

CITY OF CONCORD, NEW HAMPSHIRE

100% RENEWABLE ENERGY GOAL

STRATEGIC PLAN

July 31, 2019

Prepared by Concord Energy & Environment Advisory Committee

EXECUTIVE SUMMARY

In July 2018, the City of Concord adopted a 100% renewable energy goal by unanimous vote of the City Council. Specifically, the City committed to the following community-wide goals:

- 100% of electricity consumed in Concord will come from renewable energy sources by 2030;
- 100% of thermal energy (heating and cooling) consumed in Concord will come from renewable energy sources by 2050; and
- 100% of transportation in Concord will be clean transportation by 2050.

The Concord Energy and Environment Advisory Committee (the EEAC) led a public process to draft this strategic plan charting a path towards achieving these renewable energy goals. The plan anticipates achievement of the 100% renewable energy goal will bring economic benefit to the City. To be clear, the plan is designed to achieve a goal of 100% renewable energy. If fully implemented, it will substantially reduce but will not eliminate Concord's community-wide greenhouse gas (GHG) emissions. Additional actions beyond those contemplated in this plan would be needed to reduce Concord's GHG emissions to net zero. The plan does not address all aspects of sustainability. It is intended to be a living document and will need to be updated on an ongoing basis. It is more specific about strategies and actions to be undertaken in the first 2 to 5 years of the plan than in later years because the EEAC recognizes that circumstances and opportunities will change.

Energy efficiency is a key component of the 100% renewable energy goal. For municipal operations, benchmarking of energy use and early "lead by example" demonstration projects are important first steps the City can take. Community-wide, the EEAC can engage in public outreach campaigns to spread the benefits of energy efficiency opportunities to residents, businesses, low/moderate income communities, and other city partners. All energy efficiency efforts should be conducted in partnership with utility-administered efficiency programs under the NHSaves brand.

Achieving 100% renewable electricity by 2030 is ambitious but achievable. One early emphasis is moving the City's own municipal electricity consumption to locally-generated renewable energy. Another is bringing the benefits of renewable energy to our low/moderate income communities. Perhaps the most critical step will be to convert electricity delivered over the grid to renewable energy via municipal aggregation. Under a municipal aggregation program, the City will cause the community's electricity supply delivered over the electric grid to come from 100% renewable electricity. Finally, achieving this goal will support electrification, which will lay the groundwork for achieving 100% clean transportation and 100% renewable thermal energy by 2050.

Reducing GHG emissions from the transportation sector requires a combination of reducing vehicle miles travelled (i.e., expanding public, human-powered, and other transportation alternatives) and electrifying modes of transport with renewable electricity. Clean transportation options have become widely available. The plan presents recommendations for ensuring that appropriate infrastructure, such as electric vehicle charging stations, will be available to facilitate widespread adoption of clean, electrified transportation.

Much of Concord is currently heated using natural gas. As with transportation, one of the most readily available sources of renewable thermal energy comes from renewable electricity. While heat pumps, modern wood heating, and other commercially available technologies present viable alternatives to fossil fuel heating systems, it will take some time to fully transition the City away from fossil fuel heating sources. Strategies for renewable thermal energy will evolve as markets, technologies, and policies advance in the coming years.

In order to fully achieve these goals, we will need to document our progress in a transparent way. Data tracking is therefore required for effective target setting, progress monitoring, and reporting.

Finally, the plan identifies three central components that are essential for successful plan implementation: (1) additional City staff dedicated to performing some of the action steps called for in this plan; (2) increased public awareness and engagement; and (3) ensuring that city policies align with the goal and the strategies. A summary of all action steps recommended in the plan are listed in Chapter 8.

ACKNOWLEDGEMENTS

This report is the product of an extensive stakeholder process led by the EEAC in close partnership with the Concord Planning Division. The authors would like to acknowledge and thank the following individuals, organizations, businesses, and government entities for contributing their input and expertise into the drafting of this report:

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Henry Herndon (EEAC)
Zach Jonas (EEAC)
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Rich Maher (EEAC)
Ridgely Mauck (resident)
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Stakeholder Committee

~ 5 Rivers Conservation Trust ~ CATCH Neighborhood Housing ~ Change for Concord ~
~ City of Concord ~ Clean Energy NH ~
~ Community Action Program Belknap/Merrimack Counties Inc. ~
~ Community Development Finance Authority ~ Concord Conservation Commission ~
~ Concord High Environmental Club ~ Concord Transportation Policy Advisory Committee ~
~ Concord Unitarian Universalist Church ~ Concord YMCA ~ Concordia Lutheran Church ~
~ Conservation Law Foundation ~ Cycle Main Street ~
~ Foxfire Property Management and Duprey Companies ~ Essex Hydro Associates LLC ~
~ Grappone Auto ~ Greater Concord Chamber of Commerce ~
~ Kent Street Coalition ~ Lewis Farm ~ Liberty Utilities ~ Mom's Clean Air Force ~
~ New American Africans ~ NH Department of Administrative Services ~
~ NH Public Health Association ~ Organization for Refugee and Immigrant Success ~
~ Resilient Buildings Group ~ ReVision Energy ~ SEA/SEIU Local 1984 ~ Sierra Club ~
~ St. Paul's Environmental Club ~ Tangent Energy Solutions ~ Temple Beth Jacob ~
~ Unitil Service Corporation ~ Wheelabrator Technologies Inc. ~

100% Renewable Energy Strategic Plan 2050 Vision Statement

Concord, New Hampshire will be a thriving, carbon-neutral city, powered, heated, and moved by 100% renewable energy that strives to enhance the lives and experiences of all its residents, businesses, and visitors through economically viable, livable communities steeped in historic character, surrounded by the natural environment, and connected by a multi-modal, accessible transportation system.

INTRODUCTION

In July 2018, the City of Concord adopted a 100% renewable energy goal by a unanimous vote of the City Council. Specifically, the City committed to the following goals:

- 100% of electricity consumed in Concord will come from renewable energy sources by 2030;
- 100% of thermal energy (heating and cooling) consumed in Concord will come from renewable energy sources by 2050; and
- 100% of transportation in Concord will be clean transportation by 2050

The goal, which applies to the entire community and not just municipal operations, was adopted with wide ranging support from the business community, numerous organizations and members of the public. While it does not contemplate any specific mandate, the resolution anticipates energy cost savings and other economic and societal benefits over time through implementation of a strategic plan. The Concord Energy and Environment Advisory Committee (the EEAC) has worked with the business community, City staff, non-profit organizations, and community members to develop this plan, which will be presented to City Council for approval.

Process to Develop Strategic Plan

In 2008, the City Council formed the EEAC and charged it with recommending best practices, projects, and programs pertaining to, among other things, energy sources, air quality and climate change. The 100% renewable energy goal and this strategic plan fall squarely within the EEAC's mission.

The EEAC led the drafting of this strategic plan with an emphasis on collaboration and public participation. The EEAC convened a stakeholder committee of community leaders to provide formal feedback on the plan as it developed. The stakeholder committee met on January 22, March 27, and June 11, 2019. To inform the plan, EEAC members met with key City departments and committees, consulted outside experts, and talked with other regional municipalities pursuing similar goals. The EEAC conducted public information and input sessions on April 24, May 4, and May 6 in different locations around the City. In addition, the City provided information and opportunities to comment at various City events and via the City website. A large number of individuals, organizations, businesses and government departments gave input into the plan. By these means, the EEAC received broad community input which was incorporated into the strategic plan.

Scope of the Plan

The plan outlines strategies and action steps toward achieving the City's 100% renewable energy goal, including electricity, transportation and thermal energy. It addresses strategies for reducing energy consumption through efficiency as a means of facilitating a transition to 100% renewable energy. If this plan is fully implemented, it will reduce Concord's community-wide greenhouse gas (GHG) emissions/carbon footprint substantially, perhaps by as much as 70 to 80%. Reducing Concord's community-wide GHG emissions to net zero would require taking additional steps such as reducing GHG emissions from solid waste and agriculture and improving the capacity of our natural environment to serve as carbon sink. It does not address other sustainability issues. These issues are important but are beyond the scope of this plan. The EEAC recommends that the City undertake the preparation of sustainability and climate action plans to address these issues, perhaps in the context of master plan updates. The EEAC is willing to participate in the development and drafting of such plans.

The plan is intended to be a living document. Since renewable energy technologies and pricing are changing quickly and will continue to change, the EEAC anticipates that ongoing implementation of the plan will involve technologies and approaches not presently available. Applicable laws and market conditions are also changing. The plan is therefore intentionally more detailed with regard to short-term strategies than to long-term strategies. The EEAC recommends that the City maintain flexibility with implementation, reviewing and amending the plan on an ongoing basis to reflect changed circumstances and new opportunities.

Principles and Ideals Behind Strategic Plan

The EEAC drafted this strategic plan with the following principles and ideals in mind:

- In its 2008 resolution forming the EEAC, the City Council noted a goal of helping local households and businesses reduce GHG emissions by 80% by 2050. Adopting and implementing this plan helps achieve that goal.
- The City Master Plan (including but not limited to the Energy, Transportation and Housing Chapters) supports pursuit of renewable energy, energy efficiency and sustainability.
- The Conservation Commission's Conservation and Open Space Plan Update in June 2017 calls for stewardship of natural resources, wise management, to protect and enhance air quality, and to preserve and protect plant and animal species.
- The EEAC believes Concord should have a larger environmental vision that reflects the world beyond our borders. We should think globally and act locally.
- The EEAC believes Concord should be a state, regional, and national leader, as demonstrated by its recent energy actions listed in Chapter 2. We recognize that we can set an example for other communities in how we implement this plan.
- The EEAC believes Concord should be committed to equity and justice and should transition our energy usage to renewable energy in a way that brings the benefits of renewable energy to low/moderate income residents at an early point in time.
- The EEAC believes Concord should be fiscally prudent. We should leverage our investments in energy efficiency projects and distributed renewable energy sources to reduce our long-term energy costs.
- The EEAC believes Concord should value self-sufficiency and energy independence and should generate as much renewable energy as we can locally. We should aspire to become more energy independent.
- The EEAC believes Concord should recognize the value of collaboration and work with other communities pursuing similar goals to identify best practices, achieve economies of scale, and share good ideas and successful strategies amongst each other.

Desired Outcomes of Transitioning to 100% Renewable Energy

The EEAC drafted this strategic plan to achieve the following outcomes:

1. Ensure that Concord does its part to combat climate change and inspire others to do the same.
2. Enable Concord to take full advantage of the economic opportunity that accompanies a renewable energy transition, attracting new businesses and creating new jobs.
3. Reduce Concord's overall per capita energy consumption through energy efficiency measures.
4. Move towards energy independence by generating more of our energy sources close to home, reducing our vulnerability to outages and interruptions of supply caused by weather events, terrorism and other causes outside our control.
5. Control our energy costs by reducing our exposure to energy commodity prices.
6. Make Concord a more attractive place to live and work in the eyes of current and potential new residents who want to make a positive impact in reducing climate change.
7. Influence New England's eventual transition to 100% renewable energy and clean transportation.

This strategic plan is ambitious because Concord's 100% renewable energy goal is ambitious. Achieving the goal will require community-wide participation, as well as a commitment of resources from the City including both expanding roles of existing City staff and potentially adding additional City staff to perform functions recommended under this plan.

Organization of Strategic Plan

This strategic plan is designed to help achieve these goals and is outlined as follows:

- Chapter 1: Background. A short summary of the issue and benefits of transitioning to 100% renewable energy.
- Chapter 2: Energy Efficiency. A strategy for utilizing energy efficiency as an early priority to reach renewable energy goals.
- Chapter 3: Electricity. A strategy for reaching the 100% renewable electricity goal.
- Chapter 4: Transportation. A strategy for reaching the 100% clean transportation goal.
- Chapter 5: Thermal Energy. A strategy for reaching the 100% renewable thermal energy goal.
- Chapter 6: Target Setting, Monitoring, and Reporting. A strategy for holding ourselves accountable for reaching renewable energy goals.
- Chapter 7: General Recommendations Regarding Implementation.
- Chapter 8: Recommended Action Steps.
- Appendices
 - A. Additional Information on Climate Change
 - B. Concord's Carbon Footprint
 - C. The Global Movement Towards 100% Renewable Energy
 - D. Energy Markets and Energy Policy in New Hampshire and New England

Chapters 2 through 7 of this strategic plan outline recommended strategies recommended to achieve the goals set forth in the resolution. Chapter 8 identifies recommended action steps to implement the strategies.

Chapter 1 BACKGROUND

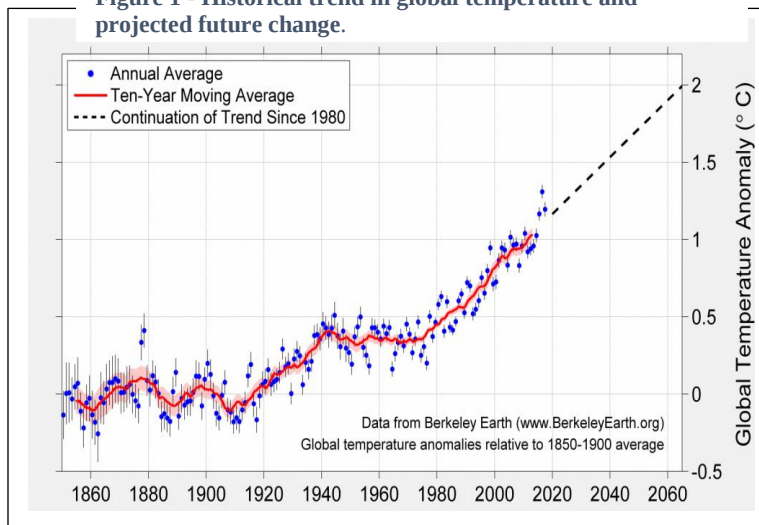
The Urgent Need for Action on Climate Change

The 100% renewable energy goal is driven by the urgent need to combat climate change. Climate change is the result of emission of greenhouse gases (GHGs) into the atmosphere, which in turn is primarily caused by combustion of fossil fuels by humans since the beginning of the industrial age. In the last 150 years, global average temperatures have increased by about 1°C (1.8°F) over preindustrial temperatures.¹

The effects of climate change are being felt around the world and across the US. The effects include melting glaciers and ice caps, warming oceans, more powerful storms, sea level rise, bleaching of coral reefs, more extreme weather events, more frequent and prolonged droughts, loss of water supply, record-setting wildfires, loss or dislocation of species and the spread of disease. The economic cost of climate change is enormous.

New Hampshire has already experienced many negative impacts of climate change, including rising temperatures, shorter winters, more extreme weather events (e.g., short-duration high precipitation events), sea level rise, drought, respiratory illness from air pollution and heat, spread of infectious disease (e.g., Lyme disease) and threats to the well-being of our native wildlife (e.g., fish, moose, loons). These negative impacts will become more severe in the future and pose a serious threat to our local economy and our way of life.

Figure 1 - Historical trend in global temperature and projected future change.



GREENHOUSE GAS EMISSIONS

Main sources of GHG emissions –

- Carbon Dioxide (CO₂),
- Methane (CH₄),
- Nitrous Oxide (NO₂)
- Flourinated Gases (hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride).

Source:

<https://www.epa.gov/ghgemissions/overview-greenhouse-gases>.

Scientists believe that if we continue on our present course global average temperature rise will reach 1.5°C by 2040, and 3°C (5.4°F) or higher by the end of the 21st century. In October 2018, the Intergovernmental Panel on Climate Change reported that we must limit temperature rise to 1.5°C in order to limit climate change to a level that is considered adaptable. This will require reducing global GHG emissions nearly in half by 2030 and to net zero by the middle of this century. If we do not act at this scale and in these timeframes, we can expect climate-related problems to worsen, resulting in human dislocation and threats to our national security, health and economic well-being. Each 0.1°C of avoided temperature rise matters a great deal, as the negative effects of each increment of temperature rise are not proportional. They become ever worse the more temperature goes up.

For more information on the science and effects of climate change, see Appendix A.

¹ Several recent years have had temperatures more than 1°C (1.8°F) above the average temperature from 1850-1900. Since 1980, the overall trend is +0.18°C/decade (+0.33°F/decade) and has changed little during this period. At the current rate of progression, the increase in Earth's long-term average temperature will reach 1.5°C (2.7°F) above the 1850-1900 average by 2040 and 2°C (3.6°F) will be reached around 2065.

What Concord Has Done to Reduce Its Climate Footprint

The City's municipal government has already taken steps to reduce its climate footprint and energy usage and move toward renewable energy. These steps include:

- Embraced Goal of Reducing Carbon Emissions by 80% by 2050. In the 2008 resolution creating the EEAC, the City Council embraced a goal of reducing Concord's GHG emissions 80% from 1990 levels by 2050. Achieving 100% renewable energy would help ensure achieving that goal.
- Invested in Energy Efficiency. Over the past decade, Concord has invested in a number of energy efficiency projects, including those listed in Chapter 2, Table 1.
- Added Energy Chapter to City Master Plan. Concord's Master Plan includes an Energy Chapter written in 2012 that encourages renewable energy. The Chapter needs to be updated to incorporate the City's 100% renewable energy goal.
- Procurement of Green Energy for City Government. Concord's municipal government currently purchases energy from Constellation Energy, a competitive electric supplier, under a short-term contract that is due to expire in December 2020. This energy is green – power generated in New England is coupled with Renewable Energy Credits (RECs) from wind projects in Texas to meet to 100% of City government's electricity consumption needs.
- Climate Mayors Agreement. In 2017, Mayor Bouley signed the Climate Mayors Agreement committing to uphold the Paris Climate Accord and committing to develop a climate action plan. Concord's 100% renewable energy commitment and development of this strategic plan fulfills the commitment made under the Climate Mayors Agreement.
- Property Tax Exemption for Solar. In 2017, Concord adopted a property tax exemption for solar equipment used to generate on-site power.
- Developing Solar Projects on Municipal-Owned Property. In November 2018, the City Council authorized preparation and issuance of a Request for Proposals (RFP) to develop solar projects at the closed landfill on Old Turnpike Road, the wastewater treatment plant on Hall Street, and the water treatment facility on Hutchins Street. The RFP is expected to be issued in early August.²
- Developed Solar Ordinance. The City Council is poised to enact amendments to Concord's zoning ordinance to addressing the permitting of ground-mounted solar projects, following preparation of a draft ordinance by the Planning Division and recommendation of its adoption by the Planning Board.

An estimate of Concord's present carbon footprint is set forth in Appendix B.

² The projects that are the subject of the RFP are conceived as net metering projects. The landfill has enough space to host a solar project of perhaps 4 to 5 megawatts (mW), but New Hampshire's net metering program currently has a maximum project size of 1 mW. HB 365, a bill to raise the maximum net metering size from 1 mW to 5 mW, passed both houses of the legislature overwhelmingly but was vetoed by Governor Sununu in June. The legislature will attempt to override the veto in September.

The New Economic Opportunity Presented by Energy Efficiency and Renewable Energy

Beyond the imperative of acting in the face of the climate crisis, a renewable energy transition brings with it vast economic opportunity. Increased energy efficiency is an essential step toward reducing GHG emissions and provides an economic benefit (reduced energy costs) at the same time. Many investments in energy efficiency pay for themselves quickly. Prioritizing energy efficiency early in the process of transitioning energy supply also allows us to right-size our investments in non-GHG emitting energy.

Even with increased energy efficiency, we will still need non-GHG-emitting energy for electricity, transportation and thermal applications. The non-GHG-emitting energy we will generate and procure is renewable energy. In the past few years, a transition to 100% renewable energy has become technically and economically feasible.³ Recent technological and economic changes include the following:

- **Solar Energy** - The cost of generating solar energy has fallen by nearly 90% in the last 10 years. Energy from large solar projects is now cost-competitive with conventional energy sources. The cost of energy from solar projects of all sizes is expected to continue to drop thanks to continued technological advances and increased production and installation efficiencies.
- **On-Shore Wind** - The cost of generating energy from on-shore wind sources has fallen by 70% in the last 10 years and is by some measures already the least expensive form of new electricity generation. As with solar, the cost of wind energy is expected to decline further.
- **Off-Shore Wind** - Off-shore wind energy is currently more expensive than on-shore wind energy, but the cost of off-shore wind has fallen dramatically since the first US-based off-shore wind farm began operation off Block Island at the end of 2016. Hundreds of megawatts of offshore wind capacity are in development off the southern coast of New England. Off-shore wind's potential for further technological improvements and additional cost savings is enormous.
- **Energy Storage** - Energy storage technology is critical to electric vehicles and is increasingly becoming integral to solar and wind energy projects because it mitigates the intermittency of those sources. Storage also has the potential to save energy costs by reducing peak loads and avoid the need for some electricity transmission projects. Commercial-scale energy storage technology in the U.S. is mainly used in states like California and Massachusetts that have offered incentives but is expected to be utilized more widely in the coming decade. Investment dollars have been pouring into energy storage technologies. As a result, they are rapidly improving and becoming less costly. The most frequently used form of energy storage, the lithium ion battery, has declined in price by 84% between 2010 and 2018, and is expected to decline significantly further in the coming years.⁴
- **Electric Vehicles** - The cost of electric vehicles (EVs) is declining rapidly. The total cost to own and operate an EV (including the cost to charge the vehicle) is expected to fall below the total cost to own and operate a conventional combustion vehicle (including gasoline costs) by the early to mid-2020s.⁵ Performance (miles per charge) and the availability of charging stations are also improving. Automakers are responding to these trends by committing to adding more EV lines.

HOW DOES CONCORD DEFINE RENEWABLE ENERGY?

Concord's 100% renewable energy resolution refers to the EPA definition of renewable energy, as follows –

resources that rely on fuel sources that restore themselves over short periods of time and do not diminish, including the sun, wind, moving water, organic plant and waste material (eligible biomass), and the earth's heat (geothermal).

Other authorities may define renewable energy differently.

³ Lazard's Levelized Cost of Energy Analysis – Version 12.0 (November 2018), <https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf>; Bloomberg NEF, New Energy Outlook 2019 (June 2019), <https://about.bnef.com/new-energy-outlook/>.

⁴ Bloomberg NEF, New Energy Outlook 2019 (June 2019), <https://about.bnef.com/new-energy-outlook/>.

⁵ McKinsey, Global Energy Perspectives 2019: Reference Case (January 2019), <https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-energy-perspective-2019>.

To be sure, renewable energy is not the only climate-friendly form of energy. Nuclear power also does not emit GHGs. Advances in carbon capture and storage might someday enable natural gas plants to be carbon-neutral. The urgency of combatting climate change demands that we consider all available options. However, these “clean” energy sources are expected to be more expensive than renewable energy sources over time. Nuclear plants are difficult to site and expensive to build, present unique security issues, and generate nuclear waste. Only two nuclear power plants operate in New England today, down from eight in 1990.⁶ Moreover, these sources rely on fuel imported from outside of the country (nuclear), or outside of New England (natural gas). Renewable energy does not have fuel security or procurement risks.

The economic and social benefits of energy efficiency, renewable energy and clean transportation include the following:

- Job Creation and Workforce Development. By some measures, energy efficiency and renewable energy employ three times more American workers than the fossil fuel industry.⁷ Clean technology jobs are growing at a rate faster than jobs in the overall economy and will likely continue to do so. In 2018, Massachusetts had over 110,000 clean energy workers, representing 3.1% of the state’s overall workforce (the second highest percentage by state in the country).⁸ Offshore wind alone is expected to create tens of thousands of jobs in the northeast.
- Reduced Energy Costs. Energy efficiency is the first and best source of energy cost reductions but switching to renewable energy is increasingly likely to result in additional savings over time. New renewable energy installations are outcompeting new fossil fuel generation on price and will soon become less expensive to build and operate than already operating fossil fuel generation.
- Stable Energy Prices. Unlike fossil fuel, renewable energy is not subject to commodity market price fluctuations. Energy consumers can lock in a steady long-term price for solar and wind power because they pay nothing for fuel. By contrast, fossil fuel prices are volatile and cannot be locked in over the long term.
- Local Control & Energy Independence. Renewable energy can be generated locally. Generating and buying more locally-generated renewable energy enables better local control over energy supply, reducing reliance on foreign and far-away energy sources and vulnerability to supply disruptions and price spikes.
- Better Health Outcomes and Reduced Health Costs. Use of energy efficiency, renewable energy and clean transportation avoids harmful air emissions, which positively affects human health and significantly reduces health care costs. A study by Lawrence Berkeley Lab found that wind and solar power in the U.S. reduced SO₂, NO_x (smog), and particulate emissions (soot) by over a million tons between 2007 and 2015, helping to avoid 7,000 premature deaths. Those avoided deaths, and other avoided public health impacts, saved our country an estimated \$56 billion.⁹
- Avoiding Damage Caused by Climate Change and Associated Cost. Researchers examining the economic impact of climate change are concluding that the economic cost of climate change will cost trillions of dollars each year by late this century.¹⁰ Concord will suffer its share of those costs if sufficient action is not taken. Taking sufficient action against climate change avoids those costs.

⁶ These projects are Seabrook Station in New Hampshire and Millstone Station in Connecticut. Pilgrim Station in Massachusetts permanently ceased operation on May 31.

⁷ The U.S. Energy and Employment Report, <https://www.usenergyjobs.org/>.

⁸ 2018 Massachusetts Clean Energy Report, <https://www.masscec.com/2018-massachusetts-clean-energy-industry-report>.

⁹ Milstein, et al., The climate and air-quality benefits of wind and solar power in the United States, published in Nature Energy (August 2017), <https://www.nature.com/articles/nenergy2017134>.

¹⁰ Hsiang, et al., Estimating Economic Damage from Climate Change in the United States, published in Science (June 2017), <https://science.sciencemag.org/content/356/6345/1362>; Martinich & Crimmins, Climate Damages and Adaptation Potential Across Diverse Sectors of the United States, published in Nature Climate Change (April 2019), <https://www.nature.com/articles/s41558-019-0444-6>.

The Movement Toward 100% Renewable Energy

Concord's commitment to 100% renewable energy is part of a much larger movement by U.S. state and local governments, some nations and private companies to adopt 100% renewable and clean energy goals. As of this writing, 132 U.S. cities and towns have committed to (and in a handful of cases, achieved) 100% renewable energy. Concord was the 72nd municipality to make this commitment. Seven states, plus the District of Columbia and Puerto Rico, have committed to reach 100% clean or renewable energy in the coming decades, and other states are considering making the commitment. In June, the United Kingdom made a binding commitment to achieve net-zero GHG emissions economy-wide by 2050. Some utilities have committed to decarbonize their generation sources. Major automakers are planning to shift their vehicle fleets from combustion vehicles to EVs. For more information on the global and national movement to 100% renewable/clean energy, see [Appendix C](#).

Goal: Pursue Cost-Effective Energy Efficiency Projects Early and Often

Strategy #1: Benchmark Municipal Energy Use with EPA Portfolio Manager.

Strategy #2: Prioritize High Impact Municipal Government Energy Efficiency Upgrades.

Strategy #3: Prioritize High Impact Low/Moderate Income Community Energy Efficiency Upgrades.

Strategy #4: Facilitate Community-wide Energy Efficiency Improvements Through Public Education and Partnership with NHSaves Program.

Strategy #5: Develop Local Policies That Encourage Energy Efficiency and Track State Legislation.

Background

Concord's 100% Renewable Energy Resolution did not specify an energy efficiency goal, but this plan recognizes the central importance of energy efficiency and energy conservation measures in the planning and implementation of the overall 100% renewable energy goal. This chapter discusses energy efficiency with respect to electricity and thermal energy (transportation efficiency is discussed in Chapter 4). Planning and implementing energy efficiency measures should be an early priority relative to other components of the plan and will help lay the groundwork for other actions.

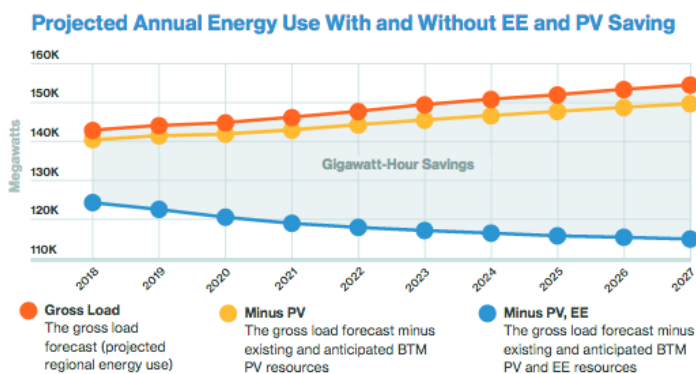
Energy efficiency is widely considered the least costly energy resource and will be a critical component of achieving Concord's 100% renewable energy goal. The less energy we consume, the less energy we need to generate or purchase.

Energy Efficiency Versus Energy Conservation

Energy efficiency refers to any technology, process, or practice that allows the same task to be achieved by using fewer units of energy, while energy conservation means reducing energy consumption through behavioral changes such as turning down the thermostat, turning off unnecessary lighting. The City can encourage individuals, businesses and institutions to undertake energy conservation measures, and can share information about potential energy conservation measures.

Energy efficiency projects reduce energy costs both for the end user, and for the electric grid as a whole. Energy efficiency lowers system-wide costs by lowering overall load and peak load demanded across the system. By reducing load and peak demand through energy efficiency improvements, utility costs are reduced and all rate payers benefit. Figure 2 illustrates how energy efficiency and distributed solar power reduce overall system load,

Figure 2. Energy Efficiency and Solar Photovoltaic Power Reduce System-wide Energy Load and Cost



Source: ISO New England 2018 CELT Report (April 30, 2018)

and thus reduce cost for ratepayers across the electric system. Energy efficiency is especially important for low/moderate income residents who spend a disproportionate amount of household income on meeting their energy needs.

Energy efficiency measures in New Hampshire are funded by money raised by the System Benefits Charge (SBC), Regional Greenhouse Gas Initiative (RGGI) auctions and ISO New England Forward Capacity Market auctions.¹¹ These funds are directed to the NHSaves program (discussed below) and other dedicated

¹¹ See Appendix D for further information on energy efficiency funding sources and policies.

energy efficiency-related purposes, including to municipal and local government projects. Under the New Hampshire Energy Efficiency Resource Standard (EERS), utilities are subject to statewide electric savings goals for the years 2018-20.¹²

Concord's Energy Efficiency Actions

Concord has a history of implementing energy efficiency projects to reduce municipal government operating expenses. Past projects have included energy audits, lighting upgrades, heating and cooling equipment upgrades, HVAC upgrades, and more across numerous buildings and facilities. As technology improves and becomes more affordable, opportunities to achieve further cost savings from efficiency projects will expand. Table 1 lists a selection of energy efficiency projects implemented by the City.

Table 1. Selected Concord Municipal Energy Efficiency Projects Completed 2016 – 2019	
<u>Lighting</u>	Interior and exterior LED lighting upgrades (e.g., Arena, Combined Operations & Maintenance Facility (COMF))
<u>Heating & Cooling Systems</u>	• Municipal Complex heating conversion ○ High-efficiency boilers (94% efficient, up from 78%) ○ High-efficiency variable speed pumps ○ Terminal equipment – high-efficiency cabinet heaters and fan coil units • COMF boiler replacement – new high-efficiency condensing boiler, 94% efficient versus 85% for the legacy oil burning high-mass forced hot water system. • West Street Ward House – new high-efficiency hot air furnace. • Library cooling tower and chiller – Replacement of deteriorating evaporative cooling tower and new chiller elements. • City-wide Community Center – Energy efficiency measures including condensing boilers, a water heater and energy recovery ventilators. • Automation System Upgrades – allow for more precise and targeted climate control and temperature “set-backs” when buildings are not occupied • Radiant Heat – replacement of legacy hot air furnaces in equipment shops with more precise overhead radiant heating units. • Ductless Split Replacements – Replacement of 1st generation ductless split A/C units with modern and efficient combined heat and A/C systems reducing the need for central heat during “shoulder seasons”
<u>Roof Replacement</u>	• Airport – white colored roofing reducing the solar load on the buildings. • Library – added insulation and replaced leaky doors and hatches. • Hall Street – added insulation
<u>Windows & Doors</u>	Replaced old and deteriorated windows, doors, and door seals reducing the ingress of outside air in the following facilities: • Police Department • Hall Street • City Auditorium • Overhead Door Weather-stripping
<u>General Sustainability & Efficiency</u>	• Ice Arena Chiller – modern, efficient, more heavily insulated brine chiller for the ice sheet • Pool media pumps – more energy efficient, allow for more precise and efficient water flow. • “Bottle Fill” water fountains – replacement units foster the use of reusable water bottles and have more efficient cooling units. • Added electric golf carts at Beaver Meadow Golf Course

Concord municipal government can continue to lead by example by prioritizing efficiency upgrades in municipal buildings and facilities. Additionally, the EEAC can lead collaborations among City staff, volunteers, NHSaves professionals (see Figure 3), and other community partners to expand public awareness of energy efficiency opportunities.

¹² <https://www.puc.nh.gov/Electric/SBC%20Reports/20181001-system-benefits-charge-report-2018.pdf>.

Strategy Detail

Strategy #1. Benchmark Municipal Government Energy Use with EPA Portfolio Manager.

The first step toward maximizing energy efficiency is carefully documenting current energy consumption. EPA offers free technical assistance and training for municipal staff using ENERGY STAR EPA Portfolio Manager. Portfolio Manager is a freely available online software tool that combines user-input building energy usage information and historical weather data to produce an Energy Usage Intensity (EUI) value from 1-100 that can be used to compare a building's energy usage against the average energy usage of similarly situated peer buildings. The City can investigate the suitability of EPA Portfolio Manager and similar tools and commence usage if suitable.

Partnerships with the electric and gas utilities can streamline energy use/cost data access and analysis. The City can work with the utilities to develop data that it can use to make energy decisions.

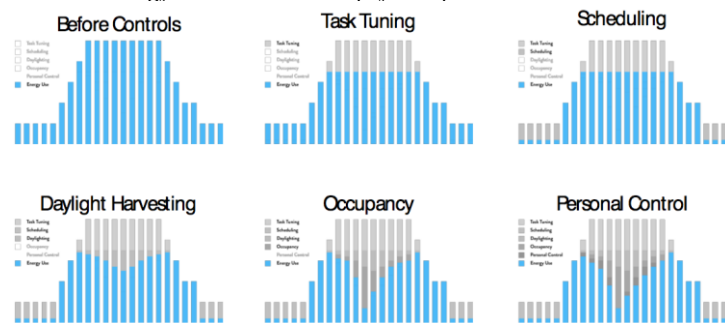
Strategy #2. Prioritize High Impact Municipal Government Energy Efficiency Upgrades

The EEAC recommends that the City Council set a goal to reduce its municipal government energy consumption by 25% by 2025. The first task is to conduct comprehensive energy audits of municipal facilities and implement recommended upgrades.¹³ Based on the audit, the City government can prioritize, budget for and implement energy efficiency projects.

The City is already exploring a potential conversion of streetlights to LED. This project alone could reduce the City

Figure 3. Layered Savings with Networked Lighting Controls

Wireless-based networked lighting controls – including task tuning, scheduling, daylight harvesting, occupancy/vacancy sensors, and personal control – can save up to 68% on energy costs and result in payback periods of as little as 6 months.



government's electricity consumption by a significant amount. Other potential City government projects include cost-effective energy savings measures at Hall Street wastewater treatment plant by taking advantage of the NH Department of Environmental Services Wastewater Treatment Facility Energy Audit program.¹⁴ The City can consider other emerging technologies such as smart networked lighting controls in municipal buildings and facilities (See [Figure 3](#)).

To the extent achievable, the City can also consider the deep energy retrofit of at least one highly

visible municipal building or facility to serve as a demonstration project with the potential of achieving net zero energy usage.

Strategy #3 Prioritize High Impact Low/Moderate Income Community Energy Efficiency Upgrades.

No one feels the pain of monthly energy bills more than people with limited/modest incomes, and none would realize more benefit from a reduction in their energy bills. For reasons of justice and equity, it is imperative to deploy energy efficiency projects to bring price relief to low/moderate income energy customers at an early point in

¹³ Concord last conducted an energy audit of municipal government buildings around 2011.

¹⁴ <https://www.des.nh.gov/media/pr/2019/20190502-wastewater-treatment.htm>

Table 2 - Housing Complexes with Designated Low-Income Housing Units in Concord

Provider	# Units
Royal Gardens Apartments	257
Pitman Place	105
Friedman Court	95
John F. Kennedy Apartments	86
Firehouse Block	83
Horseshoe Pond	73
Hodges Apartments	50
William Haller Apartments	50
Others	279
Total	1078

Source: New Hampshire Housing Finance Authority
https://www.nhhfa.org/assets/pdf/DAH_Statewide.pdf

These units may be designated for elderly, special needs or general occupancy (including families). The complexes are owned or administered by ten different entities, including Concord Housing Authority and Concord Area Trust for Community Housing.

the implementation of this plan. There are a significant number of low/moderate income households in Concord, including residents who live in designated low-income housing, residents who live in other housing but receive rent assistance,¹⁵ and residents who may own their homes. Concord has a history of pursuing energy efficiency measures in low income housing projects, as Concord Royal Gardens complex has participated in NHSaves (see [Figure 4](#)).¹⁶ Concord can build on that success.

Performing energy efficiency projects working with building or unit owners and with tenants (where applicable). The City (led by the EEAC) can discuss energy audits, potential projects and funding opportunities with the owners of the designated low-income housing complexes, other landlords who serve low-income tenants, any groups representing low income homeowners or tenants and/or individual homeowners or tenants. One challenge to be overcome is that low-income tenants generally lack both the legal right and the economic means to implement energy efficiency measures in the dwellings they occupy, so a key to success is encouraging or incentivizing landlords to implement such measures. Concord can discuss resources available under NHSaves or other programs with the local utilities and can explore opportunities under the Weatherization Assistance Program (WAP).¹⁷ Concord can also work with the Community Action Program – Belknap-Merrimack Counties, Inc. (CAPBMCI),¹⁸ the New Hampshire Housing Finance Authority (NHHFA) and others to identify opportunities and resources.

Aside from housing units, the City government can seek a comprehensive energy audit of low/moderate income community buildings, such as the Penacook Community Center.

In the course of investigating the community-wide low-income energy efficiency potential, Concord can consider setting a goal to reduce per capita annual energy consumption in these communities by a specific percentage in a specified time frame.

Strategy #4. Facilitate Community-Wide Energy Efficiency Improvements Through Public Education and Partnership with NHSaves Program.

The City can facilitate community-wide energy efficiency improvements by engaging in public education efforts, including Button Up Workshops and Weatherize Campaigns (in partnership with the electric and gas utilities and with support from Vital Communities, Clean Energy NH, and other partners).¹⁹ The City can also expand existing

What are Button Up Workshops & Weatherize Campaigns?

Button Up Workshops are 90-minute, NHSaves-sponsored presentations by energy professionals about improving the energy efficiency of your home.

Weatherize campaigns are grassroots educational programs focused on raising awareness for energy and cost saving opportunities associated with home efficiency improvements. Weatherize tends to focus on air-sealing and insulation, two technologies that help tighten up a building envelop. Weatherize makes it easy for homeowners by identifying qualified contractors and streamlining rebate application processes with NHSaves.



¹⁵ The main form of assistance is Section 8 housing vouchers.

¹⁶ Royal Gardens Concord, NHSaves: <https://nhsaves.com/resources/royal-concord-gardens/>.

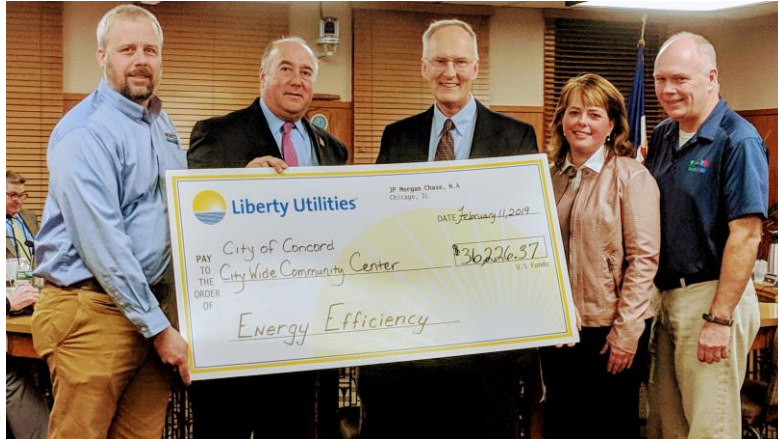
¹⁷ This program is largely federally funded and is administered by the New Hampshire Office of Strategic Initiatives. Web site: <https://www.nh.gov/osi/energy/programs/weatherization/>

¹⁸ Web site: <https://www.bm-cap.org/>.

¹⁹ Vital Communities Weatherize, <https://vitalcommunities.org/energy/weatherize/>.

Figure 4. NHSaves, Your Source for Energy Efficiency

NHSaves is a statewide program offering rebates, financing, and other incentives for energy efficiency projects. In Concord, Unil and Liberty Utilities administer NHSaves programs. NHSaves rebates are available for residential, commercial, municipal, and low-income customers. NHSaves is a critical partner and resource for implementing energy efficiency projects. In January 2019, Liberty Utilities presented the City of Concord with a check for \$36,226 to contribute to the cost of new high-efficiency boilers and other equipment installed at the Citywide Community Center. <https://nhsaves.com/>



partnerships with the utilities under the NHSaves brand, leverage funding and financing opportunities, and support community-based marketing programs (e.g., rebates, on-bill financing, low-interest loans, and a Main Streets program). The City could also contribute to public education by including information on rebate opportunities offered by NHSaves along with other materials the City already provides, such as property tax bills, the City Manager's newsletter, and welcome packages to new homeowners.

The City and public utility companies can also encourage conservation through online data sharing. For example, the town of Middlebury, Vermont publishes an online energy usage dashboard where community members can share actions they have taken to reduce their energy usage and

cost.²⁰ These strategies inform residents and businesses about actions they can also take to reduce their carbon footprints and energy costs.

Finally, on behalf of the City, the EEAC can engage Concord School District and Merrimack Valley School District with regard to establishing an energy curriculum in Concord Schools. For example, the New Hampshire Energy Education Project (NHEEP) offers resources to school districts and teachers to facilitate STEM energy education. NHEEP services include teacher professional development, in-class workshops for students, and curriculum resource kits.²¹

Strategy #5. Develop Local Policies to Encourage Energy Efficiency.

At the local level, Concord can consider enacting a number of policies in order to incentivize and maximize energy efficiency.

Energy Efficiency Standards for New Municipal Construction: The City can demonstrate the value of implementing energy efficiency in municipal facilities by adopting a policy that sets minimum standards for efficiency in all new municipal buildings. The City of Portland, Maine adopted a policy in 2009 that requires all new construction or major renovation of municipal buildings of 2,000 square feet or more to meet the LEED Silver Standards for energy efficient construction.²²

Building Codes and Standards: Adoption of new building code standards will encourage greater energy efficiency in buildings. Ensuring buildings are constructed using the latest energy efficiency technologies and according to the most recent construction standards is more cost-effective than retrofitting those same buildings post-construction. Any building efficiency ordinance adopted by the City might consider

²⁰ Middlebury, VT Community Energy Dashboard: <https://www.vtenergydashboard.org/my-community/middlebury/analysis>

²¹ NH Energy Education Project, <http://veep.org/nhenergyed/>.

²² Portland, ME Green Building Code: <http://www.portlandmaine.gov/AgendaCenter/ViewFile/Item/212?fileID=894>

encouraging or incentivizing developers to meet a more recent version of the Energy Conservation Code (IECC). For example, the Town of Durham, New Hampshire requires all new construction to comply with the 2018 IECC.²³ In July, Governor Sununu signed into law HB 562 updating state building codes from 2009 to 2015, including the 2015 IECC. The City of Concord currently operates under the 2009 IECC and will need to update its code at least to the 2015 IECC to conform with HB 562 but can consider going further and adopting the 2018 IECC.

Building Energy Rating and Disclosure Ordinance: A building energy rating and disclosure ordinance is a policy that creates a market mechanism for encouraging energy efficiency improvements by providing prospective lessors or purchasers with building energy usage data prior to signing a purchase or lease.²⁴

The EEAC can track legislation under consideration in the state legislature that would encourage increased energy efficiency. Such bills might include proposals to update the statewide building energy code, update statewide appliance standards, expand funding to support energy efficiency upgrades for low/moderate income communities, and better secure overall funding for energy efficiency through the SBC, RGGI and other funding sources. Where appropriate, the EEAC may propose that Concord take a public position on such pending legislation.

²³ Durham, NH Ordinance #2001-01 Establishing a Building Construction Energy Efficiency Standard:
<https://www.nh.gov/osi/planning/resources/conferences/spring-2016/documents/durham-ordinance-forcey.pdf>

²⁴ NEEP. Public Sector Building Energy Benchmarking: Utility Data Access Options and Opportunities.
<https://neep.org/sites/default/files/resources/Public%20Sector%20Building%20Energy%20Benchmarking%20-%20Utility%20Data%20Access%20Options%20and%20Opportunities.pdf>

Goal: 100% Renewable Electricity by 2030

Strategy #1: Transition Concord City Government Electricity Consumption to 100% Locally-Generated Renewable Electricity at the Earliest Opportunity.

Strategy #2: Prioritize Making Solar/Renewable Electricity Available to Low/Moderate Income Residents at the Earliest Opportunity.

Strategy #3: Streamline and Clarify Permitting Processes to Encourage Installation of Renewable Energy Projects within Concord's Borders.

Strategy #4: Offer Local Incentives for Renewable Energy Projects Where Appropriate.

Strategy #5: Serve as Information Resource for Concord Residents and Businesses Seeking to Generate Their Own Renewable Power.

Strategy #6: Convert Grid Power in Concord to 100% Renewable Electricity by Municipal Aggregation.

Strategy #7: Advocate for State Policy and Participate in Innovative Utility Programs.

Introduction

The timeline to achieve Concord's 100% renewable electricity goal is only eleven years away, but the pathway to achieving that goal is apparent. Technology needed to achieve the goal is already in commercial use, and new and improved technologies will become available over time. The EEAC anticipates that the goal can be achieved without increasing our electric bills, as renewable energy sources have become dramatically less expensive, certain sources (large solar and on-shore wind) are already cost-competitive with conventional fuel technologies, and others (small solar and off-shore wind) are expected to become cost-competitive before 2030.

Reaching the electricity goal by 2030 is important in its own right and can also facilitate achieving the transportation and thermal energy goals through electrification. Electrifying transportation and thermal energy applications will increase our community electric load between now and 2050, though we hope that energy efficiency measures will at least partially offset an increase in electric demand.

Concord's Electricity Baseline

Community-Wide Electricity Consumption

Most electricity consumed in Concord is supplied by Unitil Energy Services (Unitil), an electric distribution company regulated by the New Hampshire Public Utilities Commission (PUC). According to Unitil, it delivered about 390 million kilowatt-hours (kWh) of electricity to its customers in Concord in 2018.²⁵ Eversource serves as the electric utility for a limited number of customers in discrete areas of Concord.

Concord Community-wide Electricity Consumption from the Electric Grid (2018) (source: Unitil 2019)	
Sector	Total Billed kWh
Residential	100,738,889
Commercial & Industrial	219,762,251
Municipal/Governmental	69,137,638
Total	389,638,778

²⁵ The Energy Chapter of the Master Plan states that Concord's community-wide electricity consumption was 473,858,826 kWh in 2011.

The electricity delivered by our utilities mainly comes from natural gas, nuclear and coal generating sources in New England. Under the state Renewable Portfolio Standard (RPS) law, discussed below, electric utilities are obligated to deliver an increasing percentage of electricity from renewable resources. In 2019, electric utilities were required to obtain at least 19.7% of the electricity they supply to customers from renewable energy sources. By this measure, electricity delivered to customers in Concord in 2019 can be considered 19.7% renewable.

City Government Electricity Consumption

Concord city government currently receives all of its electricity supply under short term contracts with Constellation Energy, a competitive electricity supplier. Under those contracts, Constellation supplies conventionally generated power coupled with Renewable Energy Credits (RECs) generated by wind projects in Texas for all of the energy purchased. In 2018, the city government consumed 8.9 million kilowatt-hours (kWh) of electricity, a little over 2% of the community-wide electricity consumption.

Kilowatts, Kilowatt-hours, Megawatts and Megawatt-hours

Electricity consumption is generally quantified using two measures: (1) energy usage in a given moment, quantified by watts, kilowatts (kW) and megawatts (mW), and (2) energy usage over time, quantified by kilowatt-hours (kWh) and megawatt-hours (mWh).

A kW is 1,000 watts. A mW is 1,000 kW. A gigawatt is 1,000 mW.

A mWh is 1,000 kWh.

Electricity Generation in Concord

Residents, businesses and other electricity consumers may generate their own electricity, typically using roof-mounted or ground-mounted solar arrays. Based on information obtained from the PUC and the City of Concord, we estimate that solar projects totaling between 1,500 kW and 2,000 kW in capacity have been installed in Concord to date, including a 32 kW project at the Unitarian Universalist Church on Pleasant Street. Nearly all of these projects are relatively small in size.²⁶

Other existing electric generation sources in Concord include the Wheelabrator waste incineration plant (14 mW capacity) in Penacook, three hydroelectric plants (11.2 mW in aggregate) owned by Briar Hydro Associates on the Contoocook River in Penacook, and a hydroelectric plant (12.3 mW) owned by Hull Street Energy on the Merrimack River between Concord and Bow.



Briar Hydro Penacook Upper Falls project



Unitarian Universalist Church Solar Project

²⁶ According to data from the PUC, state rebates have been paid out to 106 residential solar projects in Concord totaling 742 kW in capacity and 10 commercial and industrial projects with 592 kW in capacity and solar projects in Concord totaling 1,542 kW are certified to claim RECs. Information received from the PUC on July 24, 2019.

Our New England Energy Market and Our State Energy Laws

Concord's electricity supply, like the rest of New England's electricity supply, is generated in New England, with only a limited amount imported from immediately adjacent outside sources (mainly hydroelectric power from Canada).²⁷ Our electricity supply will continue to come from these areas. ISO New England (ISO-NE) operates New England's electricity grid and wholesale power markets.

Renewable energy has become increasingly price competitive in New England. Vineyard Wind, the first offshore wind project selling power to Massachusetts, offered Massachusetts utilities a price of 6.5 cent per kWh.²⁸ A Connecticut RFP for clean power received bids from nine solar projects averaging 4.9 cents per kWh.²⁹ These prices are in the range of the typical wholesale price of electricity in New England.

Several laws affect the generation and sale of renewable energy in New Hampshire, most notably:

- Regional Greenhouse Gas Initiative (RGGI). RGGI is a collaboration of ten northeastern states (including New Hampshire) to administer a regional carbon cap and trade program. RGGI puts a price on GHG emissions from large fossil fuel power plants in the region.
- New Hampshire Renewable Portfolio Standard (RPS). The RPS requires electric utilities to procure a certain percentage of their electricity supply each year from renewable energy resources. Utilities comply by purchasing renewable energy credits (RECs) from renewable energy resources located in ISO-NE territory or that deliver power into ISO-NE territory. If a utility fails to procure enough RECs in a year, it pays an Alternate Compliance Payment (ACP) to the PUC. ACPs fund the New Hampshire Renewable Energy Fund, discussed below. Other New England states have their own RPS programs.
- New Hampshire Net Metering Program. Net metering allows owners of eligible distributed generation systems (e.g., solar photovoltaics and hydroelectric projects) to receive payment from their utilities for electricity they deliver into the electric grid. Projects larger than 1 mW are ineligible for net metering under current law.

For further information on ISO-NE, RGGI, the New Hampshire RPS program and the New Hampshire net metering program, see Appendix D.

Sources of Renewable Electricity and Storage in New England

Sources of renewable electricity deployed or being deployed in New England include the following:

- Ground-Mounted Solar. Ground-mounted solar arrays are installed on available land. They vary widely in size, from as small as a few kilowatts (kW), enough to power a small house, to tens or even hundreds of megawatts (mW) where sufficient land is available. Ground-mounted solar may provide electricity “behind the meter” to a building or buildings located on site or may be interconnected to the electric grid.
- Roof-Mounted Solar. Roof-mounted solar arrays are smaller than most ground-mounted solar arrays because their size is limited by available roof-space. Usually, roof-mounted solar is designed to provide electricity to the building on which it is installed.
- Canopy-Mounted Solar Projects in Parking Lots. Solar projects can also be developed in the form of canopies in parking lots.

²⁷ It is not feasible to import power from generation sources located further away.

²⁸ <https://commonwealthmagazine.org/energy/offshore-wind-prices-look-competitive/>.

²⁹ <https://www.ct.gov/deep/cwp/view.asp?Q=607002&A=4965>.

- **On-Shore Wind.** On-shore wind projects operate in all six New England states, with Maine having over 900 mW of onshore wind capacity. Four on-shore wind farms operate in New Hampshire - in Lempster, Groton, Millsfield/Dixville and north of Berlin. Another is under development in Antrim.
- **Off-Shore Wind.** Off-shore wind farms have the potential to deliver power more reliably than on-shore wind farms because winds over the ocean blow more steadily than winds over land. Massachusetts, Rhode Island and Connecticut are aggressively pursuing off-shore wind farms along the southern New England coastline. The first off-shore wind farm in the United States, consisting of 5 turbines with a total capacity of 30 mW, operates near Block Island, Rhode Island. Much larger projects have been proposed, including the 800 mW Vineyard Wind project being developed 15 miles south of Martha's Vineyard and expected to reach commercial operation by the end of 2021. ISO-NE reported that there were over 13,000 gigawatts of offshore wind projects in its interconnection queue, enough to meet nearly half of New England's electricity needs.³⁰ In January, Governor Sununu requested the formation of a task force to study the potential for off-shore wind energy generation off New Hampshire's coast.³¹ This study will examine wind energy potential in the Gulf of Maine off the coasts of Maine and New Hampshire and the northern coast of Massachusetts.
- **Grid-Connected Battery Storage.** Commercial-scale battery storage is increasingly being deployed in Massachusetts and some other states. Energy storage projects enhance the reliability of the energy grid, either working in tandem with intermittent sources like solar or reducing the need for transmission projects. We are not aware of any currently operating storage projects in New Hampshire, but Liberty Utilities and Eversource are currently pursuing projects (discussed below).
- **Biomass.** Biomass-fired electric generation facilities can provide steady baseload power. Five or six wood-fired biomass plants operate in New Hampshire, and others operate in other New England states, using low-grade wood for fuel. The low-grade wood consists of forest products not used for construction or other high-end uses, which is then chipped, loaded into trailers and delivered to the biomass plants. Harvesting the low-grade wood improves the woodlots and employs many people across the state. There is uncertainty about the continued operation of some of the biomass



Block Island Wind Farm, Rhode Island

What Are Energy Storage and Battery Storage?

Energy storage allows energy to be stored at one time and released later when needed. There are many potential sources of energy storage. Pumped hydro storage projects have operated in New England for years.

In recent years, battery storage (especially lithium-ion batteries) has become the energy storage technology of choice. Electric vehicles use li-ion batteries, and commercial scale li-on storage projects are being connected to the electric grid to improve system reliability, avoid the need for system upgrades, or complement solar and wind energy projects. Investment dollars are pouring into this technology, prices are decreasing rapidly and li-ion battery performance is improving.

Other storage technologies are in research and development but have not yet come to market.



³⁰ ISONE, State of the Grid: 2019. Link: https://www.iso-ne.com/static-assets/documents/2019/02/20190220_pr_state-of-the-grid_presentation_final.pdf.

³¹ <https://www.governor.nh.gov/news-media/press-2019/documents/20190107-boem-offshore.pdf>.

projects. Legislation passed last year required the electric utilities to pay an above-market rate for the power from these projects for three years but is under legal challenge. Another bill to support biomass projects is pending in the legislature.

- **Small Hydroelectric.** Small hydroelectric projects can provide steady, inexpensive baseload power to complement intermittent solar electricity. Dozens of small hydroelectric projects, including four in Concord (discussed above), operate in New Hampshire, and many others operate elsewhere in New England. These projects were encouraged by federal law enacted decades ago. In recent years, some hydroelectric projects have experienced economic stress caused by low wholesale electricity prices and other factors and might not continue to operate. Since it is not likely that new dams will be built, locally generated electricity from hydroelectric projects is likely to come from existing facilities or modest expansions thereof.

Strategy Detail

Strategy #1. Transition Concord City Government Electricity Consumption to 100% Locally-Generated Renewable Electricity at the Earliest Opportunity

To help achieve the community-wide 100% renewable electricity goal, the EEAC recommends moving the City government's electricity consumption to 100% locally-generated renewable energy. This step could be achieved within the next two to three years and would set a visible and powerful example for the rest of the community, signaling that the transition to renewable energy is feasible and is already underway.

As discussed above, the City government can justifiably say that it already purchases 100% renewable energy given its purchase of RECs. However, these REC purchases are not assured beyond the term of the short-duration contracts with Constellation, and because the power purchased comes from conventional "brown" energy sources, the REC purchases do not help transition the local electric grid to renewable energy nor do they achieve the positive local economic, energy security and health benefits associated with locally-generated renewable energy. Transitioning the City government's electricity consumption entirely to locally-generated renewable energy would achieve these benefits.

The City is preparing to issue a request for proposals (RFP) for solar projects to be developed on several City-owned properties – the landfill on Old Turnpike Road, the wastewater treatment plant on Hall Street and the water treatment plant on Hutchins Street. These projects could become operational as early as 2020. Together, these projects are expected to meet all or a large portion of the City government's electricity needs.³²

Beyond these three projects, the City can investigate solar energy potential at other municipal properties, even if the municipal government's electricity in the upcoming procurement, as such projects can be used to generate electricity to meet community energy needs. The City can establish a practice of assessing the suitability of solar projects in all new City building projects including renovations (e.g., parking garages).

Strategy #2. Prioritize Making Solar/Renewable Electricity Available to Low/Moderate Income Residents at the Earliest Opportunity

As discussed in Chapter 2, a significant portion of Concord's population lives in low/moderate income housing, and these communities represent a significant portion of the energy consumption in the City. For equity and justice reasons, it is important to make low-cost reliable solar (or other renewable) energy available to the low/moderate income residents of Concord at an early point in the process of implementing the 100% renewable electricity goal. This prioritization is also synchronous with state policy, as noted below. We believe that City attention and encouragement are crucial in determining whether or not low/moderate income solar projects are developed in the near future.

³² The City can also explore the potential of developing projects on other City-owned properties, including parking garages, either for the City government's own consumption or for the consumption of other customers. These projects could generate lease or tax payments for the City even if they aren't supplying the City government with electricity.

As is the case with energy efficiency projects, the City can work with low/moderate income housing owners/providers and tenants in Concord, the utilities, CAPBMCI, the NHHFA and other parties to plan and develop solar projects to serve these residents.

New Hampshire law requires that at least 15% of the Renewable Energy Fund administered by the PUC must be allocated to grants for solar energy projects for low/moderate income residents. In 2018, the PUC issued grants from this program to three currently-operating solar projects in Laconia, Lebanon, and Plymouth. Each of these projects is structured differently and offers a different model for developing low/moderate income solar projects in Concord.³³ The PUC issued grants to four additional low/moderate income solar projects in 2019.³⁴ We hope that applications will be filed and grants will be awarded for low/moderate income solar projects in Concord in future rounds of funding.

In 2017, the PUC ordered New Hampshire electric utilities to develop pilot programs for low/moderate income solar projects.³⁵ In May 2019, Eversource proposed a Clean Innovation Community Solar Program.³⁶ Under the proposal, Eversource would run a competitive procurement process for new solar projects up to 5 mW that would serve income-eligible Eversource customers enrolled in its Electric Assistance Program (EAP). The total program procurement is 20 mW. If the PUC approves the proposal, Eversource anticipates selection of proposals and beginning of construction in 2020. Unitil is currently preparing a proposal for its own low-income community solar program. The EEAC looks forward to seeing that proposal.

The 2019 legislative session is bringing additional policy support for low/moderate income solar. SB 165, signed into law by Governor Sununu in July, provides additional compensation for low/moderate income community solar projects and requires the PUC to authorize at least two new low/moderate income community solar projects each year in each utility's service territory beginning in 2020.³⁷

Strategy #3. Streamline and Clarify Permitting Processes to Encourage Installation of Renewable Energy Projects within Concord's Borders

While Concord's 100% renewable energy goal does not require that all of the renewable energy consumed in Concord be generated in the City, generating as much renewable electricity as we can within our borders or in the region would enable Concord to realize the following economic benefits (further discussed in Chapter 1):

- Bring renewable energy and energy efficiency jobs to Concord.
- Generate new property tax revenues, broadening tax base and reducing tax burden on others.
- Open new revenue streams (lease payments) for farmers and other local landowners (a solar project sited on one part of a farm's land enables the farm to continue farming areas activities on parts of the land).
- Achieve energy independence by bringing our electricity supply closer to home.

One of the most important steps that the City can take to encourage renewable energy projects in Concord is to make sure the permitting processes required for such projects are transparent, predictable and easy to navigate while being appropriately protective of the City's interests.

The potential sources of renewable electricity that could be feasible to install in Concord include the following:

- Solar energy projects, including
 - Roof-mounted projects
 - Ground-mounted projects

³³ Local Energy Solutions Webinar: "Low Income Community Solar Projects in New Hampshire" (2019). This and other webinars are available for viewing at: <http://www.nhenergy.org/webinars.html>

³⁴ Renewable Energy Fund LMI Community Solar Program. Link: <https://www.puc.nh.gov/Home/RFPs/2019-001/20190206-PUC-RFP-2019-001-REF-LMI-Community-Solar-Grants.pdf>.

³⁵ https://s3.amazonaws.com/dive_static/paychek/26-029_1.pdf.

³⁶ <https://www.puc.nh.gov/Regulatory/Docketbk/2019/19-104.html>.

³⁷ http://www.gencourt.state.nh.us/bill_status/billText.aspx?sy=2019&id=1054&txtFormat=pdf&v=current.

- Parking lot canopy projects
- Energy storage projects (especially battery storage projects).
- Cogeneration (generating electricity and thermal energy) projects fueled by biomass or geothermal energy.
- Small wind turbines on farms (already allowed under Concord’s zoning ordinance).³⁸

Solar Projects Can Deliver Power in Different Ways

- **“Behind the meter solar projects”** are located on a customer’s property and deliver power directly to the customer without using the utility’s distribution lines. A typical rooftop solar project is a behind-the-meter project, although a ground-mounted project could also be behind-the-meter.
- **“Community solar projects,”** also known as **“group net metering projects”** in New Hampshire, deliver power to the electric grid that is then credited to customers (group members) that may be located elsewhere, though required to be in the same utility territory as the solar project.
- **“Commercial solar projects”** deliver power to the electric grid that may be purchased by a utility, a community with a municipal aggregation program (perhaps Concord in the future) or in some cases an end use customer.

The EEAC believes all of these kinds of solar projects are needed in Concord in order to achieve a transition to 100% renewable energy.

We expect proposals for new renewable energy sources in Concord to be dominated by solar energy projects, especially ground-mounted projects and roof-mounted projects, in the near term. Those projects will vary in size and may consist of behind-the-meter solar projects, community solar projects and commercial solar projects.

Ground-mounted solar energy projects require space, generally 4-5 acres per mW of capacity using current technology.³⁹ The City Council is currently considering amendments to its zoning ordinance to expand the use of solar in its agricultural and urban districts to help meet the need for large scale commercial and community solar projects. The amendments would increase the percentage area of a parcel that could be used for a solar project in these districts and would also clarify the permitting process for ground mounted solar facilities. After some experience with administering the soon-to-be enacted ordinance, the City can evaluate what additional changes might be needed to further accommodate demand for solar energy from ground-mounted projects.

Rooftop solar projects are best suited for roofs that are (a) properly oriented toward the sun and (b) structurally sound. Not all roofs will meet these criteria. The only permits required for a roof-mounted solar project in Concord are a building permit and an electrical permit. The EEAC and City staff can explore whether the process to issue building and electrical permits for rooftop solar can be shortened or streamlined. One potential improvement is establishing an on-line permitting portal at the Concord city web site for rooftop solar projects and also certain small ground-mounted projects that

require only building and electrical permits. This portal would make the application process transparent and understandable and would save applicants the trouble of having to obtain and file hard copy permit application forms.

The EEAC would welcome the development of solar canopy projects in public and private parking lots in Concord. The appeal of solar canopy projects is that they utilize paved spaces rather than open land and provide the amenity of shade to parked cars. Solar canopy projects are being developed in other states, but we are not aware of any solar canopy projects presently operating in New Hampshire, almost certainly because such projects are more expensive to install than ground-mounted projects and are not economic in New Hampshire without a solar canopy-specific incentive.⁴⁰ A solar canopy project located in Concord would require only building and electrical permits, which could be offered through an on-line portal as discussed above.

The EEAC expects that Concord will receive proposals for energy storage projects (especially battery storage projects, discussed above) in the near future. Energy (battery) storage projects offer two distinct benefits. They

³⁸ We do not expect large-scale wind projects because the wind resource in Concord is not optimal and there would be limited sites available.

³⁹ Space needs vary by site. See <https://greencoast.org/solar-farm-land-requirements/>.

⁴⁰ By contrast, the Massachusetts SMART program (Massachusetts’ current solar incentive program) offers owners and developers of solar canopy projects additional compensation for power generated from a solar canopy project above and beyond the compensation offered to a ground-mounted project developed on open land.

allow renewable power to be generated at one time and delivered or consumed at a later time, which greatly increases the reliability and value of the power. They also have the potential to reduce the need for electricity distribution or transmission system upgrades, avoiding construction of additional poles and wires. The EEAC recommends that the City review land use regulations and consider necessary amendments to ensure that the permitting process for energy storage projects is clear and accommodates the community need for such projects.

The Planning Division has taken steps to identify optimal locations for solar energy projects in Concord within a feasible distance from 3-phase power lines, which form the backbone of the electric grid. The City can also identify candidate sites for energy storage projects in Concord, in coordination with Unitil and Eversource.

While siting renewable energy projects locally offers many advantages, we are unlikely to generate all of our renewable electricity within the City borders and will need to import renewable electricity from outside our borders. It would be wise to think of renewable electricity generation and procurement in regional terms. For that reason, collaboration between the City and the Central New Hampshire Regional Planning Commission (CNHRPC) will be an integral part of achieving this goal.

Strategy #4. Offer Local Incentives for Renewable Energy Projects Where Appropriate

State law allows the City to enter into payment in lieu of taxes (PILOT) agreements with certain kinds of renewable energy projects.⁴¹ PILOT agreements give renewable energy developers a degree of certainty as to the tax payments they will owe over time, which encourages investment in such projects. The EEAC hopes that the City will continue to utilize PILOT agreements as appropriate.

In 2017, Concord adopted a property tax exemption for solar energy systems that heat or cool a building or provide electricity for use on the subject property, as authorized by state law. The exemption took effect in 2018 and is scheduled to sunset after 10 years. Concord can consider whether to extend the exemption for a longer period and may have the statutory right to exempt other kinds of equipment from taxation.⁴²

The City can consider adopting other forms of local incentives for categories of projects that it deems desirable that might be allowed under state law.

Strategy #5. Serve as Information Resource for Concord Residents and Businesses Seeking to Self-Generate Renewable Power

A key component of a plan to move the community to 100% renewable electricity is to encourage self-generation of electricity by residents and businesses. Self-generation typically has the primary purpose of providing electricity to serve a customer's electric needs (load) on-site. The most likely form of self-generation in Concord is roof-mounted or ground-mounted solar projects.

One factor limiting a transition to solar power is a lack of readily available public information about issues including the following:

- What local contractors install solar projects?
- What is the approximate range of cost of installing solar?
- What local permits are required to install solar?
- What federal and state incentives are available?
- What financing arrangements are available?

⁴¹ RSA 72:74. The City has entered into a PILOT Agreement with Briar Hydro Associates for the Penacook hydro projects.

⁴² RSA 72:62. HB 464, passed by both houses of the legislature and currently awaiting the Governor's signature, would broaden the definition of solar projects potentially eligible for a property tax exemption to include group net metering projects and would offer a potential exemption to energy storage projects, among other things. Municipalities may decide whether or not to offer the exemptions allowed under the statute.

What Federal and State Incentives Are Available for Solar Projects?

- Federal Investment Tax Credit (ITC). The owner of a solar energy project is eligible for a one-time federal tax credit of 30% of the cost of installing the project if the project commences construction on or before December 31, 2019. The credit value will decline to 26% in 2020, and to 22% in 2021. After 2021, the ITC will be 10% for commercial and utility-scale solar projects and 0% for residential solar projects.
- PUC Solar Rebate Program. The PUC periodically issues grants under its solar rebate program funded by the Renewable Energy Fund, divided between commercial/industrial and residential. Funding is sporadic so the program is frequently closed and reopened. The residential program is currently open and accepting applications but the commercial/industrial program is closed. For maximum rebate levels and other details, see the program link: <http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates.html>
- REAP Grants/Loan Guarantees. Grants for up to 25% of project costs and loan guarantees of up to 75% of project costs are available under the USDA's Rural Energy for America Program. Solar and other renewable energy projects in Concord are eligible. Link: <https://www.rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency/nh>.
- Net Metering (discussed above). Solar projects are compensated for the power they deliver to the grid under net metering. Solar projects up to 1 mW are eligible for net metering under current law.
- Renewable Energy Credits (discussed above). Solar projects are eligible to generate and sell RECs, which offers an additional revenue stream to the project owner.
- Other funding sources potentially available depending on the circumstance.

The City can play a role as a public information resource, informing the public about Concord's 100% renewable electricity goal, how solar projects can help meet it and answering questions like those above, using its web site, social media platforms and other communication tools. The City can also facilitate active public education campaigns. Public education models for renewable energy exist across the state, ranging from simple one-off Solar 101 workshops⁴³ to more intensive Solarize Campaigns. Many New Hampshire communities have implemented Solarize campaigns under which they vet and approve qualified solar vendors to partner with in grassroots educational programming.⁴⁴

Some individuals and companies are pooling their purchasing power in order to obtain better solar project pricing arrangements from providers. The City could seek to facilitate or encourage solar panel purchasing pools to enable Concord residents and business wishing to develop solar projects on their properties.

Strategy #6. Convert Grid Power in Concord to 100% Renewable Electricity by Municipal Aggregation.

The EEAC anticipates that self-generation and community solar will meet only a portion of our electricity demand. Not all homes or properties are suitable for solar, and not all residents or businesses will choose to self-generate or participate in community solar projects. To reach the 100% renewable electricity goal will require causing all power delivered to the Concord community by the electric grid to be renewable. One pathway to achieving this end is municipal aggregation.

Municipal aggregation, sometimes called "community choice aggregation," is a program under which a municipality purchases electricity supply in bulk on behalf of residential and business customers in the municipality. Typically, the charge for the energy purchased by the municipality is included as the energy charge in the electric utility's monthly bill. The local electric distribution utility continues to be responsible for electricity transmission and

⁴³ Lakes Region Community College Solar 101, <https://www.lrcc.edu/solar101>.

⁴⁴ New Hampshire solarize programs include Solarize Upper Valley, Solarize Southern NH, Solarize Ammonoosuc, Seacoast Energize 360, Nashua Solarize +, Solarize Wolfeboro, Solarize Kearsarge, Monadnock Solarize, others. Vital Communities Solarize Toolkit, <https://vitalcommunities.org/energy/solarizetoolkit/>.

distribution services and billing. Municipal aggregation programs in Massachusetts have reduced community-wide energy costs while boosting renewable energy procurement.⁴⁵

A key factor in the success of a municipal aggregation program is whether it is opt-in or opt-out. Customers participate in an “opt-in” program only if they make an affirmative decision to do so. Customers participate in an “opt-out” program unless they make an affirmative decision to leave the program. In the former, non-participation is the default choice, while in the latter, participation is the default choice. Not surprisingly, participation rates are much higher in opt-out programs than in opt-in programs. Currently, RSA 53-E only allows New Hampshire municipalities to run an opt-in program. However, if SB 286 becomes law,⁴⁶ municipalities could elect to create either an opt-in program or an opt-out program. The EEAC takes the view that an opt-in program would not help Concord achieve its 100% renewable electricity goal, but might in the future, after further investigation, recommend the City establish an opt-out program.

We expect that a municipal aggregation program would work basically along the following lines. It would begin with a City Council decision to start a program. The City would seek 100% renewable electricity supply, with the selection of specific sources performed by either City staff or an energy supply contractor chosen by the City pursuant to an RFP. If City staff selects electrical supply, the City would enter direct agreements with generators to supply power and would probably manage energy supply as a portfolio. If the City works through an energy supply contractor, the contractor would procure supply from power generators within parameters required by the City (e.g., some percentage of procured power must come from renewable sources). After the program start date, customers would purchase City-selected electricity, to be delivered using Unitil’s poles and wires. Charges for City-selected energy would appear on Unitil’s monthly electricity bill, along with Unitil’s distribution, transmission and other charges. Customers could opt out of the program and purchase energy from another provider. Most likely, larger customers that presently use competitive electric supply will continue arranging their own energy supply and would opt out. Some smaller customers might also opt out. The EEAC will investigate further details on how a municipal aggregation program would work.

The scope of an energy aggregation program does not need to be limited to a single municipality. For example, in California, energy aggregations often span larger regions such as counties. If it appeared advantageous, the City could pool its energy purchases with other communities pursuing similar renewable energy goals, achieving increased purchasing power with increased choices and better pricing for all participants.

The City should also anticipate that some electricity customers, such as major institutions in Concord, might not want to participate in a municipal aggregation program. These institutions— e.g., the State, Concord School District, Merrimack Valley School District, Concord Hospital, St. Paul’s School - are accustomed to making their own energy decisions. Many of them currently procure their own energy through competitive electric supply arrangements. The EEAC anticipates that they might continue to act independently with respect to energy decisions but hopes to persuade them to align their own decisions with the outlines of Concord’s 100% renewable energy goal even if they are doing so independently. We hope that these institutions will set a good energy example for the rest of the community, just as we anticipate the City government will do.

Strategy #7. Advocate for State Policy and Participate in Innovative Utility Programs

State policy will have a significant effect on the relative ease or difficulty of achieving Concord’s 100% renewable energy goal, including the electricity portion of the goal.

Energy issues played a prominent role in the 2019 New Hampshire legislative session. At the EEAC’s recommendation, the City Council voted to take a position supporting enactment of HB 365 (raising the size limit on projects participating in the net metering program from 1 mW to 5 mW) and SB 286, the municipal aggregation bill.

⁴⁵ For example, the City of Newton, Massachusetts, runs a successful operating municipal aggregation program called Newton Power Choice. This program targets 60% renewable energy, and reportedly supplies power at or below the utility’s standard default service rate. For details, refer to the program web site: <https://masspowerchoice.com/newton>.

⁴⁶ As of this writing, SB 286 has passed both the Senate and the House and awaits the Governor’s signature.

Energy initiatives being discussed by the PUC and utilities could also affect implementation of this plan. A 2017 PUC order required New Hampshire electric utilities to develop pilot programs for time of use rates and non-wires alternatives. Specific proposals by utilities in response to this order include the following:

- Liberty Utilities Residential Time-of-Use Energy Storage Pilot Program. In January, the PUC approved a pilot program proposed by Liberty Utilities to use residential energy storage resources to reduce peak demand charges across its service territory in the Upper Valley.
- Eversource Westmoreland Clean Innovation Project. Eversource is in the process of developing a program to deploy a combination of targeted energy efficiency investments, residential batteries, and a larger grid-scale battery to address reliability issues in the town of Westmoreland.
- Eversource Oyster River Clean Innovation Project. Eversource is in the process of developing a community microgrid project in partnership with UNH and the Town of Durham. This project contemplates an interconnected system of distributed energy resources including solar energy and battery storage installations that would act as an island during extreme weather events with the purpose of ensuring that power serving UNH and critical Durham town facilities is not interrupted.
- Unitil Request for Information (RFI) for Non-Wires Alternatives. This spring, Unitil issued an RFI from energy project developers on potential non-wires alternatives projects to reduce load and deliver system relief in lieu of a distribution line upgrade in northern Concord and towns to the north. We do not know the results of the request, but we anticipate that Unitil will continue to explore alternatives to conventional “poles and wires” system upgrade projects in the future.

We can expect to see additional utility proposals and programs in the future.

The EEAC can track energy bills at the legislature, proposals at the PUC and potential program opportunities with the utilities and make recommendations to the City Council from time to time regarding steps the City can take. In particular, we look forward to the opportunity to partner with the utilities on innovative projects in Concord similar to those outlined above.

What Are ...

Time-of-Use (TOU) Rates?

TOU rates price electricity differently at different times of day, with higher rates when electricity demand is higher (e.g., late afternoon) and lower rates when electricity demand is lower (e.g., overnight). TOU rates send price signals that can stimulate customer behavior change or technology adoption to reduce peak loads and thus reduce system costs. In general, TOU rates tend to reward customers for installing clean energy technologies. Energy storage and electric vehicle charging are considered especially suited for use in conjunction with TOU rates.

Non-Wires Alternatives?

Non-wires alternatives are utility investments in electrical transmission and distribution systems or changes in operating practices that avoid or defer the need for conventional “poles and wires” projects and improve reliability by reducing congestion or system constraints at a lower cost to ratepayers.

Bring Your Own Device (BYOD) Programs?

Under a BYOD program, an electric utility rewards customer utilization of energy storage devices and other technologies and behavioral changes to respond to grid needs such as peak demand events. BYOD programs can stimulate competitive investment in emerging technologies such as energy storage, distributed generation, smart thermostats, electric vehicle charging stations, etc.

Microgrids?

A microgrid is a miniature version of the larger electrical grid, including both electrical demand/load and sources of electrical generation, with a balance between supply and demand. Typically, a microgrid is connected to and operates in conjunction with the larger electrical grid, and may at different times supply power to or draw power from the larger grid, but is capable of operating independent of the larger grid (“islanding”) and can operate when the larger grid is down. A microgrid may use any source of energy that is connected to the microgrid but increasingly use solar panels and battery storage. Microgrids vary in size – they might serve a building or a building complex or an entire community. Smaller microgrids can operate within larger microgrids.

Goal: 100% of Concord's Transportation is Clean Transportation by 2050

Strategy #1: Reduce Vehicle Miles Travelled (VMT)

Strategy #2: Prepare for the Installation of EV Charging Infrastructure.

Strategy #3: Transition City-Owned Vehicles to Clean Transportation.

Strategy #4: Transition CAT Buses to Clean Transportation.

Strategy #5: Encourage School Districts in Concord to Transition School Buses to Clean Transportation.

Strategy #6: Encourage and Facilitate the Transition to Electric Vehicles for the Private Sector.

Strategy #7: Ensure EVs Are Powered by Renewable Energy and Minimize Costs of Charging.

Introduction/Background

Today, nearly all of our transportation is powered by the combustion of gasoline or diesel fuel. The exhaust from this combustion contain several known or suspected carcinogens, and the particulates emitted contribute to lung disease (especially asthma) and heart disease for hundreds of thousands of people in the U.S. An MIT study from 2013 estimated that there are 53,000 premature deaths per year in the U.S. because of vehicle emissions, a number significantly larger than the number of deaths caused by vehicle accidents.

In addition, internal combustion engine (ICE) vehicles in the U.S. also emit over a billion metric tons of GHGs into our atmosphere each year, according to the EPA. Transportation accounts for up to 40% of the GHGs emitted in the U.S., making it the number one contributor of GHGs, ahead of electricity generation and thermal generation.

Concord's Transportation Baseline

Private Vehicles

According to Concord city records, there were 45,565 vehicles registered in Concord in 2018. Of this number, 40,273 were gasoline-fueled vehicles, 1,170 were diesel-fueled vehicles, 387 were hybrid electric vehicles and 27 were electric vehicles (EVs). The remainder were miscellaneous other vehicles.

There are at least five public electric vehicle charging stations in Concord – at the Centennial Inn, the Marriott Courtyard, the Residence Inn, the State Office Park on Hazen Drive, and Concord Nissan. Some of the chargers at these charging stations as Tesla chargers (good for use only on Tesla vehicles) and some are regular chargers (good for use on non-Tesla vehicles). Availability of the charging stations may be limited (e.g., the hotels generally limit availability to hotel guests). Residential EV and hybrid owners in Concord most likely have chargers installed at their homes.

City Government Vehicles and Public Transportation

Concord city government owns a fleet of vehicles that include police cars, fire trucks, emergency vehicles, general services vehicles, construction vehicles, snow plows, and other vehicles.

Concord School District and Merrimack Valley School District each own fleets of school buses. At present, none of the buses are electric buses, though both school districts are exploring the possibility of electric buses.

Public transit within Concord's borders includes Concord Area Transit (CAT) buses owned by CAPBMCI. Bus service from Concord to Boston and other locations is provided by Concord Coach Lines and Greyhound. There are currently no electric or hybrid vehicles in any of these public fleets.

For Concord to transition from using gasoline and diesel combustion powered vehicles, there are two paths: **first**, reduce the overall number of vehicle miles driven each year by increasing alternatives to driving, and **second**, transition to the use of vehicles that are powered by clean, renewable energy and support the development of appropriate infrastructure necessary for this transition

Clean Transportation Technologies and Methods

The cleanest form of transportation is that which is powered by the user, i.e. walking and bicycling. These modes are affordable and emit no GHGs other than the CO² exhaled by the user. Their practicality can be limited by the built environment so it is important that as Concord develops, special consideration be paid to the non-motorized connectivity of neighborhoods, recreational areas, and commercial centers, so that the non-motorized choice is not just the healthier and more environmentally-friendly choice, but also the most convenient.

Users in a well-connected environment can greatly benefit from amenities such as bike and ride share services. Bike-share systems are common in large cities all over the world. It is a simple concept where a user can rent a bike from a station, or off the sidewalk in a dock-less system and return the bike to another station close to their destination. Companies like Uber and Lyft provide ride share services that are already reducing the need for owning a car in cities across the globe. The Bicycle and Pedestrian subcommittee of TPAC has been exploring bicycle-share programs through various providers. Some of these providers offer electric-assist or E-bikes and electric scooters, which are attractive alternatives to pedal bikes in areas with hill or for users with long trips.



When self-propelled transportation is not practical, clean vehicles provide an alternative. “Clean Vehicles” include all vehicles that emit no gases other than water vapor. This includes both electric vehicles (EVs) and hydrogen fuel-cell powered vehicles (FCVs). Right now, EVs are what nearly all car manufacturers are gearing up to build, but FCVs may have a larger role in the more distant future.

Plug-in hybrid cars, which have both a battery powered motor and a combustion engine, and which may be charged at charging stations, offer better gas mileage (or equivalent) than an ICE vehicle, thereby reducing its emissions of pollutants and GHGs. These vehicles offer drivers a bridge technology, which allows them to use the electric motor for short trips and the combustion engine when the battery runs out of power. As EVs improve their range, charging stations become more ubiquitous, and battery prices decrease, most analysts believe that full EVs will replace plug-in hybrids over time.

Battery packs for EVs comprise a very large percentage of the vehicle’s cost, and battery prices have been falling rapidly over the years. Increased research and development, increased competition, and cost efficiencies from mass production of batteries are factors that lead analysts to conclude that battery prices will continue to fall over the coming years.

Total Cost of Ownership (TCO)

The TCO of many EVs is expected to be equal to that of a comparable combustion vehicle within the next few years, and some analyses show that EVs have already reached TCO parity with combustion vehicles in some parts of

the country. The TCO of a vehicle is the sum of the purchase price, the operating (“fuel”) costs, and the maintenance costs of the vehicle over its serviceable lifetime. It is expected that falling battery prices will cause EVs to reach purchase price parity with comparable combustion vehicles within 10 years.

New York City released a study on March 8, 2019 that analyzed fuel and maintenance costs for a sample of its light-duty passenger vehicles. The graphic above illustrates the impressive savings on

maintenance and fuel costs EVs offer. The Nissan Leaf is expected to save \$8,748 (21%) over a nine-year lifespan compared to the gas-powered Ford Fusion.⁴⁷

	Leaf (all-electric)	Prius (hybrid)	Fusion (gas)
Purchase price	\$25,797	\$22,984	\$22,866
Cost of fuel / yr	\$141	\$326	\$765
Maintenance / yr	\$317	\$859	\$1,287
EV charger	\$2,656	\$0	\$0
Ownership cost / yr	\$3,620	\$3,738	\$4,592
Total cost (9 years)	\$32,580	\$33,644	\$41,328

For Concord, it is likely that thousands of EVs will be driving, parking, and re-charging within city limits in the near future. One study projects that by 2030 there will be 273,000 EVs in New Hampshire, which by extrapolation means that Concord residents will own roughly 10,000 EVs by 2030.

Strategy Detail

Strategy #1. Reduce Vehicle Miles Travelled (VMT)

Just as energy efficiency steps are the simplest, most effective ways to reduce costs and energy-related GHGs in the electricity and thermal sectors, so it is with transportation. The cheapest and cleanest mile is the mile not driven.

To reduce the use of vehicles we need to have access to reasonable alternatives: enhanced public transportation, increased pedestrian-friendly and bicycle-friendly infrastructure, incentives for carpooling, etc. The Concord Transportation Policy Advisory Committee (TPAC) has worked diligently to help Concord promote these alternatives to driving. The EEAC will be coordinating with TPAC closely as we go forward.

TPAC has supported two projects that are specifically geared towards reducing VMT:

- The Merrimack River Greenway Trail, which will provide a non-motorized link between Loudon Road and Manchester Street along the river as well as serving as a larger recreation trail through the City.
- A redesign of Loudon Road from the Merrimack River bridge to Hazen Drive. This project will provide protected bike lanes, shaded sidewalks, and driveway crossing improvements to make the Gully Hill section of Loudon Road safer and more accessible for non-motorized travel.

TPAC is also involved in other initiatives identified in the Bicycle and pedestrian Master Plans, including:

- Traffic management initiatives such as traffic circles which keep traffic flowing and reduce fuel consumption.
- Complete Street initiatives which promote multi-modal use of the City’s roads, as exemplified by the bike lanes on North State St./Fisherville Rd.

⁴⁷ <https://qz.com/1571956/new-york-city-says-electric-cars-cheapest-option-for-its-fleet/>

- Working with CAT and its operators to improve public bus routes and service.
- Researching the feasibility of a bike share program in Concord.
- Supporting bicycle and pedestrian demonstration projects to build community support for permanent infrastructure changes.
- Continuing to develop creative design solutions to problem corridors and intersections as identified in the Pedestrian and Bicycle Master Plans.
- CommuteSmart NH – a program managed by the CNHRPC that provides resources and information to encourage alternatives to drive single-occupancy vehicles to work.

The EEAC supports all of these initiatives.

Another idea is to explore the feasibility of other alternatives to combustion vehicle use, including promoting the use of electric bikes and electric scooters.

Strategy #2. Prepare for the Installation of EV Charging Infrastructure

EVs require charging stations. These can be at home for those people who have a garage or private driveway. For our residents who do not have the ability to home charge, we need to plan for and facilitate the building of a charging infrastructure. We will need chargers in our parking garages, in long term parking spaces, in parking lots of businesses and apartment complexes. What types of chargers, where they are located, who builds them, owns and operates them, and how they are regulated to ensure fairness will all be determined by a combination of market forces along with planning, facilitation, permitting, and oversight by the City. This means putting in place a simple, easy-to-understand, and stable regulatory environment so that individuals and businesses may proceed to build this infrastructure without undue delay.

In order to begin the process of facilitating and encouraging the development of an EV charging infrastructure, several of the City's divisions will need to be involved, notably, Planning, Engineering, Code Administration, and General Services. The City's building and electrical codes will need to reflect the intrinsic characteristics and infrastructure needs of the various levels of charging stations to facilitate an easy installation process.

Current public charging infrastructure options include the Level 2 charger (240 volts AC) which takes about 8-10 hours to recharge an EV and the Level 3 charger which charges an EV in 30-60 minutes depending on available power and delivery infrastructure. The less powerful Level 2 chargers are appropriate for long-term parking lots, workplaces, long-term street parking spaces, etc. These faster Level 3 chargers or "superchargers" are getting more powerful every year so that charging times are beginning to decrease. They may be appropriate for downtown Concord, restaurant parking lots, shopping centers, etc. These require 3-phase power and conversion to DC electricity which makes them considerably more expensive to install than Level 2 chargers. The EEAC will need to provide the Planning and Engineering Services Divisions information on the intrinsic needs and characteristics of charging stations in order to expedite selection of sites where chargers are most appropriate given current infrastructure conditions. The EEAC can also work with private developers to construct infrastructure that is easily upgradeable.



With a clear understanding of the infrastructure needs of charging facilities, future planning and engineering can begin for locating Level 2 and Level 3 EV chargers on City-owned properties for City use and public use. Possible locations include City-owned parking garages, the police station, the fire stations, the General Services building and possibly select on-street parking spaces. Pre-planning for future charging infrastructure could save the City money through efforts such as installing conduits when sidewalks or roads are being excavated.

Code updates, site plan regulation updates, and zoning amendments will be necessary to ensure a clear process for charging station permitting & installation, and to prepare to regulate the private development of EV chargers. Outreach to large landlords in the City will be important to ensure the placement of EV infrastructure meets the needs of the broader community.

Strategy #3. Transition City-Owned Vehicles to Clean Transportation

Virtually all of the City's own light vehicles are police cruisers, pickup trucks, 4-wheel drive SUVs, and vans. These types of vehicles are not yet being mass-produced as EVs, but they are expected to be in the next 3-5 years. When the TCO of these types of vehicles is comparable to combustion vehicles, the City can begin to gradually introduce EVs into its municipal fleet.

To implement this strategy, Concord can develop a municipal government purchasing plan for gradually introducing EVs into the City's fleet. Concord can begin replacing vehicles in its fleet with EVs as soon as the transition is economically advantageous. This purchasing plan would include a Total Cost of Ownership analysis for the vehicle, excluding the cost of charging infrastructure. The EEAC can work with the City to pursue available grants to offset the costs of clean vehicle replacement and construction of EV charging stations, including monies from the Volkswagen Settlement Fund, distributed by the NH Department of Environmental Services.

Strategy #4. Transition CAT Buses over to Clean Transportation

The CAT buses providing service to the residents of Concord are operated by CAPBMCI through an agreement with the City of Concord. The City provides matching funds for federal monies to purchase the buses and a portion of the operating expenses. In addition to its fixed routes, CAPBMCI also provides demand-response transportation services



for elderly and handicapped residents. Several of the CAT buses have been purchased recently, and those buses are expected to have an operational life of about 10 years. Electric transit buses are just beginning to emerge as an alternative to combustion powered buses and are gaining popularity in several large cities throughout the world. It will probably take several years before their cost (on a TCO basis) reaches parity with traditional combustion powered buses. By the time CAT needs to replace its recently purchased buses, electric buses should be the cost-effective option. Planning and engineering for transit bus charging infrastructure will have to be in place, however.

Actions to implement this strategy include tracking the TCO of electric transit buses and compare to the TCO of combustion transit buses over the next several years. The EEAC can communicate with the City and with CAPBMCI about the feasibility and optimal timing of transitioning the CAT buses, trolleys, and other vehicles it may operate, to electric power. Concord can plan and engineer for charging infrastructure for the CAT transit buses and other vehicles it operates in Concord.

Strategy #5. Encourage School Districts in Concord to Transition School Buses to Clean Transportation

Both Concord School District and Merrimack Valley School District have indicated interest in converting their school buses from combustion vehicles to electric. Electric school buses are being developed by several established and well-known school bus manufacturers, but the costs today, even using TCO analysis, are still too expensive relative to combustion vehicles. As more are produced due to purchases by early adopters (e.g. in California), we can expect to see prices drop. The charging infrastructure for these school buses is likely to be specialized and require significant power, so planning and engineering for this can take place well in advance of the fleet transition.

The EEAC can work with appropriate school personnel from both school districts to track availability of electric school buses. The EEAC can work with both school districts to track the TCO of new electric school buses vs. new combustion engine vehicles, over the coming years. The EEAC can encourage both school districts to be ready to

purchase and integrate electric buses into their fleets as they become cost-effective. The EEAC can encourage both school districts to begin planning for charging infrastructure for electric school buses and their other vehicles.

Strategy #6. Encourage and Facilitate the Transition to Electric Vehicles for the Private Sector

It is important to emphasize that the transition to EVs will be driven strictly by economics and market forces, and not by any mandate by the City. Once it has become clear that EVs are less expensive than combustion vehicles, and charging is not an impediment to their purchase, the transition will rapidly accelerate. Bloomberg Finance projects EV sales will jump from 1.1 million worldwide in 2017, to 11 million in 2025, and then to 30 million in 2030 as they become cheaper to manufacture than combustion vehicles. The EEAC can help keep the public informed about the advantages of clean powered vehicles through educational outreach, vehicle demonstrations, and website information. Providing the public with information about available charging infrastructure will be critical.

The EEAC can work to inform the residents and businesses of Concord of the advantages of EVs over combustion vehicles, including: the importance of zero emissions to public health, the contribution EVs make in reducing Climate Change, the lower operating costs and lower maintenance costs, the increased torque and performance, etc. The EEAC can partner with organizations and automobile retailers to hold EV demonstrations and test drives for residents to see and drive EVs for themselves. It would be beneficial to consider extending the property tax exemption for on-site solar generation to include EV chargers for on-site use and simplifying and clarifying the permitting and inspection process for residences, and businesses to install EV chargers.

Strategy #7. Ensure EVs Are Powered by Renewable Energy and Minimize Costs of Charging

EVs today, powered by our current less-than-clean electric grid, are still far cleaner than combustion vehicles. When calculating the indirect CO₂ emissions of an EV which receives its charging from the present-day grid, it is still about 60% cleaner than a comparable combustion vehicle. To accomplish our goal of using 100% renewable energy for transportation, however, we must gradually increase our overall amount of clean electricity to accommodate the increased load of charging the new EVs that are coming.

To mitigate the effects of these increases in electricity use, we will want to encourage NH electric utilities to implement “smart” metering and TOU pricing, discussed in Chapter 3, in order to incentivize EV owners to charge their vehicles in off-peak, low demand times, such as after 9:00 PM. Some have proposed that using more electricity at night could actually *reduce* overall kWh rates because the significant fixed costs of the grid would be spread out throughout a 24-hour period where electricity is being sold, rather than the typical 16-hour period.

Analysts are also predicting that the battery packs in EVs will someday play a role as an energy storage system, and could be used to collect energy when it is cheap and give it back to either the home of its owner to use or to the grid when it is in great demand and therefore expensive (assuming the EV is idle).

Conclusion

In pursuing the transportation goal, we must account for the electrical power needed for transportation when we estimate how much clean renewable energy we will need in the future. The EEAC can explore whether Concord can advocate for a TOU pricing structure and “smart” metering, so that EVs can be charged at night and benefit from reduced non-peak, low-demand rates, and make appropriate recommendations to the City.

Goal: 100% Renewable Thermal Energy (Heating and Cooling) by 2050

Strategy #1: Facilitate transition to renewable thermal sources by city government.

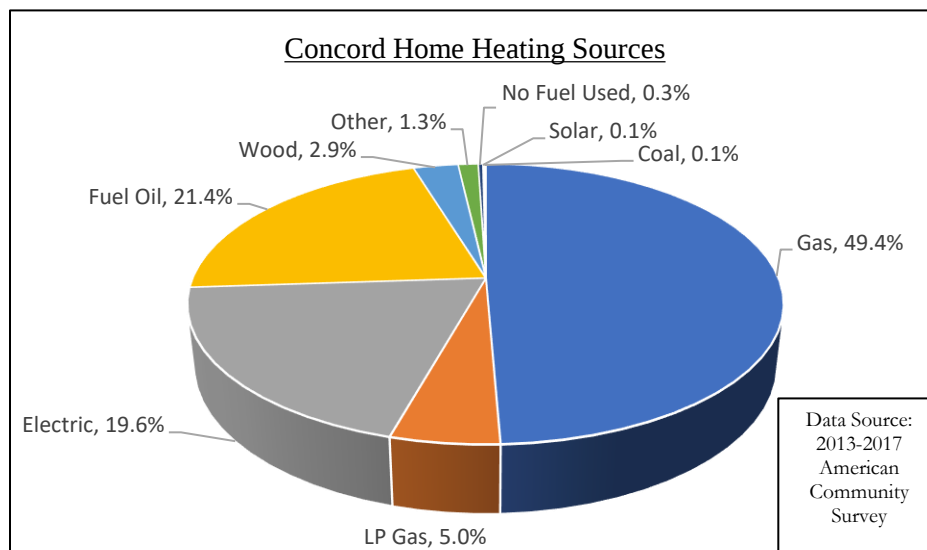
Strategy #2: Facilitate transition of community members to replace old heating systems with renewable thermal resources.

Strategy #3: Explore opportunities for district heating and co-generation.

In the United States, heating and cooling account for more than 25 percent of total energy use across residential, commercial, and industrial sectors at a cost of \$270 billion annually. Most heating systems run on fossil fuels, which are either burned on-site or used to generate the electricity that powers the heating system. As a result, the heating and cooling of buildings contributes significantly to GHG emissions and climate change.

Concord's Thermal Energy Baseline

In Concord, most homes, businesses, and government buildings are heated with fossil fuels (the chart below shows heating sources for homes). Many downtown buildings were recently converted to natural gas heat, following the closure of the Concord Steam plant in 2017. Because we rely so heavily on fossil fuels for our heat, there is great opportunity to reduce emissions in Concord by reducing the use of fossil fuel heating and converting buildings to renewable thermal systems. Given existing infrastructure there are future possibilities to convert fossil fuel heating systems to renewable sources.



Community-wide Thermal Energy Consumption

Concord's homes and businesses are generally heated by furnaces or boilers that burn natural gas, oil or propane, along with a scattering of wood pellet stoves and other biomass applications. Liberty Utilities, a regulated gas utility, supplies natural gas to Concord customers. There are a number of heating oil and propane suppliers serving Concord.

There are approximately 1,400 commercial gas customers in Concord consuming approximately 11 million therms of natural gas annually.

Much of downtown Concord recently converted its thermal energy supply from steam heat supplied by Concord Steam to natural gas supplied by Liberty Utilities.

At this point, there is limited deployment of renewable thermal energy in Concord. Among renewable thermal energy projects in operation are a biomass heating facility at Merrimack Valley High School, a biomass heating facility at the State office park on Hazen Drive and solar thermal hot water systems at certain City facilities.

City Government Thermal Energy Consumption

Nearly all of Concord city government's space heating needs are met by natural gas, after the conversion from Concord Steam. The City has a contract for natural gas with Direct Energy that expires in June 2020. The Penacook Library is fueled by heating oil, and the Hall Street wastewater treatment plant uses kerosene and diesel fuel.

Concord Steam

The Concord Steam plant began operation in 1938. Originally fueled by coal, the plant switched to biomass in the 1970s to produce the steam that heated 180 downtown buildings. After its closure in 2017, most of those buildings have been converted to natural gas heating systems.

Thermal Efficiency and Conservation

As with electricity, the best way to cut emissions from heating and cooling is to reduce demand. Reduced demand can be achieved through conservation and increased energy efficiency. Conservation refers to simply forgoing the use of heating and cooling systems, such as choosing to stay warm in the winter with blankets and sweaters rather than turning the thermostat up. Increased efficiency can include using newer and more efficient appliances, as well as ensuring that the building is well-insulated and free of air leaks.

Renewable Thermal Technologies

Emissions can also be reduced by using renewable thermal sources instead of fossil fuels. Renewable heating, ventilation and air conditioning (HVAC) systems can be used in conjunction with traditional fossil fuel-based systems (thus reducing the total amount of fossil fuels used) or can completely replace a traditional heating system. Examples of renewable thermal technologies include: geothermal, biomass, biogas, solar thermal, and hydrogen gas.

Geothermal. Geothermal technology harnesses the heat generated by the Earth. There are three main types of geothermal heating systems: direct use geothermal, enhanced geothermal, and ground-source heat pumps. In New Hampshire, ground-source heat pumps are already in use, and 1,230 new systems are installed each year.⁴⁸ Heat pumps are used in both single-family residences and in public and commercial facilities. Examples include the Kingswood Regional School in Wolfeboro, the Cheshire County House of Corrections in Keene, and the Merrimack County Nursing Home in Boscawen.

Biomass. Biomass is fuel that is created from organic materials, such as plants or biological industrial wastes. The organic material (or "feedstock") must be converted to usable energy through one of many processes, including combustion, gasification, and anaerobic digestion. For example, burning wood chips in a home woodstove or in an industrial boiler are examples of biomass thermal energy. In Concord, Merrimack Valley High School and Middle School have been heated by a highly efficient biomass boiler since 2006.

Biogas and Bio-Synthetic Gas. Biogas and bio-synthetic gas can be used to heat buildings in the same way that natural gas is used. Both types of gas are produced from biomass. Biogas is formed by the anaerobic (without oxygen) decomposition of organic material. Bio-synthetic gas is created by a chemical process that involves the gasification of biomass materials. The Wastewater Treatment Facility in Nashua currently uses an anaerobic digester to produce biogas. Concord can explore the possibility of a similar project at the Hall Street Wastewater Treatment Plant or the Penacook Wastewater Treatment Plant.

Solar Thermal. Solar thermal technologies capture the heat energy from the sun and use it to heat a building. This is different from photovoltaic solar panels, which directly convert the sun's radiation to electricity. There are two main types of solar thermal systems for energy production—active and passive.

⁴⁸ Hongoltz-Hetling, Innovation, Or Just Hot Air? Heat Pumps Gain Popularity in Cold Weather Climates (Mar. 25, 2018), <https://www.vnews.com/Heat-pump-report-16048079>.

Active systems require moving parts like fans or pumps to circulate heat-carrying fluids. Passive systems have no mechanical components and rely on design features only to capture heat (e.g. greenhouses). Solar water heaters can be used in conjunction with conventional heaters and can reduce a typical heating bill by 50–80%.⁴⁹ The New Hampshire Renewable Energy Fund currently offers rebates for both residential and commercial/industrial solar thermal projects.

Hydrogen Gas. Hydrogen gas (H₂ gas) can be used for heating buildings just as natural gas is used. Burning hydrogen produces only water and heat, so it is an emissions-free renewable thermal resource. The widespread use of hydrogen for heating (and many other energy applications) has long been challenged by the high costs of producing, storing, and converting it into useable forms of energy. However, recent technological developments may mean that a viable hydrogen economy is closer than ever, and certain countries are already experimenting with H₂ gas heating. In England, for example, Keele University will launch a pilot project this year called “HyDeploy,” and in northern England three natural gas companies have proposed a detailed engineering plan, known as “H21 North of England,” for converting the gas networks across the region to hydrogen between 2028–2034.⁵⁰

Thermal Delivery Methods

In addition to using renewable sources, there are also several design strategies that can be used in order to reduce emissions from heating-ventilation-air-conditioning (HVAC) systems. These strategies include electrification, cogeneration, and district heating.

Electrification. Electrification refers to electrifying end uses that were historically powered by fossil fuels, such as heating and cooling. The electrification of heating and cooling systems can be accomplished by supplementing or replacing fossil fuel systems with electric heat pumps. Heat pumps use less energy than fossil fuel-systems to heat the same amount of space, thus reducing emissions. Emissions are reduced even further if the electricity used to run the heat pumps is generated using renewable sources. Because electricity is increasingly generated from renewable sources, the electrification of HVAC systems is seen as one of the most promising means of reducing the emissions currently associated with heating and cooling.

Cogeneration. Cogeneration or Combined Heat and Power (CHP) involves producing electricity from a specific fuel source, such as natural gas, biomass, coal, or oil. Cogeneration captures the excess heat which would otherwise be wasted (wasted heat typically makes up 2/3 of the energy input to generate the electricity). In 2016, there were 17 cogeneration facilities in New Hampshire, including at hospitals, colleges and universities, government buildings, commercial buildings, and other sites.⁵¹ While cogeneration in the U.S. is mostly used in large facilities, it is also possible to use it in the home. This is known as residential cogeneration or “micro CHP,” and is more prevalent in Europe and Asia. However, some analysts are predicting a growth in residential cogeneration in the U.S. in the next several years.

District Heating. In a district heating system, heat is generated in a central location and then distributed to a network of buildings using insulated pipes. A district heating system can produce heat more efficiently than a single-building heating system (thus reducing emissions), and can also utilize renewable technologies that might not be cost effective for individual building owners to install. District heating is popular on university campuses, and is also used effectively in downtown areas. For example, District Energy St. Paul uses hot water to heat approximately 85% of the city’s “downtown corridor,” produced primarily by burning biomass.

⁴⁹ New Hampshire Public Utilities Commission, Renewable Energy Technologies (Mar. 11, 2019), <http://www.puc.state.nh.us/sustainable%20energy/RenewableEnergyTechnologies.html>.

⁵⁰ Sadler, H21 North of England (Nov. 2018), <https://northerngasnetworks.co.uk/h21-noe/H21-NoE-23Nov18-v1.0.pdf>; Shrestha, New UK Hydrogen Gas Network Trial Cleared By HSE (Nov. 6, 2018), <https://www.energylivenews.com/2018/11/06/new-uk-hydrogen-gas-network-trial-cleared-by-hse/>.

⁵¹ U.S. Department of Energy, The State of CHP (last accessed Mar. 11, 2019), <https://www.energy.gov/sites/prod/files/2017/11/f39/StateOfCHP-NewHampshire.pdf>.

Renewable thermal technologies can be used on a number of scales. On the small scale, homeowners can install boilers, heat pumps, and other systems that run on renewable fuel. Larger facilities, such as schools and hospitals, can install technologies like industrial biomass boilers. One consideration that a building owner will need to take into account is whether the building's current HVAC system can be adapted to run on the desired renewable source, or whether the installation of an entirely new system will be required. This will depend in part on the type of distribution system that the building uses (forced air vs. radiant heating, furnace vs. boiler, etc.)

Cost Effectiveness

The cost of installing and operating a renewable thermal system can vary widely and depends on a number of factors. On the residential scale, homeowners can contact local HVAC vendors for an estimate of installing a renewable system in their home. Many vendors will provide an initial quote for free. As far as estimating annual operation costs, New Hampshire homeowners may find it helpful to use the online comparison tool developed by Efficiency Maine (partly shown in the screenshot below). Efficiency Maine offers a similar tool for home water heating systems.

Decrease		Increase		Reset		CALCULATE	
Fuel Type (Units)	Cost per Unit Delivered	Heating System	See Details	Annual Cost			
1. Firewood (cord)	\$ 250	wood stove	☐	\$ 1,039			
2. Electric (kWh)	\$ 0.16	ENERGY STAR® geothermal heat pump	☐	\$ 1,142			
3. Electric (kWh)	\$ 0.16	Ductless heat pump	☐	\$ 1,247			
4. Natural Gas (ccf)	\$ 1.73	parlor stove	☐	\$ 1,592			
5. Wood pellets (ton)	\$ 258	pellet stove	☐	\$ 1,610			

Home Heating Cost Comparison Tool by Efficiency Maine (www.energycmaine.com)

For homeowners interested in electric heat pumps, the American Council for an Energy-Efficient Economy (ACEEE) offers a comparison tool specific to electric heating systems, with an emphasis on “payback periods” (screenshot below). New Hampshire homeowners can also take advantage of heat pump rebates offered through the NHSaves program.

Original Heat Source	Replacement Heat Source	Typical Payback Period
Oil or Propane Furnace	High-efficiency Electric Heat Pump	1 – 2 years*
Oil Water Heater	Electric Heat Pump Water Heater	Immediate
Oil Boiler	Ductless Heat Pumps	4 – 7 years*
Propane Water Heater	Electric Heat Pump Water Heater	4 years
Propane Boiler	Ductless Heat Pumps	8 – 16 years*

Source: ACEEE (www.aceee.org)

Industrial entities in Concord might consider joining in national initiatives to make renewable heating and cooling more cost-effective. For example, the Renewable Thermal Collaborative (RTC), a coalition of corporations and other organizations, encourages businesses to sign its Renewable Thermal Buyer's Statement, a call-to-action with the intent of driving more renewable thermal options for industrial businesses. More information about RTC and the Buyer's Statement is available at renewablethermal.org.

Strategy Detail

Strategy #1: Facilitate Transition to Renewable Thermal Sources by City Government.

After the closing of the Concord Steam plant in 2017, many downtown municipal buildings were converted to natural gas heating. While re-converting those buildings to renewable thermal systems may not be economically feasible in the near future, the City can identify other municipal buildings that could be converted to renewable thermal in the next several years. In addition to targeting individual buildings, the City can explore possibilities for a new renewable-based district heating system. Finally, the City can explore innovative large-scale projects, such as using biogas generated at the Hall Street Wastewater Treatment Facility or the Penacook Wastewater Treatment Plant to heat local homes and businesses.

Strategy #2: Facilitate Transition of Community Members to Replace Old Heating Systems with Renewable Thermal Resources.

Most Concord residents rely on fossil fuels to heat their homes. There is therefore great opportunity to reduce local greenhouse gas emissions by converting residential buildings to renewable thermal heating and cooling. The most important step toward this goal will be empowering homeowners with the information and resources that they need to make the transition. A dedicated website, for example, could offer information on the various types of renewable home heating systems that are available on the market, as well as direct homeowners to resources like the WAP or the NHSaves program.

Strategy #3: Explore opportunities for district heating and co-generation.

As new facilities are constructed, the City can identify opportunities to install cogeneration systems. The City can also study the feasibility of retrofitting existing facilities with cogeneration systems. There are many resources available online to help guide municipalities on cogeneration projects, such as the EPA's *Combined Heat and Power: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs*. The City can also consult with New Hampshire companies that have experience with cogeneration systems.

Similarly, there are resources available to help communities with the implementation of district heating systems, such as the EPA's *District-Scale Energy Planning* guide. The City can consult with regional entities that have knowledge or experience with district heating systems, such as the city of Montpelier, Vermont or the International District Energy Association (IDEA), which is headquartered in Massachusetts.

The existing but presently dormant Concord Steam lines throughout downtown Concord may provide a conduit for the delivery of future renewable thermal energy sources.

Conclusion

One of the challenges of transitioning to renewable thermal technologies is that the conversion must take place on a building-by-building basis. There is no “thermal grid” equivalent to the electricity grid, meaning that building owners cannot simply plug into a system that is carrying renewable thermal heat. The transition will instead rely, at least at first, on the initiative of individual building owners to reduce their demand and to convert to renewable thermal technologies.

Chapter 6 TARGET SETTING, MONITORING AND REPORTING

Goal: Establish a data-driven system for tracking progress toward Concord's 100 Renewable Energy Commitment.

Strategy #1. Refine strategies and actions into quantitative, time-defined and measurable goals for management actions and interim emissions targets through a participatory process. Establish a monitoring process towards these goals using accepted standards.

Strategy #2. Build a web-based energy and emissions dashboard that city staff and the public can use to view progress towards the goals.

Target setting, monitoring progress, and reporting help to ensure the successful implementation of Concord's 100% Renewable Energy strategy. There are two levels at which this can occur: (1) at the meta-level, for tracking broad-scale trends in the city's energy consumption and emissions; and (2) at the strategy level.

Strategy Detail

In Chapters 3, 4 and 5 and [Appendix B](#), we presented baseline energy consumption and emissions profile for the City, from which the City aims to achieve reductions over time. It is wise to include interim reduction targets and collect data at relevant intervals to ensure we are on track to meet our 2030 and 2050 goals. The *Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories: An Accounting and Reporting Standard for Cities*⁵² provides an accepted standard for measuring and tracking emissions at the municipal level over time. In addition, the *EPA Portfolio Manager*⁵³ provides a benchmarking and tracking tool for individual buildings, with can also be helpful for municipal properties in particular.

Strategy #1: Refine Strategies and Actions into Quantitative, Time-Defined and Measurable Goals

While knowing about broad scale trends in city-wide energy consumption and emissions is useful to review progress at the meta-level, the same process needs to occur for individual goals, strategies and even actions to monitor progress at finer scale. Where not already done, strategies need to be refined into quantitative, measurable, time-defined targets. Relevant indicators need to be identified to establish baselines and monitor progress. For example, goals can be established around the number of homes that receive energy efficiency renovation and renovations by a certain date. This can be an iterative, expert-based process in order to uncover the data that exists and that will be available over time, and to ensure benchmarks are realistic.

Strategy #2: Build a Web-Based Energy and Emissions Dashboard to Track Progress Toward Goals

We envision a web-based tool that will display and track Concord's progress towards the different goals related to energy efficiency, our energy portfolio, and our carbon footprint. This tool may also be participatory and aid in data collection. There are already models available, such as the Vermont Energy Dashboard⁵⁴ and MassEnergyInsight,⁵⁵ that Concord can draw from to design a tool that best fits our needs. Overall, this goal focused on tracking, monitoring and reporting ensures that we meet our energy transition goals, while promoting transparency, and engaging and motivating the public.

⁵² World Resources Institute (WRI), C40 Cities, Local Governments for Sustainability (ICLEI). 2014. Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories: An Accounting and Reporting Standard for Cities. Available at: http://c40-production-images.s3.amazonaws.com/other_uploads/images/143_GHGP_GPC_1.0.original.pdf?1426866613. Accessed on: March 2, 2019.

⁵³ United States Environmental Protection Agency (US EPA). 2019. Energy Star Portfolio Manager. Available at: <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager>. Accessed on April 23, 2019.

⁵⁴ Energy Action Network Vermont (EANVT). 2019. Vermont Energy Dashboard. Available at: <https://www.vtenergydashboard.org/>. Accessed on: March 2, 2019.

⁵⁵ Massachusetts Department of Energy Resources (MASS DOER). 2019. MassEnergyInsight. Available at: <https://www.massenergyinsight.net/home>. Accessed on: March 2, 2019.

Chapter 7 IMPLEMENTATION

Goal: Assure successful implementation of Concord's 100% Renewable Energy Strategy

Strategy #1. Enable successful 100% Renewable Energy strategy implementation by hiring city energy staff

Strategy #2. Raise awareness and motivate public participation toward the 100% Renewable Energy Goal

Strategy #3. Ensure that city planning documents and codes are aligned with the 100% Renewable Energy goal and strategy

Concord's 100% Renewable Energy goal is ambitious. Assuring the successful transition to renewable energy sources will require coordinated effort by a range of stakeholders. This will involve ongoing leadership by the City, cooperation among entities, and general public awareness and motivation. Strategies designed to address these implementation challenges involve building the necessary capacity within the City to lead on projects, raising awareness and motivating the public through initiatives such as a City-sponsored energy website, and updating City planning documents to ensure that City policy is aligned with the 100% Renewable Energy strategy.

Strategy Detail

Strategy #1: Enable Successful Implementation of Strategic Plan by Hiring City Sustainability Staff

We recommend that the City hire one or more staff to take leadership on implementation of the 100% Renewable Energy goal in order to position the City for a successful process and outcome. Planning department staff are currently stretched to the maximum and cannot absorb the tasks of this plan. In addition, the City cannot rely on volunteers for daily implementation of this plan over time. The benefits achieved by such additional staff in terms of energy savings should enable the position to pay for itself over time.

The responsibilities of this staff person could include the following:

- Identify energy efficiency and renewable energy projects for the City to pursue.
- Administer and coordinate energy efficiency and renewable energy projects approved by the City.
- Identify pockets of capacity within the City to take leadership on different parts of the plan as appropriate
- Administer the City's municipal aggregation program (if adopted).
- Administer and update the City's energy web page (described below).
Facilitate community awareness of energy efficiency information and opportunities.
- Build a Concord solar fund, by researching and applying for grant money available for energy efficiency and renewable energy projects, and designing distribution
- Coordinate data gathering, monitoring and reporting of progress towards goals

Strategy #2: Raise Awareness and Motivate Public Participation in the 100% Renewable Energy Goal through Initiatives Including Building a City Energy Website

Engaging public participation in the 100% Renewable Energy goal is essential, since much of the success of the goal relies on the efforts of individuals and organizations. Initiatives to promote awareness and motivate the public include educating the public at city events, implementing programs in schools, the launch of an energy (or sustainability) website, and the preparation of hard-copy awareness materials.

A City energy/sustainability website would serve several functions, including:

- Information portal: How individual residents and businesses can pursue energy efficiency and renewable energy measures to save money. It would also include links to outside resources.
- Options for community members to network and share information

- Energy dashboard for the City, perhaps including a carbon footprinting tool (discussed in Chapter 6)
- One-stop permitting shop
- Identify opportunities for Concord residents to participate in local community solar projects.
- Promote the work the City is doing

Strategy #3: Ensure that City Planning Documents and Codes Are Aligned with the 100% Renewable Energy Goal and Strategy

Successful implementation of the 100% Renewable Energy strategy requires that City efforts and policies are aligned with the plan. For example, the energy chapter in the Master Plan will be re-written to reflect the 100% Renewable Energy goal and the strategic plan. In addition, City codes can be updated to facilitate easy adoption of renewable technologies, such as solar, wind, storage, and EV charging. Finally, we see this plan as a living document in a rapidly evolving policy, economic, and technological landscape. It can be updated every 5 years or as needed.

Chapter 8 TABLE OF RECOMMENDED ACTION STEPS

This Chapter 8 lists recommended action steps to implement the strategies outlined in Chapters 2 through 7. The actions steps mainly consist of steps to be taken in the next five years. Action steps beyond that timeframe will be developed as this plan is updated over time.

<u>Goal: Pursue Cost-Effective Energy Efficiency Projects Early and Often</u>			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1: Benchmark Municipal Government Energy Use with EPA Portfolio Manager.			
1. Sign up for and take advantage of free technical assistance and training for municipal staff using ENERGY STAR EPA Portfolio Manager.			
2. Partner with utilities to streamline energy use/cost data access and analysis.			
Strategy #2: Prioritize High Impact Municipal Government Energy Efficiency Upgrades.			
1. Conduct comprehensive energy audit of municipal facilities and implement recommended upgrades.			
2. Implement LED streetlight conversion (with smart controls).			
3. Implement cost-effective energy savings measures at wastewater treatment facilities			
4. Implement smart networked lighting controls in municipal buildings and facilities			
Strategy #3: Prioritize High Impact Low/Moderate Income Community Energy Efficiency Upgrades.			
1. Discuss energy audits, potential projects and funding opportunities with owners of low/moderate income complexes, landlords, homeowners and tenants.			
2. Seek a comprehensive energy audit of low/moderate income community buildings.			
3. Consider setting a goal to reduce per capita annual energy consumption in low/moderate income communities.			
Strategy #4: Facilitate Community-Wide Energy Efficiency Improvements Through Public Education and Partnership with NHSaves Program.			
1. Conduct public education, including Button Up Workshops and Weatherize Campaigns partnering with utility efficiency departments, with support from Vital Communities, Clean Energy NH, others.			
2. Include information on rebate opportunities offered by NHSaves within any relevant communication materials the City may already be providing to residents.			
3. Enable conservation through better data access and data platforms including online dashboard to help residents, businesses understand actions neighbors are taking to reduce carbon footprints, energy costs.			
4. Expand energy curriculum in Concord Schools (e.g., NH Energy Education Project offers teacher professional development, in-			

class workshops for students, and curriculum resource kits).			
Strategy #5: Develop Local Policies That Encourage Energy Efficiency and Track State Legislation.			
1. Adopt policy that sets a minimum standard for energy efficiency measures in all new municipal buildings (e.g., Portland, Maine).			
2. Adopt new building code standards to ensure latest energy efficiency techniques and most recent construction standards are used.			
3. Enact a building energy rating and disclosure ordinance.			
4. Track state legislation on energy efficiency.			

Goal: 100% Renewable Electricity by 2030			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1: Transition Concord City Government Electricity Consumption to 100% Locally-Generated Renewable Energy at the Earliest Opportunity.			
1. Issue RFP seeking proposals by solar developers to develop solar projects at the Old Turnpike Road landfill, Hall Street wastewater treatment plant and Hutchins Street water treatment plant.	August 2019	City Staff	
2. Investigate solar energy potential at other municipal properties.			
3. Include an assessment of the suitability of solar in all new City building projects including renovations.			
Strategy #2: Prioritize Making Solar/Renewable Electricity Available to Low/Moderate Income Residents at the Earliest Opportunity.			
1. Work with low/moderate income housing owner/providers, tenants, the utilities, CAPBMCI, the NHHFA and other parties to plan and develop solar projects to serve low/moderate income residents.		EEAC	
Strategy #3: Streamline and Clarify Permitting Processes to Encourage Installation of Renewable Energy Projects within Concord's Borders			
1. Adopt solar ordinance clarifying the permitting process to site different forms of ground-mounted solar projects in Concord.	August 2019	City Council	
2. Clearly communicate the process for obtaining permits to install roof-mount and other solar projects; consider establishing an on-line permitting portal for submitting building and electrical permit applications.			
3. Consider amendments to zoning ordinance to address energy storage projects in relatively near future.			
4. Work with Unitil to identify optimal locations for energy storage projects in Concord.			
5. Work closely with CNHRPC on regional energy considerations.			

Strategy #4: Offer Local Incentives for Renewable Energy Projects Where Appropriate.			
1. Continue to utilize PILOT agreements to incentivize renewable energy projects.			
2. Consider whether to extend existing solar property tax exemption for a longer period than 10 years.			
3. Consider whether to offer property tax exemption to other kinds of energy projects within parameters of RSA 72.			
4. Consider other kinds of local incentives for energy projects deemed desirable by the City.			
Strategy #5: Serve as Information Resource for Concord Residents and Businesses Seeking to Generate Their Own Renewable Energy			
1. Use City website, social media platforms and other communication tools to allow City to serve as a public information resource for Concord residents.			
2. Facilitate active public education campaigns from Solar 101 Workshops to Solarize Campaigns, or other programs.			
3. Facilitate or encourage solar panel purchasing pools.			
Strategy #6: Convert Grid Power in Concord to 100% Renewable Electricity by Municipal Aggregation			
1. Investigate the feasibility of a municipal aggregation program for Concord.			
2. Investigate the possibility of pooling energy purchases with other communities pursuing similar goals to increase purchasing power.			
3. Discuss the 100%RE goal with major institutions in Concord and persuade them to align their own energy decisions with the goal.			
Strategy #7: Advocate for State Policy That Helps Concord Achieve its 100%RE Goal; Participate in Innovative Utility Programs			
1. Track legislative, regulatory and utility program developments with regard to renewable energy policy.	Ongoing	EEAC	
2. Take positions on pending legislative bills and other matters where appropriate.	Ongoing	EEAC to recommend, City Council to decide	
3. Investigate opportunities to partners with utilities on innovative renewable energy programs and projects in Concord.			

<u>Goal: 100% of Concord's Transportation is Clean Transportation by 2050</u>			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1: Reduce Vehicle Miles Travelled (VMT)			
1. Support initiatives outlined in the Concord Bicycle and Pedestrian Master Plans			

2. Support initiatives of TPAC and its subcommittees that have worked on vehicle-mile reduction and EE initiatives.			
3. Explore the feasibility of other alternatives to CV use, including promoting the use of electric bikes and electric scooters.			
Strategy #2: Prepare for the Installation of EV Charging Infrastructure			
1. Provide City departments, businesses and residents with information on the intrinsic characteristics and infrastructure requirements of the various levels of chargers.		EEAC	
2. Engage City departments and interested private developers to identify key areas ready or easily made ready to support charging infrastructure.			
3. Prepare, plan, and engineer for the first Level 2 and Level 3 EV chargers. Pre-planning for future charging infrastructure could save the City money through efforts such as installing conduits when sidewalks or roads are being excavated.			
4. Plan and engineer for EV chargers on City-owned properties for City use and public use. Possible locations include City-owned parking garages, the police station, the fire stations, the General Services building and possibly select on-street parking spaces.			
5. Initiate Code updates and Site plan updates, to ensure a clear process for charging station permitting & installation.			
6. Be prepared to regulate the private development of EV chargers to ensure the placement of EV infrastructure meets the needs of the broad community.			
Strategy #3: Transition City-Owned Vehicles to Clean Transportation.			
1. Develop a municipal government purchasing plan for gradually introducing EVs into the City's fleet when advantageous based on TCO analysis.			
2. Pursue available grants to offset the costs of clean vehicle replacement and construction of EV charging stations, including monies from the Volkswagen Settlement Fund, distributed by NHDES.			
Strategy #4: Transition CAT Buses over to Clean Transportation			
1. Track the TCO of electric transit buses and compare to the TCO of combustion transit buses over the next several years.			
2. Communicate with the City and with CAPBMCI about the feasibility and optimal timing of transitioning the CAT buses, trolleys, and other vehicles it may operate, to electric power.			

3. Plan and engineer for charging infrastructure for the CAT transit buses and other vehicles it operates in Concord.			
Strategy #5: Encourage School Districts in Concord to Convert School Buses to Clean Transportation			
1. Work with appropriate school personnel from both school districts to track availability of electric school buses.		EEAC	
2. Work with both school districts to track the TCO of new electric school buses vs, new combustion engine vehicles, over the coming years.		EEAC	
3. Encourage both school districts to be ready to purchase and integrate electric buses into their fleets as they become cost-effective		EEAC	
4. Encourage both school districts to begin planning for charging infrastructure for electric school buses and their other vehicles		EEAC	
Strategy #6: Encourage and Facilitate the Transition to Electric Vehicles for the Private Sector			
1. Work to inform the residents and businesses of Concord of the advantages of EVs over ICE vehicles, including: the importance of zero emissions to public health; the contribution EVs make in reducing Climate Change; the lower operating costs and lower maintenance costs; the increased torque and performance, etc.		EEAC	
2. Partner with organizations and automobile retailers to hold EV demonstrations and test drives for residents to see and drive EVs for themselves.		EEAC	
3. Extend the property tax exemption for on-site solar generation to include EV chargers for on-site use			
4. Simplify and clarify the permitting and inspection process for residences, stores, gas stations, restaurants and other businesses to install EV chargers.			
Strategy #7: Ensure EVs Are Powered by Renewable Energy and Minimize Costs of Charging			
1. Make sure we account for the electrical power needed for transportation when we estimate how much clean renewable energy we will need in the future.			
2. Encourage PUC and electric utilities to adopt TOU pricing structure and “smart” metering, so that EVs can be charged at night and benefit from reduced non-peak, low-demand rates.			

Goal: 100% Renewable Thermal Energy (Heating and Cooling) by 2050			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1: Facilitate Transition to Renewable Thermal Sources by City Government.			
1. Explore whether municipal buildings can be converted to renewable or clean thermal energy.			
2. Discuss the possibility of biogas recovery project at the Hall Street WWTP with Liberty Utilities.			
3. Explore possibilities for a new district heating system.			
4. Coordinate with street tree committee to minimize heat island effect.			
Strategy #2: Facilitate Transition of Community Members to Replace Old Heating Systems with Renewable Thermal Resources.			
1. Educate public about ways that they can replace old heating systems with renewable sources.			
2. Facilitate access to funds to help individuals and businesses with transitioning to renewable thermal.			
3. Target replacement opportunities: educate homeowners on the average lifespan of their traditional boilers and furnaces, and the warning signs for when such units should be replaced.			
4. Organize public demonstrations of renewable thermal systems – e.g., open houses of Concord residents or Concord businesses with renewable systems.			
Strategy #3: Explore Opportunities for District Heating and Co-Generation.			
1. Identify opportunities to install cogeneration systems in new facilities.			
2. Conduct a feasibility study on retrofitting existing facilities with cogeneration systems.			
3. Identify areas within the City with highest potential for the installation of a district heating system.			

Goal: Establish a Data-Drive System for Tracking Progress Toward Concord's 100% Renewable Energy Commitment.			
Proposed Actions	Time Frame	By whom (Proposed)	Notes
Strategy #1: Refine Strategies and Actions into Quantitative, Time-Defined and Measurable Goals.			
1. Organize planning workshops with relevant stakeholders on EE, electricity, thermal and transportation.*	December 2019	EEAC/City Planning/ Sustainability coordinator/Relevant stakeholders	
Strategy #2: Build a Web-Based Energy and Emissions Dashboard Track Progress Toward Goals.			
1. Identify best indicators for tracking and communicating progress	September 2020	City sustainability coordinator to coordinate (if hired)	
2. Research existing models			

3. Identify design specifications			
4. Build tool and website			
5. Public outreach			

* Participants should set SMART (Specific, Measurable, Attainable, Realistic, Timely) goals and to refine action steps. Assess data availability, indicators, and set baselines. Recommend process for monitoring and reporting over time.

Goal: Assure Successful Implementation of Concord's 100% Renewable Energy Strategy			
Proposed Actions	Time Frame	By whom (Proposed)	Notes
Strategy #1: Enable Successful 100% Renewable Energy Strategy Implementation by Hiring City Sustainability Staff			
1. EEAC and others will coordinate to help identify early EE cost-saving projects to initially pay for additional staff.	July 2019	EEAC, City Staff, other stakeholders (Banks, RE business, funders)	
2. EEAC recommends that the City hire at least one full-time energy/sustainability staff person	October 2019	EEAC and City Staff	
Strategy #2: Raise Awareness and Motivate Public Participation in the 100% Renewable Energy Goal through Initiatives Including Building a City Energy Website			
1. Identify and post content for strategic planning phase website (phase I)	Ongoing	EEAC, City Staff	
2. Design and build implementation phase website (phase II)	January 2019	Sustainability Staff, EEAC, City planning	
3. Post energy dashboard and footprinting tool on site	July 2020	Sustainability staff, EEAC, City Staff	
4. Identify community events and opportunities to educate the public	Ongoing	Sustainability staff, EEAC	
5. Prepare hardcopy awareness materials	September 2019	Sustainability staff, EEAC	
Strategy #3. Ensure that City Planning Documents and Codes Are Aligned with the 100% Renewable Energy Goal and Strategy			
1. Energy chapter of updated Concord Master Plan should be written to reflect the 100% RE goal and the strategic plan.	2021-2022	Planning staff, EEAC	
2. City codes should be updated to facilitate renewable energy adoption	Ongoing	Planning staff, EEAC	
3. Update the 100% RE Strategy every 5-years or as needed	2024 or before	EEAC, Sustainability staff, City Staff	

Glossary

Alternative Compliance Payment (ACP): Payments made by an electric utility if it fails to procure enough RECs to meet requirements under an RPS program. In New Hampshire, ACPs are paid to the PUC, which uses the proceeds to fund grants and rebates for renewable energy projects.

Alternating Current (AC) Power: A form of electricity in which the flow of electrons changes at regular intervals. Electricity distribution lines and home electrical wiring carry AC power.

Amperage: The strength of electric current (amps).

Battery Storage: A form of energy storage that utilizes batteries (typically but not exclusively lithium-ion batteries) to store electricity. Battery storage is used to power EVs and may be grid-connected and used to store electricity generated from intermittent solar and wind energy projects or as an alternative to distribution or transmission system upgrades.

Biogas: Biogas is a gaseous fuel formed by the anaerobic (without oxygen) decomposition of organic material, such as food waste, decaying plants and sewage sludge. Anaerobic microorganisms feed off of the organic material and produce methane gas and carbon dioxide. The methane gas can be used for thermal energy and electricity generation applications, just as natural gas is used.

Biomass: Biomass is the organic material that is used for production of energy. Biomass is primarily found in the form of living or recently living plants and biological wastes from industrial and home use. The organic material (or “feedstock”) must be converted to usable energy through one of many processes, including combustion, gasification, and anaerobic digestion.

Building Envelope: The physical separator between the conditioned and unconditioned environment of a building including the resistance to air, water, heat, light, and noise transfer.

Cogeneration or Combined Heat and Power (CHP): CHP is on-site electricity generation that captures the heat that would otherwise be wasted to provide useful thermal energy such as steam or hot water that can be used for space heating, cooling, domestic hot water and industrial processes. CHP can achieve efficiencies of over 80 percent, compared to 50 percent for conventional technologies (i.e., grid-supplied electricity and an on-site boiler).

Community Solar: A solar project whose output is shared by more than one end user. End users may own a community solar project or may subscribe to the power output of the project without owning the project.

Conservation: Reducing the overall consumption of kilowatt hours through the installation of more efficient equipment or devices or by changing energy usage patterns.

Demand Charge: A monthly utility charge based upon the fifteen-minute interval during which a commercial or industrial customer consumes its maximum energy. A demand charge can be thought of as a peak consumption charge, a measure of the maximum amount of power the utility will need to provide to a customer at any given time. Demand charges are measured in kilowatts (kW).

Demand Management: Reducing the maximum power taken off of the grid by installing equipment or appliances that draw less wattage or by shifting consumption to non-peak hours.

Direct Current (DC) Power: A form of electricity in which electrons flow in only one direction. Solar panels generate and batteries store DC power. Some long-distance transmission lines carry DC power, which must be converted to AC power before distribution.

Direct Use Geothermal: A system in which a well is drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system - piping, a heat exchanger, and controls - delivers the heat directly for its intended use.

Distribution: Conductors and equipment which deliver power to the ultimate customer. Distribution lines originate at substations and travel along streets delivering power through transformers to customers' premises.

District Heating (DH): In DH systems, heat is generated centrally or derived from an existing heat source, and distributed to consumers by pipelines, mostly in the form of hot water. The DH heat sources include cogeneration plants producing both heat and power (i.e., CHP), different types of boilers, industrial facilities producing waste heat, geothermal heat sources, solar heat, heat from waste incinerators, heat pumps.

Electric Vehicle (EV): A vehicle that uses an electric motor powered by electricity from a battery or a fuel cell.

Electrification: The process of converting thermal energy and transportation end uses from fossil fuel combustion to electricity.

Energy Conservation: Reducing energy consumption, generally through behavioral changes such as turning down the thermostat, turning off unnecessary lighting, etc.

Energy Efficiency: Any technology, process, or practice that allows the same task to be achieved by using fewer units of energy.

Energy Storage: A means of storing energy so that it may be utilized or consumed at a different time than the time it was generated or inputted. Energy storage devices may store different forms of energy (electricity or thermal energy) and may utilize different technologies.

Enhanced Geothermal System (EGS): EGS offers great potential for dramatically expanding the use of geothermal energy. The EGS concept is to extract heat by creating a subsurface fracture system to which water can be added through injection wells. Creating an enhanced, or engineered, geothermal system requires improving the natural permeability of rock. Rocks are permeable due to minute fractures and pore spaces between mineral grains. Injected water is heated by contact with the rock and returns to the surface through production wells, as in naturally occurring hydrothermal systems. EGS are reservoirs created to improve the economics of resources without adequate water and/or permeability.

FCV: Hydrogen fuel-cell powered vehicle.

Geothermal: Geothermal technology harnesses the Earth's heat. Just a few feet below the surface, the Earth maintains a near-constant temperature, in contrast to the summer and winter extremes of the ambient air above ground. Three main types of technologies take advantage of Earth as a heat source: ground source heat pumps, direct use geothermal, and deep and enhanced geothermal systems. Ground source heat pumps are the most promising type of geothermal technology for use in New Hampshire. See the "Electric Heat Pumps" box below for more on ground source heat pumps.

Greenhouse Gas (GHG): A gas in earth's atmosphere that traps heat, allowing sunlight to pass into the atmosphere but not allowing the heat associated with such light from leaving the atmosphere. GHGs create what is called the "greenhouse effect." The main GHGs are water vapor, carbon dioxide, methane, ozone, nitrous oxide and chloroflourocarbons.

Group Net Metering: Group net metering is New Hampshire's version of Community Solar, under which multiple entities may receive power from a single net metering renewable energy project. Under Group Net Metering, a "Group Host" would develop a renewable energy project that would participate in net metering. Other energy customers could become "Members" of the Group Net Metering project that is administered by the Host. The utility compensates the Group Host for energy produced by the net metering system, and the Host distributes that benefit among the Members of the Group according to negotiated contracts. Group Net Metering can extend the benefits of distributed renewable generation to customers who do not have suitable sites, or cannot develop a project on their own for other reasons.

Heat Pumps: Like refrigerators, heat pumps use electricity to move heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. Heat pumps can reduce the electricity used to heat a building by

approximately 50%, because the system is designed only to move heat, not to generate it. There are three types of heat pumps: air-source, water-source, and ground-source/geothermal.

Hydroelectricity: Electric power generated from harnessing the power of falling water or fast-running water. Hydroelectric power projects usually involve using the controlled flow of water trapped behind a dam.

HVAC: Heating Ventilation & Air Conditioning System.

ISO New England: The non-profit organization responsible for overseeing New England's wholesale electricity marketplace.

Kilowatt (kW): 1,000 watts

Kilowatt-hour (kWh): 1,000 watts measured over a period of one hour

Landfill Gas: A form of biogas that is produced from the decomposition of organic materials within landfills.

LEED: Leadership in Energy and Environmental Design Certifications are the most widely used green building rating system in the world.

Level 2 Charger: An EV charger that uses a 240-volt AC plug. It generally takes about 4 to 6 hours (some report 8 hours) to charge a depleted battery to full using a Level 2 Charger, and less time if the battery is not fully depleted.

Level 3 Charger: An EV charger that uses a 480-volt DC plug. It generally takes about 30 minutes to charge a depleted battery to 80% using a Level 3 Charger.

Megawatt-hour (MWh): 1,000 kilowatt-hours.

Megawatts (MW): 1,000 kilowatts. The maximum capacity of a generator to produce power is measured in megawatts. Similarly the load that a large customer or an entire community uses at the peak hour is measured in megawatts.

Microgrid: A sub-section of an electric distribution system that can disconnect or "island" itself from the larger network and be powered self-sufficiently. Microgrids require generation assets, either renewable or non-renewable, and may also utilize energy storage technologies. Microgrids are often associated with hospitals, college and universities, government or business complexes, municipal downtowns, or other similar types of geographies or campuses.

Municipal Aggregation: A policy that enables a municipality or other entity to become a bulk purchaser of power on behalf of its citizenry/constituency.

Negawatt: A watt of energy that is conserved using energy efficiency measures.

Net Metering or Net Energy Metering: A program administered by an electric utility under which a customer that generates electricity (usually from solar or other renewable energy sources located on the customer's property) and delivers such electricity to the electric grid for the utility's use is credited or paid for the power delivered to the grid.

Off-shore Wind: The use of wind turbines or farms constructed in oceans or other bodies of water to harvest wind energy to generate electricity.

On-shore Wind: The use of wind turbines or farms constructed on dry land to harvest wind energy to generate electricity.

Peak Load: The maximum demand for power on the grid system during a single month or year. Measured in megawatts for the highest hour of power draw on the system, peak demand can be measured for a single customer, the entire utility, or the entire New England Power Pool.

Renewable Energy Credit (REC): A market-based instrument that represents the property rights to the environmental, social or other non-power attributes associated with renewable electricity generation. 1 REC generally means the attributes associated with 1 MWh of electricity generation by a renewable energy source.

Regional Greenhouse Gas Initiative (RGGI): Nine northeastern U.S. states participate in the RGGI, a program designed to reduce greenhouse gas emissions from the power sector. In New Hampshire as in other states, RGGI generates funding for energy efficiency programs

Renewable Portfolio Standard (RPS): A state policy that sets annually increasing renewable energy targets. Utility companies and energy suppliers are obligated to comply with RPS targets by purchasing RECs, paying ACPs which are used by the state as grants and rebates for renewable energy projects, or by developing renewable energy projects.

Solar Photovoltaic (PV): A method or technology for using solar cells to convert sunlight into electricity using the photovoltaic effect.

Solar Thermal: Solar thermal technologies capture the heat energy from the sun and use it for heating and/or the production of electricity. This is different from photovoltaic solar panels, which directly convert the sun's radiation to electricity. There are two main types of solar thermal systems for energy production – active and passive. Active systems require moving parts like fans or pumps to circulate heat-carrying fluids. Passive systems have no mechanical components and rely on design features only to capture heat (e.g. greenhouses). Source: (Muisse).

Substation: A utility installation of transformers which accepts high voltage power from transmission lines, steps down the voltage and connects to distribution lines that leave the substation delivering power to the ultimate consumers' premises.

System Benefits Charge (SBC): A small surcharge on all New Hampshire gas and electric customer's energy bills that is used to fund NH Saves energy efficiency programs statewide.

Therm: A non-SI (systeme internationale) unit of heat energy equal to 100,000 British thermal units (Btu). It is approximately the energy equivalent of burning 100 cubic feet (2.83 cubic metres) – often referred to as 1 CCF – of natural gas.

Time of Use Rates (TOU): An approach to electricity pricing under which the price of electricity varies depending on time of day and/or other factors. Time-of-Use rates vary from simple on-peak/off-peak pricing to Real Time Pricing which can change with real-time energy demand (as frequently as 15-minute intervals, or even more frequently).

Total Cost of Ownership (TCO): When referring to a vehicle, the TCO is the sum of the purchase price, the operating (fuel) costs and the maintenance costs of the vehicle over its serviceable lifetime.

Transmission: Large electrical conductors that carry high voltage bulk power cross country from generators to substations. Generally, no customers are served directly by transmission.

Volts/Voltage: The measure of electromotive force.

Watts/Wattage: The measure of electric power. Watts roughly equal amps times volts.

Appendix A

Additional Information on Climate Change

[to be inserted before the plan is considered for final approval].

Appendix B

Concord's Carbon Footprint

[Concord carbon footprint information to be inserted before the plan is considered for final approval].

Appendix C

The Global Movement Toward 100% Renewable Energy

[to be inserted before the plan is considered for final approval].

Appendix D

Energy Policy and Energy Markets in New Hampshire and New England

[to be inserted before the plan is considered for final approval].