commitments for supply to customers and obligations to federal regulators.

- The Town will work with commercial property owners to develop reasonable timelines needed to accomplish an appropriate transition to zero emissions fuel sources, taking into account the quality assurance, industrial hygiene issues, and industrial process certification requirements for their businesses

Programs and Partnerships: Develop Local Business Capacity

Act as a “market maker” by establishing network of businesses to prompt and support action and share resources, lessons, ideas, and tools. (2018-2025)

- The Town is uniquely positioned to play a catalytic role in building local capacity, increasing energy and emissions literacy, and connecting individuals and businesses to resources to improve the performance of their buildings.

Commissioning and Air-Tightness Testing*

Promote envelope and mechanical commissioning and airtightness testing as a standard practice to reduce operating costs. (2018-2025)

- Develop training programs to build local capacity in airtightness testing, and envelope and mechanical commissioning.
- Promote the above as best practices, to the extent that indoor air quality is not sacrificed, using research to demonstrate how to best achieve healthy indoor air quality, efficiency gains, and cost savings associated with operating properly sealed, ventilated, and commissioned buildings.

Promote Electric Heat Pumps*

Promote the use of electricity over oil and natural gas. (2018-2025)

- Establish fuel switching campaigns to promote the adoption of air source and ground source heat pumps instead of natural gas boilers.
- Fuel switching campaigns will be integrated with energy efficiency campaigns to enhance the economic viability of heat pumps solutions.

Encourage Zero Emission Large Developments

Engage owners of any large future developments regarding building all-electric and/or to zero-emissions. (2018-2025)

- Work with developers during the permitting process to encourage a strategic shift to zero emissions development, or zero emissions-ready development. Encourage electricity as the heat source.

Promotion, Information and Capacity Building: Share Best Practices for Labs and Manufacturing Facilities

Identify and promote energy efficiency best practices for laboratories and manufacturing facilities. (2018-2030)

- Engage in existing community of practice that exists for both universities and private labs (see City of Cambridge) to develop a strategy for addressing energy efficiency and zero emission targets for labs.
- Encourage adoption of industry best practices for manufacturing facilities.

Promotion, Information and Training (Capacity Building): Promote available financing tools*

- Promotion of Mass Save, PACE, Green Leases, and other financial tools.
- Promote Mass Save offerings, including audits, incentives, and retrofits (strategically informed by analyzing BEUDO data). (2019-2035)
- Use existing channels of communication to promote and increase uptake of Mass Save offerings. (e.g. to large condo boards, high energy users)
- Use BEUDO data to target promotion of Mass Save to areas of greatest opportunity for savings.
- Explore grant funding opportunities to support the nexus of preservation and environmental performance improvements.

Planning and Zoning: Zoning Amendments to Encourage Net Zero Emissions Construction

Revise zoning to strategically promote net zero-emissions construction across all planned and existing Commercial and Industrial Districts. (2020-2021)

- For new commercial development, explore the introduction of tools such as relaxation of height restrictions, increasing floor area/density allowances to encourage development of local energy systems including microgrids and on-site solar production.
- Remove “green tape.” Review current zoning to identify potential barriers to high performance building design (e.g. increased insulation; triple-pane windows) and onsite renewable energy production.

Requirements and Standards: Building Energy Performance Standard

Implement a Building Energy Performance Standard (BEPS). (2022-2023)

- A building energy performance standard is a regulatory tool that can be used to require buildings to meet a minimum level of performance. All buildings could be required to reach a certain threshold, or all buildings that score below a certain threshold could be required to improve by a certain number of points or percentage. BEPS are typically introduced in conjunction with BEUDO ordinances and phased in following 1-3 years of data collections.

PRODUCE

State Advocacy: Green Bank*

Advocate for the State to establish a Green Bank. (2018-2025)

- The goal of a Green Bank is to increase investment and accelerate the deployment of clean energy by removing the upfront cost of adoption, leveraging private investment, and increasing the efficiency of public dollars.

Advocacy: State Requirements for Solar, Storage and EV Charging*

Advocate for State building code requirements to support readiness for solar, storage, and EV charging in partnership with other cities. (2018-2025)

- Collaborate with other Massachusetts towns and cities to advocate for amendments to the State building code to require buildings to be solar-ready, solar storage-ready, and install electric vehicle charging capacity.
- Draft a model code based on codes and ordinances from other jurisdictions.

Microgrid Pilot Program

Investigate zero-emissions microgrid pilot program in commercial and industrial zones (e.g. Hartwell Avenue). (2019-2021)

- Explore tools such as zoning relaxations to incent investment in local energy systems.
- Partner with utilities to explore feasibility of the development of a microgrid in the commercial district.

Commercial/Industrial District Energy Infrastructure Overhaul

Target existing Commercial/Industrial District for an 'energy infrastructure overhaul,' prioritizing zero emissions and long-term resilience. (2021-2030)

- Consider back up power and storage capacity.

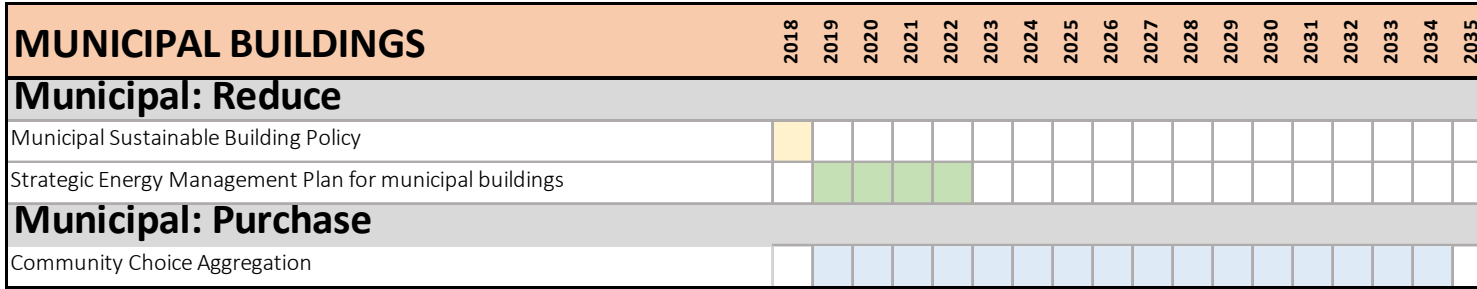
PURCHASE

Community Choice Aggregation*

Continue promoting benefits of 100% renewable energy Municipal Aggregation option to eligible customers not currently enrolled. (2018-2035)

- It's important to note that this is the single largest and possibly the lowest cost source of emissions reductions in the proposed road map.
- Target large landholders and businesses first, and previous customers who have opted out.
- Encourage largest commercial electricity customers to enroll in or establish zero-emission electricity purchasing program (>25,000 ft²).
- Encourage medium and large non-residential customers to enroll in or establish zero-emission electricity purchasing program (>10,000 ft²).
- Encourage remaining non-residential electricity customers to enroll in or establish zero-emission electricity purchasing program.

3.8 Municipal Buildings Roadmap



3.9 Municipal Buildings Strategies

REDUCE

Municipal Sustainable Building Policy

Adopt a Sustainable Building Design Policy for Municipal buildings. (2018)

Introduce a policy that will establish stepped targets toward net zero emissions for future municipal buildings. The policy should include the following:

- Health and Cognitive Performance
 - Zero Fossil Fuel Emissions on site
 - Indoor Environmental Air Quality
 - Enhanced Particulate Matter Filtration
 - Avoid Toxic Substance during construction and operation
 - Reduce CO₂ levels below 600 ppm
- Energy Efficiency and Renewables
 - Building energy use intensity at least 30% below code
 - Present alternative for maximizing onsite renewables
 - Present alternatives for achieving net zero energy use
- Energy Management
- Update Sustainable Building Design Policy every three years.

Municipal Buildings Energy Management Plan

Develop and implement a Strategic Energy Management Plan for municipal buildings (2019-2023)

- Conduct an existing conditions analysis to develop a strategic approach to equipment replacement and energy efficiency upgrades.
- Integrate findings of the analysis into a long-term, capital plan strategy focused on reducing greenhouse gas emissions and maximizing return on investment.
- Advanced metering to track energy use by category.
- Building Management systems capable of managing peak demand and designed to incorporate energy storage to continue delivering services for 5 days during extreme events.
- Explore local microgrid for municipal building energy resilience.

PURCHASE

Community Choice Aggregation

Target 100% renewable energy for Municipal Operations (2019)

The town of Lexington pursues 100% renewable electricity through either community choice electrical aggregation or a private purchase power agreement(s). It's worthy to note that this is one of the most significant opportunities to reduce emissions in the municipal buildings sector.

4. ENGAGEMENT

A successful effort to achieve the community-wide zero emissions goal will rely on the participation of a broad set of stakeholders. The Town has already begun the process of raising awareness among residents about the net zero emissions initiative. Engagement is an ongoing component of project delivery and should remain a central focus of the Town and implementation partners. Below is a selection of high level strategies to raise awareness and report progress toward the net zero emissions target.

Periodic community updates

Publicize and provide periodic community updates on the Town's commitment to eliminate GHG emissions from buildings. (2019-2035)

- The town's website and any existing media can be used to provide periodic updates on progress toward the target.
- Public information sessions.
- Re-engage Getting to Net Zero emissions task force every three years to reassess performance, set next three-year near term goals, and to develop programs to achieve those goals.

Promote successes and achievements

Promote local energy and emission achievements and successful projects. BEUDO data can be used to help identify cases of substantial savings. (2020-2035)

- Consider introduction of an award or recognition program to publicize and celebrate leading edge projects.

5. GOVERNANCE

Successful implementation of the recommendations in this report will rely upon a considered approach to governance. In addition to mapping out the incremental steps to implement a particular action, governance involves assigning responsibility to an individual or a department to deliver the program and establishing procedures to ensure effective management and delivery over time.

The following recommendations are in support of effective governance.

Responsibility and accountability

One individual or department should be made responsible for implementation, delivery, and management of each recommended action. There will be instances where management and delivery might be under the oversight of different individuals or departments or external parties. In all cases, roles and responsibilities should be clearly articulated and understood by all parties and each team member held accountable. Progress and data should be tracked and reported annually by the 'owner' of each action. Measured impacts for all actions should be aggregated to a centralized progress report. In light of the depth and breadth of the net zero emissions recommendations, the Task Force recommends that the Town hire or appoint a Sustainability Director, whose explicit role is to oversee the implementation of the recommended actions.

Program-Wide Review

To maximize impact and ensure effectiveness of the programs associated with the Roadmap to Net Zero Emissions, it is recommended that the Town commit to program-wide reviews at regular intervals throughout implementation. The appropriate interval for review is every three years. A three-year review cycle aligns with implementation periods for the various actions and allows adequate time to introduce new initiatives, build momentum, and calculate impacts. (Building code is updated every three years for example).

The program-wide review comprises an assessment of the following, for each action:

- Was the program or policy implemented?
- Was it implemented on time, behind or ahead of schedule?
- Was the update as predicted? (Where relevant)
- Is the impact of the action being measured?
- Is the impact on target? Does it align with the energy and emissions model projections?
- Is the cost of implementation within projected budget?

If below target, consider:

- Is the program or policy adequately resourced?
- What factors are influencing low uptake/poor compliance/low performance?
- Does the policy or program need to be refined/ramped up/cancelled?
- Is further research needed?
- Are there external factors that have arisen during the review period that present opportunities for increased impact? (e.g.

fluctuating costs of fossil fuel energy; increasing cost effectiveness of renewable energy)

- Where relevant, it is recommended to solicit stakeholder input to understand areas of opportunity to improve upon actions or particulars of implementation. Stakeholders may include front line employees, third party delivery agents or partners, or residents impacted by a specific action.

Principles to Guide Future Revisions

When the Roadmap is refined or updated, it is recommended that any future implementation framework adhere to the following principles:

- Supports long range economic and social equity objectives as well as climate goals
- Uses market-based, data-driven analysis and decision making
- Commits to identifying and testing the best available policies, practices, and technologies; and supports an openness to new ideas when circumstances change
- Commits to measuring and monitoring the impact over time and implements course corrections where required
- Ensures that consultation is comprehensive and engages affected stakeholders, the general public, and subject matter experts
- Commits to developing informative and replicable models that will be shared with others