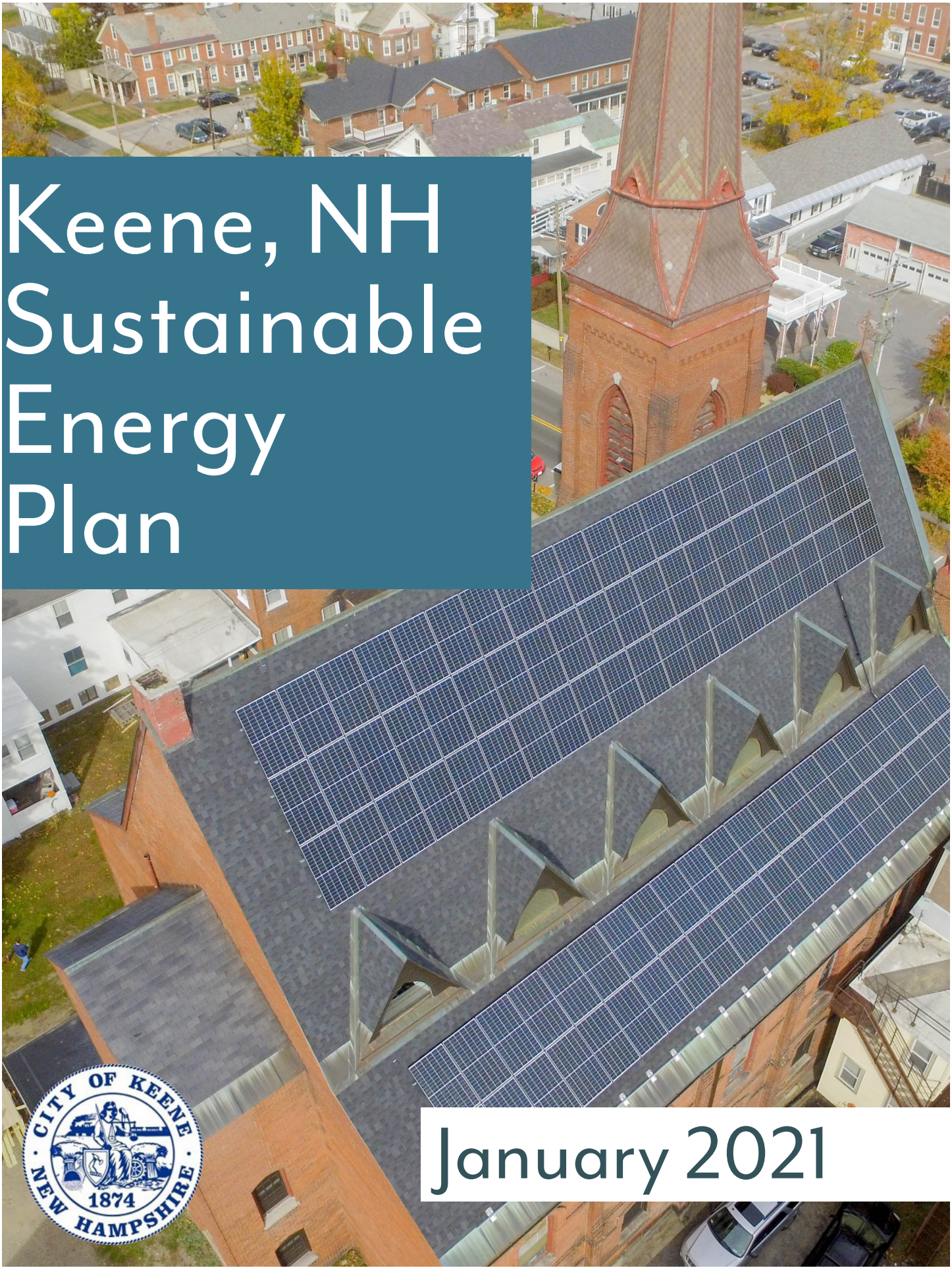
Keene, NH Sustainable Energy Plan



January 2021

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ACKNOWLEDGEMENTS

The City of Keene gratefully acknowledges the participation and efforts of the following people and groups in the creation of this plan. Keene is indebted to your continued commitment to creating a sustainable, resilient, and thriving community powered by renewable energy.

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Special Thanks

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Morgan Urquia — Planning Intern
Northeast Energy Efficiency Partnerships (NEEP)
Shaylin Salas — Communications & Outreach Intern
Southwest Region Planning Commission
The Cadmus Group

In addition to those mentioned above, the City of Keene thanks the focus group participants, interviewees, and community members who shared their feedback, ideas, and expertise with the City. Your participation was invaluable to the creation of this plan.

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CHAPTER 1 | INTRODUCTION

Keene's Sustainable Energy Goals

On January 17, 2019 the Keene City Council passed Resolution R-2018-36, which set a goal to transition Keene to a 100% renewable energy future by 2050, with an interim goal to reach 100% renewable energy for all electricity by 2030. This Sustainable Energy resolution highlights the City's long-standing commitment to climate action, and calls on the City to develop a strategic plan to achieve its renewable energy goals by December 2020. The full text of this resolution is included in Appendix A of this plan.

> "It is the goal of the City of Keene that all electricity consumed in the City will come from renewable energy sources by the year 2030 and that 100% of all thermal energy and energy used for transportation come from renewable energy sources by the year 2050. This goal will apply to the entire Keene community, not just municipal government operations."
> - Resolution R-2018-36, "Sustainable Energy Goals"

A History of Climate Action

Keene's commitment to pursuing these sustainable energy goals is consistent with the City's long history as a climate leader. The City made its first formal commitment to climate action in 2000, when it joined the Cities for Climate Protection campaign and formed the "Cities for Climate Protection Committee", later named the "Energy and Climate Committee." This Committee, which is comprised of residents and business leaders in Keene, has worked on a number of initiatives over the past two decades. In 2001, the City's first greenhouse gas (GHG) emissions inventory was completed for baseline year 1995, and in 2004, the City adopted a climate action plan which set 20-year GHG reduction targets for both the community (10% reduction below 1995 levels by 2015) and local government (20% reduction below 1995 levels by 2015). In 2007, the City of Keene was one of the first communities in the nation to develop a Climate Adaptation Plan, and in 2010, many of the City's climate mitigation, adaptation, and sustainability goals were incorporated into the Comprehensive Master Plan.

Leading up to and following the adoption of the 2004 Climate Action Plan and the City's GHG reduction targets, the City took a variety of steps to reduce carbon emissions. Major accomplishments include the following:

- In 1994, the City installed a partial methane recovery system at the municipal landfill, and expanded the system when the landfill was capped in 1999. This methane-to-energy system powered the landfill for over 25 years, until the supply of methane from the capped landfill began to run out. In 2018, the City received an EPA Climate Showcase Community Grant to replace the methane-to-energy system with a generator that runs on biofuel made from 100% post-consumer vegetable oil.

- Since 2002, the City has been using a biodiesel blend to fuel its vehicle fleet to reduce emissions and fumes. In 2005, the City added hybrid vehicles to the fleet to further reduce emissions.

- In 2003, the City installed a geothermal HVAC system at the Public Works facility on Marlboro Street in Keene, and in 2018, the City installed the largest solar PV array in Keene at the time (643.2-kilowatts) on the roof of this same facility.[1]

- Between 2000-2017, all traffic signals, airport beacons, parking facility lights, and street lights in Keene were converted to LEDs.

- The City entered into an energy services contract from 2011-2020 to make various building envelope and lighting upgrades to City facilities and replace outdated systems, such as the chiller at City Hall.

- In 2015, the City made a commitment to the concept of "Complete Streets," formalizing its long-held approach to designing City streets to enable access and mobility for everyone, including pedestrians, bicyclists, children, older adults, and people with disabilities.[2]

- Over the past three decades, the City has prioritized infrastructure improvements that support reducing emissions, reducing traffic congestion, and increasing safety for walkers and bicyclists. Some of these infrastructure improvements include replacing five signalized intersections with roundabouts, improving rail trails and pedestrian infrastructure in the downtown and near schools, and installing pedestrian bridges over busy state routes to connect the Cheshire Rail Trail and Ashuelot Rail Trail to downtown Keene.

- Since 2007, the City has offered a property tax exemption for renewable energy systems, including solar energy systems (total assessed value), woodheating energy systems (up to $10,000), and wind powered energy systems (total assessed value). [3]

- In 2019, the City entered a two-year contract with Constellation Energy to procure Green-e® Certified Renewable Energy Certificates equivalent to 100% of municipal electricity use beginning in 2020.

Spotlight: Clean Energy Team

The Clean Energy Team (CET) is a grassroots group of Keene residents, businesses, and leaders from education, faith, nonprofit and other sectors that works to make energy efficiency and renewable energy options accessible for residents and businesses in the Monadnock region. In 2018, the CET heard about the Sierra Club "Ready for 100" campaign, a national movement to transition communities in the United States to 100% clean and renewable energy. The CET knew they wanted to pursue this in Keene.

At the start of this effort, CET members made it a priority to listen. They interviewed City Council members, the Mayor, city and regional planners, and business owners to hear their concerns and ideas. Then, they led a public outreach campaign to share their vision with the public through tabling at events, participating in a local climate march, and getting signatures for a petition to City Council.

After extensive outreach and building public support for 100% renewable and clean energy goals, CET wrote a letter to the City Council asking them to adopt a 100% Renewable Energy Resolution, and delivered this letter along with a petition with signatures from Keene residents and businesses. The Mayor assigned it to the Municipal Services, Facilities, and Infrastructure Committee. On the night of the Committee's hearing, the room was filled with supporters of the resolution, all wearing green; over 20 members of the public spoke at the hearing to ask the City to pass the resolution. The Committee ultimately voted for the Resolution to be considered by the full City Council. On January 17, 2019 the City Council voted to adopt the Sustainable Energy Resolution.

Above: Clean Energy Team (CET) memers and supporters attended a City Council committee meeting on November 19, 2018 to express support for the then-proposed renewable energy goals. Photo credit: CET.

Planning & Public Engagement Process

Following the passage of the Sustainable Energy Resolution, City staff began working with the Keene Energy and Climate Committee (ECC) and other community partners to obtain input on the energy plan vision, strategies, and objectives. During the spring of 2019, staff interviewed 18 key stakeholders in the community and worked with the ECC to develop a community engagement plan. This plan called for a series of three focus groups with the following stakeholders: 1) residential landlords, 2) businesses, and 3) large energy users (e.g. Cheshire Medical Center, Keene State College, and Hillside Village). The first focus group was held in August 2019, and the second and third focus groups were both held in February 2020. During this same timeframe, the City hired an energy planning consultant, The Cadmus Group ("Cadmus"), to conduct a baseline analysis of electricity consumption in Keene and help the City identify strategies to achieve 100% renewable electricity by 2030.

Outreach to the public kicked off in October 2019 with an in-person workshop held at Keene State College. Throughout the Fall 2019 and Winter 2020, the City worked with community volunteers to hold a series of 14 volunteer-led group discussions at various locations in the community to gather input from residents of Keene and surrounding towns. In addition, City staff presented at various local schools and civic organizations, including but not limited to MC2 Charter School, Surry Village Charter School (in Keene), the Rotary Club of Keene, and the Elm City Rotary Club. The summary notes and feedback from these discussions were shared with City staff and Cadmus to help inform the strategy prioritization process for the energy plan. Based on the priorities expressed by Keene residents at these meetings, Cadmus developed a preliminary list of criteria to evaluate and rank sustainable energy strategies. These criteria were refined by the ECC, then used to rank and prioritize strategies and actions to achieve the City's energy goals.

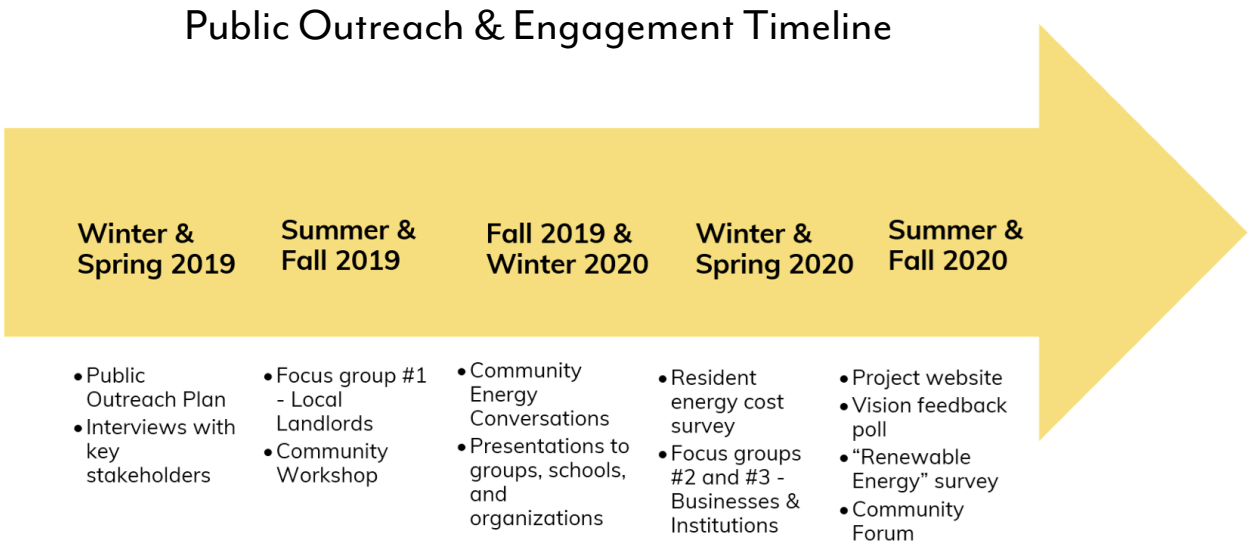


Figure 1.1. Summary of the public outreach and engagement timeline for the Sustainable Energy Plan project.

In April 2020, The Cadmus Group gave a public presentation summarizing their final report, "City of Keene Renewable Energy Transition Analysis." This 1.5-hour virtual community meeting gave an overview of the Keene's electricity context, summarized the findings of the electricity baseline analysis for the City, and gave a brief overview of six renewable energy strategies for the City to consider. A shorter presentation covering these same topics was provided at the City Council meeting later that same day. The full report prepared by Cadmus is attached to this plan in Appendix B.

Throughout the winter of 2020, staff worked with a group of students from Keene State College to conduct a Resident Energy Use Survey to better understand how energy costs for electricity, heating, and transportation affect residents in Keene. The results of this online survey, which garnered 75 responses, were shared with the ECC and presented at a KSC student research symposium. The summary of responses to this survey are included in Appendix C. In addition, staff collected data for the thermal and transportation energy baseline analysis and compiled baselines for thermal and transportation energy use. These baseline chapters were shared with the ECC at their regular meetings, and are summarized in Chapter 3 of this plan.

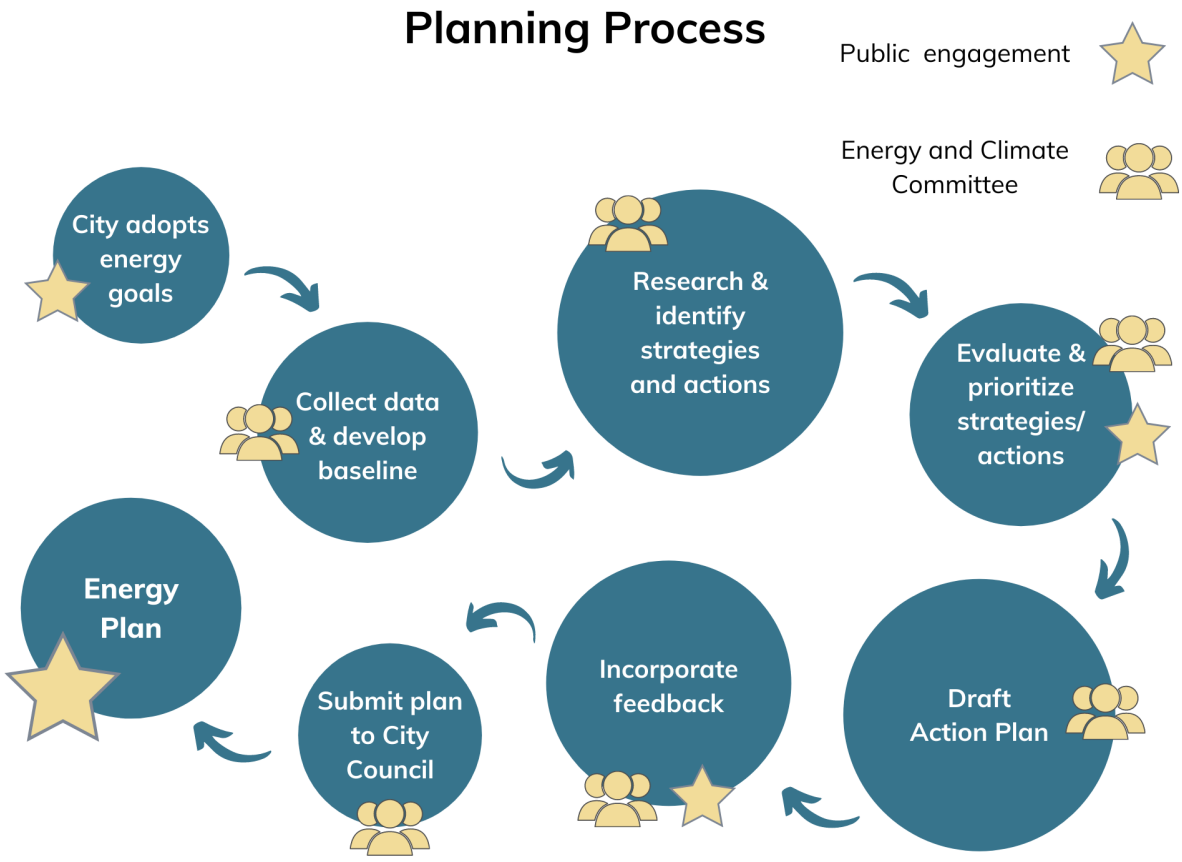


Figure 1.2. A graphic that provides an overview of the planning process that City staff and the Energy & Climate Committee (ECC) followed in developing the Sustainable Energy Plan.

In the summer of 2020, the City worked with a Sustainability Fellow from the University of New Hampshire Sustainability Institute to launch a project website (KeeneEnergyPlan.com) to gather public feedback through online polls and surveys, share educational information and resources, and highlight local success stories. This website also features podcast-style episodes to help explain key programs and actions proposed within this energy plan.

Energy Plan Guiding Principles

The public input that the City received helped the ECC to identify several key guiding principles for this sustainable energy plan:

I. **"Renewable Energy" should be defined as green power sources that have the most environmental benefits and the fewest adverse impacts.** The City should transition to sources of energy that are both renewable and clean, such as solar, biomass, geothermal, and low impact hydropower. This approach is aligned with the U.S. EPA's definition of green power sources.[4]

II. **Equity should be at the forefront of the City's efforts for a just transition to a sustainable energy future.** Economically disadvantaged residents, older people and children, people who are experiencing homelessness, people with disabilities or health conditions, and members of minority groups experience the impacts of climate change disproportionately. The City should prioritize strategies and actions that reduce existing inequities and advance a future that benefits everyone in Keene.

III. **Energy efficiency measures that drive down energy demand should be the first step in the path to a renewable energy future.** The most inexpensive source of energy with the least impact is the energy we do not use. By prioritizing and promoting energy efficiency, the City can help residents, businesses, and others save money and make the goal of sourcing all of our energy from renewable sources more attainable.

IV. **Keene should harness the economic opportunity of clean energy in order to create jobs and attract new talent.** Clean energy jobs are growing; the renewable energy sector employed approximately 786,000 Americans in 2018,[5] and the energy efficiency sector employed over two million in 2019.[6] As the City increases renewable energy and energy efficiency projects, the demand for talent will increase, too. Keene residents can fill this job demand, which keeps money in our community.

V. **Keene's movement towards 100 percent renewable energy use should support climate resilience and preparedness.** The City should anticipate and prepare for disruptions from a changing climate by embracing new technologies and building partnerships with community members, businesses, and institutions. In this way, Keene can better support and respond to residents' needs.

Defining Renewable Energy

Renewable energy sources are those that restore themselves. The Energy and Climate Committee recommends refining this definition of "renewable energy" to include only those renewable energy sources that have the most environmental benefits and the fewest adverse impacts. This approach is aligned with the U.S. EPA's definition of "green power," which is described as a subset of renewable energy, as shown in Figure 1. Green power sources include, but are not limited to, solar, biomass, geothermal, wind, and low-impact hydropower.

While all green power is renewable energy, not all renewable energy is considered green power. Large scale hydropower, for example, has impacts on fisheries and land use. For this reason, large hydropower is considered to be renewable, but not "green."

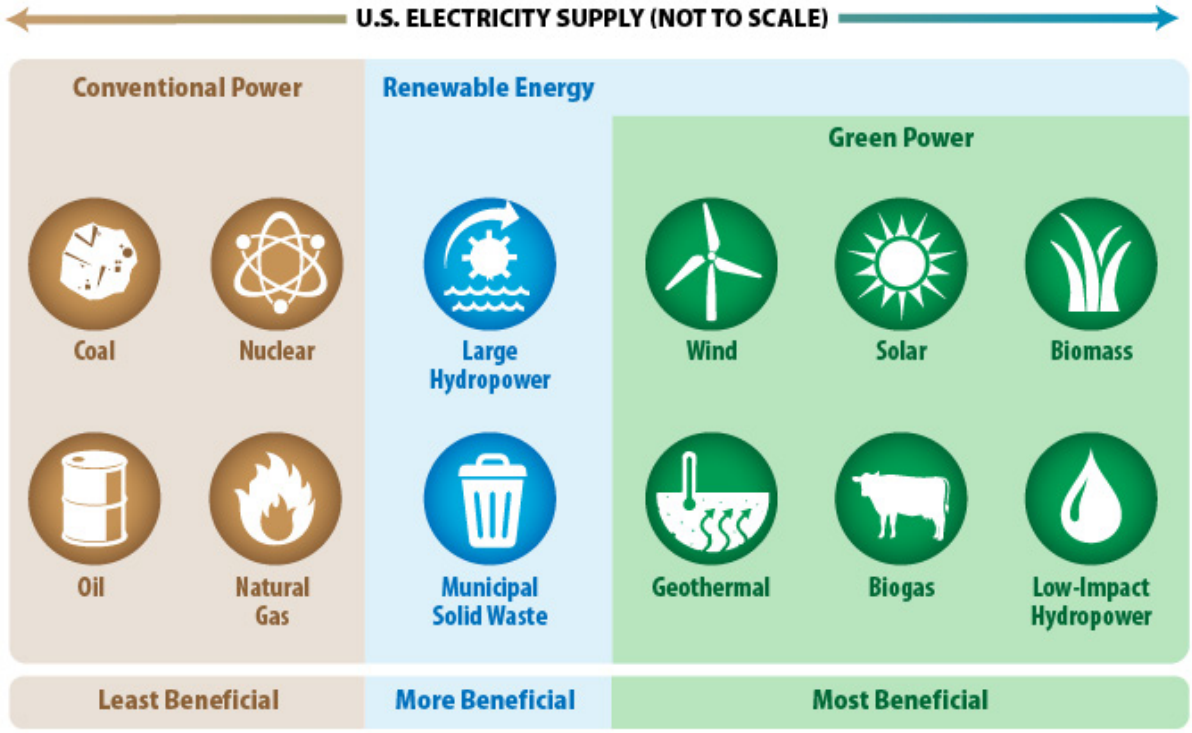


Figure 3. A graphic that depicts how the United States Voluntary Market defines green power based on its relative environmental benefits. Source: U.S. EPA "What is Green Power" webpage.

Keene residents were asked to weigh in on the ECC's proposed definition of renewable energy through an online poll. This poll included a brief description of renewable energy and green power, and asked residents whether Keene should include all renewable energy sources or just green power sources, or use a different definition. Twenty one people responded to this poll, 15 of whom agreed with the ECC's proposal to use the definition of green power, 4 said the City should consider all renewable energy sources, and 2 responded "other" (see Figure 4). The full summary of responses to this survey, including written comments, is included in Appendix C.

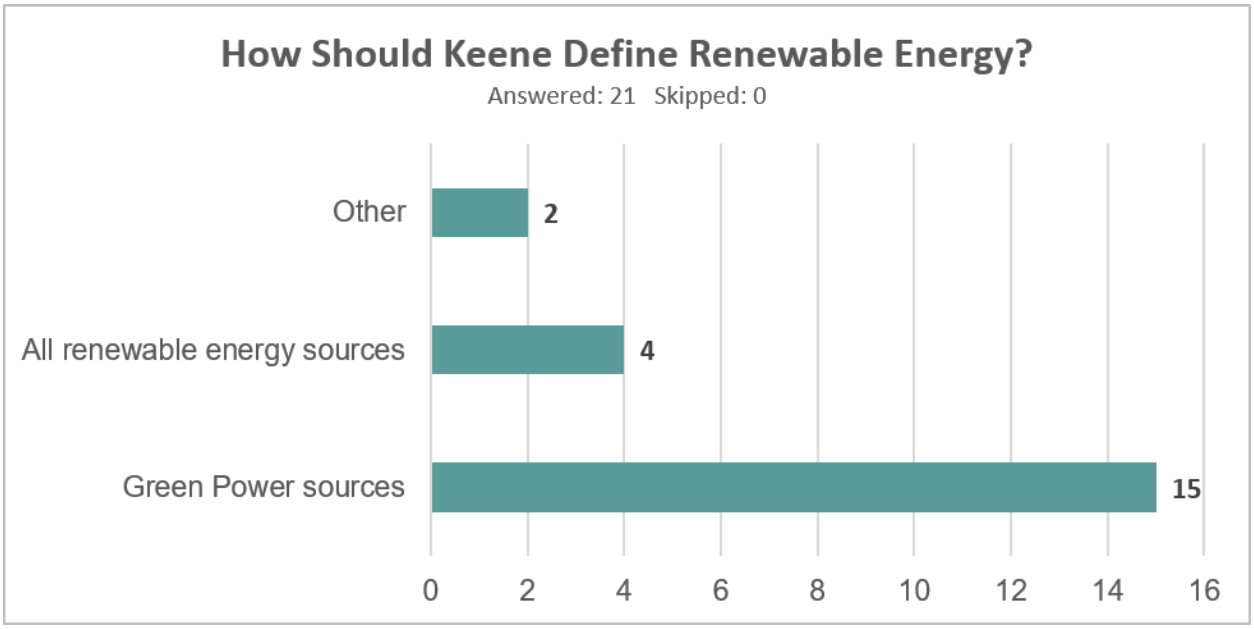


Figure 4. Bar graph summarizing responses to the "Defining Renewable Energy" online survey that was posted throughout July and August 2020 on the www.KeeneEnergyPlan.com website.

Developing a Vision for Keene's Energy Future

At the beginning of the planning process, the Energy and Climate Committee held a 2-hour retreat to begin discussing their vision and guiding values for the sustainable energy plan. The vision and guiding values were refined as the committee received feedback and input from the public. Then, in July 2020, the ECC put forward a proposed vision statement and asked for input from Keene residents, businesses, and others with a strong connection to Keene. The goal of this vision statement is to provide a concise statement that answers the question: "Where do we want to go?" It describes Keene's values and aspirations as a community, and a shared image of what the community's energy future will become in the next 30 years.

A Sustainable Energy Vision for Keene

In 2050, Keene will be a thriving and resilient community powered by affordable, clean, and renewable energy. All electricity and energy used for heating, cooling, and transportation will come from renewable energy sources.

The public was asked to weigh in on this proposed vision statement using an online poll, which asked residents to indicate the extent to which they agree with the vision statement using a sliding scale of 0 (strongly disagree) to 6 (strongly agree). The results of this poll indicate that, in general, respondents agree with this vision statement. Of the 28 people who responded, 19 said they strongly agreed, 5 said they agreed, 2 were neutral, 1 disagreed, and 1 strongly disagreed. The average value of all responses was 5.1. The full summary of responses to this survey, including written comments, is included in Appendix C.

Endnotes

1 City of Keene. “Solar panels installed on the roof of the Police/KeeneIce/Public Works buildings.” https://ci.keene.nh.us/our-city/news/solar-panels-installed-roof-police-keene-ice-public-works-buildings

2 City of Keene Community Development Department. “Complete Streets.” https://ci.keene.nh.us/community-development/projects/complete-streets

3 City of Keene Assessing Department. “Solar/Wind/Wood Energy System Property Tax Exemptions.” https://ci.keene.nh.us/assessing/solar-wind-wood-energy-system-property-tax-exemptions

City of Keene 2015 Greenhouse Gas Emissions Inventory (2018). https://ci.keene.nh.us/sites/default/files/Keene%20GHG%20Report%20FINAL_no%20draft%20mark.pdf

4 U.S. Environmental Protection Agency. “What is Green Power?” (Accessed 2020). https://www.epa.gov/greenpower/what-green-power

5 International Renewable Energy Agency. “Renewable Energy and Jobs--Annual Review 2018.” May 2018. https://www.irena.org/publications/2018/May/Renewable-Energy-and-Jobs-Annual-Review-2018

6 USEnergyjobs.org. “The 2020 U.S. Energy & Employment Report.” 2020. https://www.usenergyjobs.org/

CHAPTER 2 | ROADMAP TO 2050

Overview

Achieving the City's vision of becoming a thriving and resilient community powered by affordable, clean, and renewable energy will require collaboration between the City and community partners as well as coordination and support across all levels of government. There is no "silver bullet" strategy to reach this vision; rather, the City will need to enact a diverse array of policies, programs, and incentives with buy-in and support from the community. To reach the City's goals, it will be essential to reduce total energy use through energy efficiency and conservation, while simultaneously switching to renewable electricity and renewable fuels for heating, cooling, and transportation.

To guide these efforts, the Energy and Climate Committee identified four key pathways, or approaches, to achieving the City's energy goals: reduce energy use, generate and store renewable energy locally, and meet remaining energy demand through renewable energy procurement or fuel switching. Throughout this process, the City will need to advocate to remove barriers to renewable energy at the state and federal level, and inform the public of renewable energy options and resources.

Pathways to 100% Renewable Energy:

Pathway 1. Reduce energy use.

By reducing community-wide energy use, Keene will reduce the amount of both nonrenewable and renewable resources consumed in the City.

Pathway 2. Generate and store renewable energy locally.

Generating renewable resources (like solar) in Keene can create jobs locally and keep money circulating in the community.

Pathway 3. Switch remaining energy purchases to renewable sources.

The City can meet its remaining energy demand by switching to renewable energy sources from outside Keene and the region.

Pathway 4. Conduct ongoing advocacy and information sharing.

Throughout this process, ongoing advocacy and information sharing will be critical in order to reduce barriers at the state and federal levels and increase community buy-in.

This chapter is organized into three sectors, which correspond to the City's sustainable energy goals: Electricity, Thermal (Heating and Cooling), and Transportation. Within each sector, a set of strategies and actions were identified as priorities for near-term implementation. These 17 priority actions are listed here and further described in Chapter 5 – Action Plan.

Sectors in this Plan

Electricity

This sector includes all electricity consumed within the City, including electricity consumed by residential, commercial, manufacturing/industrial, and municipal electricity accounts.

Thermal

The thermal sector includes all energy used to heat and cool buildings located in Keene. Electrical energy used to heat and cool is counted under the electricity sector.

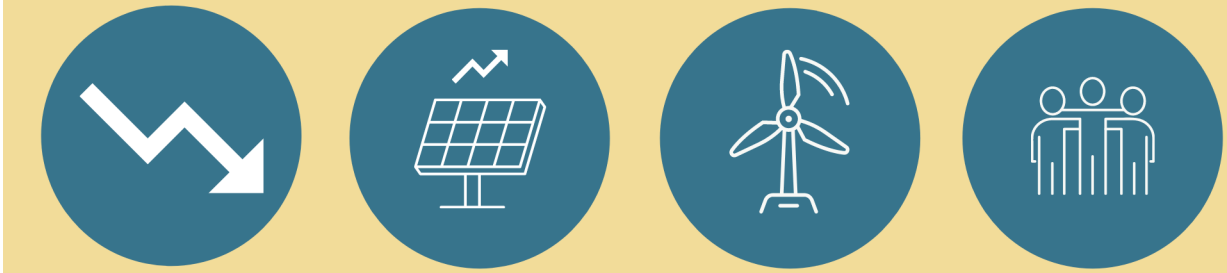
Transportation

Transportation - In the context of this plan, the transportation sector is defined as the energy consumed by Keene residents to travel from place to place. This sector includes ground transportation only.

ELECTRICITY SECTOR

Transitioning to a 100 percent renewable electricity supply by 2030 is a critical first step to achieving the City's goal to have all energy consumed come from renewable sources by 2050, as the electrification of thermal and transportation energy consumption will only be beneficial if the electricity source itself is clean and renewable. The main electric utility in Keene is Eversource, an investor-owned utility that delivers electricity and natural gas service to customers in New Hampshire, Connecticut, and Massachusetts. Eversource customers receive electricity from the New England power grid. In 2019, the NEPOOL system mix was approximately 20.1% renewable and 79.9% non-renewable. The 20.1% of renewable energy was comprised of hydropower (8.9%), refuse/other (3.5%), wind (3.4%), wood (2.4%), and solar (1.8%).

Because New Hampshire has a deregulated electricity market, investor-owned utilities, including Eversource, are not permitted to own and operate power plants that generate electricity. Retail customers are free to purchase energy from a competitive supplier, while the utility continues to provide transmission and distribution services. In 2019, there were approximately 15 residential[1] and 25 commercial/industrial[2] energy suppliers active in Eversource's territory. Eversource reported that approximately 22% of its residential customers and 58% of total customer load in New Hampshire had migrated to the competitive supply market by the end of the third quarter in 2019.[3]



Pathway 1: Reduce electricity use for all buildings in Keene

Reducing electricity use in all buildings will help control costs by reducing total energy demand and limiting or deferring the need to upgrade the electricity grid. Examples of electric efficiency measures for buildings include weatherization, thermal envelope retrofits, plug load management, LED lighting, and using intelligent sensors and controls to optimize system performance in commercial buildings.

Priority implementation steps that fall within this pathway are listed below. These actions also fall within the Thermal Sector, as they impact both electrical and thermal energy consumption.

I. Adopt a voluntary "Home Energy Labeling" program for residences: Encourage energy efficiency disclosure for existing and new residential properties at the time a property is listed for sale or rent.

II. Adopt a voluntary Benchmarking program: Encourage building owners of certain sizes or in certain districts to report energy use data to the City.

III. Partner with existing weatherization programs to enhance public outreach and education, amplify impact, and increase capacity.

Pathway 2: Increase renewable energy generation & storage

Generating renewable energy locally will maximize benefits to the local community by creating and supporting local jobs and businesses, reducing reliance on imported fuels, diversifying the electricity supply, and increasing the reliability and resilience of the grid to severe weather events and other potential system disruptions. Energy storage offers further opportunities for enabling increased use of renewable electricity generation, creating a more efficient grid that is resistant to disruptions, and creating jobs in supporting sectors such as manufacturing, engineering, construction, transportation, and finance.[4]

Priority implementation steps that fall within this pathway include the following:

I. Adopt solar photovoltaic (PV) and electric vehicle (EV) ready guidelines to encourage or require new developments to be built in a manner that accommodates future solar and EV charging station installations.

II. Partner with a local financial institution to create a loan product to finance renewable energy installations targeted at businesses or residents.

III. Work with the utility to develop a pilot battery storage program for residents and/or businesses in Keene.

Electricity Pathway 3: Procure renewable energy to meet remaining electricity demand

The City recognizes that it will not be possible for all of the City's electricity demand to be met by generating renewable energy locally by 2030. For a variety of reasons, not all residents, businesses, and organizations in Keene will be able to install renewable energy systems. In some instances, up-front costs and financing can be a barrier, and in other situations, the physical limitations of a site (e.g. lack of solar exposure) may limit opportunities for on-site renewable generation. However, there are a variety of options the City can pursue to provide the benefits of renewable energy to all residents, businesses, and other organizations in Keene, regardless of their ability to install renewable energy systems on their own property.

Priority implementation steps that fall within this pathway include the following:

I. Establish a Community Power Program: Aggregate community load and purchase electricity from an alternate electricity supplier, while still receiving transmission and distribution service from Eversource.

II. Virtual Power Purchase Agreements (VPPAs) by City: Enter into a long-term, fixed price contract for renewable energy from a specific project (i.e. agree to a contract for differences, or CfD). The renewable energy system developer sells the energy generated into the normal power market and uses the CfD as a hedge on the variable price of power.

Electricity Pathway 4: Conduct ongoing advocacy and information sharing

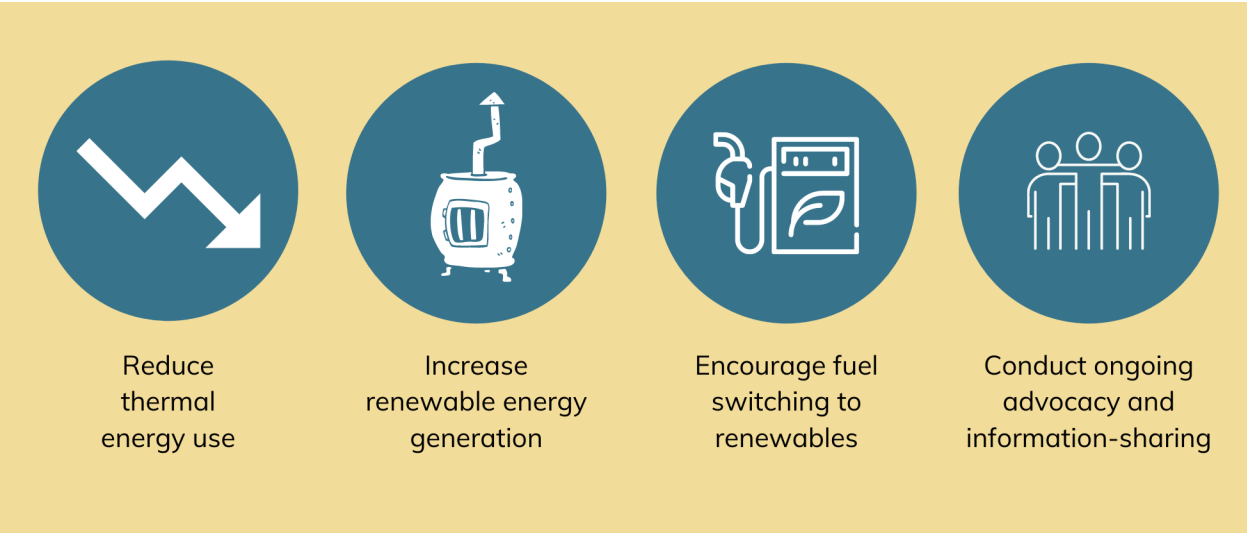
Renewable energy technologies, programs, and incentives are constantly changing and evolving over time. For residents and small businesses in particular, it can be challenging to parse out what opportunities exist at any given time, and which are most advantageous to pursue. The City should take an active role in providing resources and sharing information that is most relevant and useful for Keene residents and businesses. One way to do this would be to post information and resources in a central location, such as on a website that is periodically updated and maintained. Other opportunities include hosting workshops for residents, businesses, and other stakeholder groups (e.g. NHSaves "Button Up" weatherization workshops), partnering with local volunteers and organizations to run programs with a large educational component, such as "solarize" campaigns, and collaborating with local educational institutions and job training programs.

Achieving 100 percent clean and renewable energy will require action across all levels of government. In addition to education and resource sharing, the City should advocate for state and federal policies and programs that support energy efficiency and renewable energy in New Hampshire. The City has done this in past by expressing support for legislation that would benefit the City's residents and businesses. For example, the City has expressed support for continuing New Hampshire's participation in the Regional Greenhouse Gas Initiative (RGGI), and on a couple of occasions the City has submitted a letter of support for legislation that would have raised the individual project net metering cap in New Hampshire from one megawatt to 5 megawatts, which would have benefitted larger energy users in Keene. Additional opportunities in New Hampshire include strengthening the Renewable Portfolio Standard, allocating a greater share of RGGI funds to energy efficiency, and at the federal level, extending the investment tax credit (also known as the federal solar tax credit).

THERMAL SECTOR

Achieving 100 percent renewable energy for all heating and cooling will require aggressive energy efficiency and weatherization paired with "beneficial electrification" – i.e. replacing fossil fuel-powered heating and cooling systems with more efficient electrical systems and other fossil fuel-free alternatives. Although 2050 is 30 years away, the average lifespan of a heating system (15-20 years) means that, in order to source 100 percent of all thermal energy from renewable sources by 2050, any new heating systems installed in 2040 or later should be electricity-based or run on renewable fuels. As fossil fuel heating systems come to the end of their useful life, it will be important to provide residents, businesses, and nonprofits with options and incentives to replace them with electric or renewable alternatives.

The two most consumed heating fuels in Keene are No. 2 heating oil and propane. Other heating fuels include electricity, wood (wood/pellet stoves & commercial-scale biomass), compressed natural gas (CNG), biofuel, and solar. There is also a geothermal heating system at the City's public works complex located at 350 Marlboro Street.



Pathway 1: Reduce thermal energy use for buildings in all sectors

Energy efficiency within the thermal sector can mainly be accomplished by weatherizing existing buildings, ensuring that new buildings are constructed with proper insulation, sealing, and ventilation, and by upgrading, replacing, or better controlling HVAC and hot water heating equipment so that they use less energy.

Priority implementation steps that fall within this pathway are listed below. These actions also fall within the Electricity Sector as they impact both thermal and electrical energy consumption.

I. Adopt a voluntary "Home Energy Labeling" program for residences: Encourage energy efficiency disclosure for existing and new residential properties at the time a property is listed for sale or rent.

II. Adopt a voluntary Benchmarking program: Encourage building owners of certain sizes or in certain districts to report energy use data to the City.

III. Partner with existing weatherization programs to enhance public outreach and education, amplify impact, and increase capacity.

Pathway 2: Increase local renewable energy generation and storage

There are already several examples of renewable thermal systems in Keene that use locally generated sources of renewable energy, such as solar thermal and geothermal systems. In addition, there are a number of wood stove and pellet stove systems as well as commercial-scale wood chip plants which may use wood-based biomass fuel sourced within New Hampshire or the New England region. For example, in 2017 Filtrine Manufacturing, a Keene-based manufacturer of water chilling and filtering systems, installed a 1 million BTU wood chip boiler. The company reports that this renewable thermal system reduced Filtrine's reliance on heating oil by 90%.[5]

Priority implementation steps that fall within this pathway include the following:

I. Commission a study to assess the potential for a renewable district heating system in Keene to understand what areas of the city would have the appropriate demand characteristics to justify a district energy system, as well as what local renewable sources are available and at what potential and likely cost.

  A. Explore options for a renewable district heating and/or combined heat and power pilot project, including possible public-private partnerships, grants, and other funding opportunities.

Pathway 3: Encourage fuel switching to renewable fuel sources

Fuel switching, such as replacing furnace and boiler heating systems with air source heat pumps (ductless and/or ducted), will be necessary in order to move away from Keene's dependency on fossil fuels. Currently, heating oil and propane are the two most widely used heating fuels in Keene. However, some organizations in Keene have already switched to renewable fuel sources. For example, Keene State College switched its heating plant from heavy No. 6 oil to a biofuel made from recycled vegetable oil over a two-year period starting in 2016, and is now one of the New Hampshire's largest generators of Thermal Renewable Energy Credits (T-RECs), using over 8,000,000 gallons of the biofuel each school year.

Priority implementation steps that fall within this pathway include the following:

I. Host a renewable heating and cooling (RH&C) campaign (e.g. “Heatsmart” campaign). RH&C campaigns are a type of bulk purchasing program aimed at homeowners and small businesses. These campaigns encourage the installation of renewable thermal technologies for space heating and cooling or for hot water heating through targeted local out-reach efforts and, often, with bulk discount prices.

Pathway 4: Conduct ongoing advocacy and education

As discussed under the Electricity Sector section, the renewable energy landscape is changeable and constantly evolving. The City should partner with local businesses, contractors, and installers to offer workshops and trainings on energy efficiency and renewable thermal technologies for residents and businesses. In the spirit of collaboration, the City should promote existing programs, such as New Hampshire Saves, and share information and resources related to energy efficiency and renewable thermal technologies in one central location. In addition, the City should track state and federal legislation and weigh in when opportunities arise to support renewable energy and energy efficiency programs, policies, regulations, and incentives.

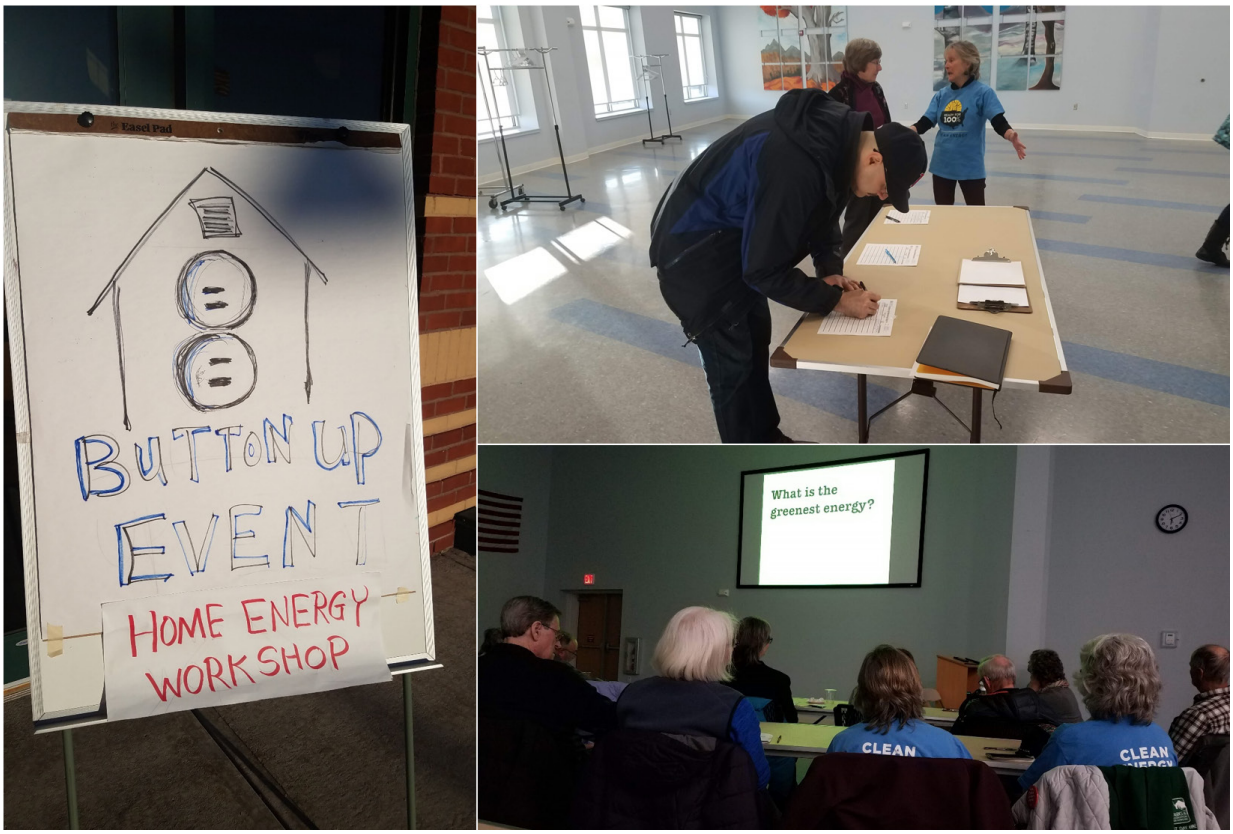
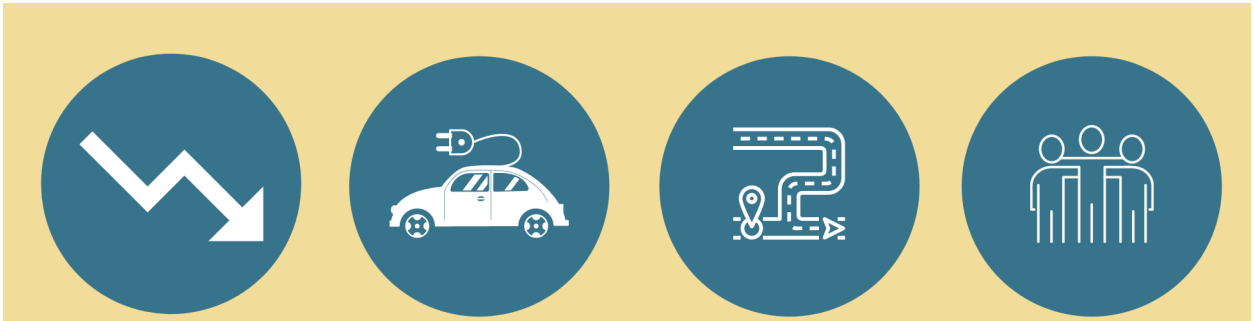


Figure 2.1. In 2019, the City's Energy & Climate Committee and the Clean Energy Team hosted a NHSaves "Button Up Workshop" to provide residents with home energy weatherization resources. Over 50 people attended this free workshop.

TRANSPORTATION

The Transportation Sector currently relies heavily on fossil fuels. In 2015, ground transportation in Keene accounted for almost half (46%) of all greenhouse gas emissions. The majority of these emissions were generated by on-road gasoline use (84%) followed by on-road diesel use (16%). Only a small fraction, about 0.1%, were attributable to the City Express bus service and the Friendly Bus Service operated by Home, Healthcare, Hospice and Community Services (HCS).[6]

Vehicle emissions are generally a function of three variables: fuel carbon content, vehicle efficiency, and how much people drive (i.e. vehicle miles traveled, or VMT). At the national scale, gains in vehicle efficiency have been more than offset by increases in VMT. From 1990-2020, the US population grew by 32%, whereas VMT grew 51%.[7] According to the U.S. Environmental Protection Agency (EPA), over that same time period, transportation emissions increased about 23% despite overall increases in vehicle efficiency.[8] This trend suggests that the City should focus on reducing overall VMT and switching to carbon-free fuels in order to reach the City's goal to source 100% of all transportation energy consumption from renewable sources by 2050.



Pathway 1: Reduce vehicle miles traveled

Enabling people to get around without a car can significantly reduce fossil fuel consumption while providing many co-benefits, such as reducing transportation costs, increasing physical activity, improving air quality, and providing access to jobs and other necessities for people who either cannot afford or choose not to own a car. Increasing transportation choices to encourage more walking, bicycling, and public transit use within City limits is a well-established goal in Keene. The 2010 Comprehensive Master Plan refers to this concept as a "park and walk community."

"Other alternatives should be explored to reduce fuel use by reducing vehicle miles traveled, such as rideshare programs, car-share programs, and the exploration of an official community Zip Car or Segway Safe program. All of these have potential to assist in moving people in a more economical, environmentally friendly way, which will assist in creating a sustainable community as well as highlighting Keene's creative problem-solving mentality."

–Keene Comprehensive Master Plan (2010)

Examples of strategies and actions that can help reduce VMT include improving public transportation access and service, improving walkability, and improving bikeability. These strategies encourage people to choose alternate modes of travel. In addition, land use strategies such as increasing density, promoting mixed uses, and increasing local and regional access to jobs can help reduce VMT by reducing trip distances and promoting carpooling and non-car travel modes. Land use strategies are discussed further under Pathway #3, "Promote Efficient Growth Patterns."

Priority implementation strategies and actions that fall within this pathway include the following:

I. Promote active transportation (walking, bicycling, and other "human-powered" transportation modes.

- **A.** Incorporate the adopted City of Keene Complete Streets Design Guidelines (2015) into the City's street standards for new streets, and develop Complete Streets standards for re-construction of existing streets.

II. Promote intracity and intercity transit options.

- **A.** Increase financial support for the City Express and Friendly Bus programs, and encourage HCS to expand services/routes.
- **B.** Work with Southwest Region Planning Commission and other community partners to explore options for a multi-modal transportation center in Keene and promote intercity transit options.

Pathway 2: Accelerate the shift to EVs and other alternative fuel vehicles

Electric Vehicles (EVs) are becoming more widely available and affordable, and as a result, EV market adoption is expected to increase. The Bloomberg NEF "Electric Vehicle Outlook 2020" report predicts that 500 EV models will be available globally by 2022, and by 2040, over half of all passenger vehicles sold will be electric.[9] However, the long average lifetime of vehicles, which in 2019 was 11.8 years in the U.S., can lead to a significant lag between increases in EV sales and increases in the total number of EVs on the road.[10] For this reason, it is important to begin increasing the adoption of EVs now to ensure that a majority of passenger vehicles on the road in 2050 are EVs or other alternative vehicles that use renewable energy sources.

Priority implementation strategies and actions that fall within this pathway include the following:

I. Install EV charging stations (level 2 and fast-charge) in on-street parking areas and in public parking lots or structures.

II. Adopt solar PV and electric vehicle (EV) ready guidelines to encourage or require new developments to be built in a manner that accommodates future solar and EV charging station installations.

III. Work with the Keene School District and local school bus company to encourage the switch to electric school buses. Explore "battery to grid" programs to increase financial viability of electric buses and improve the resilience of the electricity grid.

Figure 2.2. An EV was on display in Keene in August 2019 as part of the NH Department of Environmental Services Air Quality Day, an education event where residents got an opportunity to try out battery-powered lawn equipment and view an EV up close.

Transportation Pathway 3: Promote efficient grown patterns

As discussed above under Pathway 1: Reduce Vehicle Miles Traveled, reducing driving could generate many public benefits in addition to reducing fossil fuel consumption, such as improving public health through improved air quality, better individual health due to increased exercise from walking and biking, increasing access and equity for low and moderate income people, and enhancing interactions within our communities. However, reducing VMT will require coordinated land use and transportation planning. Local land use policies have the potential to shape and rearrange the origins and destinations of travel and can either support or hinder accessibility and mobility. For example, allowing a mix of land uses, providing thoughtful parking requirements, and permitting an increase in land use densities can decrease distances between different destinations, leading to shorter trip distances, a blend of jobs and housing within a community, and an increase in alternative modes of transportation. On the flip side, local policies that separate out land uses, provide inflexible or high minimum parking requirements, and/or reduce density have the opposite effect and lead to car-dependent communities.

The City of Keene has already taken steps to promote a mixed-use, walkable environment in the downtown and surrounding neighborhoods. For example, there are no minimum parking requirements in the core of the downtown, and as part of the Land Development Code project, the City is considering expanding the area where there are no parking minimums, allowing for shared parking and offsite parking arrangements, and offering parking reductions on a case-by-case basis. The City is also in the process of exploring form-based zoning in Downtown Keene in order to ensure that future development is compatible with historic development patterns and continues to foster a pedestrian-friendly environment, and for many years, the City has promoted a context-sensitive approach to street design through the implementation of a complete streets program. The City should continue to coordinate land use and transportation planning, and prioritize local policies that promote efficient growth patterns.

Pathway 4: Conduct ongoing advocacy and information-sharing

Although there are many actions the City can take to work towards increasing the share of renewable energy within the transportation sector, the City cannot get there on its own without state and federal action to support EVs, public transportation, and other alternative transportation modes. In addition, the City will need to prioritize education and sharing information and resources in order to help residents and fleet managers make informed choices about transportation mode choices and alternative vehicle adoption.

Priority implementation strategies and actions that fall within this pathway include the following:

I. Advocate for more funding at the state and federal levels for transportation, including funding for transit and "alternative" transportation options (in addition to funding to maintain / repair bridges, roads, and other infrastructure development and maintenance).

II. Advocate for state allocation of funding through the federal Transportation Alternatives Program for "non-infrastructure" Safe Routes to School projects (Education, Encouragement, and Evaluation programs).

III. Advocate for state-level policies, programs, and incentives for electric vehicles and other alternative vehicle technologies.

IV. Inform community members about the environmental, public health, and social benefits of public transportation and active transportation.

V. Promote EVs through education and marketing campaigns. For example, "drive electric" events can be leveraged as opportunities to educate Keene residents about the benefits of EVs as well as existing rebate programs and incentives to reduce costs of buying EVs.

Endnotes

1 New Hampshire Public Utilities Commission. Residential (Accessed 2020). https://www.puc.nh.gov/consumer/Residential%20Suppliers.html

2 New Hampshire Public Utilities Commission. Commercial (Accessed 2020). https://www.puc.nh.gov/consumer/Commercial%20and%20CI.html

3 Eversource. Interconnected PV in Keene, New Hampshire. (Accessed April 24, 2020).

4 U.S. Department of Energy, February 2012. Energy Storage: The Key to a Reliable, Clean Electricity Supply. (Accessed 2020). https://www.energy.gov/articles/energy-storage-key-reliable-clean-electricity-supply

5 Filtrine Manufacturing Company website. Filtrine Reduces Its Use of Fossil Fuel by 90% with a New Wood Chip Boiler (Accessed 2020). https://www.filtrine.com/company-news/filtrine-reduces-its-use-of-fossil-fuel-by-90-with-a-new-wood-chip-boiler/

6 City of Keene 1995-2015 Greenhouse Gas Emissions Inventory. 2018.

7 U.S. Department of Transportation, Federal Highway Administration (2020). Highway Statistics 2018 (Accessed 2020). https://www.fhwa.dot.gov/policyinformation/statistics/2018/

8 U.S. Environmental Protection Agency (2020). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018.

9 Bloomberg NEF. Electric Vehicle Outlook 2020 (Accessed 2020). https://about.bnef.com/electric-vehicle-outlook

10 U.S. Department of Transportation Bureau of Transportation Statistics. Average Age of Automobiles and Trucks in Operation in the United States (Accessed 2020). https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states

CHAPTER 3 | ENERGY SNAPSHOT

Overview

This chapter provides a snapshot of energy use and trends in Keene for calendar year 2019.

The electricity baseline, which was prepared by the Cadmus Group, provides an estimate of total electricity consumption for all electricity accounts across the City using Keene-specific data provided by the local utility. In addition, the Cadmus Team developed a business as usual estimate of the projected 2030 electricity supply mix, assuming no further action from the City is taken between now and 2030.

The thermal sector baseline relies heavily on City Assessing data and average energy consumption data from the US Energy Information Administration scaled down to the local level. This baseline involves a number of assumptions in order to provide an estimate of energy consumption for the two most commonly used heating fuels in Keene, No. 2 heating oil and propane. It also provides information about the primary fuel types used for space heating and cooling in Keene by total building area (in square feet).

The transportation sector baseline does not attempt to estimate the amount of energy consumed or the percent energy that comes from renewable sources; however, it does provide information about indirect indicators that can be used to track progress towards the transportation energy goal, such as the number of EVs registered in Keene and transportation mode share.

It will be important for the City to continue to improve these estimates and seek and collect more accurate and reliable sources of data over time in order to accurately track its progress toward its energy goals, particularly for the thermal and transportation sectors.

2019 ELECTRICITY BASELINE

Introduction

The electricity sector includes all electricity consumed in Keene, including electricity consumed by residential, commercial, municipal, and industrial/manufacturing accounts. The electricity baseline was prepared by the City's consultant, The Cadmus Group, in order to understand the starting point of electricity consumption within the City and the mix of generation resources producing the consumed electricity. The baseline draws from a combination of available state-level data, Keene-specific utility data provided by Eversource, and insights provided by the current regulatory landscape to estimate an electricity baseline for the City. As part of the baseline analysis, the Cadmus Team also developed a business as usual estimate of the projected 2030 electricity supply mix, assuming no further action from the City is taken between now and 2030. This analysis allows Keene to better understand the gap between the business as usual projection and the City's target of 100% renewable electricity by 2030.

Electricity Consumption in Keene

In 2019, electricity accounts across the City of Keene consumed over 222 gigawatt-hours of electricity. On average, in 2019, a residential account used 4,089 kWh of electricity, a commercial account used 69,478 kWh, and a manufacturing/industrial facility used 28,930 kWh of electricity. It is important to note that industrial accounts are those that manufacturing/industrial accounts by the Eversource definition are those accounts whose demand exceeds 1,000 kW. All other manufacturing/industrial accounts are combined with commercial accounts.

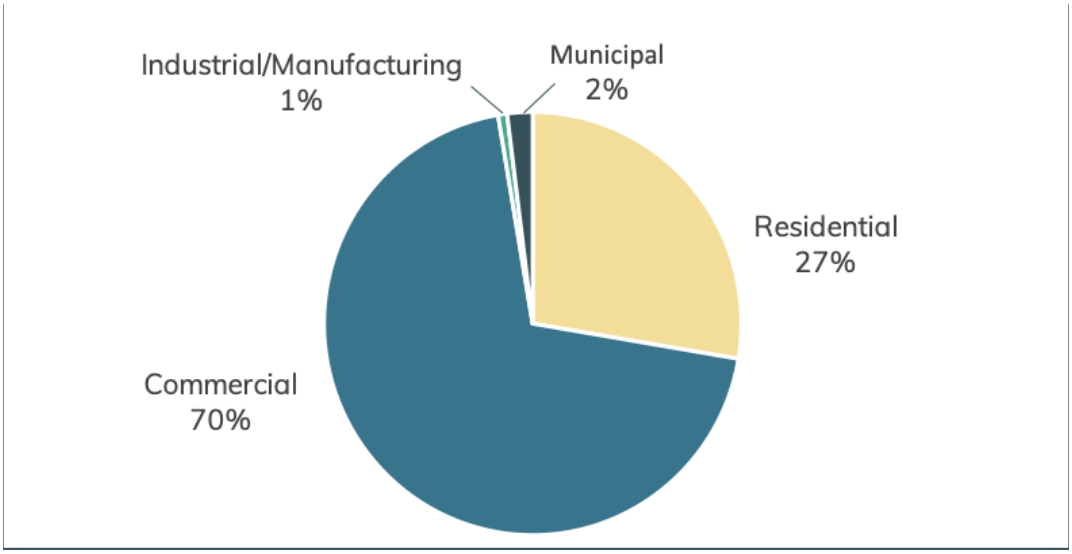


Figure 3.1. Electricity Consumption by Sector 2019

The commercial sector was the largest consumer of electricity, accounting for 70% of total community usage. Residential accounts made up 27% of usage in 2019, while municipal and industrial/manufacturing accounts made up the remaining 3% of electricity consumption in Keene (see Figure 3.1).[1]

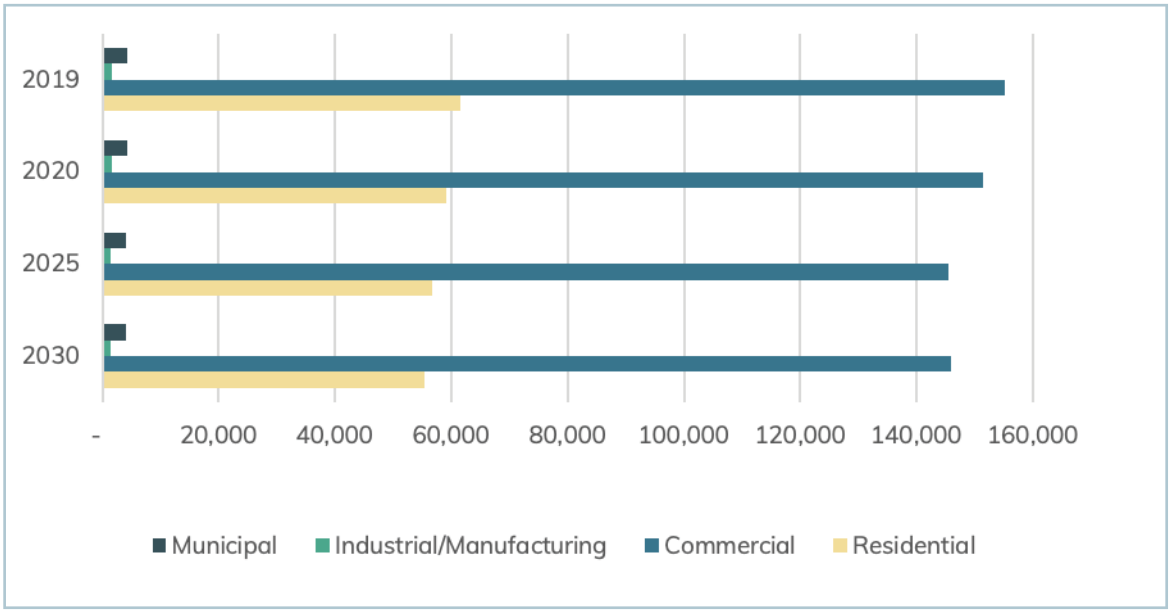


Figure 3.2. Estimated Changes to Electricity Consumption in Keene (MWh)

Over time, consumption is expected to shift due to the impacts of population growth and the increasing effectiveness of energy efficiency. In 2030, 78,315 people are expected to live in Cheshire County, representing an overall growth of 1.25% from 2015.[2] Factoring in both energy efficiency[3] and population growth, it is estimated that overall electricity consumption will decrease by approximately 7% by 2030. However, this analysis does not consider new potential sources of load growth through building electrification, electric vehicle infrastructure, or new capital assets that could drive demand.

Renewable Energy in Keene

Currently, there are a number of systems in Keene that generate renewable electricity. Keene is home to a micro-hydropower system of 90 kW and over 3,300 kW of installed solar photovoltaic (PV) capacity across local homes and businesses.

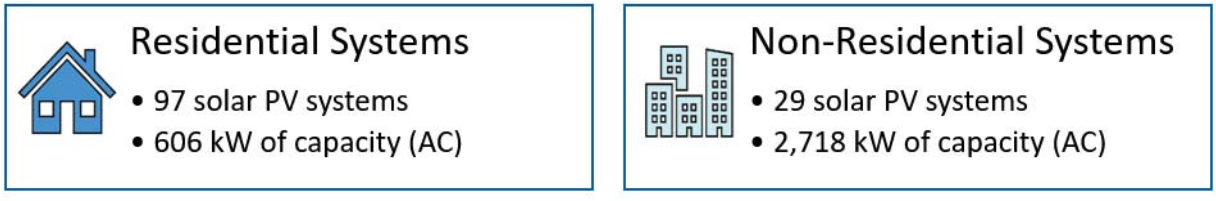


Figure 3.3. Interconnected Solar PV in Keene[4]

Figure 3.3 only includes interconnected systems and does not include off-grid systems within Keene. While distributed generation penetration is expected to grow over time, the 2030 forecast conservatively assumes the number of local renewable energy installations will stay constant over time.

New Hampshire Energy Supply Mix

The local utility, Eversource, has divested its generation assets and relies on the New England Power Pool (NEPOOL[5]) and local energy generation to meet its customer demand for electricity and RPS requirements. The RPS ratchets up the renewable energy requirements every year. By 2025, in order to comply with the RPS, 25.2% of all electricity provided by Eversource will need to be generated using renewable sources. Currently, the RPS is projected to stay constant at 25.2% in 2025 and thereafter. The 2030 forecast conservatively assumes that the percentage of renewable generation mandated by the RPS will not increase after 2025.

Conservatively, the default electricity supply provided by Eversource will need to comply with the RPS. In actuality, the electricity supply that Eversource purchases may exceed this requirement. Eversource interacts heavily with the New England Power Pool (NEPOOL) to source electricity supply. In 2019, the New England-based generation that feeds into the NEPOOL to serve the electricity load was 20.12% renewable, up from 18.3% renewable in 2018.[6] While the regional 2019 level of 20.12% renewable supply exceeded the New Hampshire 2019 RPS requirement of 19.70%, the conservative RPS projections were the foundation of the Keene electricity baseline analysis. As Eversource's default supply changes periodically, the RPS provides a conservative baseline for understanding renewable and non-renewable supply over time, assuming the electric utility is compliant.

Generation Type	Natural Gas	Nuclear	Coal	Oil	Hydro	Refuse/ Other	Wind	Wood	Solar	All Renewables
Capacity (MW)	16,563	4,025	917	7,139	3,393	462	415	503	440	5,213
Net Energy for Load (GWh)	39725	25,182	369	117	7,305	2,895	2,794	2,004	1,474	16,472
% of Total Gneration	48.5%	30.8%	0.45%	0.14%	8.9%	3.5%	3.4%	2.4%	1.8%	20.1%

Table 3.1. NEPOOL Generation Sector 2019[7]

As of 2019, the regional grid relies heavily on natural gas (48.5% of total generation) and nuclear (30.8%), despite the recent closures of nuclear plants across the region, including the 2014 closure of Vermont Yankee Nuclear Power Plant in Vermont and the 2019 closure of the Pilgrim Nuclear Power Plant in Massachusetts. Renewable energy resources, including hydropower, refuse, wind, wood, solar, and other renewables sources made up a combined 20.1% of total regional generation.

A Note on Competitive Suppliers

In New Hampshire, customers have the option between default electricity supply from the utility and choosing supply from a competitive supplier. In both scenarios, electricity is still delivered to customers through the electric utility's transmission and distribution grid. In 2018, Eversource noted that 42% of customer load in New Hampshire was served through default service, while 58% of customer load had migrated to competitive energy suppliers. Competitive suppliers are still subject to the state's RPS, but may offer products to customers that exceed this requirement by offering contracts with higher renewable energy mixes than the default service from the utility. Competitive supplier contracts are typically short-term (12-36 months) and can offer fixed or variable pricing to customers for their electricity.[8] In 2020, the City of Keene entered into two competitive supply agreements for 100% renewable electricity for all but one of its municipal facilities. One contract is subject to a one-year term, and the other is two years. The New Hampshire Public Utilities Commission does not regulate the prices offered by competitive suppliers. However, it does provide questions that consumers should ask competitive suppliers while assessing options.[9]

What this means for 2030

Overall, the business as usual case conservatively estimates that electricity consumption in the City of Keene will be 27% renewable by 2030. The baseline points to a steady increase in renewable electricity supply, largely driven by RPS compliance. Despite population growth, electricity consumption is anticipated to decrease slightly, driven primarily by expected energy efficiency improvements.

Sector	Energy Type	Consumption 2019* (MWh)	Consumption 2030 (MWh)
Residential	Renewable	12,137	13,945
	Non-Renewable	49,471	41,393
Commercial	Renewable	30,563	36,781
	Non-Renewable	124,580	109,176
Industrial / Manufacturing	Renewable	308	370
	Non-Renewable	1,254	1,099
Municipal	Renewable	860	4,109
	Non-Renewable	3,507	0

*Table 3.2: Electricity Consumption by Sector. *Note: The 2019 consumption figures for renewable energy are based on the 2019 NH RPS requirement of 19.70%, to be consistent with the 2030 forecast. The actual renewable energy content in 2019 was 20.1%.*

This baseline assumes that the City continues sourcing 100% renewable electricity for its municipal accounts through 2030 from competitive supply agreements. If the municipality chooses not to extend these agreements and default back to the utility supply, then the overall community renewable electricity mix is expected to decrease slightly.

In 2030, it is estimated that the commercial and residential sectors will be the largest consumers of electricity (71% and 27% of electricity consumption, respectively), but that a larger proportion will be sourced from renewable energy due to the RPS. Without further action, it is estimated that the City will achieve 26.7% of its 100% renewable electricity target by 2030.

2019 THERMAL BASELINE

Overview

The Thermal Sector includes all energy except electrical energy used to heat and cool buildings located in Keene. Electrical energy used to heat and cool is already accounted for within the electricity baseline. Information about heating and cooling systems, as well as the area of buildings, was derived from data provided by the City Assessing Department, and thermal energy consumption was estimated using energy intensity figures and average consumption data for residential and commercial properties from the Energy Information Administration.

The Thermal Sector is divided into three types of buildings: Residential, Commercial, and Public / Non-profit.

Data Limitations and Assumptions

The data obtained from the City Assessing Department provides information about the area (in square feet) of livable space by building type, as well as the type of heating or cooling system for each building and heat fuel type. There are several limitations to this data, including gaps in the data (fields not filled in), changes over time in how data is recorded by the Assessing Department, and the frequency with which the data about heating systems and heat fuel is updated. In addition, the data from the City Assessing Department only includes the primary heat source for each building, and does not include secondary heat sources such as wood stoves or pellet stoves. In the case where a home is heated primarily

by a wood stove or pellet stove and there is a back-up heating system for emergencies, the back-up system is typically recorded in the Assessing data and not the wood or pellet stove. Therefore, this baseline is likely to underestimate the amount of biomass consumed in Keene, while over-estimating the amount of heating fuel (heating oil and propane). In addition, in many instances the fuel type field is indicated as "typical," which means that the fuel type is unknown. This is especially true for commercial buildings and buildings in the "public/nonprofit" category.

Fuels used for Space Heating and Cooling in Keene

There are a variety of fuels used for space heating in Keene. Figure 4 provides an overview of the total building area that is heated (in square feet), broken down by fuel type and by building category (residential, commercial, and public/nonprofit). Figure 5 shows the percent of total building area that is heated by fuel type. Number 2 heating oil is the most widely used heating fuel, followed by propane and piped propane (propane and air mix), electricity, wood, and solar. About 19% of all heated building space, corresponding to 102 buildings, is heated by an unknown fuel type.

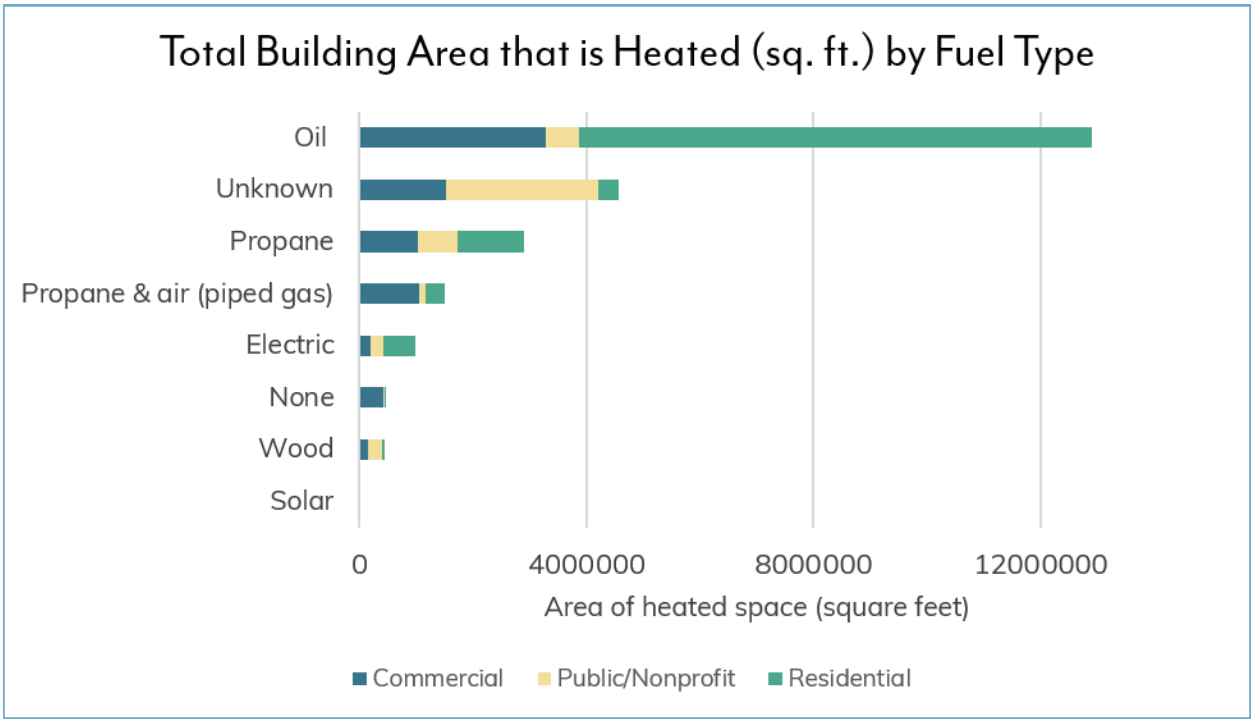


Figure 3.4. Total building area that is heating, in square feet, by fuel type and by building category (residential use, commercial use, or public/nonprofit use).

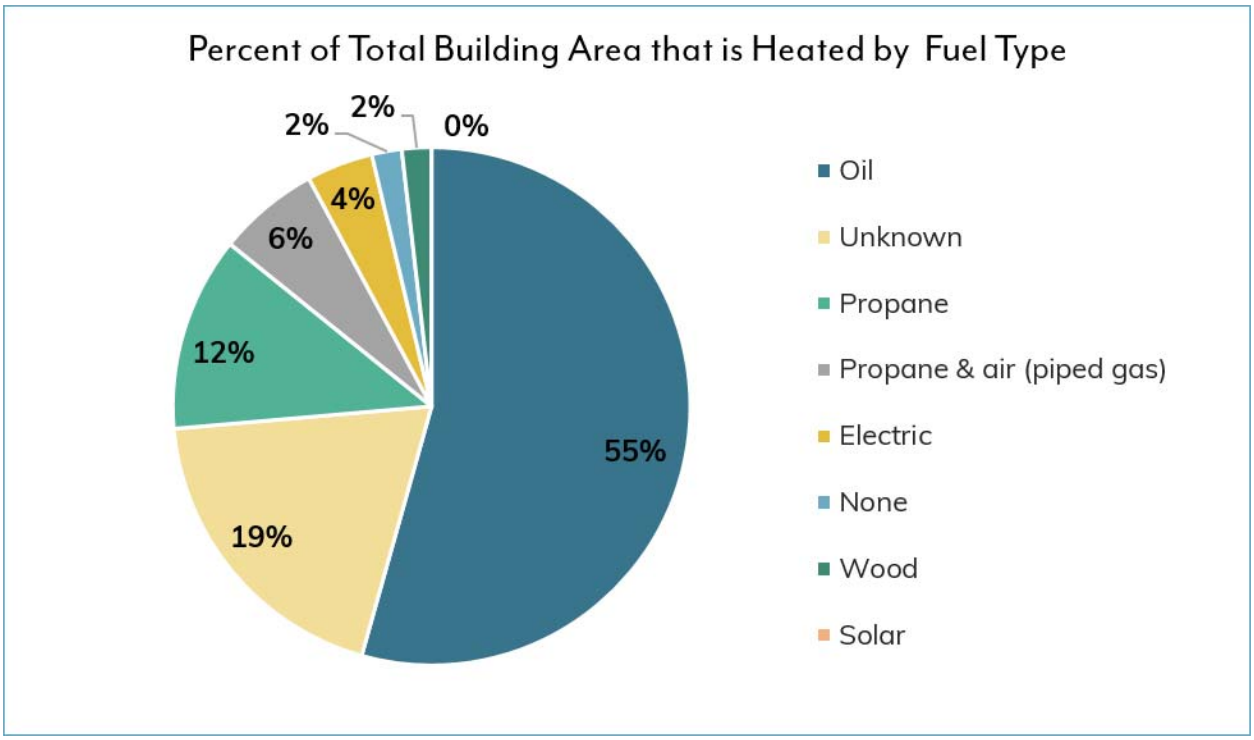


Figure 3.5. Percent of total building area in Keene that is heated, by fuel type.

There are examples of renewable thermal systems in Keene, including (but not limited to) a geothermal heating system at the City of Keene Public Works building, a biofuel plant that uses recycled vegetable oil to heat the Keene State College campus, a wood chip heating plant at the Keene Middle School, and wood chip boiler at Filtrine Manufacturing. Natural gas is not widely available in Keene; however, there are a limited number of buildings located in the Monadnock Marketplace development (about 5% of commercial space) that are heated by compressed natural gas (CNG).

Fuel Costs and Vulnerability

In general, while the weekly residential heat oil and propane prices in New Hampshire have not increased significantly in the last 15 years, the price of propane and oil have been unpredictable and subject to spikes in the winter months when demand and need are highest (Figure 3.6). In addition, while costs have not increased significantly, average fuel costs in New Hampshire are consistently higher when compared to the rest of the country (Figure 3.7). High average fuel costs, in combination with price variability of the two most consumed fuels in the city, puts many Keene residents in a vulnerable place to meet their winter heating needs, cooking needs, and other critical building costs during high-demand months.

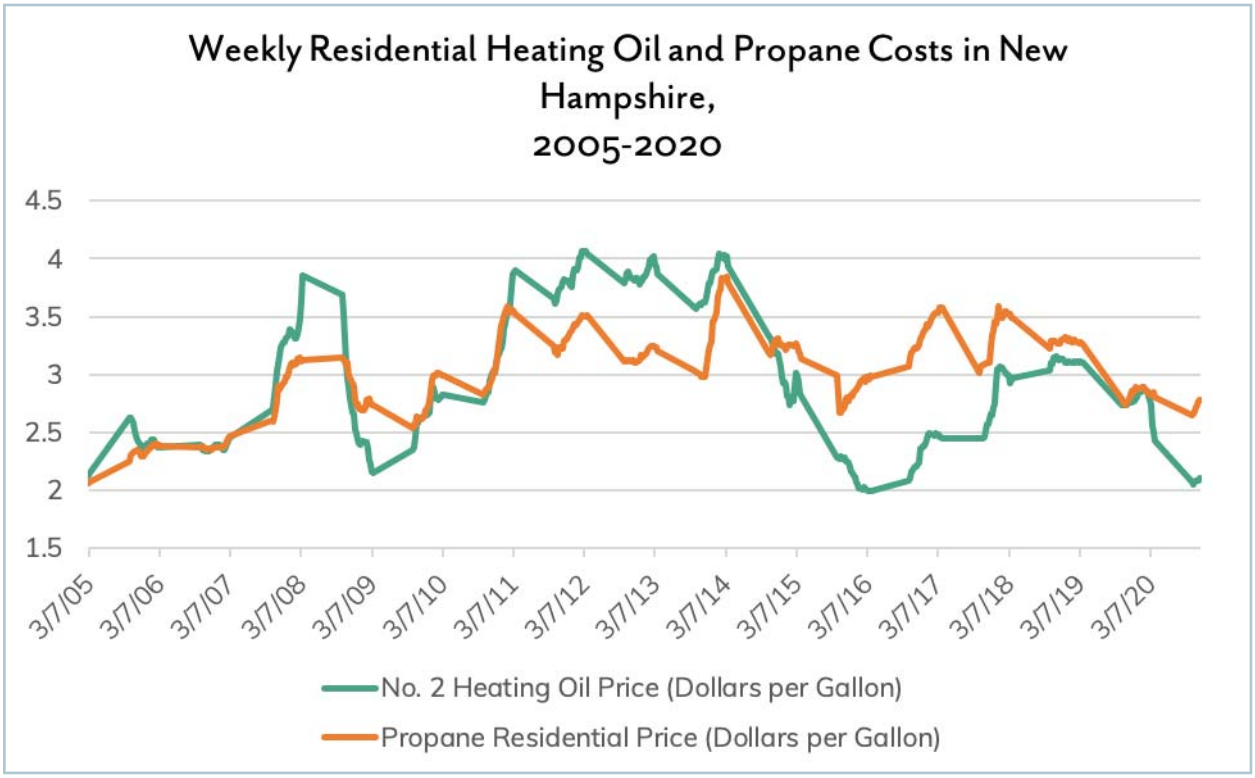


Figure 3.6. Weekly Residential Heating oil and Propane costs for October-March, 2005-2020[10]

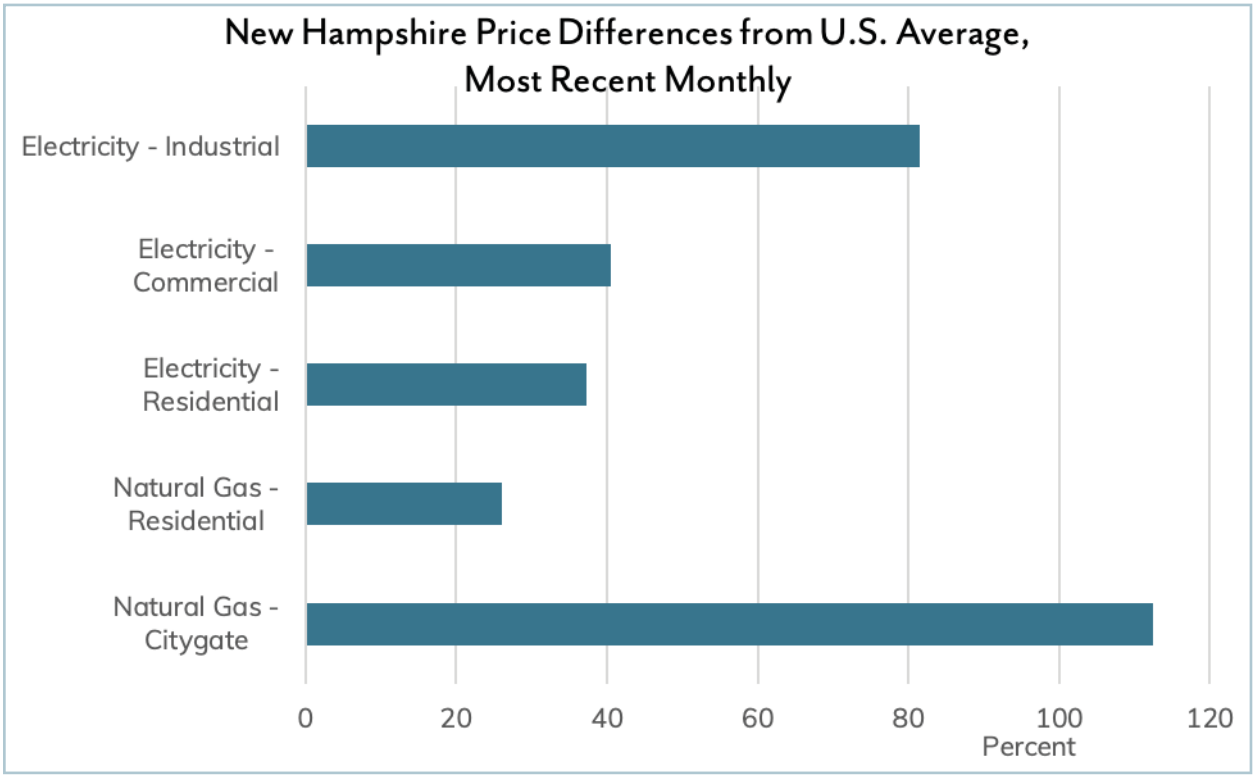


Figure 3.7. Percent above US-average that NH Hampshire residents pay for building costs in January 2020.[11]

Estimated Fuel Consumption in Keene

While the City's Assessing data provides some information about the type of heating system and primary fuel type by building, it does not provide information about the amount of fuel used to heat and cool buildings in Keene. In order to estimate the amount of fuel consumed for space heating, average New England and Cold Climate consumption figures were used from the US Energy Information Administration (US EIA) and scaled to best match Keene building data.[12] Because electricity consumed for space and water heating and electricity for plug load cannot be separated, this analysis considers only the two most used heat fuels in Keene: No. 2 heating oil and propane. Electricity energy consumption for space heating and cooling is captured within the 2019 electricity baseline data.

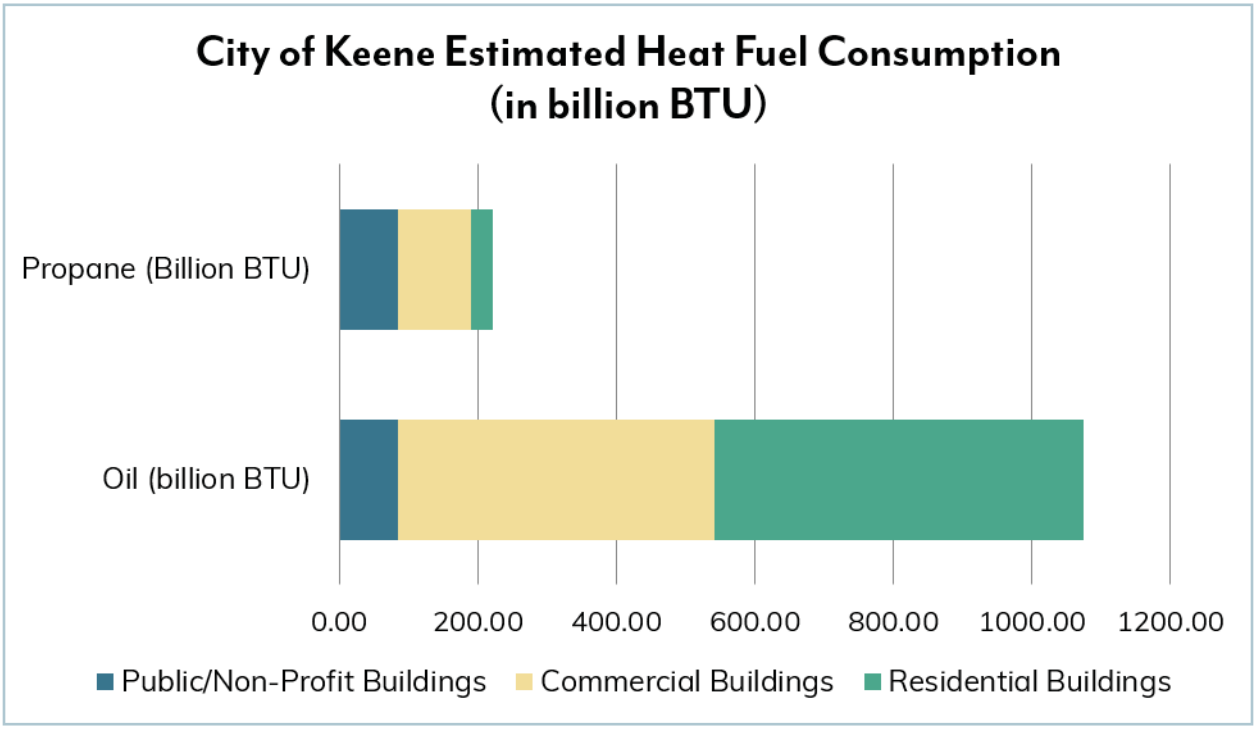


Figure 3.8. Estimated heat fuel consumption (billion BTU) for propane and number 2 heating oil in Keene.

Heating Fuel Consumption Estimates	Oil (billion BTU)	Propane (Billion BTU)
Public/Non-Profit Buildings	85.24	84.95
Commercial Buildings	455.62	105.31
Residential Buildings	534.85	30.44
Total	1075.71	220.69

Table 3.3. Annual heating fuel consumption estimates for buildings in Keene, in billion BTU.

Two methods were used to estimate Keene's heat fuel consumption for propane and oil. For residential buildings, US EIA data for Average Site Energy Consumption in the Northeast US, recorded in million BTU per household by fuel type, was applied to local figures for Keene. For each fuel – propane and oil in this case – the US EIA provides an average consumption

figure for the following sub-units: single family home attached, single family home detached, multi-family home 2-4 units, multi-family home 5+ units, and manufactured (mobile) homes. Using the assessing data from the City of Keene, the number of households in a given sub-sector were multiplied by the average site consumption per household figure. This includes each residential unit, for example 2-units in a 2 family home, 9 units in a 9-occupancy apartment building, and so on. Each sub-sector total was then combined to approximate total residential energy consumption: 534.85 billion BTU for Oil and 30.44 billion BTU for Propane.

For Commercial and Public/Non-Profit buildings, heat fuel consumption was estimated based on US EIA energy intensity figures (thousand BTU/square foot) for New England (very cold/cold climate designation). The US EIA estimates that the energy intensity for the sum of major fossil fuels in a commercial building is 86.1 thousand BTU/square foot. The EIA also provides specific energy intensity figures for propane (88 thousand BTU/square foot) and fuel oil (115 thousand BTU/square foot). These figures were multiplied by the total area of heated space for each fuel type to estimate fuel consumption in buildings used for a commercial or public/nonprofit purpose.

These energy consumption estimates can be better understood when they are converted from billion BTUs to "native" energy units. Based on average consumption, Keene buildings consume an estimated 221 billion BTUs of propane and 1,076 billion BTUs of Oil per year. Using the US EIA conversion table[13] that equates to:

	BTU consumption	Conversion ratio (US EIA)	Total consumption/year
Propane	221 billion BTUs	1 gallon of propane = 91,333 Btu	2.4 million gallons of propane
Oil	1,076 billion BTUs	1 gallon of heating oil = 138,500 Btu	7.8 million gallons of heating oil

Table 3.4. Estimated annual heat fuel consumption in Keene for propane and number 2 heating oil.

2019 TRANSPORTATION BASELINE

Introduction

The Transportation Sector includes the movement of people and goods within, into, and out of Keene. For the purposes of measuring and tracking progress towards the 2050 Transportation Sector goal, the scope of the baseline metrics is limited to ground transportation of Keene residents. However, the City recognizes that non-residents visiting or working in Keene likely account for a large proportion of the travel that occurs within the City limits. As such, the transportation strategies in this plan are intended to have a broader impact.

The transportation baseline considers how residents choose to get around (transportation mode choice), the types of vehicles residents choose to buy or lease, and the infrastructure and systems in place to support different transportation modes (cars, buses, bicycles, walking, etc.). How people choose to travel directly translates into fossil fuels consumed (or not consumed) and the host of local and global environmental impacts that result from our reliance on combustion fuels.

Vehicles Registered in Keene

According to data from the New Hampshire Department of Environmental Services, there were 19,911 registered vehicles in Keene as of December 2019, or about 2.1 vehicles for every household and approximately 1 vehicle for every adult age 16 or older. Of these, 92% were light-duty conventional vehicles with internal combustion engines (ICE), 6% were heavy-duty conventional vehicles, 1% (222) vehicles were registered as hybrid electric vehicles (HEVs), 1% were registered as plug-in hybrid electric vehicles (PHEVs), and less than 1% (15 vehicles) were registered as all-electric vehicles (AEVs).

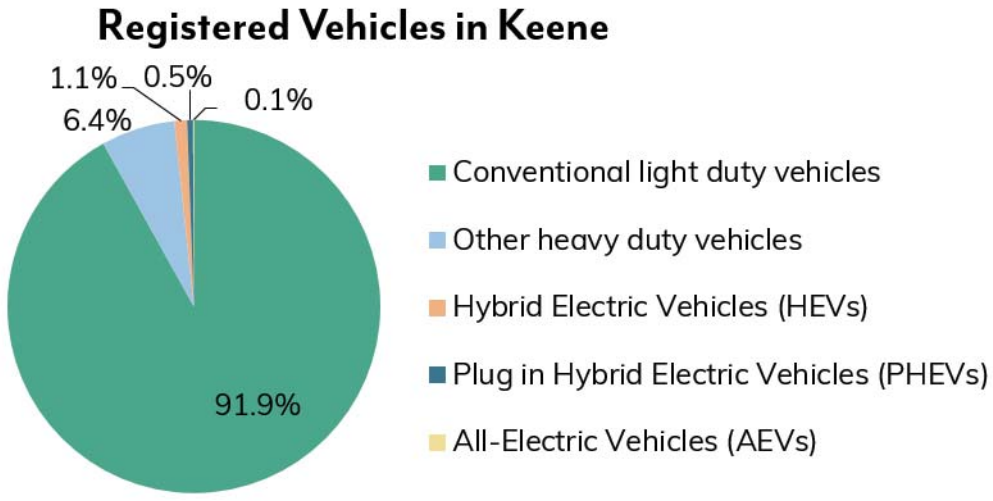


Figure 3.9. Percent total registered vehicles in Keene by vehicle type as of December 2019.

Conventional and Electric Vehicle Designation: An Overview			
Conventional Passenger Car	Hybrid Electric Vehicle (HEV)	Plug-in Hybrid Electric Vehicle (PHEV)	All Electric Vehicle (AEV)
Conventional passenger cars are motor vehicles with internal combustion engines. This includes gasoline, diesel, and flex (ethanol capable) vehicles.	Hybrid electric vehicles (HEVs) are powered by an internal combustion engine and an electric motor. Batteries can be charged by the internal combustion engine or through regenerative braking, but not by an outside electric power source.	Plug-in hybrid electric vehicles (PHEVs) use batteries to power an electric motor and use another fuel, such as gasoline or diesel, to power an internal combustion engine or other propulsion source. Batteries can be charged by an outside electric power source, by the internal combustion engine, or through regenerative braking.	All-electric vehicles (AEVs) operate on electricity alone using batteries charged by an outside electric power source. They include battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs).

How Residents Choose to Travel

Information about how people commute, or transportation mode share (TMS), indicates that the majority of Keene residents prefer using a personal motor vehicle to get to and from work or school. According to Transportation Mode Share data from the American Community Survey in 2017, 73 percent of survey respondents drove alone for their commute, 8 percent carpooled, 0.2% used public transit, 7% walked, 9% worked from home, and 4% selected "other" (see Figure 10).[14] This data does not include how people choose to travel for other types of trips, such as shopping or recreational trips. However, it is reasonable to assume that the majority of trips made by residents in Keene are made using a personal motor vehicle due to several factors, including long distances that people may need to travel to get to their destination, the lack of alternative transportation options outside of Keene, the convenience of personal vehicles as compared to other options, and climate/weather conditions.

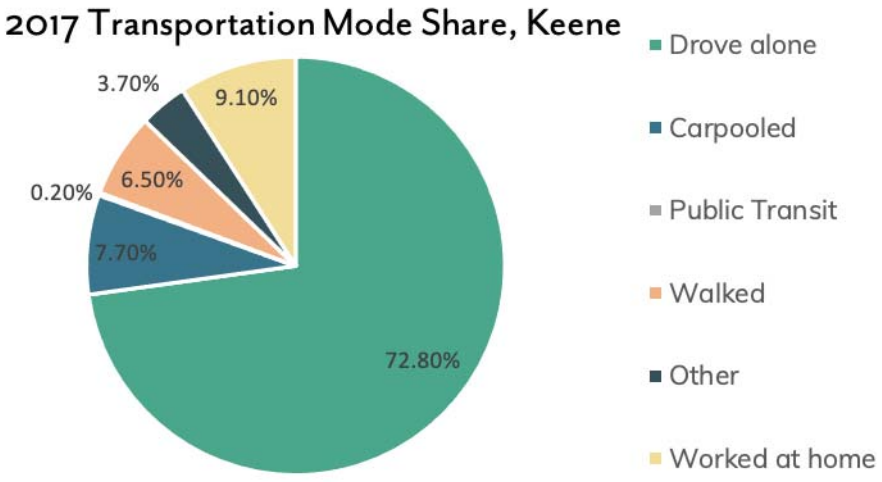


Figure 3.10. Transportation Mode Share among workers age 16+ (data source: American Community Survey, 2017)

Public Transportation Options

Keene is currently home to one fixed-route bus system, the City Express Bus, as well as a demand-response bus designated to meet the needs of people aged 60 or older, the Friendly Bus. During the academic school year, the Keene State Campus Community Shuttle bus is also available for Keene resident use. The City Express Bus, campus shuttle, and the Friendly Bus are operated by Home, Healthcare, Hospice and Community Services of Southwestern New Hampshire (HCS). The City Express service has two operating bus lines which run outside of typical work hours. Both lines operate Monday through Friday, starting at 8:00 am and finishing at either 4:09 pm or 5:04 pm. Both routes originate and terminate at the Keene Transportation Center, and a bus runs once every hour for each line. While there are 39 set bus stops along the two lines, the bus can be hailed or stopped at the rider's request as long as it is on the bus path.[15] Given these factors, ridership is estimated by the 2018 American Community Survey as 27 (+/-32) people per day,[16] and HCS reports an average of 72 riders per day, with some fluctuation due to whether or not Keene State College is in session.

Two Greyhound Bus routes provide service in Keene, heading either north to beyond White River Junction or south to Springfield, MA. According to Southwest Region Planning Commission (SWRPC), the average ridership for both of those lines is about 5 riders getting on and 5 riders getting off the bus each day.

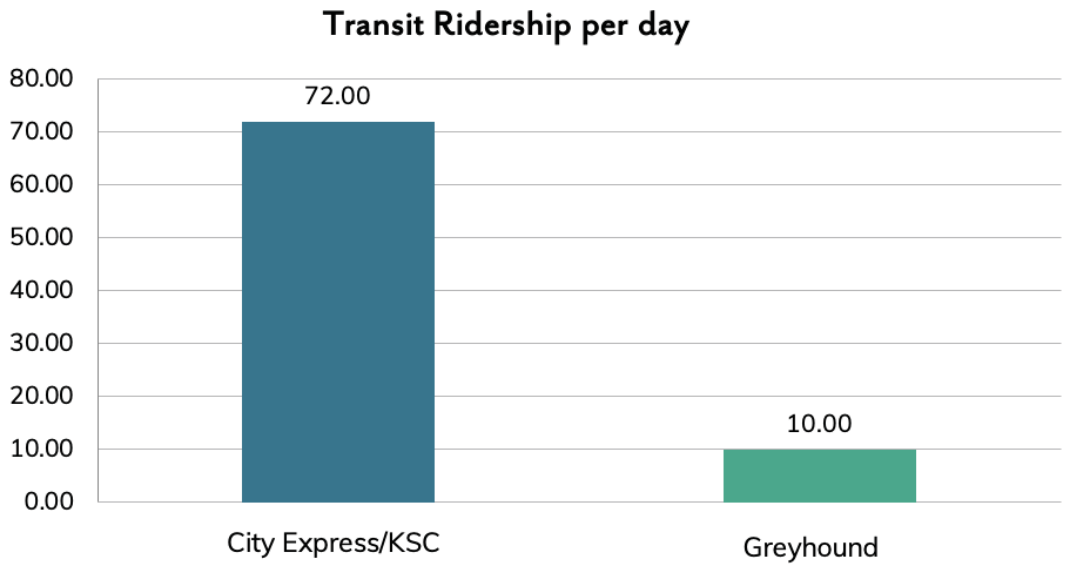


Figure 3.11. Average transit ridership per day in Keene, NH

Transportation Infrastructure

Roundabouts

As a way to reduce vehicle delay time and improve the flow and safety of traffic, the City of Keene and NH Department of Transportation have installed six roundabouts throughout the city at busy intersections where traffic delay, congestion, and/or safety issues were identified. Roundabouts are circular intersections where entering traffic yields to traffic

in the circle. Design features, such as a smaller diameter and splitter islands, slow traffic speeds. Because they reduce idle time and improve traffic flow, the replacement of a failing signalized intersection with a roundabout has been shown to reduce fuel consumption and emissions.[17] As of October 2020, Keene had 6 roundabouts and 20 signalized intersections, with an additional two roundabouts planned for construction on Winchester Street in 2021.

Pedestrian, Bike and Transit Miles

Infrastructure such as sidewalks, marked crosswalks, bicycle lanes, bicycle boxes, and other supportive infrastructure for pedestrians and bicyclists improves safety and helps promote "human-powered" transportation modes that do not rely on fossil fuels. As of October 2020, the City maintains over 54 miles of pedestrian sidewalks year-round, 3.75 miles of bicycle lanes, and 2.92 miles of shared bicycle lanes. In addition, there are over 13 miles of multi-use trails within the City limits, and over 41 miles of fixed bus routes.

Figure 3.12. Image of a painted "bicycle box" on Central Square in Keene.

The City has installed 15 enhanced pedestrian crossings in locations where traffic speed, traffic volume, or proximity to a grade school or other destination for pedestrians warrants increased safety measures. An example is the two crosswalks on Winchester Street near its eastern terminus, where high volumes of student foot traffic led to the installation of raised crosswalks with automated flashing lights to increase the visibility of pedestrians and slow motorized traffic. In 2017, the City installed "Bicycle Boxes," or painted areas where bicyclists can queue at an intersection, in order to increase the visibility and safety of people riding bicycles as they enter the busy Central Square intersection (see Figure 3.12).

Figure 3.13 on the next page depicts a map of bicycle infrastructure in downtown Keene, which includes in-street shared lane markings (sharrows) and bicycle lanes, as well as off-street multiuse rail trails. Table 3.5, below, includes counts for the number of bicycle boxes, enhanced pedestrian crossings, road/trail crossings, and bus stops in Keene as of October 2020.

Type of Infrastructure	Count
Bicycle Boxes	2
Enhanced pedestrian crossings	15
Road crossings for multiuse trails/paths	32
Bus stops	39

Table 3.5. Selected bicycle, pedestrian, and transit infrastructure counts in Keene

Figure 3.13. A map of bicycle infrastructure in Downtown Keene.

EV Charging Infrastructure

There are 3 charging locations within the City of Keene, including two "Level 2" charging ports in the Commercial Street parking lot (available for a parking fee of $1.49/hour), two "Level 2" charging ports at the Fairfield Kia Dealership, and one "Level 2" charging port at the Antioch University New England campus. There are no DC fast charge stations ("Level 3" charging stations) in Keene. However, within 20-30 miles of Keene, there are a number of charging stations and charging ports, most of which are along the Route 91 corridor between Brattleboro and Putney across the Connecticut River in Vermont, including 4 public DC fast charging locations. There are 13 "Level 2" charging locations within 20 miles, and 16 additional "Level 2" charging locations within 30 miles of the City (Figure 3.14).

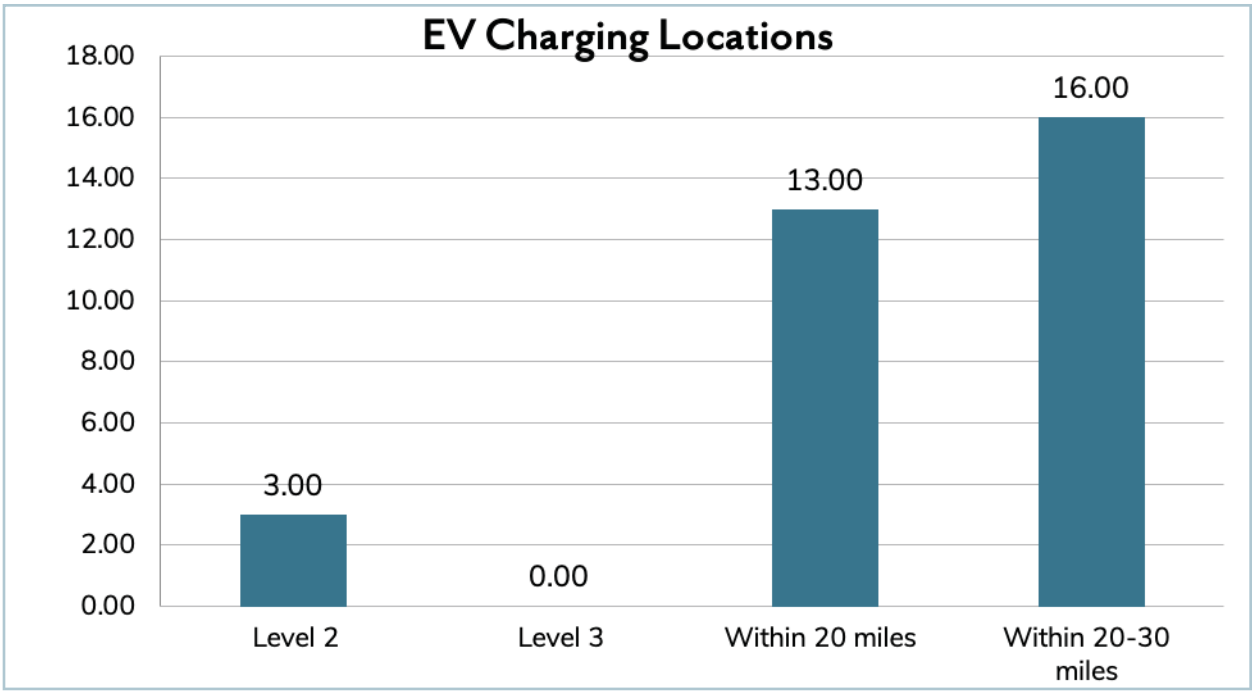


Figure 3.14: Number of EV charging location at varying distances from Keene, NH.

Transportation and Land Use

Coordinated transportation and land use planning can help reduce energy use within the transportation sector over the long term by shortening trip distances, reducing the need for parking, and supporting sustainable travel modes such as public transit, walking, and bicycling. There are several land use factors that impact how much people drive (vehicle miles traveled) and the number of single occupancy vehicle trips, which is among the most inefficient and energy intensive ways to travel. These factors include the density and mix of land uses, access to transit, interconnected and well-designed streets, and walkable neighborhoods.

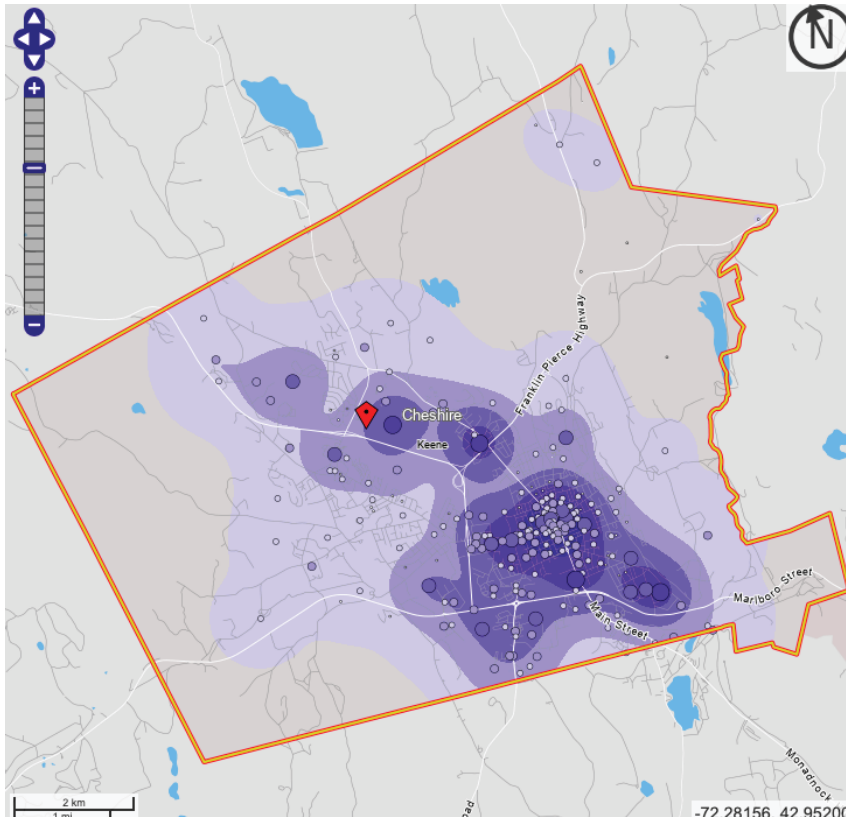
Housing in Mixed Use Areas

According to a housing inventory analysis presented to the Keene City Council in February 2020, 26 percent (2,628 units) of all residential dwelling units in the City are located in the Central Business (7 percent or 725 units), Central Business Limited (1 percent or 111 units), or High Density (17.4 percent or 1,792 units) Zoning Districts. These districts are located in either the downtown or areas directly surrounding the downtown and provide easy access to a multitude of services and resources, including convenient access to public transportation. Most of the City's dense residential developments are located in these areas with 54 percent of all residential buildings with over 8 Units, and 54 percent of all residential buildings with 4-8 units being located in these districts. Figures 3.15 and 3.16 on the next page show a side-by-side comparison of where people work in Keene (Figure 3.15, on the left) and where people live in Keene (Figure 3.16, right) using the US Census "On the Map" tool. This data shows that job centers and population centers within Keene are well-aligned, which can help support more energy-efficient transportation modes such as walking, bicycling, and public transit.

Complete Streets

In 2015, the City of Keene adopted a Complete Streets policy (in the form of a resolution) which made a commitment to designing, constructing, operating, and maintaining all City-owned transportation facilities to support the needs of all users of the roadway, including bicyclists, pedestrians, transit riders, and motorists. To support this policy, the City also adopted a set of Complete Streets Design Guidelines that establishes a Complete Street Typology system and map (see Figure 3.17). This typology system classifies the streets in Keene based on each roadway's function and surrounding land use context, including right of way width, building types, predominant travel modes, and surrounding land uses. For each street type, the guidelines includes a list of features that should be considered in the form of a checklist. Examples of complete streets features includes pedestrian crossings, medians, pedestrian islands, street furniture, pedestrian-scale lighting, bicycle lanes, sidewalks, and on-street parking in appropriate areas.

In 2018/2019, a group of Keene State College students in the Geography Department prepared a report that addresses the City's progress on its Complete Streets commitment. This analysis was limited to a review of "Slow," "Bicycle," and "Gateway" street types. The students evaluated a random sample of streets throughout Keene within each of these three street types, and assigned letter grades to each street segment based on how well the street matched the list of suggested Complete Streets treatments listed in the City's Design Guidelines (see Figure 3.18). The student report concludes that, of the 24 street segments that were assessed, many do not meet the City's Complete Streets design guidelines, with only one street segment receiving a letter grade of "A" – the segment of Main Street between Central Square and the Winchester Street/Marlboro Street/Main Street intersection.



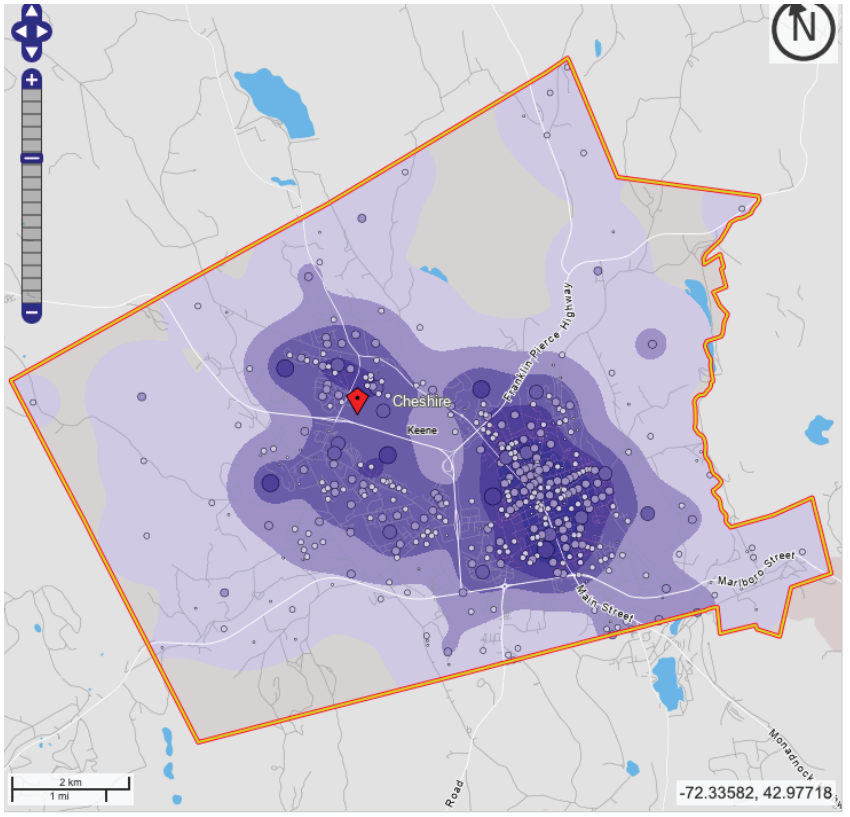


Figure 3.15 (left) and Figure 3.16 (right). Heat maps that show where people work (left) and where people live (right) in Keene, generated by the US Census "On the Map" tool. The darker colors represent higher density areas.[18]

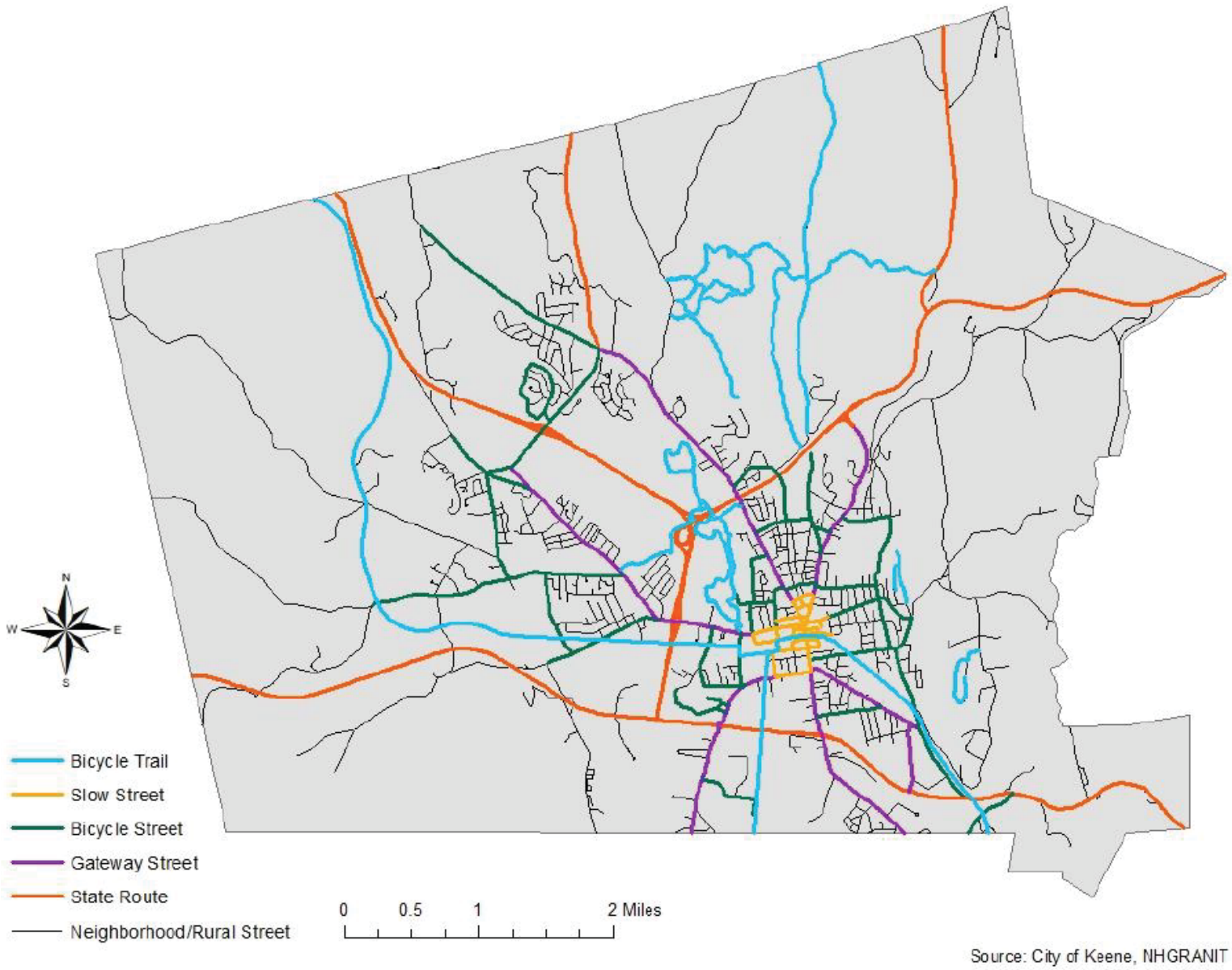


Figure 3.17. City of Keene Complete Streets typology.

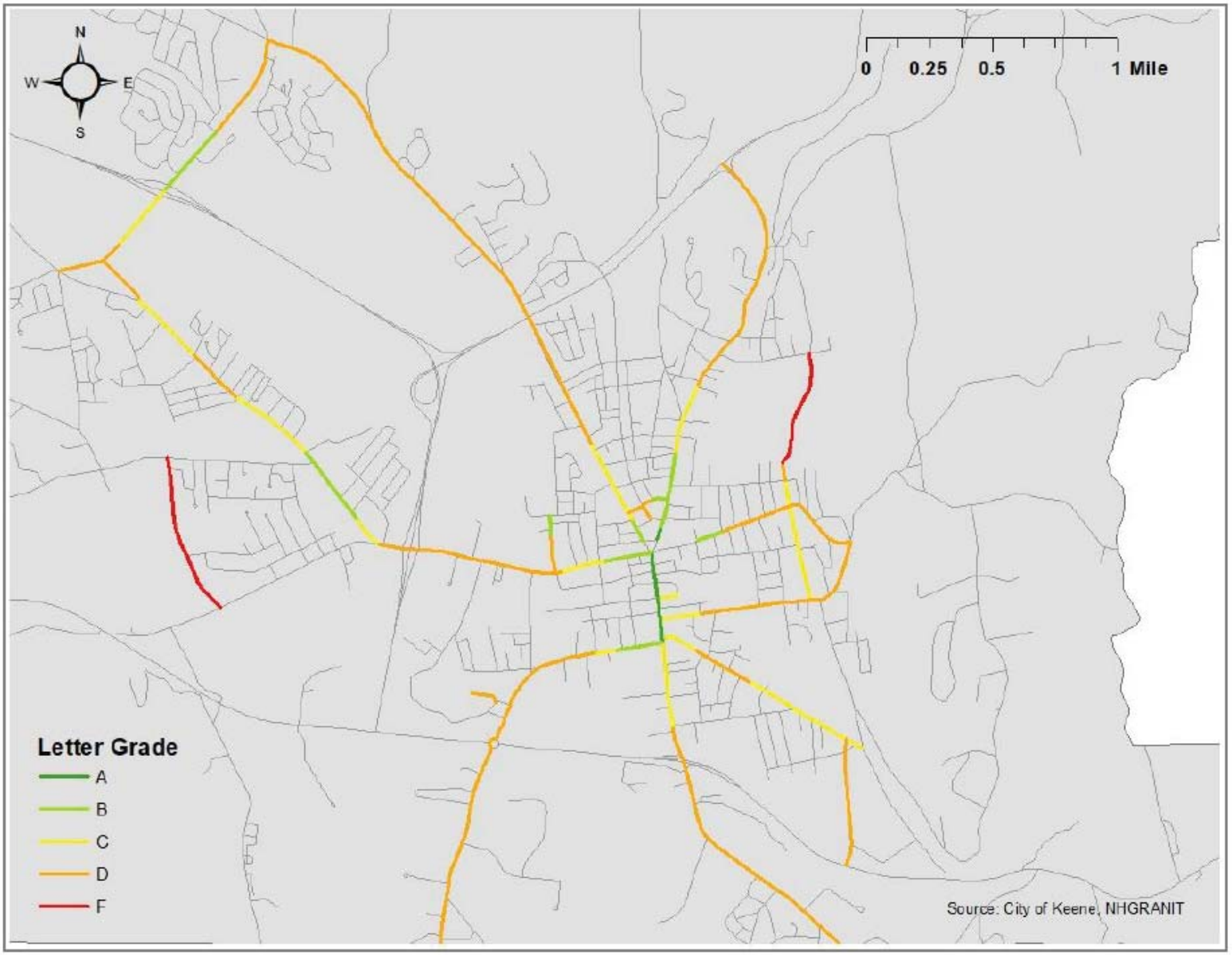


Figure 3.18. City of Keene street grade by segment.

Endnotes

1 Data provided by Eversource. Industrial accounts are those that have peak electricity demand greater than 1,000 kW.

2 The New Hampshire Office of Energy and Planning. *State of New Hampshire Regional Planning Commissions: County Population Projections* (2016). https://www.nh.gov/osi/data-center/documents/2016-state-county-projections-final-report.pdf

3 Energy efficiency is based on delivered energy from the EIA Annual Energy Outlook (Publication 2019). https://www.eia.gov/outlooks/aeo/data/browser/#/?id=2-AEO2019&region=1-1&cases=ref2019

4 Distributed generation information was provided by Eversource.

5 New England Power Pool (Accessed 2020). http://nepool.com/

6 New England Power Pool. *Working Together to Shape Tomorrow: Annual Report* 2019 (2020). http://nepool.com/uploads/Annual_Report_2019.pdf

7 ibid

8 Information was not available about the current competitive supply agreements or environmental disclosures of those agreements within Keene. Therefore, this analysis assumes that all electricity mix throughout Keene met the RPS requirements and did not exceed the renewable energy carve outs.

9 New Hampshire PUC. *Choosing an Energy Supplier: Suppliers and Aggregators* (Accessed 2020). https://www.puc.nh.gov/consumer/energysuppliers.htm

10 US Energy Administration. Weekly Heating Oil and Propane Prices (October-March). https://www.eia.gov/dnav/pet/PET_PRI_WFR_DCUS_SNH_W.htm

11 US Energy Information Administration. NH Price Differences from U.S. Average, Most Recent Monthly. https://www.eia.gov/state/?sid=NH#tabs-5

12 US Energy Information Administration. Commercial Buildings Energy Consumption Survey (CBECS). https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c10.php and US Energy Information Administration. 2009 RECS Survey Data. https://www.eia.gov/consumption/residential/data/2009/#structural

13 US Energy Information Administration. Units and calculators explained. https://www.eia.gov/energyexplained/units-and-calculators/

14 https://data.census.gov/cedsci/table?q=Keene,%20NH&g=1600000US3339300&tid=ACSST5Y2017.S0801&layer=VT_2018_160_00_PY_D1&vintage=2017

15 https://www.hcsservices.org/services/transportation/city-express/

16 https://data.census.gov/cedsci/table?q=Keene,%20NH&g=1600000US3339300&tid=ACSST5Y2017.S0801&layer=VT_2018_160_00_PY_D1&vintage=2017

17 U.S. Federal Highway Administration Publication No. FHWA-SA-15-071. *Accelerating Roundabout Implementation in the United States - Volume III of VII: Assessment of the Environmental Characteristics of Roundabouts*. September 2015.

18 https://onthemap.ces.census.gov/

CHAPTER 4 | MEASURING OUR PROGRESS

Why Track Progress?

As the City and community partners work to achieve the sustainable energy goals for electricity by 2030 and for thermal and transportation by 2050, it will be important to track and report our progress towards these goals. Measuring progress will enable improved and informed management of projects and programs, helping to drive continuous improvement. Effectively communicating progress will help generate and maintain interest among residents and stakeholders, increase transparency and trust, and provide quantitative support for existing strategies or, if necessary, for changing course.

Performance Metrics

A performance metric, sometimes referred to as an "indicator," is a measurement for understanding the impacts of actions and progress toward goals. For example, a good performance metric for a program that aims to increase the number of EV charging stations would be the number of new EV charging stations installed over a given time period.

Metrics can be used to measure the overall impact of a combination of strategies ("system-level metric"), for example, total residential energy use in MMBtu per year. They can also be used to measure the impact of a specific activity or program ("program-level metric" – see EV example above) or to illustrate whether or not a specific action has been taken ("milestone metric"). An effective metric should be aligned with a specific goal or outcome, be relatively easy to understand, rely on trustworthy data (be accurate), and be timely (can be updated frequently enough to be useful).

2030 ELECTRICITY GOAL

Due to the shorter timeframe to achieve the electricity goal and the availability of locally specific data through the utility, this plan recommends tracking progress towards the 2030 electricity goal on an annual basis using the metrics listed below. As the City pursues specific programs and actions, additional metrics should be identified and tracked to evaluate the effectiveness of these initiatives.

Electricity Sector Performance Metrics

Performace Metric	Data Source	Responsibility	Requency
Annual electricity consumption by sector (residential, commercial, industrial/manufacturing, municipal).	Eversource or Community Power program	City staff	Annual
Electricity supply mix (renewable v. non-renewable) by sector (e.g. ISO New England Resource Mix).	Eversource or Community Power program	City staff	Annual
Percent of households/customer load on competitive energy supply (or participating in Community Power program)	Eversource or Community Power program	City staff	Annual
Number of solar installations by sector (residential, commercial, etc.)	Eversource; City Assessing Department	City staff	Annual
Installed solar capacity by sector (residential, commercial, etc.)	Eversource; City Assessing Department	City staff	Annual
Number/percent of eligible homeowners and businesses that take advantage of the renewable energy property tax exemption.	City Assessing Department	City staff	Annual

2050 THERMAL GOAL

In contrast to the electricity sector, the thermal sector does not have a readily available, locally-specific source of data to measure the amount of energy consumed for heating and cooling within the City. The metrics listed below are indirect indicators to help the City and public understand trends in weatherization, building energy efficiency, and uptake of renewable thermal technologies. These metrics rely on several data sources with varying degrees of accuracy and timeliness. For example, City Assessing data on the type of heating system and type of heating fuel is not regularly updated, and is unlikely to show any measurable change year to year. Therefore, the recommended frequency for updating these metrics varies depending on the data source(s), the accuracy of the data, and the level of effort it will take to collect the necessary data.

As programs such as benchmarking, home energy labeling, and Community Power are adopted and implemented, accurate and reliable data at the local level will become more available to track progress towards the thermal goal on a more frequent basis.

Thermal Sector Performance Metrics

Performance Metric	Data Source	Responsibility	Frequency
Number of households and businesses that participate in weatherization programs per year (e.g. NHSaves, local weatherization campaign)	NH Saves program; local weatherization programs	City staff, NHSaves, SCS	Annual
Number of high performance buildings in Keene (e.g. NE-CHPS, LEED, etc.)	Local survey; Organization contacts	City staff & Energy and Climate Committee	2-3 years
total building area/ percent of building area using renewable thermal (e.g. biomass, solar thermal, geothermal, etc.) for space and hot water heating, by sector	City Assessing Data; Local surveys or organization contacts	City staff & Energy and Climate Committee	2-3 years
Estimated energy consumption for space heating (per household / per square foot commercial floor space)	Assessing Data (sq. ft of building space); Energy Information Administration (energy intensity figures; average consumption per sq. ft. commercial space, average consumption per household)	City staff	3-5 years

2050 TRANSPORTATION GOAL

As with the Thermal Sector, the Transportation Sector lacks a locally-specific source of data to measure the amount of energy consumed for ground transportation directly. However, locally-specific data is available for the number and types of vehicles registered in Keene, allowing the City to track adoption of electric vehicles and other alternative fuel vehicles. In addition, the City has access to data on transportation infrastructure, public transportation ridership, and Census data such as transportation mode share. As with the Thermal Sector, these metrics rely on various different data sources and are associated with varying degrees of accuracy and level of effort for data collection.

Transportation Sector Performance Metrics

Performance Metric	Data Source	Responsibility	Frequency
Total number of vehicles registered in Keene / Number vehicles per household and per capita	NH Department of Environmental Services (NHDES); US Census	City staff	Annual
Percent of new light-duty vehicle registrations and total light-duty vehicle registrations that are electric vehicles or hybrid vehicles	NHDES	City staff	Annual
Transportation Mode Share (Percent who drive, walk, bike, take transit) for work / school	U.S. Census / American Community Survey (ACS)	City staff	Every 5 years
Transit ridership (City Express Bus)	Home, Healthcare, Hospice and Community Services (HCS)	City staff	Annual
Number of bus stops / Miles of bus routes	City GIS data / City Engineering Office	City staff	Every 2-3 years
Miles of bike/ pedestrian pathways and sidewalks maintained year-round	City GIS data / City Engineering Office	City staff	Annual
Number/distribution of EV charging stations by type (level 2/level 3)	PlugShare.com	City staff	Annual
Proportion of residents living in locations with mixed land uses	City Assessing Department	City staff	Every 5 years
Number of roundabouts compared to signalized intersections	City GIS data / City Engineering Office	City staff	Annual

CHAPTER 5 | ACTION PLAN

Implementation

The City recognizes that in order to meet its ambitious energy goals, the City and its community partners need to act now using the tools that are available today. Future technologies, policies, and incentives will – and should – influence the specific actions and strategies that the City and others deploy to reach the energy goals by the 2030 and 2050 target dates. However, given the urgency of climate change and the short time frame for achieving the community's energy goals, implementation must start now. To that end, the City should allocate appropriate staffing and other resources to achieve the priority action strategies outlined in this plan.

The Energy & Climate Committee (ECC) recommends that the City consider the following to ensure implementation happens in a coordinated and effective fashion:

I. In the near-term (6 months - 1 year), the City should identify a team of existing staff to lead implementation efforts within the City. The membership of this "implementation team" may vary over time depending on the current focus of the group (e.g. Community Power, Benchmarking policy, EV charging infrastructure, etc.). The team would work together in coordination with the ECC and City Council to implement policies and actions to achieve the City's Sustainable Energy Goals. This internal City staff team could be an informal group appointed by the City Manager, or it could be more formally created through a City Council resolution.

II. Explore options for hiring a shared Sustainability Coordinator position with other local governments or institutions. While hiring a full-time sustainability coordinaor may not be feasible at this time, there are existing models for shared sustainability positions that the City could look into. For example, Clean Energy NH has created a "North Country Circuit Rider" position. This person acts as an additional staff person for communities in Coös County, helping them implement energy projects. Just over the border in Maine, the Southern Maine Planning & Development Commission has created a Sustainability Coordinator position that is shared among six towns. This person works with each of the six communities to research effective actions and assist with implementation of programs to help each community reach its local energy and resilience goals.

Priority Action Strategies

In order to identify priority strategies for implementation, the ECC worked with staff to identify, evaluate and rank a set of policies, programs, incentives, and other actions that the City can pursue in the near-term to make progress towards achieving its energy goals. These action strategies were ranked using the following evaluation criteria:

I. **Scale of Impact:** Extent to which the action has the potential to increase the level of renewable energy in the electricity mix, thermal energy mix, or transportation energy mix.

II. **Local Impacts:** Extent to which a strategy will increase renewable energy development or generation within the region and increase resiliency to shocks to the energy system.

III. **Environmental & Social Goals:** Extend to which a strategy is expected to contribute to local job growth and impact greenhouse gas emissions.

IV. **Inclusion & Equity:** Extent to which a strategy is expected to be affordable and cost-effective for residents and businesses of all income levels within Keene, and extent to which the benefits associated with the strategy are expected to be distributed equitably.

V. **Feasibility:** Extent to which the City will incur costs to implement the strategy, and extent to which the strategy is technically possible. This rating criteria also includes the availability of existing funding sources and incentives.

The evaluation criteria above were developed based on feedback gathered from a series of outreach events conducted in the fall of 2019 and early winter of 2020. Using these evaluation criteria, the ECC identified 17 priority action strategies, which generally fall into three broad categories:

Energy Efficiency: Many of the priority strategies focus on reducing energy use as a first and critical step in reducing the total supply of renewables needed to meet energy demand and control costs. This is especially true with the electricity sector, as the electrification of thermal and transportation energy consumption will lead to a substantial increase in total electricity consumption.

Renewable Energy – Generation & Procurement: In order to reach the 100% renewable energy goals, the City, businesses, and residents will need to both procure electricity from renewable sources and substantially increase local renewable energy generation.

Fuel Switching: The long lifespan of heating and cooling systems, vehicles, and new construction means that the City should start encouraging and supporting the replacement of fossil fuel systems with electric or renewable systems as soon as possible. Each fossil fuel-based vehicle and/or heating & cooling system purchased today will be around for years to come, and represents a lost opportunity for transitioning away from fossil fuels.

Table 5.1 on the next two pages summarizes the 17 priority implementation tools & strategies by category (energy efficiency, renewable energy, and fuel switching) and sector (electricity, thermal, or transportation). It also includes information about the potential lead organization for each strategy, potential partners, and implementation timeframe (1-2 years, 3-5 years, or 5-10 years).

	Tool / Strategy	Description	Sector(s)	Lead	Partners	Timeframe
Energy Efficiency	Benchmarking Program	Encourage building owners of certain sizes or in certain districts to report energy use data to the City.	Electricity, Thermal	City of Keene	Business community, large energy users	1-2 years
	Home Energy Labeling Program	Encourage energy efficiency disclosure for existing and new residential properties at the time a property is listed for rent or sale.	Electricity, Thermal	City of Keene	Association of Realtors, NEEP	1-2 years
	Weatherization Program	Partner with existing weatherization programs to enhance public outreach and education, amplify impact, and increase capacity.	Electricity, Thermal	ECC/ City of Keene	SCS, Eversource, Keene Housing	1-2 years
	Complete Streets Program	Incorporate the adopted City of Keene Complete Streets Design Guidelines (2015) into the City's street standards for new streets, and develop Complete Streets standards for re-construction of existing streets.	Transportation	City of Keene	SWRPC, MAST, BPPAC	3-5 years
	City Express Bus	Increase financial support for the City Express and Friendly Bus programs, and encourage HCS to expand services/routes.	Transportation	HCS	City of Keene, SWRPC	3-5 years
	Multi-Modal Transportation Center	Work with community partners to construct a multi-modal transportation center in Keene and promote inter-city transit options.	Transportation	City of Keene	SWRPC, Greyhound, HCS	5-10 years
	Advocacy for Public Transportation & Active Transportation	Advocate at the federal and state level for more funding to support public transportation and active transportation.	Transportation	ECC/City of Keene	MAST, MRCC	1-2 years
Renewable Energy	Community Power Program	Establish a Community Power Program to aggregate community load and purchase electricity from an alternate electricity supplier.	Electricity	City of Keene	Cheshire County, Other towns	1-2 years
	Virtual Power Purchase Agreement	Enter into a long-term, fixed price contract for renewable energy from a specific project (i.e. agree to a contract for differences, or CfD).	Electricity	City of Keene		3-5 years
	Pilot Battery Storage Program	Collaborate with Eversource to provide a pilot batter storage program for residents and businesses to reduce demand on the grid during peak times.	Electricity	Eversource	City of Keene	3-5 years
	Renewable Energy Loans	Partner with a local financial institution to create a loan product to finance renewable energy installations targeted at businesses or residents.	Electricity, Thermal	Financial Institution(s)	City of Keene	3-5 years
	Solar & EV Ready Guidelines	Adopt Solar & EV Ready Guidelines to encourage new buildings to be built in a way that accommodates future solar installations.	Electricity, Thermal, & Transportation	City of Keene		1-2 years

	Tool / Strategy	Description	Sector(s)	Lead	Partners	Timeframe
Fuel Switching	Heatsmart Campaign	Host a "Heatsmart" campaign to encourage the installation of renewable thermal technologies for space heating and cooling or for hot water heating through targeted local out-reach efforts and bulk discount prices.	Thermal	ECC / Community Volunteers	City of Keene, Local contractors	1-2 years
	Public EV Charging Stations	Install public EV charging stations (level 2 and fast-charge) in on-street parking areas and in public parking lots or structures.	Transportation	City of Keene	Eversource	1-2 years
	Electric Buses	Work with the Keene School District/local school bus company and HCS (City Express and Friendly Bus) to encourage switch to electric buses.	Transportation	First Student / HCS	SAU 29	5-10 years
	Advocacy for EVs and Alternative Fuel Vehicles	Advocate at the federal and state level for more funding to support EVs and other alternative fuel technologies.	Transportation	ECC/City of Keene	MAST	1-2 years
	Renewable District Heating system	Commission a study to assess the potential for a renewable district heating system in Keene to understand what areas of the city would have the appropriate demand characteristics to justify a district energy system, as well as what local renewable sources are available and at what potential and likely cost.	Electricity (co-generation), Thermal	City of Keene		3-5 years

Table 5.1 Priority implementation strategies and actions for the Keene Sustainable Energy Plan.

BENCHMARKING PROGRAM

Overview

A municipal and commercial building benchmarking program is an effective strategy that enables building owners to measure the energy efficiency of their building against comparable buildings from across the country and identify buildings that could benefit most from energy efficiency improvements. The vast majority of building benchmarking programs rely on the use of the Environmental Protection Agency's (EPA's) ENERGY STAR Portfolio Manager, a free online benchmarking tool that helps building managers track data and measure progress. Portfolio Manager allows building managers to compare their building to similar buildings using the 1-100 ENERGY STAR score. Achieving a score of 50 would be considered the median, while a score of 75 would indicate that the building is performing better than 75% of its peers and may be eligible for ENERGY STAR certification.

Through the identification of inefficient buildings, a benchmarking program can be effective in driving increased participation in already existing energy audit and energy efficiency programs, such as those offered through Eversource. These programs can accelerate the path towards decreased energy consumption, energy cost, and GHG emissions. Many benchmarking programs feature a public disclosure component, which can have beneficial impacts such as empowering prospective tenants to make informed decisions before entering into a lease agreement. Benchmarking programs can be voluntary or mandatory, include energy and/or water consumption, and can be customized by square footage and building type. For example, many benchmarking programs have stricter reporting requirements for larger commercial buildings that exceed a certain square footage threshold. Some benchmarking programs also link the program to mandatory energy audits or energy efficiency improvements for inefficient buildings. Since over 70% of total electricity consumption in Keene is associated with commercial and municipal buildings, a benchmarking program has significant potential to reduce electricity consumption in Keene's existing building stock.

Key Benefits and Challenges

Key benefits and challenges associated with implementing a building benchmarking program are summarized in the table below:

Key Benefits	Key Challenges
Identifies commercial and municipal buildings in Keene that could benefit most from energy efficiency improvements	Participation rates associated with a voluntary program are often very low, especially among small business owners
Drives participation in existing energy audit and energy efficiency programs offered through Eversource	Benchmarking alone does not guarantee energy-efficiency upgrades and improvements
Availability of a free online benchmarking tool, EPA's ENERGY STAR Portfolio Manager (other tools are available, but usually have an associated cost).	Potential issues with data access, quality, and accuracy
Opportunity for Keene to lead by example by benchmarking municipal buildings	A large investment of time and respources in outreach is required in order to increase participation rates

Key Benefits	Key Challenges
Potential to link financial incentives to energy-efficient upgrades (see South Portland example below)	Administrative burden associated with ongoing support and management of the program

Implementation Steps

Initial implementation steps for developing a building benchmarking ordinance are listed below:

Implementation Steps	
✓	Review EPA's list of Benchmarking Programs and Policies Leveraging ENERGY STAR[1] to evaluate options for program design, requirements, and incentives being utilized by other localities.
✓	Consider thresholds for program participation (e.g. by building size, by building type, etc.)
✓	Develop program with input from key stakeholder groups.
✓	Lead by example by publicly sharing energy use data for City buildings and facilities.
✓	Develop or enhance a webpage to host relevant resources and materials.
✓	Determine which metrics will be disclosed publicly.

Examples from Other Communities

This section includes communities that have implemented best practices related to implementation of municipal and commercial building benchmarking ordinances in the US. Each example includes a few key points and differentiating factors as well as a hyperlink to each ordinance. For additional examples, the EPA's ENERGY STAR program developed an interactive map[2] to track benchmarking programs in the US that are utilizing Portfolio Manager in their ordinance. All of the ordinances listed below involve mandatory reporting requirements and utilize Portfolio Manager as the primary benchmarking platform.

Energy & Water Benchmarking Ordinance: South Portland, Maine

Adopted in 2017, the Energy & Water Benchmarking Ordinance in South Portland, Maine requires all municipal, school, and commercial buildings larger than 5,000 square feet to benchmark and disclose their annual energy and water consumption to the city each year.[3] The ordinance also applies to residential multifamily buildings with more than 10 units. In order to encourage increases in energy efficiency, the ordinance mandates that each covered property subject to reporting requirements must complete a building energy audit once every five years. However, while disclosure of the building energy use and periodic audits are required, the policy does not mandate buildings to meet certain levels of energy efficiency, reach energy reduction targets, or make energy-related improvements. Typically, it's uncommon for mandatory benchmarking ordinances to offer incentives, but in the case of South Portland, they offer a $5,000 compliance incentive that can be used as a credit for future expenses stemming from city application, review, or inspection fees associated with construction or redevelopment projects at the property.

Building Energy Saving Ordinance: Berkeley, California

Adopted in 2015, the Building Energy Saving Ordinance (BESO) in Berkeley, California requires that all covered buildings report their annual energy consumption.[4] The BESO phases in reporting requirements by building size so that larger buildings over 50,000 square feet must report first in 2018 while smaller buildings, such as those below 5,000 square feet, are not required to report until 2022. Similarly, covered buildings over 25,000 square feet must conduct an energy assessment every five years while covered buildings below that threshold must only conduct an energy assessment every ten years. Berkeley also operates an Energy Efficiency Incentive Program that complements the BESO and encourages building upgrades and improvements.

Building Energy Use Disclosure Ordinance: Cambridge, Massachusetts

Adopted in 2014, the Building Energy Use Disclosure Ordinance (BEUDO) in Cambridge, Massachusetts is a time-tested ordinance that provides a wealth of resources and data that can be leveraged by those looking to create ordinances in other jurisdictions. Covered buildings include all buildings over 25,000 square feet, residential buildings with over 50 units, and municipal buildings over 10,000 square feet. Each of these building subsets is required to report energy and water usage to the city on an annual basis. The results of the reporting are publicly disclosed on a building-level basis on the Cambridge Open Data Portal. Cambridge also publishes annual reports, summary statistics, and compliance maps.[5]

HOME ENERGY LABELING PROGRAM

Overview

A Home Energy Labeling program provides an assessment of a home's energy performance, typically in MMBtu/year, and compares it to that of other similar homes. It uses the same approach as other labeling programs, such as miles-per-gallon ratings on cars, nutrition labels on food, and Energy Guide labels on appliances, to compare two "products." Homebuyers, homeowners, and renters can use this information not only to estimate energy use, but also to estimate energy costs and potential energy efficiency upgrades to make a home more comfortable and less expensive to run. When properly designed, home energy labels allow the consumer to make an informed decision about home purchases, rentals, or upgrades they can make.

A key benefit of Home Energy Labeling is its ability to help overcome the "split incentive," an often-cited barrier to energy efficiency for homes and rental properties. For new homes, the split incentive arises when builders have little or no incentive to build to higher efficiency standards, which is largely invisible to homebuyers and increases the build cost. A home energy label addresses this by adding visibility to the energy costs of operating a home, which in turn increases the marketability of homes that are more efficient and helps builders sell more quickly and for a better price.[6] With rental properties, the split incentive arises when the building owner, who is responsible for maintenance and major appliances, does not pay for the energy that the building uses. In this case, a home energy label allows renters to understand how much they can expect to pay for utilities and more accurately compare the options available to them.

Common Components of a Home Energy Label:

- Home profile (year built, area, # of bedrooms).
- Details about home's current structure and systems.
- Home Energy Score, Energy Star score, or similar rating.
- Annual energy use and cost based on energy modeling.
- Home's carbon footprint.
- Custom energy improvement recommendations.

Local governments can adopt a Home Energy Labeling program to encourage or require a home energy label in real estate listings, at time of sale, point of lease/rental, at time of building renovation, and/or when major systems are replaced. Mandatory programs have higher rates of participation; however, the recommendation in this plan is for the City to adopt a voluntary program.

A variety of rating systems can be used for the scorecard, including DOE Home Energy Score (HES), RESNET Home Energy Rating System (HERS) rating, ENERGY STAR Certified Homes (HPwES), and state-created stand-alone scorecards (which are often tied to the modeling engines of other labels like HERS or HES). The scorecard should be designed to include metrics that are clear and easy to understand, are aligned with local and state policy goals, and allow for tracking progress on those goals. An example scorecard from Efficiency Vermont is shown on the next page.

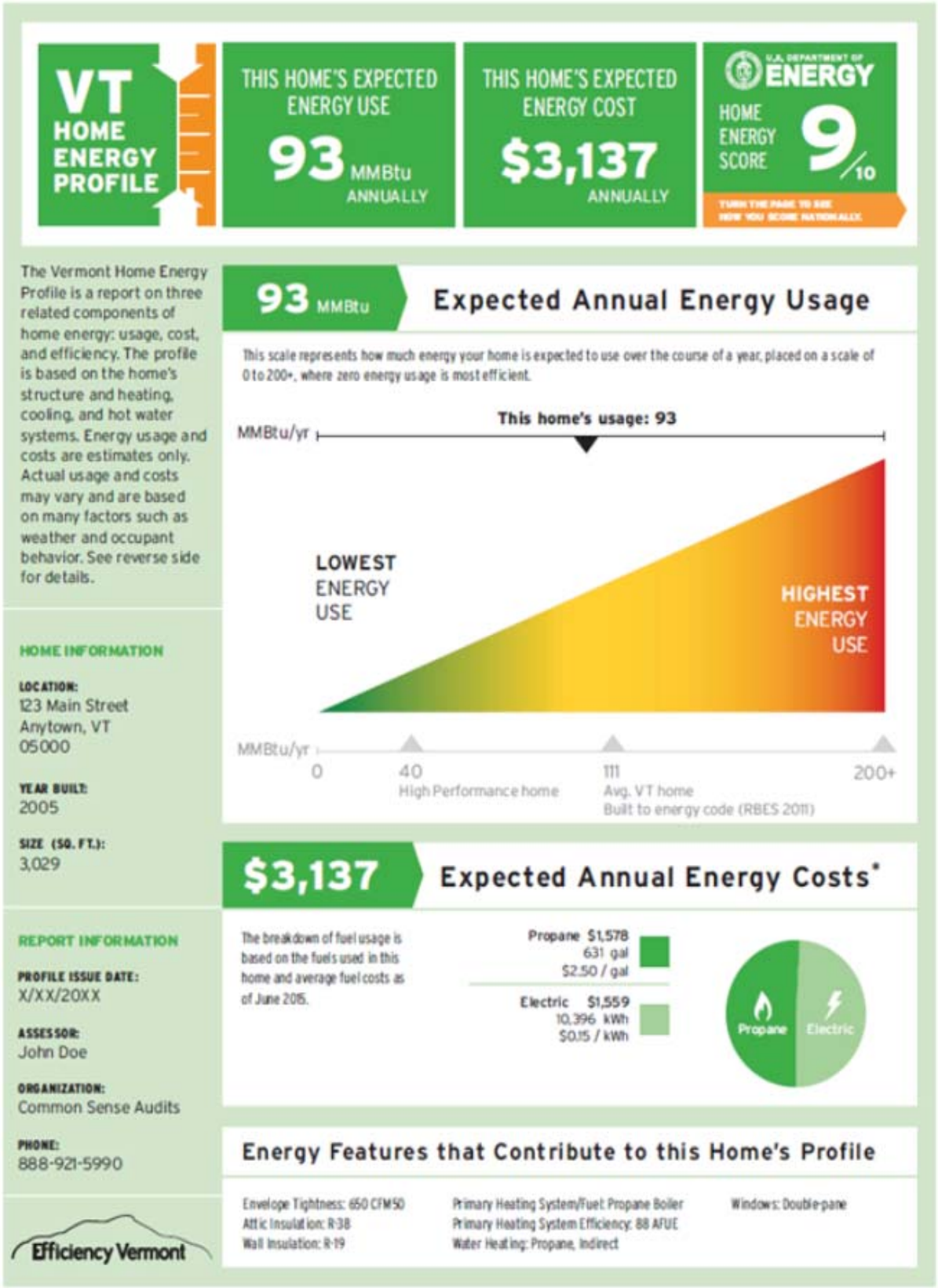


Figure 5.1. An example of the front page of the Efficiency Vermont Home Energy Profile.

Key Benefits and Challenges

Key Benefits	Key Challenges
Identifies rental properties and homes in Keene that could benefit most from energy efficiency improvements.	Participation rates associated with a voluntary program are often very low.
Applies to both existing housing stock and new homes.	Energy labeling alone does not guarantee energy-efficiency upgrades and improvements.
Provides consumers with greater transparency and a measure of protection when making large financial investment in a home or rental.	A large investment of time and respources in outreach is required in order to increase participation rates.
Helps to overcome the "split incentive" for rental properties and construction of new homes.	Administrative burden associated with ongoing support and management of the program
Potential to link financial incentives to energy-efficient upgrades	Requires buy-in and support from stakeholders groups including builders, real estate professionals, and contractors / appraisers.

Implementation Steps

Implementation Steps	
✓	Review policies and ordinances from other communities to evaluate options for program design, requirements, and incentives being utilized by other localities.
✓	Develop program with input from key stakeholder groups.
✓	Develop or enhance a webpage to host relevant resources and materials.
✓	Determine which metrics will be disclosed publicly.

Examples from Other Communities

This section includes communities that have implemented Home Energy Labeling programs in the US. Each example includes a few key points and differentiating factors as well as a hyperlink to each program page. All of the ordinances listed below involve mandatory reporting requirements and utilize a variety of tools for reporting. For a state-by-state list of home energy labeling programs in the Northeast and Mid-Atlantic, see the Northeast Energy Efficiency Partnerships Residential Labeling Dashboard.[7]

Home Energy Score Ordinance: Portland, Oregon

The City of Portland adopted the Home Energy Score Ordinance in December 2016, which went into effect just over a year later in January 2018. The ordinance requires sellers to obtain a home energy performance report prior to listing their properties.[8] The report must contain the DOE Home Energy Score and must be provided to prospective buyers and included in the real estate listing. Home Energy Score data is entered into a local Green Building Registry, which then auto-populates Portland's local multiple listing service, which in turn, populates several consumer-facing real estate portals, such as Zillow and Trulia. Sellers who fail to comply with the ordinance receive a warning notice, and if the seller does

not take corrective action within 90 days, they must pay a fine of $500. The City of Portland maintains a dedicated webpage with information, tools, and resources to help support homeowners with compliance - www.pdxhes.com.

Rental Housing Time of Sale Energy Efficiency Ordinance: Burlington, Vermont

In order to strengthen the City's response to the "split incentive paradigm" and increase energy efficiency in rental housing, the City of Burlington, VT adopted a "Time of Sale Energy Efficiency Ordinance" which mandates that cost-effective energy efficiency standards be met when buildings are sold and inspected every 1 to 5 years.[9] This ordinance only applies to rental properties where tenants pay directly for heating costs. In addition, the program has a built-in cap on costs in order to mitigate pass-through of costs to tenants.

Building Energy Saving Ordinance: Berkeley, California

Berkeley's Building Energy Saving Ordinance (BESO)[10] applies to 1-4 unit homes in addition to buildings of a certain size or greater. Homeowners are required to get a Home Energy Score prior to sale. However, this requirement may be deferred to the buyer for up to 12 months at time of sale. Data from the first year of the ordinance shows that the majority of homes scored lacked proper insulation and had single paned windows. The three most common recommendations included in Berkeley Home Energy Score reports to date have been floor insulation, attic insulation and air sealing, and installing a central gas furnace. In a recent report that evaluates the BESO program, recommendations for improving the program for 1-4 unit homes include requiring the Home Energy Score at time of listing rather than at time of sale, among other recommendations.[11]

SUPPORT & ENHANCE EXISTING WEATHERIZATION PROGRAMS

Overview

This strategy leverages existing programs and seeks to extend the reach and/or enhance the impact through local volunteer support for outreach, education, and marketing. In addition, it is possible that additional financial support could extend the eligibility of these programs to currently ineligible households.

There are a couple well-established, existing weatherization programs available to homeowners, renters, and businesses in Keene, as well as new program that is in the works:

- NHSaves is a collaboration of New Hampshire's electric utilities working with the New Hampshire Public Utilities Commission and other interested parties. The program provides links and information on how customers can qualify for rebates and other incentives, including commercial and industrial energy efficiency options.12 According to Frank Melanson, Supervisor in Energy Efficiency with Eversource, the High Performance with Energy Star (HPwES) program, which assists homes with high heat fuel usages to transition to energy efficient appliances, has reached 17 households in Keene in the past 5 years, nearly doubling their 2018 totals in 2019 due to the success of the program. The Home Energy Assistance Program (HEA) has worked closely with Keene Housing and saw a dramatic increase in income eligible homes who are served by this program in recent years. In total, HEA has reached 124 homes in Keene in the past three years, 116 of which were in 2019. NH Saves Energy Efficiency Department predicts HEA will reach over 200 homes in 2020.
- Southwestern Community Services (SCS) Weatherization Assistance Program is designed to help reduce heating and other energy costs for income eligible households by improving living conditions and providing warmer, safer, and more comfortable homes. It also aims to lower energy costs by 19 to 22 percent. Priority is given to the elderly, the disabled, and households with small children. Eligibility for the program is determined by gross household income and vulnerability to heating and electricity costs.13 In addition, the SCS Heating Repair and Replacement Program (HRRP) can help clients repair or replace their heating systems. Recipients must be income-eligible and receiving fuel assistance in order to qualify for HRRP. Assistance for heating replacement is based on availability of funds.
- The City of Keene, SCS, and other potential partners are in the process of creating a program to update and weatherize homes in Keene's "middle" neighborhoods. Middle neighborhoods are places where home prices and rentals are generally affordable, but are often on the edge between growth and decline. These neighborhoods are not thriving enough to attract sustained private investment, yet are not troubled enough to warrant government intervention. They are in desirable locations near the downtown and employment. This concept, called "21 in 21," is intended to help coordinate repairs to buildings in order to abate housing/safety/zoning issues, enhance safety, increase

energy efficiency (defined as a Home Energy Score of 7 or better), improve curb appeal, and increase home ownership opportunities, which is positively associated with social capital.

By hosting local Button-Up Workshops, organizing weatherization campaigns run by a group of volunteers, or even cost sharing to hire a local or regional NHSaves representative, the reach and efficacy of these programs could be increased by building off of their existing successes.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Leverages existing program structure and design + builds on pre-existing success.	Would require an engaged group of volunteers with a high time commitment.
Takes advantage of utility/state funding, technical expertise, and preexisting infrastructure and programs.	City not in direct control of program development and implementation + success is largely dependent on Eversource / SCS being active + willing participants.
Helps lower energy costs for residents and businesses.	Need to identify the right points of contact at all participating organizations. Partnership may require connection at the upper management/admin level.
Potential to expand the reach of existing programs to residents and businesses who do not currently qualify.	Due to the high percentage of rentals in Keene, overcoming the split incentive for rental properties could be a major challenge.
Opportunity to support local economy by engaging with local contractors.	

Implementation Steps

Implementation Steps	
✓	Reach out to Eversource and/or SCS to discuss potential opportunities to collaborate on an existing weatherization program.
✓	Reach out to local energy groups / advocates to assess level of interest in volunteering or otherwise supporting a local weatherization program.
✓	Assign resources (volunteers, City staff time, and financial commitments).
✓	Develop or enhance a webpage to host relevant resources and materials.
✓	Measure and track metrics to evaluate program impact.

Examples from Other Communities

This section includes examples of how communities have partnered with existing programs and utilities to enhance weatherization efforts.

Weatherize Upper Valley: Weatherize Campaigns

Coordinated by the nonprofit organization Vital Communities, Weatherize Upper Valley enlisted community volunteers to join local outreach teams responsible for increasing participation in existing energy efficiency programs in New Hampshire (NHSaves) and Vermont (Efficiency Vermont).[14] Energy consultants offered free or discounted home energy consultations, and the volunteer teams helped generate leads for the contractors, helping justify the discounted services. This approach created economies of scale in small communities and made the vendor selection process easier for participants. According to the Island Institute 2018 report, "Bridging the Rural Efficiency Gap," Pilot Weatherize campaigns in 14 Vermont towns resulted in 100 weatherization projects in just six months, an increase of 40% above their typical annual average. During the program's second round, six New Hampshire towns with virtually no history of weatherization projects helped weatherize over 90 homes with help from seven New Hampshire contractors.

Rural Alaska Community Action Program: Energy Wise Outreach Program

The Rural Alaska Community Action Program (RurAL CAP), formed in 1965, piloted their "Energy Wise" program in 2009 to help Alaskans reduce energy consumption, create local jobs and training opportunities, and save on electric bills and home heating costs.[15] However, in an assessment conducted in 2011, insufficient public awareness was identified as a major barrier to program success. In order to address this barrier and improve public education and outreach, RurAL CAP developed a Community Energy Education Kit that utilized the existing infrastructure of the Energy Wise Program to pilot a public education delivery system. This system included the creation of nine different "Booth in a Bucket" hand-on science kits, which were featured at energy fairs in 13 Alaskan communities. RurAL CAP also created a "how-to" guide to replicate the bucket booth and energy fair model in other communities.

EXPAND COMPLETE STREETS PROGRAM

Overview

The City of Keene formally adopted a Complete Streets policy and a set of Complete Streets guidelines in 2015. The policy directs the City to consider and incorporate all modes of transportation and the safety needs of all users, including motorists, transit, pedestrians, bicyclists, seniors, youth, and persons with disabilities, when making improvements to existing infrastructure or building new projects.[16] The Complete Streets Guidelines establish a street typology system, shown in Figures 5.2 and 5.3. The guidelines provide a checklist of recommended Complete Streets treatments, such as sidewalks, pedestrian crossings, green buffers, lighting, etc. that are appropriate for each street type.[17]

What is a Street Typology?

Typology classifies streets by roadway function and surrounding context, including right of way width, building types, predominant travel modes, and land uses. The designation of Keene's roadways as different street types serves as a methodology to ensure that the design and use of a street complements the surrounding area and vice versa.

Figure 5.2. City of Keene Complete Street Types.

Since its adoption, the City has used the Complete Streets policy and guidelines to help guide decisions related to infrastructure improvement projects. The City has actively pursued grants to help offset the increased cost associated with these projects, including the NH DOT Transportation Alternatives Program (TAP) grant, the Monadnock Alliance for Sustainable Transportation (MAST) Complete Streets grant, and the US Department of Transportation Better Utilizing Investments to Leverage Development (BUILD) grant.

Providing funding for up-front capital costs as well as for ongoing maintenance of Complete Streets infrastructure is critical the success of the Complete Streets program. Often, the rationale for including or not including Complete Streets elements in a given infrastructure project is driven by the project budget. In addition, as the City has added new bicycle and pedestrian infrastructure over the past few years, the operational budget for maintaining this infrastructure has not increased. This puts a greater burden on existing resources and can cause delays in maintenance and upkeep of infrastructure, such as re-striping bicycle lanes, crosswalks, and repair of pedestrian crosswalk beacons.

As a next step, the City should incorporate the adopted City of Keene Complete Streets Design Guidelines into the City's street standards for new streets, and develop Complete Streets standards for re-construction of existing streets. As part of this effort, the

maintenance budget should be re-evaluated and adjusted to account for increased costs associated with Complete Streets infrastructure. In addition, the City should continue to pursue grant funding to install new infrastructure to support Complete Streets.

Key Benefits and Challenges

Key Benefits	Key Challenges
Increased safety for all users of the roadway.	Constrained right-of-way widths of exi[18]sting streets.
Increase in foot traffic and economic vitality of downtown centers and neighborhoods.	Balancing competing interests of diffe[19]rent users within the roadway.
Improved public health due to features that promote regular walking, cycling and transit use. ,	Increased cost of already expensive [20]in[21]frastructure projects.
Reduced barriers for seniors, young children, people with disabilities, and individuals & families who do not own a motor vehicle. , ,	Ensuring adequate funding for main[22]te[23]na[24]nce, repair, and operation of infrastructure.
Potential to increase property values, support existing businesses, and attract new businesses.,	Building and maintaining public supp[25]or[26]t for projects with a lengthy delay between planning/public outreach and construction.
Encourages people to take more trips by foot, bicycle and transit, with associated reduction in GHG emissions. , , ,	Administrative burden associated[27] w[28]it[29]h [30]developing and writing standards for existing streets, and revising standards for new streets.

Implementation Steps

Implementation Steps	
✓	Reach out to community groups and advocates to build public support. The City of Keene has a long history of citizen support for Complete Streets dating back to the 1980s. Past initiatives include the 1987 Downtown Revitalization Project, which transformed Main Street from a wide, car-centric thoroughfare to a pedestrian-friendly downtown street, a 1999 Council policy to evaluate the installation of bike lanes during road construction projects, the incorporation of Complete Streets into the City's 2010 Comprehensive Master Plan, a 2011 City Council resolution to adopt a Complete Streets policy, and the 2015 Complete Streets policy and design guidelines. This existing momentum should be leveraged to demonstrate strong community support.
✓	Submit proposal to City Council for review and approval.
✓	Assign resources (City staff time and financial commitments).
✓	Develop Complete Street standards for existing streets, and incorporate Complete Street standards for new streets into City Code.
✓	Submit the draft Complete Street standards to City Council for adoption.
✓	Advocate for funding in the Capital Improvement Program and the annual City budget.
✓	Measure and track metrics to evaluate program impact.

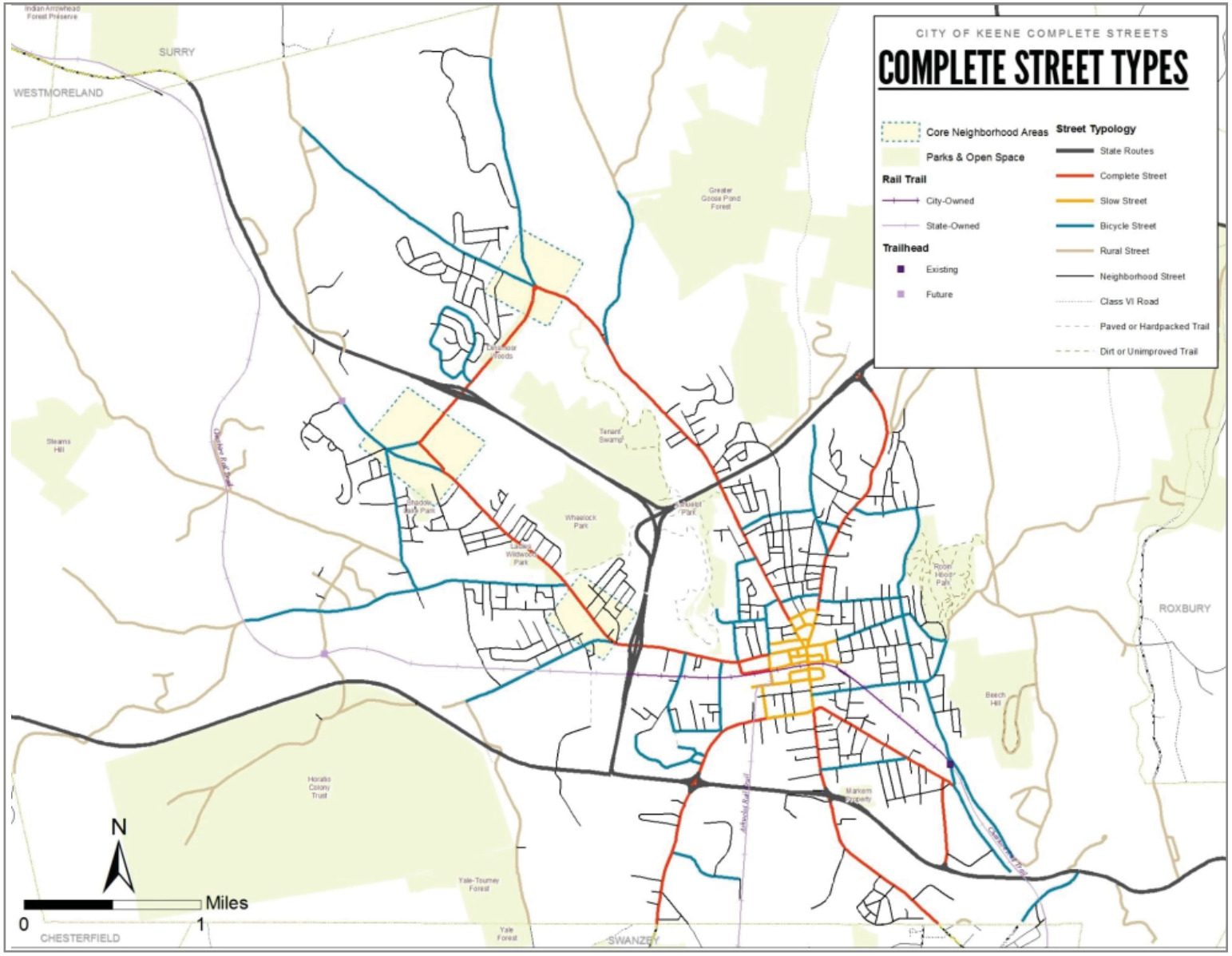


Figure 5.3. City of Keene Complete Street Types.

EXPAND AND ENHANCE CITY EXPRESS BUS SERVICES

Overview

The City Express Bus, operated by Home, Healthcare, Hospice and Community Services of Southwestern New Hampshire (HCS), is currently the only fixed-route transit system in Keene serving an average of 72 riders per day and over 30,000 rides annually.[31] There are two year-round bus lines that operate from 8:00 a.m. to 5:00 p.m. on weekdays, and a campus shuttle that operates during the Keene State College school year from 7:30 am to 7:00 pm, as shown on the bus route map in Figure 5.5. The program operates on an annual budget of about $410,000.[32]

Figure 5.4. Image of a City Express Bus. Source: www.hcsservices.org/transportation

It is possible that increasing hours of service and the frequency of bus stops would better serve a greater number of residents and increase ridership. However, doing so would require a significant investment of resources, and would not be possible without additional funding for the program and the full support of HCS and the New Hampshire Department of Transportation (NH DOT). Charlie Pratt, the Transportation Manager for the City Express Bus, estimates that adding an additional bus route would add approximately $125,000 to the annual operating budget. [33] HCS already has a spare bus; however, there are significant costs associated with maintaining and operating the bus, as well as hiring a bus driver. Mr. Pratt notes that the City Express program is always thinking about ways to increase ridership and better serve its riders, and would like to expand services if the resources are available.

Operating costs for the City Express are based on a number of variables, including the number of bus routes offered, the level of service on each route, the span of service (start and end time for each route), and the number of days that the service is operated. Before making a decision to expand service, careful study is required in order to determine when and how to make investments to expand or improve services. Conducting a study and comparing various route alternatives can also help to build the case for additional funding from major funders, including the Federal Transit Administration (through the NH DOT) and local match providers (City of Keene and HCS).

The most recent planning study for the City Express Bus was done in 1999 by Southwest Region Planning Commission (SWRPC) in order to support the design of a proposed service expansion for the City Express Bus in 2000.[34] At the time, the City Express operated a single

fixed-route bus with limited hours, serving primarily area elders for daytime trips between housing, services, and shopping. The NH DOT, HCS, and City of Keene identified a need and opportunity for expansion of public transportation services in Keene in order to better serve residents without reliable access to personal transportation. Ultimately, many of the findings and recommendations from the study were implemented, including the addition of a second bus route; however, some of the recommendations have not been implemented. A new study could help provide insights into current conditions and opportunities for expanding and/or increasing transit service in Keene.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Enhanced mobility and transportation choice for people without reliable access to a personal vehicle.	Requires up-front capital investment in buses and supporting infrastructure.
Equitable and affordable transportation option.	Securing funding for high ongoing maintenance and operational costs.
Moves people more efficiently and produces less air pollution per passenger mile than a single occupancy vehicle.	Lack of public awareness and understanding of benefits of public transit as well as needs and funding sources.
Potential to reduce traffic & parking congestion.	Effectively advertising and marketing to potential riders to increase ridership.
Potential to support economic development by shifting consumer expenditures, creating local jobs, improving access to education, job training, and employment, and increased property values.	Less convenient than a door-to-doo[35]r service or personal vehicles.

Implementation Steps

Implementation Steps	
✓	Conduct a study to assess opportunities for expanding and/or increasing City Express Bus Services. The most recent study for the City Express Bus was completed in 1999; however, local markets and conditions have shifted since that time. A new study could help identify potential new routes or expansion to existing routes, and/or improvements in service, that would be most effective at increasing ridership.
✓	Provide ongoing education to local employers and public regarding the benefits of the City Express Bus to both riders and non-riders, as well as the needs and funding requirements for the bus service.
✓	Advocate for more federal and state funding for public transportation. Work with local community partners, such as the Monadnock Region Coordinating Council for Community Transportation (MRCC) and SWRPC to educate decision-makers about the need for additional public transportation funding.
✓	Pursue new funding sources to supplement existing sources, such as grants, matches from local institutions that benefit from the bus service, and support from not-for-profit organizations and charitable foundations.

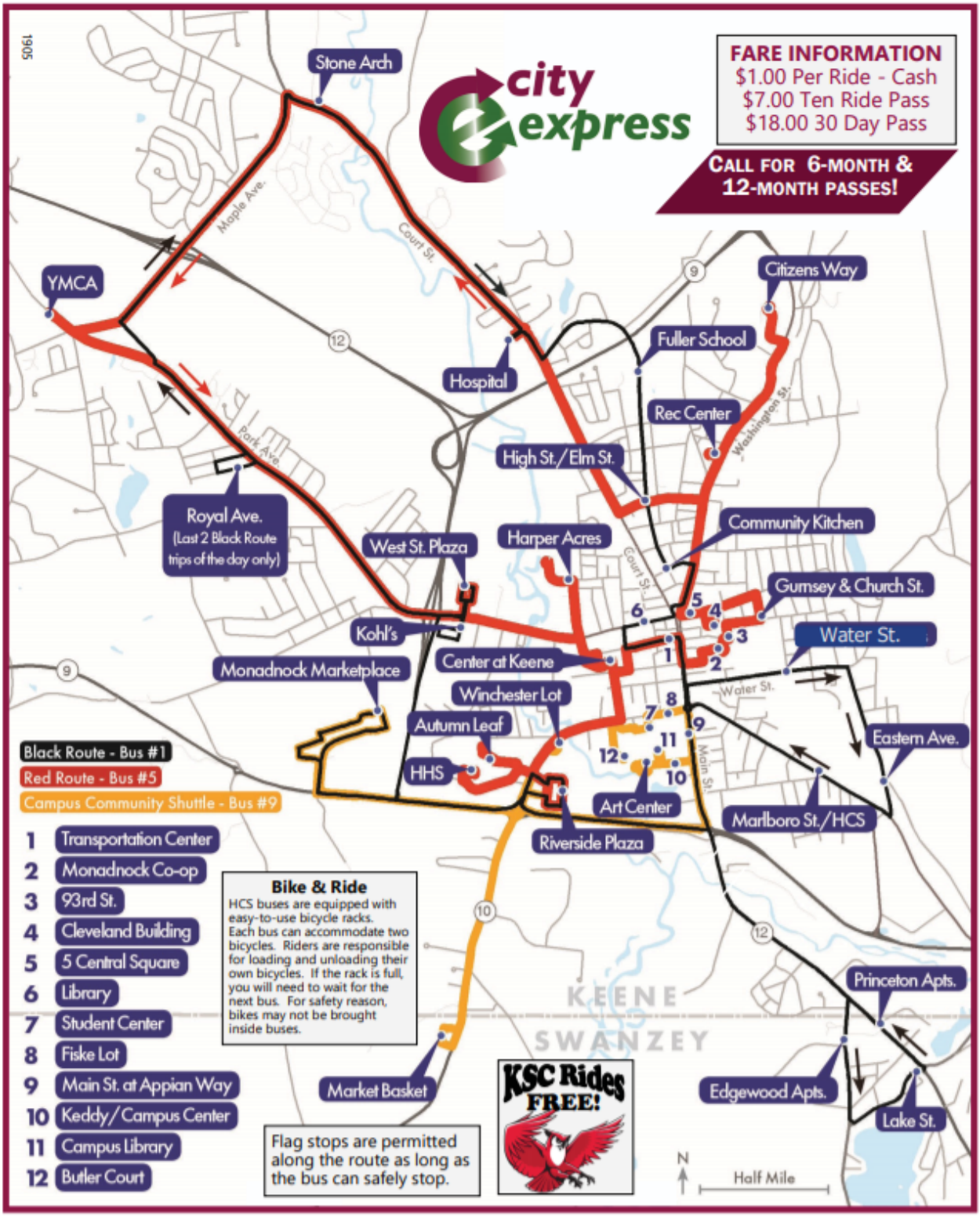


FIgure 5.5. City Express Bus Route Map. Accessed on May 27, 2020.

MULTI-MODAL TRANSPORTATION CENTER

Overview

A multi-modal transportation center is a facility that ties together several modes of transportation, such as driving, fixed-route bus transit, intercity bus transit, bicycling, walking, car-sharing, and more. It provides a convenient location for travelers to transfer among multiple types of transportation in a comfortable and attractive environment. Potential features include short-term and long-term parking, bicycle parking & storage, passenger waiting areas, carsharing services, EV charging stations, and dining facilities and/or vending machines. Southwest Region Planning Commission (SWRPC) is currently in the midst of a study to better understand what services would be most appropriate and beneficial to include in a multi-modal transportation center for Keene and the surrounding region.[36] This study will also evaluate potential sites where a transportation center could be located. Following the conclusion of this study, the City should review the recommendations included within the report and determine whether to pursue construction of a multi-modal transportation center.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Enhances the image and effectiveness of public transportation and other transportation options.	Providing sustainable funding of operation and management through revenue from meters, permits, and fines.
Increases mobility and transportation choice for people without reliable access to a personal vehicle.	Managing impacts to parking, traffic, and existing transportation system during construction.
Improves connections within Keene and the region, and between the Monadnock Region and other regional centers.	Securing grants, private investments, and other funding sources to cover the up-front cost without increasing the tax burden.
Potential to support existing and future intercity transit, including possible connections to Brattleboro, Concord, and Boston.	Political challenges with funding and supporting a high-cost, long-term capital project.

Implementation Steps

Implementation Steps	
✓	Review the results and recommendations of the Greater Keene Intermodal Transportation Center Feasibility Study.
✓	Build a coalition of advocates and community supporters to demonstrate public support for a multi-modal transportation center.
✓	Provide education and outreach to increase understanding among the public, large employers, and decision-makers of the potential benefits of a multi-modal transportation center in the Keene area.
✓	Work with decision-makers to select a location for the transportation center.
✓	Pursue funding sources to cover project costs, including land acquisition (if necessary), project design, and construction.

ADVOCACY FOR PUBLIC TRANSPORTATION & ACTIVE TRANSPORTATION

Overview

In New Hampshire, the vast majority of funding for public transportation and active transportation such as walking and bicycling comes from the federal or local level, with very little financial support from the state. New Hampshire ranks 44th in the nation in state spending per capita on public transit,[37] and the League of American Bicyclists ranks New Hampshire 47th in the nation for state funding for bicycle infrastructure.[38] A lack of funding from the state places a higher burden on local communities to provide matches for federal grants and programs. For example, Home Healthcare, Hospice and Community Services (HCS), which runs the City Express Bus (fixed route) and Friendly Bus (demand response), relies on municipal and charitable contributions to provide matches to federal grants and keep its transportation services in operation.[39]

The City should be an active participant in regional and statewide transportation planning processes, and should consider advocating for more state and federal funding for infrastructure and programs to support public transportation and active forms of transportation. These efforts should focus not only on the environmental benefits of public transportation and active transportation, but also co-benefits such as reduced congestion, improved air quality, increased mobility, reduced household expenditure on transportation, energy efficiency, and improved health outcomes through increased social inclusion and physical activity. Key partners for this strategy include local transportation providers such as HCS and the Community Volunteer Transportation Company (CVTC), the Monadnock Region Coordinating Council for Community Transportation (MRCC), Southwest Region Planning Commission (SWRPC), Monadnock Alliance for Sustainable Transportation (MAST), the National Complete Streets Coalition, the League of American Bicyclists, and other local, state, and national organizations with a focus on transportation planning and/or advocacy.

COMMUNITY POWER PROGRAM

Overview

A community power program (CPP), also known as community choice aggregation (CCA), enables a local government (or multiple local governments) to pool the electricity load of residents and small businesses and procure electricity on their behalf, while the utility continues to be responsible for electricity delivery, transmission, and distribution and maintenance of poles and wires. Community power programs (CPP) are "opt-out", meaning that residents and businesses would participate in the program by default, but would have the option to "opt-out" if they preferred to receive basic service from Eversource or purchase electricity from a competitive supplier. This is an impactful strategy because it provides New Hampshire communities with greater control over their energy mix and the opportunity to increase the percentage of renewables within the mix at potentially lower energy prices.

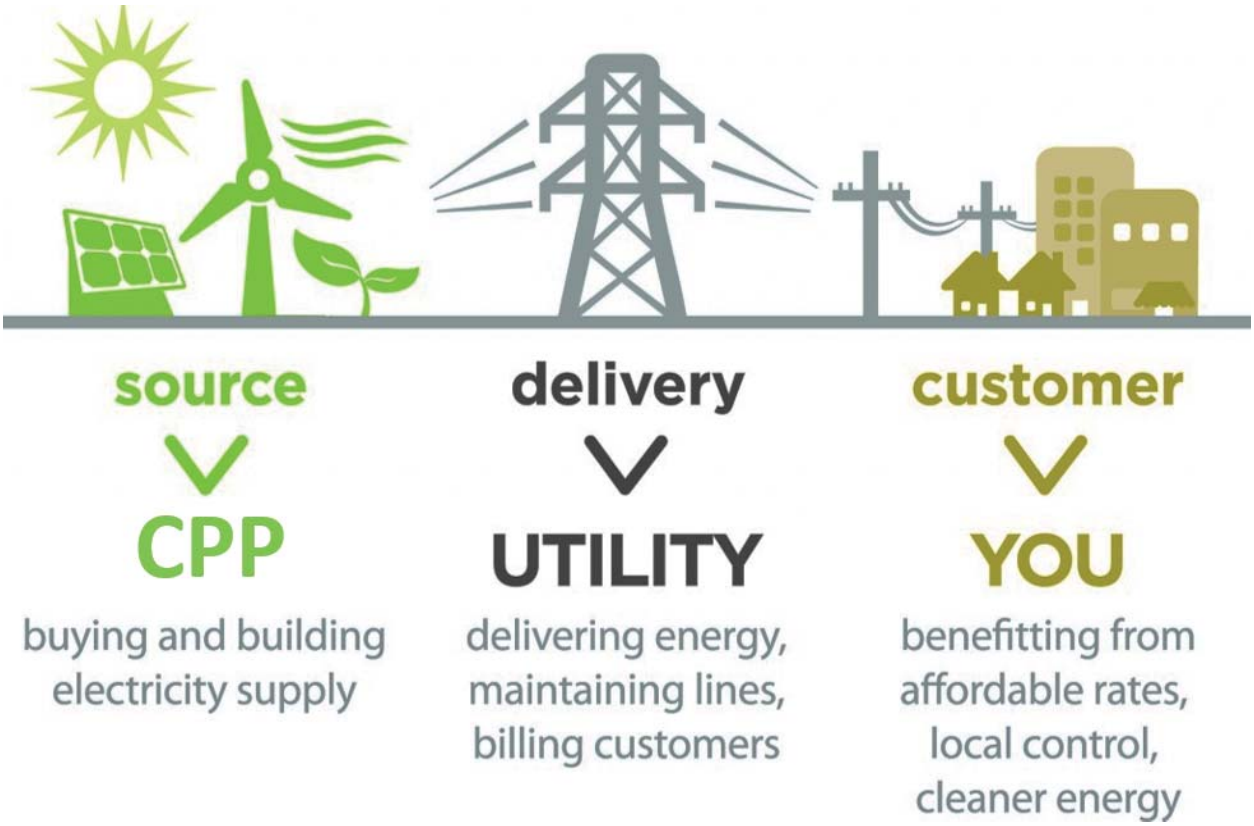


Figure 5.6. How Community Power Programs (CPP) Work[40]

Key benefits and challenges

Key benefits and challenges associated with establishing a community power program are summarized below:

Key Benefits	Key Challenges
Increases local control over the energy supply mix	Political and regulatory uncertainty in New Hampshire
Provides the ability to increase the percentage of electricity from renewables through RECs	Limited ability to achieved "additionality" due to reliance on RECs (see description below)
Potential cost savings to the community	Some administrative burden on city staff to set up program and identify a broker
Potential expansion in the future to drive local renewables, energy efficiency, and other innovative offerings	Political coordination required with neighboring communities if Keene wants to enhance economies of scale

When implementing this strategy, it will be important to have a strong understanding of renewable energy credits, or RECs. RECs are tradeable, market-based instruments that represent the legal rights to one megawatt-hour (MWh) of renewable electricity generation. There are two main types of RECs:

Unbundled RECs: Unbundled RECs are those that are sold, delivered, or purchased separately from physical electricity. Many CPPs rely on unbundled RECs as the primary means of increasing the renewable percentage of the electricity product delivered to customers. The key advantage of unbundled RECs is they can be sourced from renewable energy projects across the country, are relatively low cost and simple to procure. However, Unbundled RECs are often criticized for capitalizing on the presence of existing renewable energy projects and not driving the development of new renewable energy projects that would not have otherwise been built. Thus, unbundled RECs are generated by renewable energy projects that are referred to as "non-additional".

Bundled RECs: In contrast to unbundled RECs, bundled RECs are sold together with the physical electricity generated by a specific renewable energy project. Bundled RECs, and their associated clean electricity, are typically procured by CPPs through PPAs or VPPAs. Advantages of bundled RECs are that they drive the development of new (or "additional") renewable energy projects that would not have otherwise been built (i.e. achieving additionality). However, identifying and contracting electricity that is bundled with RECs can often be more administratively burdensome, and sometimes more expensive, for CPPs.

CPPs, especially in early stages, often rely on unbundled RECs to increase the renewable percentage of the electricity product delivered to customers; however, it is possible to shift towards bundled RECs over time as the CPP generates revenue and potentially partners with neighboring communities to increase scale.

Implementation Steps

Initial implementation steps for establishing a Community Power program are listed below:

Implementation Steps	
✓	Conduct research on community power and its potential role in achieving local RE goals.
✓	Form an electric aggregation committee or designate an existing committee to develop a Community Power Plan.
✓	Gain local approval for the finalized Community Power Plan from the local legislative body (e.g. City Council).
✓	Select a supplier and enter into a short-term (1-3 year) contract to supply residents and businesses with a greater amount of renewable electricity.
✓	Notify residents & businesses about newly formed program and ability to opt-out prior to service beginning.

Key Examples from Other Communities

A number of communities are establishing community power programs across the country and within the region. As of 2017, there were approximately 750 operational CPPs procuring electricity on behalf of about 500 million customers.[41] While these programs operate differently across states due to state-level regulation, CPPs in Massachusetts operate similarly to how they would operate in New Hampshire. Although there are no New Hampshire towns or cities that have actually launched a CPP, state legislation does allow this method of energy procurement and there is growing interest across several communities, with some in the advanced stages of the planning process. New Hampshire communities have the ability to pursue a CPP through the standard single procurer model, and there is some interest in a regional approach that would involve multiple communities combining their energy purchasing power to achieve economies of scale. This latter type of CPP is referred to as the alternate or "joint-office" model.

Cambridge Community Electricity: Cambridge, Massachusetts

One example is the Cambridge Community Electricity (CCE) program, a city-run aggregation program established in 2017.[42] CCE selected Direct Energy as the program's electricity provider from January 2019-2021 and will offer fixed electricity prices throughout this contract duration. This type of CPP, where city staff interact with a single electricity broker, is the most simplified and the least administratively burdensome. The program currently offers Cambridge residents and businesses two electricity products, including Standard Green and 100% Green Plus. The Standard Green option provides an electricity product that is similar in renewable energy content to the regional grid, about 20%, while the 100% Green Plus option offers a 100% renewable electricity product. As with most CPPs, customers "opting up" to the 100% renewable electricity product pay a slight price premium per kWh compared to the standard electricity product offering. Additionally, as of April 2020, both electricity products offered through Cambridge's CCE have lower rates for residential and small business customers than the standard Eversource offering.[43] However, these savings are subject to change as Eversource rates change every six months

for residents and small businesses. One unique aspect of the Cambridge's CCE is that both rate options include a small fee, knows as an "operational adder", that will go towards the development of new solar projects within the City of Cambridge.

Community Power New Hampshire

Community Power New Hampshire (CPNH)[44] is a municipal and county-led initiative working with Clean Energy New Hampshire and local governments throughout the state to offer an alternative to the standard CPP model, which typically involves a single community contracting with an energy broker to procure renewable energy through the purchase of RECs. Under this alternative model, also known as the joint-office CPP model, cities can form their own community power program and then join the centralized CPNH network.[45] The intention of a combined-joint office is to expand the communities' technical capacity, reduce and centralize administrative costs, leverage pooled revenue to develop and administer innovative energy efficiency, demand response, and renewable energy programs, and bolster the group's purchasing power. CPNH is still in the planning phase of development, but many New Hampshire communities are hopeful it will enable accelerated grid modernization and renewable energy adoption in the near future.

VIRTUAL POWER PURCHASE AGREEMENT

Overview

Cities and community power programs can support the creation of additional renewable energy by entering into long-term contracts with renewable energy generators in the form of a power purchase agreement (PPA) or virtual power purchase agreement (VPPA).

A **PPA** is a contract between a buyer and renewable energy generator where the buyer takes ownership of the electrons and RECs produced by the renewable energy project.

A **VPPA** is a financial transaction where the buyer does not own the electrons produced by the renewable energy project, but receives titles to the RECs.

Both contracting instruments, but especially VPPAs, allow both the buyer and the generator to hedge against electricity market price volatility and allow the buyer to benefit from long-term price stability.

A key advantage of VPPAs over traditional PPAs is their geographic flexibility. With PPAs, the renewable energy generator and the consumer must be physically connected to the same regional grid. Because a VPPA is a solely financial (i.e. "virtual") contract, the energy buyer does not receive physical possession of electricity. Instead, the buyer continues to receive energy from its current supplier while simultaneously receiving Renewable Energy Credits, or RECs. Every megawatt hour of electricity generated from a renewable source

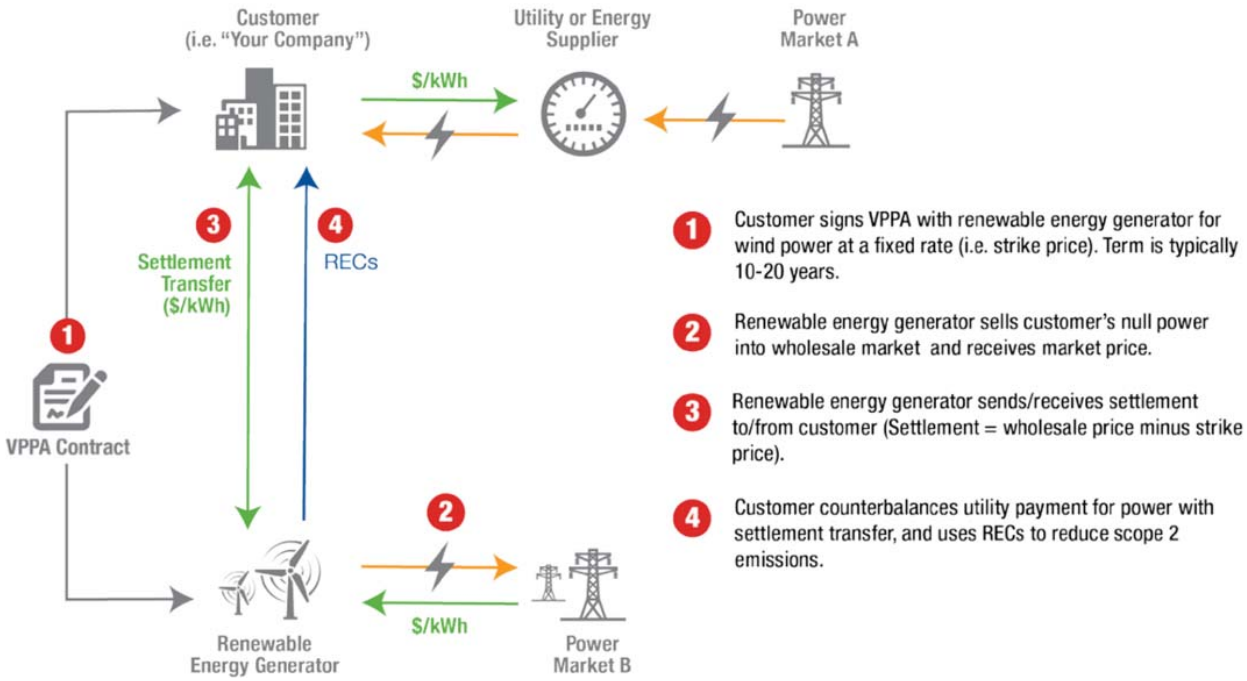


Figure 5.7 How a Virtual Power Purchase Agreement (VPPA) Works

counts as one REC. The owner of a REC has exclusive claim to the energy associated with it, meaning a REC can't be doubled counted. A REC is what substantiates that electricity can be considered renewable.

If Keene were to launch a CPP, there are strong potential synergies between a CPP and VPPAs. Leveraging VPPAs, the City could transition their CPP away from unbundled RECs and towards bundled RECs over time, driving the development of renewable energy projects that would not have otherwise been constructed.

Figure 5.7 demonstrates the step-by-step process for how a VPPA works.[46] There are a few notable takeaways from the above graphic. First, the power market that the renewable energy generator is selling electricity into ("Power Market B") does not have to be the same as the power market that the customer (e.g., Keene CPP) is physically connected to ("Power Market A"). In practical terms, this means that the Keene CPP could sign a VPPA with, for example, a wind farm project in Iowa that may have more favorable financial terms than a similar renewable energy project in New England.

Secondly, step 3 in the above figure demonstrates the price hedge value of a VPPA. By entering into a VPPA, the customer (e.g., Keene CPP) locks in a fixed price, or strike price, for Bundled RECs from the renewable energy generator. If the wholesale price of electricity rises, the customer will be insulated from these price increases because of the long-term nature of the VPPA. Conversely, if the VPPA strike price is greater than the wholesale market price, the customer would pay the net difference to the renewable energy generator. In this way, the VPPA acts as a price hedge against potentially volatile future energy costs.

Keene could consider entering into a VPPA with a renewable energy generator within the New England Power Pool (NEPOOL) to support the development of local/regional renewables and resilience. However, it is possible that the financial terms will not be as favorable as they could be in another power market.

Keys Benefits and Challenges

Key benefits and challenges associated with engaging in virtual power purchase agreements are summarized below:

Key Benefits	Key Challenges
Supports the development of new, additional renewable energy projects with no upfront cost	The commitment of a small CPP program to purchase the energy may not be sufficient to cover the financing of a project
Provides the opportunity to increase the community's % of electricity from renewables without unbundled RECs	Contracts can be complex and may be challenging to navigate without additional legal support
Enables the community power program to purchase large volumes of electricity in a single transaction from generators located across the country	By committing revenue to a long-term project, the CPP is limiting its ability to implement other initiatives in that timeframe
Hedge against electricity market price volatility, long-term price stability, and potential cost savings to the community	By locking into a long-term contract, risk that basic supply rate will dip below CPP rate

Implementation Steps

Initial implementation steps for engaging in virtual power purchase agreements are listed below:

Implementation Steps	
✓	Customer signs a VPPA with a renewable energy generator for wind power at a fixed rate (i.e. strike price). Term is typically 10-20 years.
✓	Renewable energy generator sells customer's null power into wholesale market and receives strike price.
✓	Renewable energy generator sends/receives settlement to/from customer (settlement = wholesale price – strike price).
✓	Customer counterbalances utility payment for power with settlement transfer and uses RECs to reduce scope 2 emissions .[47]

Examples from Other Communities

This section includes an example of how one Virginia community is utilizing a VPPA to reach its renewable energy goals.

Amazon Arlington Solar Farm: Arlington County, VA

Arlington County, in partnership with Dominion Energy and Amazon, recently agreed to purchase 31.7% of the energy generated by a Dominion owned solar farm in Pittsylvania County, VA. The solar farm is projected to cover 1,500 acres of agricultural land and produce 250 million kWh annually upon completion in 2022.[48] Procuring 31.7% of the electricity produced by the solar farm equates to more than 79 million kWh and will offset 83% of the electricity currently used by the county government to operate its buildings, streetlights, water pumping station, and wastewater treatment facility. For reference, annual electricity consumption across all of Keene is equivalent to approximately 222 million kWh. This VPPA agreement is key to Arlington County reaching the targets outlined in their Community Energy Plan, including a goal to use 100% renewable energy for government functions by 2025.

PILOT BATTERY STORAGE PROGRAM

Overview

This strategy involves the City of Keene establishing a close working partnership with their local utility, Eversource, to develop a pilot battery storage program. This could include efforts to collaboratively develop ideas with the utility that support battery storage initiatives and build on preexisting Eversource programs. Existing battery storage programs in other regions or operated by other utilities have utilized rebates, demand response incentives, or a combination of the two to increase proliferation of battery storage systems.

Battery storage is a rapidly developing technology that can be coupled with solar and other renewable energy resources. This strategy has the potential to significantly benefit residents, businesses, the City, and the utility by reducing demand on the grid during peak times. Through the strategic deployment of electricity stored in batteries during peak times, local businesses can significantly reduce their demand charges. Demand charges for commercial customers are based on the highest level of electricity supplied by the grid at one time during the billing period and can make up a large portion of total electricity expenses for some businesses. From an environmental perspective, the ability of batteries to reduce peak demand on the grid also reduces the reliance on natural gas "peaker" power plants, which generate a large amount of greenhouse gasses, to meet this peak demand. As battery costs continue to decrease over time, implementing a pilot battery storage program will position Keene well to take advantage of the environmental, cost, and resiliency benefits of modernizing the grid, which will be key in the City's efforts to achieve 100% renewable electricity by 2030.

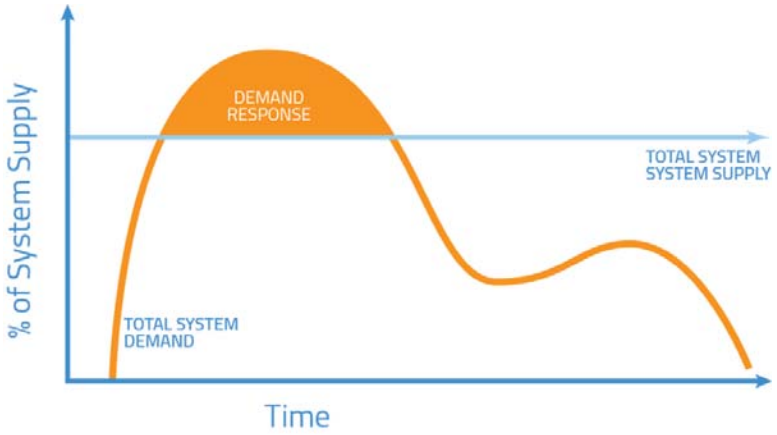


Figure 5.8. How Battery Storage Helps Reduce Demand Charge Peaks[49]

The above figure highlights the costs saving and environmental potential of battery storage systems paired with solar PV. When total electricity demand on the grid (orange line) exceeds the total electricity being supplied by power plants currently on line (the horizontal blue line), electricity stored in batteries can be deployed (orange shaded region) to reduce electricity demand charges for local businesses and reduce the need for polluting natural gas power plants to come online to meet peak demand.

Keys Benefits and Challenges

Key benefits and challenges associated with this strategy are summarized below:

Key Benefits	Key Challenges
Takes advantage of utility funding, technical expertise, and preexisting infrastructure and programs	City not in direct control of program development and implementation + success is largely dependent on Eversource being an active + willing participant.
Reduces electricity costs for consumers and the utility by minimizing peak demand	Need to identify the right points of contact at both organizations. Partnership may require connection at the upper management/admin level.
Modernizes the grid, boosts resilience, and reduces the need for gas "peaker" plants	Utility priorities can shift during a project
Pilot program is a low-cost strategy for the City to pursue	Third-party complexity is introduced, as battery vendors (i.e. Tesla, LG, Generac) often play a role in demand response
Potential to expand the pilot program by partnering with other local governments, nonprofits, and businesses in the future	Keene is at the forefront of exploring battery storage pilot program models in New Hampshire, with minimal in-state precedent to leverage
Provides a cleaner and cheaper alternative for back-up power, which can be deployed to support essential infrastructure	

Implementation Steps

Initial implementation steps for collaborating with the utility to develop a pilot battery storage program are listed below:

	Implementation Steps
✓	Discuss potential opportunities to partner with Eversource on a pilot battery storage program. Given the preexisting demand response thermostat program Eversource has already made available in New Hampshire and the demand response battery storage program deployed by the utility in Massachusetts, there is already proven interest and precedent that the City of Keene can build from.
✓	Invest in battery storage at municipal facilities through Eversource's pilot program, potentially providing City co-funding. The City can serve as an example, showing the benefits of utilizing battery storage while reducing electricity costs and minimizing the environmental footprint of municipal operations. Installing battery storage as an alternative to diesel generators for essential infrastructure could be explored.
✓	Seek opportunities to expand and publicize the pilot battery storage program to local businesses and residents, leveraging strong interest in the strategy expressed during both the community presentation and Environment and Climate Committee meetings.

Examples from Other Communities

This section includes examples of how communities and their local utility have implemented best practices related to the implementation of battery storage technology. Utility administered battery storage incentives typically compensate utility customers in one of two ways. Demand response programs pay customers for the energy their battery contributes to the grid during periods of high demand, while other programs simply provide a rebate to customers for installing battery storage at their home or business. Examples of demand response, rebate, and a hybrid program options are explained in more detail below.

ConnectedSolutions Demand Response Program: Eversource, Massachusetts

The ConnectedSolutions Demand Response Program is a program run by Eversource in Massachusetts that enables participating residents to be compensated for allowing the utility to use the energy stored in their batteries during periods of high demand on the grid.[50] Residents with battery storage can also choose not to be enrolled in the program, saving the electricity stored in their battery as a personal back-up generator instead.

Bring Your Own Device Program: Green Mountain Power, Vermont

Developed in partnership with Renewable Energy Vermont, the Bring Your Own Device Program enables participating utility customers with onsite battery storage to choose between an upfront payment from the utility or a compensation rate for demand response use. The level of compensation is determined by the size of the customer's battery storage system.[51]

Home Battery Storage Pilot: Liberty Utilities, New Hampshire

The Home Battery Storage Pilot was recently approved by the New Hampshire PUC. This program will allow residents to sign up for a home battery installation in partnership with the utility and qualify them for varying time-of-use rates.[52]

RENEWABLE ENERGY LOANS

Overview

Renewable energy loans, particularly for distributed solar PV systems, can help make the installation of renewable energy projects more affordable for Keene residents and businesses by minimizing the up-front capital costs required to complete an installation and offering low-interest, fixed rates with flexible terms. With limited renewable energy financing options currently available for residents and businesses, the City of Keene could potentially partner with a local financial institution to offer competitive financing for renewable energy projects. By financing projects with more capital from local banks or credit unions, Keene can maximize the number of renewable energy installations within the City, as well as the economic and environmental benefits associated with deployment of these technologies.

Keys Benefits and Challenges

Key benefits and challenges associated with this strategy are summarized below:

Key Benefits	Key Challenges
Increased financing access for local residents and businesses to overcome financial barriers to renewable energy adoption	City not in direct control of program development and implementation. Success is largely dependent on local banks and co-ops being an active and willing participant
Opportunity to support local economy by engaging with local banks credit unions	Keene is at the forefront of exploring partnering with local financial institutions to finance solar in the state of New Hampshire, with minimal in-state precedent to leverage
Equitable solution that increases ability of low-income residents to install solar	Potentially high administrative burden on City staff engage with local banks and co-ops to establish program
Established best practices to draw on for engaging with local banks and co-ops to develop similar programs	

Implementation Steps

Initial implementation steps for partnering with a local financial institution to offer a renewable energy loan are listed below:

Implementation Steps	
✓	Conduct a review of local financial institutions that may serve as a potential partner based on current or past offerings.
✓	Conduct outreach to local institutions and provide educational materials on the benefits of offering loans for renewable energy. Keene could further support private sector lending by offering to provide a loan loss reserve or credit enhancement program.
✓	In parallel, considering advocating for the expansion of existing state or regional loan offerings, such as NH Saves, to include renewable energy or energy storage offerings.

Examples from Other Communities

This section includes examples of other communities and organizations that have implemented innovative financing solutions to accelerate clean energy adoption.

Milwaukee Shines: Milwaukee, Wisconsin

The City of Milwaukee, Wisconsin partnered with Summit Credit Union to create "Milwaukee Shines," a special loan program for city residents. With a $2 million budget, the program offers eligible customers up to $20,000 at a low-interest, fixed-rate with flexible terms.[53] Financing can be applied to solar electric systems up to 6 kW and solar hot water systems of 1-8 panels in size. Eligible expenses include all equipment, labor, permits, and interconnection fees, as well as structural re-enforcement and re-roofing expenses, if needed.

Admirals Bank & Solarize: Multiple Locations

Admirals Bank, a Boston-based bank active in lending for residential solar projects, has partnered with local governments and non-profits administering Solarize programs in Connecticut, Massachusetts, and North Carolina to provide financing options for participants.[54] For example, during the Solarize Connecticut Durham Pilot Project, the selected installer referred customers to Admirals Bank, which worked with homeowners to put together a loan package that allowed customers to participate in the program and purchase the system. Admirals Bank Relationship Managers and Solar Financing Experts have also attended town information sessions to educate homeowners on available lending products for other campaigns they have participated in.

New Hampshire Examples

Several New Hampshire banks and credit unions offer energy efficiency loans and could potentially expand to provide renewable energy loans as well.

- BCCU[55] is a credit union with locations in Manchester, Nashua, and Bedford offering energy efficiency loans.
- NHSaves[56] is a utility-run program that has partnered with local savings banks/credit unions to offer energy efficiency loans.

SOLAR & EV READY GUIDELINES

Overview

The City of Keene can adopt solar PV and electric vehicle (EV) ready guidelines that encourage or require new developments to be built in a manner that accommodates future solar and EV charging station installations. Designing new buildings with future installations of these technologies in mind, as opposed to installing them at existing buildings not designed to accommodate the required infrastructure, can significantly reduce total costs associated with the installation. For example, one study found that installing an EV charging space at an existing commercial building is 2.8 to 4.0 times more costly than installing the same EV charging space at a new commercial building.[57] Preemptively reducing cost barriers to entry for these key technologies can accelerate community-wide adoption of solar and EV charging in commercial developments. Access to EV charging, especially at the workplace, is key to the widespread adoption of EVs. This policy could also serve as a foundation for more far-reaching guidelines in the future that could, for example, require new residential buildings to also be built solar and EV ready.

EV charging stations, like the ones pictured above at the Commercial Street parking lot in Keene,[58] will be more cost effective to install if new construction is designed to accommodate future installation by taking steps such as installing all necessary electrical infrastructure, pulling conduit and wire to the appropriate locations, and ensuring concrete work accommodates mounting of charging stations.

Keys Benefits and Challenges

Key benefits and challenges associated with adopting solar and EV ready guidelines are summarized in the following table:

Key Benefits	Key Challenges
Reduces technical and financial barriers to solar and EV infrastructure implementation over the medium/long-term	Limited direct energy impacts expected as the strategy does not directly generate clean energy and is limited to the new construction market
Facilitates community adoption of EVs by increasing access to publicly available charging infrastructure	Limited precedent, with few examples of extensive solar and EV ready guidelines currently implemented in New England
Low-cost step for building owners, positioning them to take advantage of lower infrastructure costs in the future	Additional upfront construction costs to ensure solar and EV readiness may need to be reconciled
Establishes a foundation for future action in the residential market and surrounding communities	Administrative burden associated with development of guidelines or ordinance.

Implementation Steps

Initial implementation steps for establishing a Community Power program are listed below:

Implementation Steps	
✓	Leverage the City's ability to adopt more stringent building regulations or (stretch codes). Local governments in New Hampshire have the ability to adopt stretch codes, which can be used to implement stricter guidelines than those explicitly outlined by the New Hampshire State Building Code. Stretch codes are a tool Keene can use to require higher building standards that coincide with solar and EV readiness guidelines.
✓	Evaluate if solar and EV ready guidelines will be a recommendation or requirement for new construction. For example, some communities opt to make solar and EV readiness a recommendation at first, then transition to a requirement later.
✓	Consider if Keene's solar and EV ready guideline requirements will vary based on size, function, and financial ability of the building owner. For example, communities may require larger commercial buildings to follow building guidelines and relax the guidelines for smaller entities.

Examples from Other Communities

This section includes examples from communities that have implemented best practices related to the implementation of solar and electric vehicle readiness guidelines in the United States. Each example includes a few key points and differentiating factors.

Commercial Buildings Solar Requirement: Watertown, Massachusetts

In 2018, Watertown's Planning Board amended their zoning language, requiring all developments greater than or equal to ten thousand (10,000) gross square feet or containing ten (10) or more residential units to include a solar energy system that is equivalent to a minimum of 50% of the roof area of all buildings.[59] In cases where a site includes an uncovered parking structure, the structure will also be required to have a solar energy system installed.

Solar Friendly Best Planning Practices: Southern New Hampshire

The Southern New Hampshire Planning Commission (SNHPC) created this resource to assist New Hampshire communities interested in facilitating solar PV adoption.[60] This includes guidance on how to develop solar friendly land use and zoning regulations and the policies and planning practices that remove barriers to development and reduce burdensome soft costs.

Solar and EV Readiness Reach Codes: San Mateo, CA

The City of San Mateo has effectively leveraged their ability to implement reach codes to facilitate solar and EV infrastructure adoption in their community.[61] The City requires all new construction to install a minimum size solar PV or solar thermal system in addition to requiring a minimum number of EV capable spaces or charging stations at qualifying sites. San Mateo has found that establishing minimum requirements often results in owners and developers far exceeding what is required in order to maximize cost-effectiveness.

HEATSMART CAMPAIGN

Overview

Heatsmart campaigns (also called "thermalize") are a community-based outreach and education tool that aims to increase adoption of renewable thermal technologies such as air source heat pumps, solar thermal, wood pellets, and ground source heat pumps. In addition, some campaigns have encouraged homeowners to consider energy efficiency improvements and home weatherization upgrades. Heatsmart leverages partnerships with installers, group purchasing power, and volunteer energy to provide focused community outreach and education around renewable thermal technologies, reduce logistical and financial barriers to participation, and reduce heating and cooling costs for residents and small businesses.

Renewable thermal technologies are relatively unknown by most customers, and as a result, the "soft costs" of educating consumers can be a barrier for contractors making sales. Heatsmart campaigns use the same model as "solarize" to promote public awareness of renewable thermal technologies, increase consumer confidence, and help reduce customer acquisition costs for installers. A successful campaign should include the following[62]:

- **Outreach to local contractors** in advance of program launch to ensure they understand the goals of the program, how to position themselves to participate, and how to successfully leverage the program to generate leads. Due to the nature of the HVAC contractor industry, which is typically composed of smaller, more localized firms, it may be worth exploring a contractor arrangement that utilizes multiple installers in a campaign in order to address concerns such as perceived favoritism, challenges in meeting a sudden surge in demand, and sensitivity of smaller firms to competition from larger external firms.
- **A dedicated campaign leader and a team of community volunteers** are critical to the success of a program. The leader and volunteers manage the program, plan and coordinate events, serve as a point of contact, and provide the "boots on the ground" for one-on-one outreach.
- **Support or sponsorship from a trusted organization** helps to build trust and increase consumer confidence in the program. Often, local governments will play a role in organizing or supporting a program, especially if it is aligned with local policy goals.
- **An easy sign-up process** is essential to make it as easy as possible for people to participate in the program.
- **Consistent messaging and coordinated outreach** are necessary to drive participation in the program and overcome barriers such as lack of awareness / familiarity with renewable thermal technologies and available financial incentives and programs.

- **A limited sign-up period with deadlines for customer enrollment.** This helps to create a sense of urgency and drive higher participation rates; however, the program length should be longer than a typical solarize campaign to build in extra time for education, outreach, and messaging to overcome lack of consumer awareness / familiarity with renewable technologies.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Reduces technical and financial barriers to renewable thermal adoption over the short-term.	If offering a diversity of renewable thermal technologies, the potential to achieve economy of scale is diluted and may affect ability to offer discounts.
Helps to build a local installer base and support existing contractors.	Potential for unforeseen installation costs and heating system upgrades (i.e., upgrading electrical system to accommodate an air source heat pump), which can add to overall costs
Existing federal and state rebates and loans are already available to reduce up-front costs of installation and improve rate of return on investment.	Explaining the complexity of the various renewable thermal technologies and how they integrate with existing heating systems presents a challenge for outreach and education.
Effective strategy for raising consumer awareness and increasing confidence in renewable thermal technologies.	Barriers to participation from low and moderate income households without additional funding to provide affordable access.
Opportunity to pair program with energy efficiency and weatherization programs and/or financial incentives, such as local or utility rebates.	Overcoming the split incentive for rental properties where the building owner does not pay for energy use.

Implementation Steps

Implementation Steps	
✓	Identify a local champion to serve as a team lead. A successful program hinges on having a local champion or group of champions to run and manage the program and coordinate volunteers.
✓	Reach out to local installers during program design phase. Local HVAC contractors should be engaged early on so that their perspectives and concerns can be addressed through the local program design.
✓	Review examples from other communities and identify structure/design of a Keene-specific program. Heatsmart campaigns are less established than solarize campaigns, and there are various different models that Keene can learn from. The design of a local program should be informed by best practices and lessons learned from other communities, as well as the unique characteristics of Keene.
✓	Identify community partners to help amplify messaging and outreach. For example, Northampton, MA's initial Heatsmart campaign was a collaboration between the City of Northampton Energy and Sustainability Department, Mothers Out Front, and Climate Action Now – Western Massachusetts.

Examples from Other Communities

This section includes examples from communities that have implemented a Heatsmart campaign. Information in this section was taken from the Clean Energy States Alliance June 2019 report, "Community Campaigns for Renewable Heating and Cooling Technologies: Four Case Studies." [63]

Northampton, MA: 2017 / 2018 HeatSmart Campaign

The first iteration of this program, which ran from August 2017 through February 2018, focused on cold climate air source heat pumps and owners of one- to four-unit residential buildings. The project lead was the City's Energy and Sustainability Officer; however, the program relied heavily on volunteers to provide outreach. Goals of the program included increased awareness of air source heat pumps and their benefits, increased adoption of air source heat pumps, reduced costs associated with air source heat pump installations, and reduced greenhouse gas emissions. Program outreach included "Meet the Installer" workshops, open houses at the homes of residents with air source heat pumps, social media and other online outreach, media placements in newspapers, TV, and radio, signage, direct mailings, and tabling at farmer's markets and other local community events. The program resulted in 162 people who expressed interest, 130 installer site visits, and 106 price quotes, and 54 installed air source heat pump systems. Of the systems installed, there were 19 single-zone, 34 multi-zone, and one heat pump water heater.

Boulder, CO: Comfort365 Program

Launched in April 2018, the Boulder Comfort365 program provides information and resources related to air source heat pumps and helps to connect interested consumers with EnergySmart-registered contractors, evaluate contractor bids, and access rebates and incentives at no charge. The first iteration of this campaign, which ran throughout the spring and summer, focused on the cooling aspect of heat pumps, and the second on the heating aspect. The City of Boulder and Boulder County spearheaded the program, providing free one-on-one time with personal energy advisors, access to a broad array of incentives and rebates, and assistance evaluating bids from prequalified, vetted contractors. Through a collaboration with Mitsubishi, the outreach efforts of the City and County were complemented by a regional marketing campaign that included paid advertisements, Google ads, and television marketing. Comfort365 estimates that the program resulted in the installation of 66 air source heat pumps in 2018, and set a goal of 120 installations for 2019.

EV CHARGING STATIONS

Overview

Electric vehicle charging stations, also referred to as "Electric Vehicle Supply Equipment" (EVSE), are necessary to support the shift from internal combustion engine (ICE) vehicles to electric vehicles (EVs). EVs are more efficient than ICE vehicles; according to a 2012 study by the Union of Concerned Scientists, emissions from an EV are less than those of an average conventional vehicle regardless of the mix of fuels used to generate the electricity.[64] A review of research related to life-cycle emissions of electric cars as compared to conventional vehicles, conducted by the International Council on Clean Transportation, found that EVs are much cleaner than ICE vehicles over their lifetime. In markets with low-carbon electricity, EVs produce less than a third of the life-cycle emissions of an average ICE vehicle.[65] However, in order for widespread EV adoption to occur, it will be important to provide convenient and publicly accessible EV charging stations for visitors, employees, and residents to use.

What is an electric vehicle (EV)?

Electric vehicles (EVs) derive all or part of their power from electricity. There are several categories of EVs:

- All-electric vehicles (AEVs) operate on electricity alone using batteries charged by an outside electric power source.
- Plug-in hybrid electric vehicles (PHEVs) use batteries to power an electric motor and use another fuel, such as gasoline or diesel, to power an internal combustion engine or other propulsion source.
- Hybrid electric vehicles (HEVs) are powered by an internal combustion engine and an electric motor.

There are three levels or categories of EV charging stations, summarized in Figure 5.9.

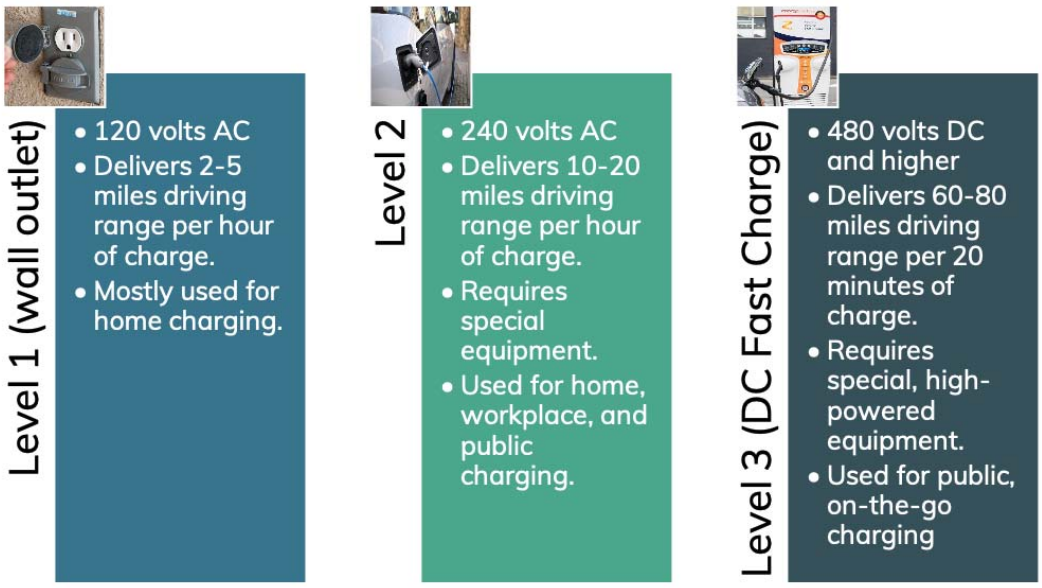


Figure 5.9. Summary of EV charging infrastructure categories, including Level 1, Level 2, and Level 3 (i.e. "DC Fast Charge").

In order to accelerate EV adoption, charging stations should be installed in key areas, such as multi-family apartment buildings and condominiums (Level 1 or 2), workplaces (Level 2), hotels, bed & breakfasts, inns, and motels (Level 2), highway corridors (Level 3), and downtown centers (Level 3). Level 3 charging stations are the most costly to install, ranging anywhere from $20,000 for a lower-end, 50 kW charging station to $150,000 for a 350 kW charging station.[66]

New Hampshire currently has funding for EV charging stations through the Volkswagen Environmental Mitigation Trust, which allows beneficiaries to use up to fifteen percent of their allocation for projects involving acquisition, installation, operation, and maintenance of new light-duty EVSE such as EV charging stations. New Hampshire has committed to using the full fifteen percent (approximately $4.6 million) available for this purpose, and has identified "Electric Vehicle Fast Charging Corridors" within the state where Level 3 charging stations will be prioritized. The Monadnock Region has one EV Fast Charging Corridor, NH Route 101 from Keene to I-93.[67]

The City of Keene should develop a plan to deploy Level 3 public EV charging infrastructure using grant funding and/or public-private partnerships. By providing DC Fast Charge stations in or near Downtown Keene, the City will help accelerate the shift to EVs and ensure the City does not discourage business from tourists and other visitors who drive EVs.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Facilitates community adoption of EVs by increasing access to publicly available charging infrastructure and leading by example.	Strategy does not directly generate clean energy; greenhouse gas benefits depend on the electricity mix used to power the charging station.
Funding is available through the Volkswagen Environmental Mitigation Trust.	Due to the high load that EVs draw from the grid, they can lead to large and variable demand charges, especially if charge management is not implemented.
Reduced tailpipe emissions resulting in reduced air pollution and improved public health outcomes.	Upfront capital costs may be required, depending on how the EVSE is funded and whether the funding source requires a local match.
Opportunity to support local economy by removing barriers to visitors who own EVs and market Keene as a leader in sustainability and alternative transportation.	Some EV charging equipment, such as DC fast chargers, may require ongoing maintenance and software upkeep.
Can be paired with solar to further increase greenhouse gas benefits.	Need to define how restrictions and time limits will be enforced, and who is responsible for enforcement.
Charge management can be used to reduce peak demand and/or peak period electricity consumption.	

Implementation Steps

Implementation Steps	
✓	Identify priority locations for public EV charging stations. Assess EV ownership trends and regional/local travel data to identify areas where there will likely be demand for EV charging infrastructure.
✓	Choose a specific location and type of charging equipment. The specific location and type of charging equipment will impact utilization and installation costs. The selected location should be convenient to drivers, in close proximity to an existing electrical panel that has the capacity to handle the additional load required for EV charging, have network access (if "smart" chargers are planned), and should meet lighting and accessibility requirements. The selected EV charging equipment (e.g. Level 2, DC fast charge, etc.) should be chosen to best meet the needs of the intended users.
✓	Determine the project budget. There are two components to EV charging station costs: the capital costs of installing the equipment, and ongoing operations and maintenance costs. Capital costs are comprised of hardware, permitting, and installation and will vary depending on the charging level, site characteristics, and equipment features. Operation and maintenance costs include electricity costs, maintenance and repair of the EV charging equipment, and network and charging session fees (i.e. cost of cellular/Wi-Fi network and back office support).
✓	Secure funding. Identify potential partners and grant or other funding (e.g. Volkswagen Environmental Mitigation Trust funds) to reduce the cost burden on the City and local taxpayers.

Examples from Other Communities

Salt Lake City, Utah: Public Level 2 EV charging stations

Through a grant from the Utah Division of Air Quality, Salt Lake City has installed 36 new Level 2 charging stations throughout the city since 2017. These charging stations are free for the public to use, and they have supported over 25,000 separate charges since their installation. Salt Lake City's installation of EV charging stations is part of its "Climate Positive" vision to reduce greenhouse gas emissions by 80 percent by 2040 and to transition to 100 percent renewable energy use for the city's electricity supply.

Fargo, North Dakota: Public Level 3 EV charging stations

In September 2020, the Cass County Electric Cooperative installed three new public Level 3 EV fast charging stations in Fargo and West Fargo, adding to the Cooperative's existing charging network of 35 Level 2 charging stations. The new Level 3 chargers are located at a shopping mall, a shopping center, and a visitors' bureau in the Fargo area. The Cass County Electric Cooperative funded this project through North Dakota's share of the Volkswagen settlement. [68]

ELECTRIC BUSES

Overview

Battery electric buses offer a number of benefits over conventional diesel buses, including reduced particulate pollution leading to improved air quality and avoided healthcare costs, lower greenhouse gas (GHG) emissions, and long-term cost savings due to lower lifecycle costs.

Improved Air Quality: Electric buses can reduce emissions of diesel exhaust, particulate pollution and pollutants that contribute to the formation of ground-level ozone. Diesel exhaust, which contains more than 40 toxic chemicals, is linked to a number of health impacts such as lung cancer, bladder cancer, asthma, and autism. It is especially harmful to children, who have developing respiratory systems and inhale more air per pound of body weight than adults. In fact, there is no established safe level of exposure to diesel exhaust for children. Despite this, 95% of all school buses are powered by diesel, and every day about half of all school children ride a bus to get to school.

Healthcare Cost Savings: By switching to electric buses, communities can realize significant healthcare cost savings. For example, a study conducted by Columbia University for New York City's Metropolitan Transportation Authority (MTA) calculated that electric buses reduced particulate matter emissions by 97.5 percent compared with diesel buses, producing a healthcare cost savings of approximately $150,000 per bus per year. The Chicago Transit Authority estimates that a single electric bus saves the city nearly $55,000 every year in avoided healthcare expenses resulting from cleaner air.

Reduced Greenhouse Gas Emissions: A 2018 study by the Union of Concerned Scientists found that electric buses produce significantly lower greenhouse gas emissions than diesel, diesel hybrid and natural gas-powered buses over their entire life cycle, including the process of generating the electricity that powers them. The study found that over its entire life cycle, an electric bus charged with the national electricity mix produces less than half of the carbon dioxide-equivalent (CO2e) emissions per mile as are produced by natural gas or diesel-hybrid buses. The GHG emissions benefits increase if the electricity mix includes a high percentage of renewables.

Long-Term Cost Savings: Although electric buses generally cost more up-front, they cost less to maintain and operate than diesel buses because they have significantly fewer parts, no exhaust systems, their braking systems last longer, and they do not require oil changes or fossil fuels. In addition, recent advances in electric bus technology and a rapid decline in battery costs over recent years have made electric buses an increasingly viable option. Some reports indicate that electric buses could achieve unsubsidized price parity with the upfront cost of diesel buses by 2030.

Revenue Generation: Electric buses also have the opportunity to generate revenue when not in use if they are equipped with vehicle-to-grid (V2G) capabilities. Vehicle-to-grid (V2G) is an innovative concept that enables energy stored in electric vehicle batteries to be sold back into the electricity grid, providing a range of services such as demand response, standby capacity, mobile emergency power, and grid stabilization.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Improved air quality due to a reduction in diesel emissions and emissions from other fossil fuels.	Higher upfront costs. Currently, a diesel-powered school bus costs about $110,000-$180,000, whereas an electric school bus costs between $230,000-$440,000.
Avoided healthcare costs due to a reduction in particulate matter emissions.	Lack of charging station infrastructure to support electric buses.
Lower lifecycle costs than diesel buses due to lower operational and maintenance costs.	Overcoming range anxiety related to shorter ranges of electric buses compared to diesel-powered buses.
Opportunity to generate revenue and provide a mobile power source to the grid through vehicle-to-grid programs.	Need to retrain drivers to drive electric buses, including learning how to maximize power usage.

Implementation Steps

Implementation Steps	
✓	Identify a local bus operator (for the Keene School district or for Keene's CityExpress) to participate in a pilot program for electric buses.
✓	Determine the project budget. The budget must include the capital costs of the buses, charging equipment, and facility work for the bus operators. Operation and maintenance costs include electricity costs, maintenance and repair of the EV buses and charging equipment, and network and charging session fees (i.e. cost of cellular/Wi-Fi network and back office support).
✓	Secure funding. Identify potential partners and grant or other funding (e.g. Volkswagen Environmental Mitigation Trust funds) to reduce the cost burden on the City and local taxpayers.

Examples from Other Communities

White Plains, New York: ConEdison Electric Bus Vehicle-to-Grid Pilot Project

Con Edison and the White Plains school district launched a pilot project in 2018 to add five electric school buses to its bus fleet. These electric buses have technology that allows them to store energy and feed it back to the electrical grid in summer months when the buses aren't transporting students. These electric school buses can send about 75 kilowatts of power to the grid when demand is high.[69]

Burlington, Vermont: Electric Buses for Commuter Public Transit

Vermont's first ever electric buses unveiled in Burlington in January 2020. The two new buses operate on the busiest route in the Green Mountain Transit system, which serves both the University of Vermont and Burlington High School areas. Funding for the project came from the Burlington Electric Department, Green Mountain Transit, VLITE (a trust that funds projects and initiatives that serve low income Vermonters), and a federal grant.[70]

ADVOCACY FOR EVS AND ALTERNATIVE FUEL VEHICLES

Overview

Of the 30.9 million dollars that New Hampshire received through the Volkswagen Environmental Mitigation Trust, New Hampshire can use 15 percent towards acquiring, installing, and operating electric vehicle charging equipment. There are currently no Level 3 fast charging stations in Keene or in Cheshire County, making Keene part of an "EV Desert."

Keene should advocate at the federal and state levels for more funding to support EVs, EV charging equipment, and other alternative fuel technologies. If Keene both increases its renewable portfolio and supports a shift to electric vehicles, then the City can move towards a transportation sector powered by renewable energy.

At the state level, the City should be an active proponent of using Volkswagen funds for the installation of a Level 3 fast charger in Keene. If the New Hampshire Department of Environmental Services releases a new RFP for fast charging infrastructure, the City should submit a proposal or assist community partners in their applications. In addition, the City should encourage the State to formally join the Transportation and Climate Initiative, a regional collaboration of 12 Northeast and Mid-Atlantic States and the District of Columbia that seeks to improve transportation, develop the clean energy economy and reduce carbon emissions from the transportation sector. In addition, the City should advocate for the state to join the Zero Emissions Vehicle (ZEV) program, which requires increasing sales of ZEVs over a 10-year period. ZEVs include AEVs, hydrogen fuel cell vehicles, and PHEVs.

At the federal level, the City should advocate for an expansion of the federal tax credit for plug-in electric vehicles. Under the current federal tax credit, automakers have a cap of 200,000 sales that are eligible for up to a $7,500 tax credit. If the automaker hits that cap, then the amount of the tax credit goes down.[71] Increasing the cap beyond 200,000 will allow more prospective buyers to receive the full $7,500 credit, which could incentivize EV adoption.[72]

RENEWABLE DISTRICT HEATING & COOLING SYSTEM

Overview

District Heating and/or Cooling Systems transfer thermal energy from a central source using a system of insulated pipes to residential, commercial, and industrial consumers for use in space heating (or cooling), water heating, and process heating.[73] District energy systems are best suited to areas with a higher density of buildings/population and relatively cold climate zones. Historically, many district heating and cooling systems have relied on fossil fuels as either a primary or backup energy source. However, the central thermal energy source could come from a number of different options, such as boiler units (which could use a variety of different fuels), geothermal, biomass, solar energy, waste-to-energy, and combined heat and power (CHP), which can result in GHG emission reductions unachievable on a building-by-building basis.[74]

By connecting multiple buildings to a district system and providing thermal energy in a usable form, district heating and cooling systems help to improve efficiency, enable fuel flexibility, simplify building operations and maintenance, eliminate the need for installing boilers in individual buildings, and reduce or avoid costs for operation, maintenance, repair, and replacement of individual building energy systems. However, building a district energy system is a major engineering project that would require buy-in from a wide array of stakeholders. It requires a local champion to build support for the concept, availability of local renewable sources of energy, a potential customer base, and turnover in existing equipment in a districts building stock. Understanding these conditions and building a business case can be a hurdle for project developers to overcome. As a first step, the City could consider commissioning a study that analyzes the local market and conditions for a renewable district heating system to set the stage for future developers.

Keys Benefits and Challenges

Key Benefits	Key Challenges
Stable thermal energy services and costs could help retain and attract industry by providing reliable thermal energy, both in terms of supply and cost.	Requires collaboration and cooperation from utility and other partners, which can add time and complexity to the process.
Creation of short-term and long-term employment opportunities, resulting from both construction and ongoing maintenance and operation of the system.	Feasibility studies are generally expensive and time-consuming. A long-term champion is required to keep momentum and interest in the project going.
Adaptable to a wide variety of fuel types.	High capital costs to design and construct a system.
Improves local air quality by replacing small, uncontrolled sources of air pollution with a more efficient, centralized source. This benefit is enhanced if a non-polluting source of energy is used.	High perceived risk to investors due to long lead time before district energy system is operational and generating revenues.

Key Benefits	Key Challenges
Requires and encourages collaboration among public and private sector, building relationships that could be applied to other projects / endeavors.	Requires strong and ongoing political support at local, state, and federal level to eliminate regulatory, policy, and institutional barriers.

Implementation Steps

Implementation Steps	
✓	Assess level of interest among key stakeholders and identify a local champion. District energy requires careful study, and the process from planning to construction can take years. Before committing resources, key stakeholders such as the City of Keene, Keene State College, and large commercial and industrial energy users who may benefit from a district energy system should be engaged to determine whether there is enough interest to warrant further exploration. Due to the long timeframe for implementation, a local champion or champions will be needed to maintain interest and momentum for the project.
✓	Commission a preliminary feasibility study to determine whether a renewable district heating system is technically and economically feasible in Keene, including cost estimates.
✓	If the study shows that a system is feasible, seek funds to commission an engineering study to examine system feasibility for a specific location in detail. The study should include a preliminary / conceptual design and improved cost estimates.
✓	If renewable district energy appears feasible and beneficial for Keene, an advisory committee should be formed (or an existing committee should be tasked) to conduct education / outreach and verify whether the concept is acceptable to the public. In addition, it is critical to engage potential users to determine whether they support further study and the commitment of resources for a local system.
✓	Secure funding and identify regulatory requirements. This may require exploring ways to reduce financial barriers, such as offering tax-exempt financing, identifying sources of grant funding, and working with regulators at the state and federal level to understand permitting requirements.
✓	Hire a firm to prepare engineering drawings and detailed cost estimates.
✓	Finalize institutional and financing arrangements for the district energy system. This step is critical, and should be done prior to finalizing construction drawings (an expensive and time-consuming task) or beginning construction.
✓	Finalize construction drawings and begin construction.

Examples from Other Communities

This section includes examples from communities and organizations that have installed a renewable district heating or combined heat and power (CHP) system.

Shands Cancer Center in Gainesville, FL: Providing Energy Security with CHP

When Shands HealthCare decided to build a new cancer hospital in Gainesville, FL, the company conducted a competitive solicitation process to find an efficient and reliable energy source to keep the hospital operational in the event of a prolonged power disruption. This process resulted in a unique public/private partnership between Shands HealthCare and Gainesville Regional Utilities (GRU) to build a state-of-the-art combined heat and power (CHP) plant that can generate all of the power needed for the hospital and use the waste heat from the generator to produce all required chilled water for cooling and steam for heating.[75] The GRU South Energy Center includes a 4.3 MW natural gas-fired recuperated combustion turbine housed in a structure designed to withstand Category 4 hurricane-force

winds. The facility went into operation in 2009 and has achieved annual energy savings equal to the power needed to run more than 3,000 homes. The Shands Cancer Hospital was awarded LEED Gold certification in 2010, due in part to its onsite district energy and CHP facility.

District Energy St. Paul: Renewable District Heating and CHP

District Energy St. Paul is one of the most advanced and integrated district energy systems in North America, incorporating CHP, biomass, solar thermal, community solar partnerships, and thermal storage to provide space heating/cooling and hot water to its customers. As of April 2019, the nonprofit served about 500 commercial and residential customers in and around downtown Saint Paul, MN and employed 45 people.[76] It began in 1979 as a public-private partnership to develop the first hot water district energy system in North America. In 2003, a biomass-powered CHP plant was constructed, and in 2011, the system was advanced further with the addition of a 1.2 MW solar thermal system. As a result of energy efficiency upgrades and fuel switching to biomass, solar, and natural gas, in March 2019 the company retired coal from its heating portfolio, two years earlier than planned. The company is currently exploring low temperature loops and geo-exchange projects to reduce emissions even further.

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CITY OF KEENE R-2018-36

In the Year of Our Lord Two Thousand and Eighteen

A RESOLUTION RELATING TO SUSTAINABLE ENERGY GOALS

Resolved by the City Council of the City of Keene, as follows:

WHEREAS, The City of Keene has formally recognized the challenges of Climate Change since the year 2000 when it became a participant in the Cities for Climate Protection Program; and

WHEREAS, The City of Keene then developed and implemented a Climate Action Plan in 2004 and a Climate Adaptation Plan in 2007 and incorporated these plans into its 2010 Comprehensive Master Plan after extensive community stakeholder engagement; and

WHEREAS, The State of New Hampshire 2009 Climate Action Plan set a goal of reducing Greenhouse Gas Emissions by 80% from 1990 to 2050; and

WHEREAS, the challenges presented by Climate Change have become increasingly apparent in the intervening years, as reported in the Congressionally-mandated National Climate Assessments; and

WHEREAS, the United States Energy Information Administration reports that the combustion of fossil fuels accounts for as much as 76% of US Greenhouse Gas Emissions; and

WHEREAS, energy efficiency measures that drive down energy demand are the most cost-effective means to reduce fossil fuel consumption, and clean energy sources such as solar, wind, and small hydro may now be cost-competitive with fossil fuel sources; and

WHEREAS, local, distributed generation of energy can provide resilience to weather-related interruptions of energy supply and economic disruptions of energy pricing while reducing air pollution and associated public health risks; and

WHEREAS, clean, renewable energy is one of the nation's fastest-growing employment sectors and represents an enormous economic opportunity for Keene to create jobs and attract talent, thereby contributing to the vision of a vibrant economy outlined in the Comprehensive Master Plan and the Economic Development Action Plan; and

PASSED

WHEREAS, economically disadvantaged residents, older people and children, people who are homeless, people with disabilities or health conditions, and

members of other underrepresented minorities experience the impacts of climate change disproportionately; and

WHEREAS, cities across the nation have made commitments to transition to 100 percent clean energy and Keene strives to remain a leader among its peer cities.

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Keene that:

A. It is the goal of the City of Keene that all electricity consumed in the City will come from renewable energy sources by the year 2030 and that 100% of all thermal energy and energy used for transportation come from renewable energy sources by the year 2050. This goal will apply to the entire Keene community, not just municipal government operations.

B. The City of Keene develop a strategic plan by December, 2020 to meet these renewable energy goals through a transparent and inclusive stakeholder process.

Kendall W. Lane, Mayor

In City Council December 20, 2018.
Referred to the Municipal Services, Facilities, Infrastructure Committee.

City Clerk

PASSED January 17, 2019

A true copy;
Attest:

City Clerk

CADMUS

City of Keene Renewable Energy Transition Analysis

April 2020

Prepared for:

The City of Keene

Prepared by The Cadmus Group:
Ben Butterworth
Megan Lynch
Anthony Albano
Zack Wyman

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Introduction and Background

Keene Renewable Energy Goals

In January 2019, the Keene City Council adopted a goal to achieve:

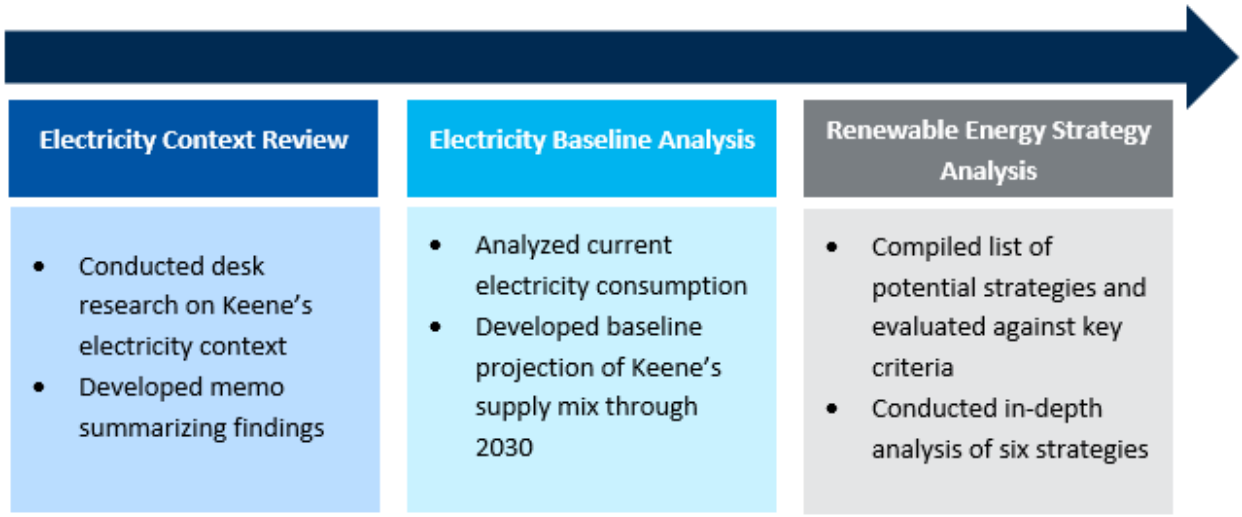
- 100% of all electricity consumed in the City will come from renewable sources by 2030
- 100% of all thermal energy and energy used for transportation will come from renewable sources by 2050

The resolution further calls for the City to develop a strategic plan by December 2020 to meet these renewable energy goals through a transparent and inclusive stakeholder process. As such, the City of Keene hired The Cadmus Group to identify and evaluate renewable energy strategies to achieve the City's 2030 renewable electricity goal.

Objective and Approach

Local governments across the United States are employing a wide range of strategies to achieve their renewable energy goals. However, the viability and impact of a given strategy across communities depending on contextual factors, such as state-level regulation, utility type, and local factors. The purpose of this report is to provide the City of Keene with actionable strategies given their specific policy and regulatory context to achieve their renewable electricity goals along with targeted implementation guidance for pursuing the selected strategies. The Cadmus Team's process for identifying these strategies is summarized in Figure 1 below:

Figure 1: Summary of Cadmus Process



1. **Electricity Context Review**. At the outset of the project, the Cadmus Team conducted a review of Keene's electricity context, including state, utility, and local electricity market context, as well as key renewable energy policies, to provide a foundational understanding of Keene's local barriers and opportunities related to increased renewable energy deployment. The findings of this review supported the development of the electricity baseline scenario and the identification of strategy options Keene could leverage to achieve 100% renewable electricity. For more information, see the Electricity Context section.
2. **Electricity Baseline Analysis**. Next, the Cadmus Team analyzed current electricity consumption in Keene and developed a baseline, or business as usual, scenario forecast of likely changes in the electric power mix during the planning period (present-2030) without any further action from the City. This analysis helps the City to better understand the magnitude of change that will be necessary to meet its 2030 goals. For more information, see the Electricity Baseline section.
3. **Renewable Energy Strategy Analysis**. Lastly, the Cadmus Team identified a list of 16 strategies that are actionable and appropriate in the City of Keene and analyzed them against key criteria identified through conversations with City staff. With insights from this prioritization exercise, the Keene Energy and Climate Committee selected six strategies for the Cadmus Team to explore in more detail. For each strategy, the Cadmus Team developed a description, key benefits and challenges, implementation steps, and relevant examples. For more information, see the Strategy Analysis and Findings section.

Electricity Context

At the outset of the project, the Cadmus Team reviewed Keene's state, utility, and local electricity market context, as well as key policies, to provide a foundational understanding of Keene's local barriers and opportunities related to increasing renewable energy deployment. This section outlines key findings from this review.

State Regulatory Context

New Hampshire is one of 17 states in the United States with a deregulated electricity market. In deregulated electricity markets, investor-owned utilities, including Eversource, are not permitted to own and operate power plants that generate electricity. Retail customers are free to purchase energy from a competitive supplier, while the utility continues to provide transmission and distribution services.

There are currently four electric distribution investor-owned utility companies in the State of New Hampshire,[1] with Eversource serving as the main electric utility in Keene. Additionally, there are a number of competitive energy suppliers active in New Hampshire, offering customers a range of electricity sourcing options and prices. There are approximately 15 residential[2] and 25 commercial/industrial[3] energy suppliers currently active in Eversource's territory. Eversource reported that approximately 22% of its residential customers and 58% of total customer load in New Hampshire had migrated to the competitive supply market by the end of the third quarter in 2019.[4] Having the ability to select a competitive supplier provides residents, businesses, and local governments with greater control over their energy mix and the opportunity to increase renewable energy supply.

Governor Hassan signed House Bill 614[5] in 2015, which aims to modernize the grid and draws from the goals outlined in the 2014 NH Energy Strategy.[6] The New Hampshire Public Utilities Commission worked alongside industry experts to develop a report titled *Grid Modernization in New Hampshire.*[7] The report detailed a number of energy initiatives and an updated 2018 State Energy Strategy,[8] which focused on building a more flexible and efficient grid capable of supporting the State's evolving energy goals more effectively than currently possible given the failing and outdated grid infrastructure in place today. Grid modernization is essential to support the growth of New Hampshire's economy and must rely on the effective integration of distributed energy resources, such as solar photovoltaic (PV) systems, which bolster resilience to grid disruptions and power outages, reduce costs, and encourage further development of clean renewable resources. The Public Utilities Commission (PUC) has continued their efforts to encourage all stakeholders to actively contribute to grid modernization,[9] with recent efforts focused on increasing the availability of consumer's utility data to make the State's energy system more responsive, dynamic, and consumer focused.[10]

Some state-level policies and programs in New Hampshire support renewable energy development, while others could benefit significantly from drawing on precedent provided by other New England states. For example, New Hampshire can increase the requirements currently outlined under the Renewable Portfolio Standard (RPS) by ratcheting up the requirements for the percent of total electricity supplied by renewable sources and ratcheting up "carve outs" that mandate what portion of the RPS must be met by

specific technologies, such as solar PV. Similar measures have already been incorporated into the Vermont Renewable Energy Standard,[11] Massachusetts' RPS,[12] and New York RPS.[13] For example, the New Hampshire RPS requires 25.2% of electricity to come from renewables by 2025, and mandates that only 0.7% of that electricity generation come from new solar by 2020. Conversely, the Vermont RPS requires 75% of electricity to come from renewables by 2032[14] and Massachusetts obtained over 13% of all electricity generated from solar in 2019[15] and is continuing to aggressively incentivize further solar expansion through the Solar Massachusetts Renewable Target (SMART) Program.[16] Beyond Massachusetts, other northeastern states have developed their own solar incentive programs to facilitate new PV development, including Rhode Island's Renewable Energy Growth Program[17] and New York's NY-Sun Solar Initiative.[18] These programs are implemented by the state to help alleviate the cost of solar for consumers and promote the adoption of renewable energy resources in accordance with aggressive state targets.

Examples of key state-level policies in New Hampshire include:

- **The New Hampshire GHG Targets and Climate Plan**: In 2009, New Hampshire established statewide carbon reduction and renewable energy goals within its Climate Action Plan (CAP). These goals include an 80% reduction in greenhouse gas emissions by 2050 below base year 1990 levels and 25% of statewide energy to be sourced from renewables by 2025. Additionally, the GHG Targets and Climate Plan called for investment in and incentivization of renewable energy via the state renewable portfolio standard (RPS) and participation in the Regional Greenhouse Gas Initiative (RGGI).[19] As of 2017, based on power plants physically located in the State, New Hampshire reported a 61% reduction in GHG levels from the electricity sector below 1990 levels, with renewables comprising 19.7% of the State's energy portfolio. This is largely a result of New Hampshire's transition away from a reliance on coal and petroleum for electricity production and the adoption of more natural gas and renewable energy resources in their place. Natural gas, despite being a fossil fuel, produces significantly less GHG emissions per unit of electricity generated in comparison to coal and petroleum. In 1990, coal and petroleum made up roughly 43% of the State's electricity generation supply mix and accounted for 98% of electricity generation GHG emissions, while in 2017 coal and petroleum comprised approximately 2.3% of the supply mix and accounted for 23% of electricity generation emissions. In 1990, no natural gas power plants were operational in New Hampshire, but, as of 2017, natural gas plants account for 73% of in-state electricity generation emissions.[20]
- **State Renewable Portfolio Standard (RPS):** New Hampshire's RPS requires private electricity providers to utilize renewable energy according to a compliance schedule with a goal of 25.2% of all electricity provided to be renewable by 2025.[21] As of 2019, the RPS mandated that 19.7% of energy consumed in New Hampshire be sourced from renewable energy.[22] Eversource currently fulfills their obligations under the State's RPS primarily through the issuance of periodic RFP's for the purchase of Class I Renewable Energy Certificates (RECs)[23] from Burgess BioPower and Lempster Wind.[24]
- **Net Metering**: Utility customers that generate electricity on-site are eligible for net metering credits when they produce more electricity than they consume in a given month. Within

Eversource territory, "each kilowatt-hour of Net Sales will earn a monetary bill credit equal to the sum of the Default Energy Service charge, the Transmission Charge, plus 25 percent of the Distribution Charge. Customers who take energy supply service from a competitive retail supplier are not eligible for the Default Energy Service portion of this credit".[25] The PUC distinguishes between small customer-generators (up to 100 kilowatts) and large customer-generators (greater than 100 kW and up to 1 MW), with slightly varied rules for each. The aggregate statewide capacity limit for all net metered systems is 100 MW, with 50% specifically held for the state's investor-owned utilities as upheld by HB 1116.[26] There have been recent motions to amend net metering, such as SB 365 (2019),[27] which would have expanded the net metering size limit for eligible customer-generators from 1 MW to 5 MWs,[28] but was vetoed. A similar bill, SB 159,[29] was passed by the legislature, but was vetoed by the governor. The state Senate overrode the veto in March 2020, but it is unclear if the House will override the veto as well.[30] Currently in New Hampshire, all municipal and residential solar PV systems wishing to net meter are guaranteed interconnection, without requirement of additional payments in the form of fees, tests, or insurance. However, some efficiency and safety requirements must be met during the interconnection process, which is upheld by New Hampshire Statutes § 362-A:9.[31]

- **Group Net Metering:** Group net metering is permissible per SB 98,[32] which allows a customer-generator (e.g. solar PV array owner) to act as a group host for non-generator customers and distribute the kWh credits generated by the host system among the group. The group host would then receive compensation from the utility, and pay members based upon their contractual agreement for their portion of the array. The challenge is that group net metering places an administrative burden on the group host and creates taxable income for members. SB 165,[33] which recently became law in NH, will allow for more traditional community solar through on-bill credits.

- **Third-Party Ownership:** The state permits third-party ownership in the form of power purchase agreements (PPAs), pending independent approval. Limitations for approval are listed in New Hampshire Statute Ann. §362-A:4-c.[34] A PPA allows for the procurement of electricity through a private third-party contractor. In this scenario, the private third-party pays for the cost of the system and bears the burden of operation and management. The consumer then purchases the energy produced by the system directly from the third-party, usually at a discounted rate compared to the default utility. There are several potential benefits to utilizing a PPA. For example, if a public or non-profit entity wishes to realize some of the Federal Investment Tax Credit (ITC) for solar installations, they can partner with a private third-party that qualifies for such lucrative incentives.

- **Community Power Program (CPP):** Also known as a community choice aggregation (CCA), this option allows New Hampshire communities to pool their electricity load and encourages the purchase of clean and renewable energy on behalf of participating customers. Communities may also implement cost-saving measures and reallocate funds towards other renewable energy-based projects as well. With the passing of New Hampshire *Senate Bill 286-FN-Local* in June 2019, New Hampshire municipalities and counties are permitted to develop plans for electric aggregation

programs for the first time.[35] In addition, the bill also allows cities and towns to implement community power on an opt-out basis, meaning customers are automatically enrolled, giving local governments far more bargaining power.[36] Development of CPPs enables communities to pursue more aggressive renewable energy goals than otherwise possible through default utility providers.

- **Financing Mechanisms and Incentives**: The state of New Hampshire offers a number of financial incentives for residents, businesses, and commercial customers interested in installing a renewable energy system. More details on these tax incentives, rebates, loan programs, and other financing mechanisms can be found in **Appendix A**.

Utilities in Keene

There are currently four electric distribution companies operating in New Hampshire, with each serving a mutually exclusive franchise territory. Eversource is the primary distributor, serving about 70% of retail customers, Unitil and New Hampshire Electric Cooperative (NHEC) serve roughly 11% each, and Liberty Utilities serves about 6% of customers.[37]

The City of Keene is located within Eversource's territory for electricity service. Eversource is an investor-owned utility that provides electricity and natural gas service to customers in New Hampshire, as well as Connecticut and Massachusetts. Eversource provides a few programs to help promote renewable energy resources in New Hampshire and comply with the state RPS requirements, such as net metering and the provision of educational materials. Additionally, Eversource owns a number of renewable generation sources across its service territory, including a 51-kW solar array in Manchester.[38] Eversource also offers a range of energy efficiency-focused programs, including their Residential Energy Efficiency Rebate Program,[39] New Equipment & Construction Schools Standard,[40] and their Commercial New Construction Energy Efficiency Rebate Program.[41] The New Hampshire PUC regulates investor-owned utilities within New Hampshire, including Eversource, and is responsible for ensuring reliable service at reasonable rates.

Eversource customers receive electricity from the New England power grid. In 2019, the NEPOOL system mix was approximately 20.1% renewable and 79.9% non-renewable. The 20.1% of renewable energy was comprised of hydropower (8.9%), refuse/other (3.5%), wind (3.4%), wood (2.4%), and solar (1.8%).

Local Policies and Initiatives

In addition to state-level policies, the City of Keene has taken steps locally to support the deployment of renewable energy. In 2018, Keene passed a resolution setting aggressive community-wide energy goals, including (1) 100% of all electricity consumed in the City from renewable sources by 2030, and (2) 100% of all thermal energy and energy used for transportation from renewable sources by 2050.[42] The City of Keene has also developed several planning documents to guide renewable energy and sustainability efforts, including:

- **Adapting to Climate Change: Planning a Resilient Community (2007)[43]:** This climate resilience action plan outlines the expected impacts of climate change in the Northeast and New Hampshire,

identifies Keene's vulnerabilities to these impacts, and lays out key goals and targets for increasing resilience along with implementation steps.

- **Local Action Plan (2004)[44]:** This climate action plan provides an overview of climate change and its impacts, and outlines key municipal, residential, and commercial/industrial opportunities for reducing greenhouse gas emissions to support efforts to mitigate the impacts of climate change.
- **Greenhouse Gas Emissions Inventory Report (2015)[45]:** This report provides an inventory of 2015 community-wide and 2015 municipal GHG emissions to help the City track progress against its emissions reduction goals and inform climate action planning.

Furthermore, the City has completed a number of projects to support renewable energy and the reduction of greenhouse gas emissions. Some key highlights include the installation of a solar PV system and geothermal HVAC system at the Public Works Department, the installation of hydropower at the water treatment facility, replacing the methane-to-gas system at the transfer station with a biodiesel generator, the installation of a solar PV system on City Hall, the conversion of all City lights to LEDs, and providing tax incentives for residential wood, wind, and solar installations.[46] Additionally, the City has entered a two-year contract with Constellation Energy to procure Green-e® Certified Renewable Energy Certificates equivalent to 100% of municipal electricity use beginning in 2020. For more information on the City's renewable energy accomplishments, please see the Energy and Climate Program Brochure.

Innovative Action in New Hampshire

A number of communities in New Hampshire have taken innovative action to support renewable energy deployment. A few key highlights are summarized below:

- The **City of Lebanon** is currently planning a CPP pilot program in hopes of realizing some of the benefits a program of this type can have for a community. This originally was an opt-in pilot program; however, the model may change with the passage of SB 286.
- Several New Hampshire communities have already leveraged their group purchasing power by participating in a Solarize campaign. During a Solarize campaign, a community partners with one or several developers, who can offer residents and small businesses competitive pricing due to anticipation of a large number of installations in one area over a condensed period of time. Communities participating in Solarize campaigns to expedite the adoption of solar include **Nashua, the Monadnock Region, and New Hampshire's Upper Valley**.
- **The City of Concord** has also taken action recently, pledging its own commitment to pursuing 100% renewable electricity by 2030 and 100% renewable energy for the thermal and transportation sectors by 2050. In July of 2019, Concord released a strategic plan outlining strategies and action steps to achieve their goals.[47]
- **Energize 360[48]** was a one-year, community-led effort in New Hampshire that took advantage of similar bulk discount incentives as leveraged through Solarize. Energize 360 allowed citizens in participating communities to request a free site visit to their home or business, providing them useful information about their energy consumption and opportunities to weatherize their property, install solar or other technologies, and implement energy efficiency measures, among other

strategies. Communities that participated in the Energize 360 campaign included Dover, Durham, Exeter, Hampton, Kensington, Lee, Madbury, New Castle, Newmarket, Northwood, Portsmouth, Rye, Somersworth, Strafford, and Stratham. The six-month campaign resulted in 251 clean energy and energy efficiency projects, which will collectively result in a reduction 1,015,937 pounds of carbon per year for the lifetime of those projects.[49]

- **Vital Communities** is a nonprofit organization that offers a range of economic, environmental, and civic-oriented programs and resources to support in the Upper Valley region of New Hampshire and Vermont. Their energy programs include Weatherize and Solarize Upper Valley campaigns, as well as a Green Real Estate Network to educate home buyers and sellers on energy efficiency.[50]

Electricity Baseline

Context

The objective of an electricity baseline is to understand the starting point of electricity consumption within the City and the mix of generation resources producing the consumed electricity. The baseline draws from a combination of available state-level data, Keene-specific utility data provided by Eversource, and insights provided by the City and the current regulatory landscape to estimate an electricity baseline for the City. Given that City-specific information is limited, much of the assumptions made are based on State-level information and scaled down to apply to the City of Keene. As part of the baseline analysis, the Cadmus Team also developed a business as usual estimate of the projected 2030 electricity supply mix, assuming no further action from the City is taken between now and 2030. This analysis allows Keene to better understand the gap between the business as usual projection and the City's target of 100% renewable electricity by 2030. The electricity baseline will serve as a starting point for the City, giving decision-makers a better understanding of what their electricity supply mix will likely be if no action is taken between baseline year 2019 and 2030. The following section outlines current consumption, energy supply, and key assumptions within the electricity baseline.

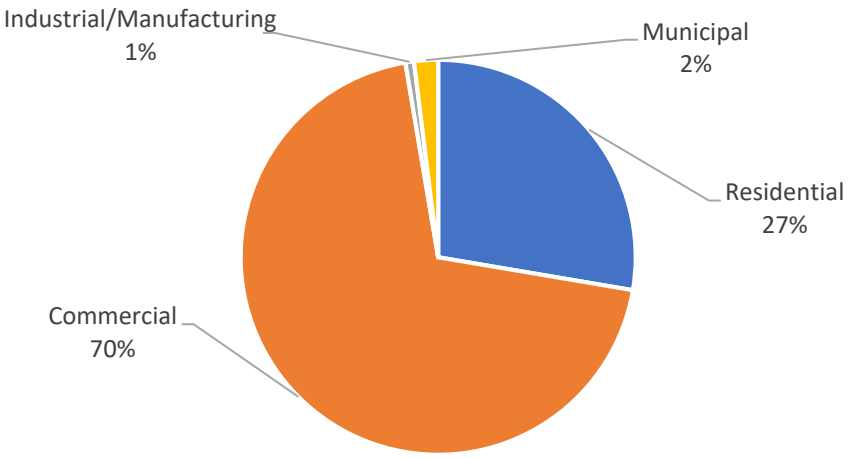
Electricity Consumption in Keene

In 2019, electricity accounts across the City of Keene consumed over 222 gigawatt-hours of electricity. On average, in 2019, a residential account used 4,089 kWh of electricity, a commercial account used 69,478 kWh, and a manufacturing/industrial facility used 28,930 kWh of electricity.

The commercial sector was the largest consumer of electricity, accounting for 70% of total community usage. Residential accounts made up 27% of usage in 2019, while municipal and industrial/manufacturing accounts made up the remaining 3% of electricity consumption in Keene (see Figure 2).[1]

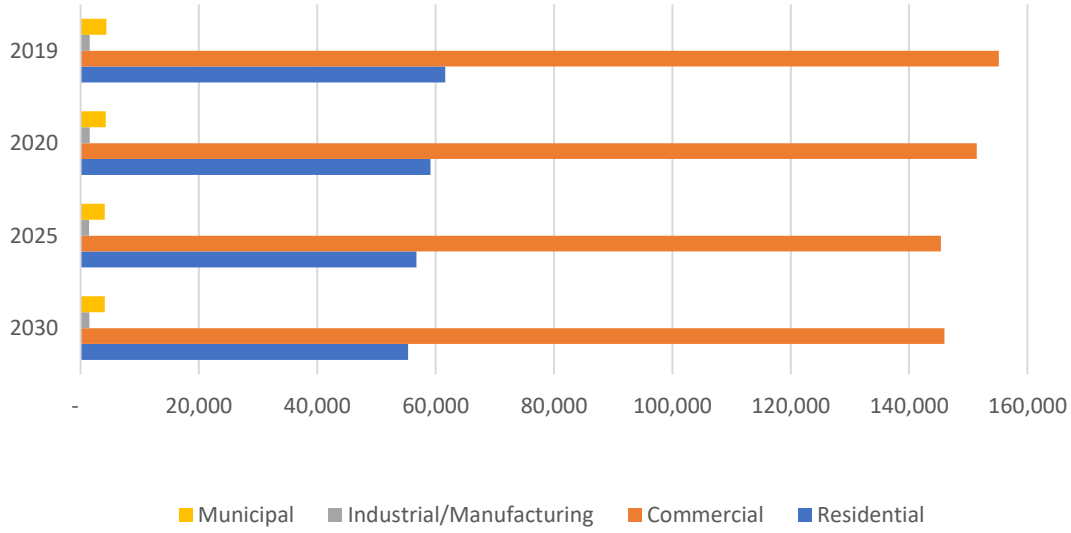
[1] Data provided by Eversource. Industrial accounts are those that have peak electricity demand greater than 1,000 kW.

Figure 2: Electricity Consumption by Sector 2019



Over time, consumption is expected to shift due to the impacts of population growth and the increasing effectiveness of energy efficiency. In 2030, 78,315 people are expected to live in Cheshire County, representing an overall growth of 1.25% from 2015.[51] Factoring in both energy efficiency[52] and population growth, it is estimated that overall electricity consumption will decrease by approximately 7% by 2030. However, this analysis does not consider new potential sources of load growth through building electrification, electric vehicle infrastructure, or new capital assets that could drive demand.

Figure 3: Estimated Changes to Electricity Consumption in Keene (MWh)



Renewable Energy in Keene

Currently, there are a number of systems in Keene that generate renewable electricity. Keene is home to a micro-hydropower system of 90 kW and over 3,300 kW of installed solar photovoltaic (PV) capacity across local homes and businesses.

Figure 4: Interconnected Solar PV in Keene[2]

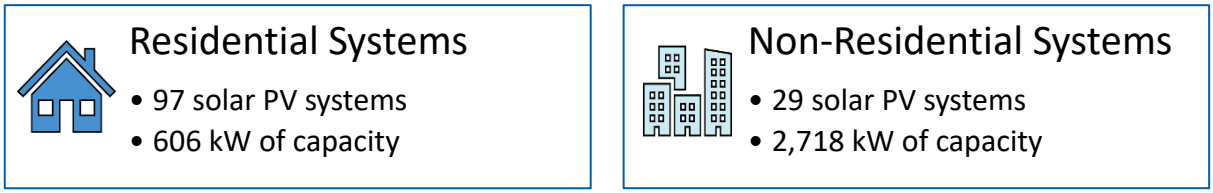


Figure 4 only includes interconnected systems and does not include off-grid systems within Keene. While distributed generation penetration is expected to grow over time, the 2030 forecast conservatively assumed the number of local renewable energy installations will stay constant over time.

New Hampshire Energy Supply Mix

As mentioned above, Eversource has divested its generation assets and relies on the New England Power Pool (NEPOOL[53]) and local energy generation to meet its customer demand for electricity and RPS requirements. The RPS ratchets up the renewable energy requirements every year (see **Table 1: New Hampshire RPS**Table 1**Error! Reference source not found.**). By 2025, in order to comply with the RPS, 25.2% of all electricity provided by Eversource will need to be generated using renewable sources. Currently, the RPS is projected to stay constant at 25.2% in 2025 and thereafter. The 2030 forecast conservatively assumes that the percentage of renewable generation mandated by the RPS will not increase after 2025.

Table 1: New Hampshire RPS[54]

Year	Annual Percent Increase	Renewable Energy Supply as Percent of Total Supply
2019	Baseline	19.7%
2020	1.0%	20.7%
2021	0.9%	21.6%
2022	0.9%	22.5%
2023	0.9%	23.4%
2024	0.9%	24.3%
2025 & thereafter	0.9%	25.2%

Conservatively, the default electricity supply provided by Eversource will need to comply with the RPS. In actuality, the electricity supply that Eversource purchases may exceed this requirement. Eversource interacts heavily with the New England Power Pool (NEPOOL) to source electricity supply. In 2019, the New England-based generation that feeds into the NEPOOL to serve the electricity load was 20.12%

[2] Distributed generation information was provided by Eversource.

renewable, up from 18.3% renewable in 2018.[55] While the regional 2019 level of 20.12% renewable supply exceeded the New Hampshire 2019 RPS requirement of 19.70%, the conservative RPS projections were the foundation of the Keene electricity baseline analysis. As Eversource's default supply changes periodically, the RPS provides a conservative baseline for understanding renewable and non-renewable supply over time, assuming the electric utility is compliant.

Table 2. NEPOOL Generation Sector 2019[56]

Generation Type	Natural Gas	Nuclear	Coal	Oil	Hydro	Refuse /Other	Wind	Wood	Solar	All Renewables
Capacity (MW)	16,563	4,025	917	7,139	3,393	462	415	503	440	5,213
Net Energy for Load (GWh)	39,725	25,182	369	117	7,305	2,895	2,794	2,004	1,474	16,472
% of Total Generation	**48.5%**	**30.8%**	**0.45%**	**0.14%**	**8.9%**	**3.5%**	**3.4%**	**2.4%**	**1.8%**	**20.1%**

As of 2019, the regional grid relies heavily on natural gas (48.5% of total generation) and nuclear (30.8%), despite the recent closures of nuclear plants across the region, including the 2014 closure of Vermont Yankee Nuclear Power Plant in Vermont and the 2019 closure of the Pilgrim Nuclear Power Plant in Massachusetts. Renewable energy resources, including hydropower, refuse, wind, wood, solar and other renewables sources made up a combined 20.1% of total regional generation.

A Note on Competitive Suppliers

In New Hampshire, customers have the option between default electricity supply from the utility and choosing supply from a competitive supplier. In both scenarios, electricity is still delivered to customers through the electric utility's transmission and distribution grid. In 2018, Eversource noted that 42% of customer load in New Hampshire was served through default service, while 58% of customer load had migrated to competitive energy suppliers. Competitive suppliers are still subject to the state's RPS, but may offer products to customers that exceed this requirement by offering contracts with higher renewable energy mixes than the default service from the utility. Competitive supplier contracts are typically short-term (12-36 months) and can offer fixed or variable pricing to customers for their electricity.[57] In 2020, the City of Keene entered into two competitive supply agreements for 100% renewable electricity for all but one of its municipal facilities. One contract is subject to a one-year term, and the other is two years. The New Hampshire Public Utilities Commission does not regulate the prices offered by competitive suppliers. However, it does provide questions that consumers should ask competitive suppliers while assessing options.[58]

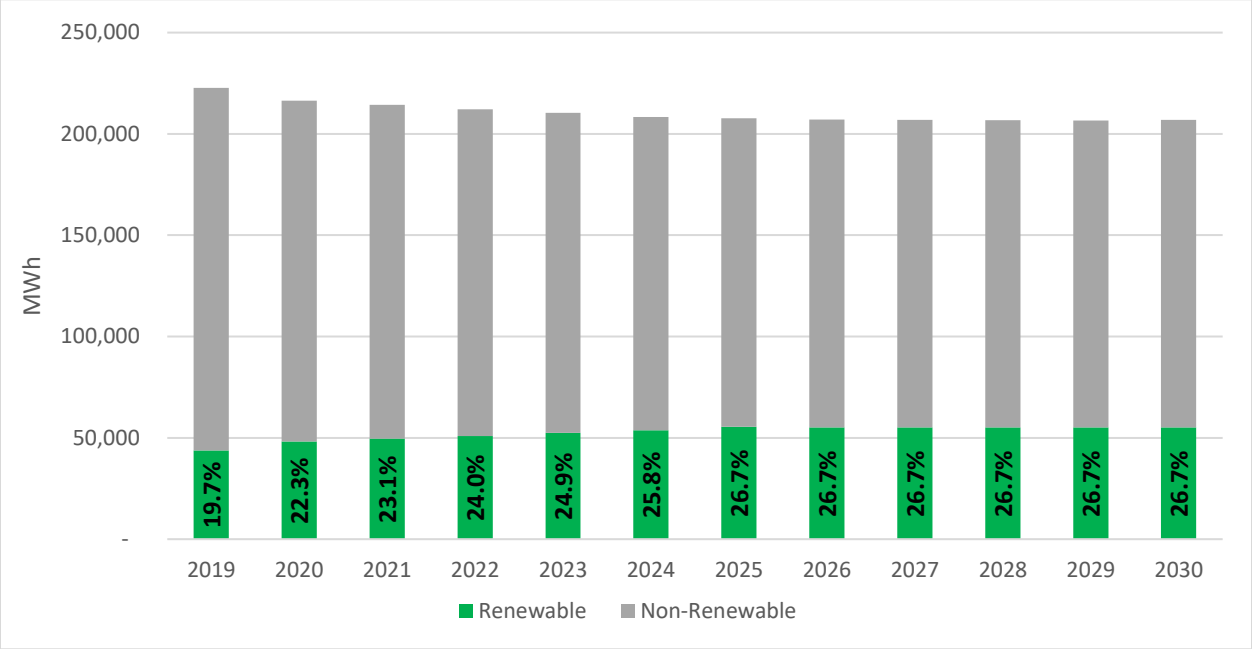
What this means for 2030

Overall, the business as usual case conservatively estimates that electricity consumption in the City of Keene will be 27% renewable by 2030. The baseline points to a steady increase in renewable electricity supply, largely driven by RPS compliance. Despite population growth, electricity consumption is anticipated to decrease slightly, driven primarily by expected energy efficiency improvements (see Figure 5).

Table 3: Electricity Consumption by Sector

Sector	Energy Type	Consumption 2019 (MWh)	Consumption 2030 (MWh)
Residential	Renewable	12,137	13,945
	Non-Renewable	49,471	41,393
Commercial	Renewable	30,563	36,781
	Non-Renewable	124,580	109,176
Industrial/Manufacturing	Renewable	308	370
	Non-Renewable	1,254	1,099
Municipal	Renewable	860	4,109
	Non-Renewable	3,507	0[59]

Figure 5. Business as Usual Electricity Consumption and Supply in Keene



This baseline assumes that the City continues sourcing 100% renewable electricity for its municipal accounts through 2030 from competitive supply agreements. If the municipality chooses not to extend these agreements and default back to the utility supply, then the overall community renewable electricity mix is expected to decrease slightly.

In 2030, it is estimated that the commercial and residential sectors will be the largest consumers of electricity (71% and 27% of electricity consumption, respectively), but that a larger proportion will be sourced from renewable energy due to the RPS. Without further action, it is estimated that the City will achieve 26.7% of its 100% renewable electricity target by 2030.

Strategy Analysis and Findings

Strategy Analysis Methodology

There are numerous strategies that the City of Keene could undertake in an effort to achieve its renewable electricity, workforce development and educational goals. To identify a subset of strategies that would be appropriate and impactful in the Keene context, the Cadmus Team first compiled an initial list of 16 strategy options based on conversations with City staff; the Cadmus Team's prior work with municipal governments nationwide; and desk research on Keene's state, utility, and local policy context, outlined in the Electricity Context section.

For each of the 16 strategies, the Cadmus Team then qualitatively assessed and ranked each strategy against key criteria, summarized below.

Criteria	Description
Scale of Impact	Includes the extent to which a strategy will increase the level of renewable energy within the electricity mix.
Local Impact	Includes the extent to which a strategy promotes renewable energy generation locally and whether it supports resiliency.
Local Environmental and Social Goals	Includes the extent to which the strategy contributes to local job growth and works to reduce greenhouse gas emissions.
Inclusion and Social Equity	Includes the extent to which the strategy is expected to be affordable for all-income levels, alignment with other community initiatives, and extent to which the benefits of the strategy are equitable.
Feasibility	Includes timeframe for implementation, costs to the City for implementation and support, and technical feasibility for implementation.

With the insights of this prioritization exercise, which can be found in **Appendix C**, the Keene Climate and Energy Committee selected six strategies for the Cadmus Team to explore in further depth, listed below:

1. Establish a community power program
2. Engage in virtual power purchase agreements
3. Collaborate with the utility to develop a pilot program related to energy storage
4. Partner with a local financial institution to offer a renewable energy loan product
5. Implement a building benchmarking ordinance
6. Adopt solar and EV ready guidelines

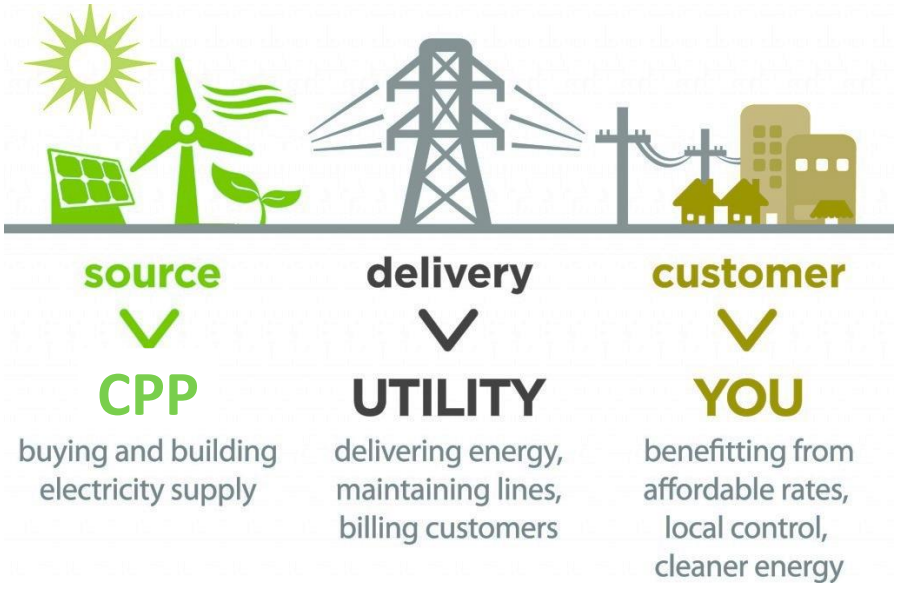
The following section summarizes key information related to each strategy, including a description, expected benefits and challenges, initial implementation steps, and examples of communities where the strategy has been implemented.

Strategy 1: Establish a Community Power Program

Overview

A community power program (CPP), also known as community choice aggregation (CCA), enables a local government (or multiple local governments) to **pool the electricity load of residents and small businesses and procure electricity on their behalf,** while the utility continues to be responsible for electricity delivery, transmission, and distribution and maintenance of poles and wires. Community power programs (CPP) are "opt-out", meaning that residents and businesses would participate in the program by default, but would have the option to "opt-out" if they preferred to receive basic service from Eversource or purchase electricity from a competitive supplier. This is an impactful strategy because it provides New Hampshire communities with **greater control over their energy mix and the opportunity to increase the percentage of renewables** within the mix at potentially lower energy prices.

Figure 6: How Community Power Programs (CPP) Work[60]



Source: Adapted from LEAN Energy

Keys Benefits and Challenges

Key benefits and challenges associated with establishing a community power program are summarized below:

Key Benefits	Key Challenges
Increases local control over the energy supply mix	**Political and regulatory uncertainty** in New Hampshire
Provides the ability **to increase the percentage of electricity from renewables** through RECs	**Limited ability to achieved "additionality"** due to reliance on RECs (see description below)
Potential **cost savings** to the community	Some **administrative burden** on city staff to set up program and identify a broker
Potential expansion in the future **to drive local renewables, energy efficiency, and other innovative offerings**	**Political coordination required** with neighboring communities if Keene wants to enhance economies of scale

When implementing this strategy, it will be important to have a strong understanding of renewable energy credits, or RECs. RECs are tradeable, market-based instruments that represent the legal rights to one megawatt-hour (MWh) of renewable electricity generation. There are two main types of RECs:

Unbundled RECs: Unbundled RECs are those that are sold, delivered, or purchased separately from physical electricity. Many CPPs rely on unbundled RECs as the primary means of increasing the renewable percentage of the electricity product delivered to customers. The key advantage of unbundled RECs is they can be sourced from renewable energy projects across the country, are relatively low cost and simple to procure. However, Unbundled RECs are often criticized for capitalizing on the presence of existing renewable energy projects and not driving the development of new renewable energy projects that would not have otherwise been built. Thus, unbundled RECs are generated by renewable energy projects that are referred to as "**non-additional"**.

Bundled RECs: In contrast to unbundled RECs, bundled RECs are sold together with the physical electricity generated by a specific renewable energy project. Bundled RECs, and their associated clean electricity, are typically procured by CPPs through PPAs or VPPAs (see Strategy 2 below). Advantages of bundled RECs are that they drive the development of new (or "**additional**") renewable energy projects that would not have otherwise been built (i.e. **achieving additionality**). However, identifying and contracting electricity that is bundled with RECs can often be more administratively burdensome, and sometimes more expensive, for CPPs.

CPPs, especially in early stages, often rely on unbundled RECs to increase the renewable percentage of the electricity product delivered to customers; however, it is possible to shift towards bundled RECs over time as the CPP program generates revenue and potentially partners with neighboring communities to increase scale.

Implementation Steps

Initial implementation steps for establishing a Community Power program are listed below:

	Implementation Steps
✓	**Conduct research** on community power and its potential role in achieving local RE goals.
✓	**Form an electric aggregation committee** or designate an existing committee to develop a Community Power Plan.
✓	**Gain local approval** for the finalized Community Power Plan from the local legislative body (e.g. City Council).
✓	**Select a supplier** and enter into a short-term (1-3 year) contract to supply residents and businesses with a greater amount of renewable electricity.
✓	**Notify residents & businesses** about newly formed program and ability to opt-out prior to service beginning.

Key Examples from Other Communities

A number of communities are establishing community power programs across the country and within the region. As of 2017, there were approximately 750 operational CPPs procuring electricity on behalf of about 500 million customers.[61] While these programs operate differently across states due to state-level regulation, CPPs in Massachusetts operate similarly to how they would operate in New Hampshire. Although there are no New Hampshire towns or cities that have actually launched a CPP, state legislation does allow this method of energy procurement and there is growing interest across several communities, with some in the advanced stages of the planning process. New Hampshire communities have the ability to pursue a CPP through the standard single procurer model, and there is some interest in a regional approach that would involve multiple communities combining their energy purchasing power to achieve economies of scale. This latter type of CPP is referred to as the alternate or "joint-office" model.

Cambridge Community Electricity: Cambridge, Massachusetts[62]

One example is the Cambridge Community Electricity (CCE) program, a city-run aggregation program established in 2017. CCE selected Direct Energy as the program's electricity provider from January 2019-2021 and will offer fixed electricity prices throughout this contract duration. This type of CPP program, where city staff interact with a single electricity broker, is the most simplified and the least administratively burdensome. The program currently offers Cambridge residents and businesses two electricity products, including Standard Green and 100% Green Plus. The Standard Green option provides an electricity product that is similar in renewable energy content to the regional grid, about 20%, while the 100% Green Plus option offers a 100% renewable electricity product. As with most CPPs, customers "opting up" to the 100% renewable electricity product pay a slight price premium per kWh compared to the standard electricity product offering. Additionally, as of April 2020, both electricity products offered through Cambridge's CCE have lower rates for residential and small business customers than the standard Eversource offering.[63] However, these savings are subject to change as Eversource rates change every six months for residents and small businesses. One unique aspect of the Cambridge's CCE is that both rate

options include a small fee, knows as an "operational adder", that will go towards the development of new solar projects within the City of Cambridge.

Community Power New Hampshire[64]

Community Power New Hampshire[3] (CPNH) is a municipal and county-led initiative working with Clean Energy New Hampshire and local governments throughout the state to offer an alternative to the standard CPP model, which typically involves a single community contracting with an energy broker to procure renewable energy through the purchase of RECs. Under this alternative model, also known as the joint-office CPP model, cities can form their own community power program and then join the centralized CPNH network. The intention of a combined-joint office is to expand the communities' technical capacity, reduce and centralize administrative costs, leverage pooled revenue to develop and administer innovative energy efficiency, demand response, and renewable energy programs, and bolster the group's purchasing power. CPNH is still in the planning phase of development, but many New Hampshire communities are hopeful it will enable accelerated grid modernization and renewable energy adoption in the near future.

[3] For more information on the structure, goals, and services of CPNH, please visit: Community Power New Hampshire (CPNH).

Strategy 2: Engage in Virtual Power Purchase Agreement (VPPAs)

Overview

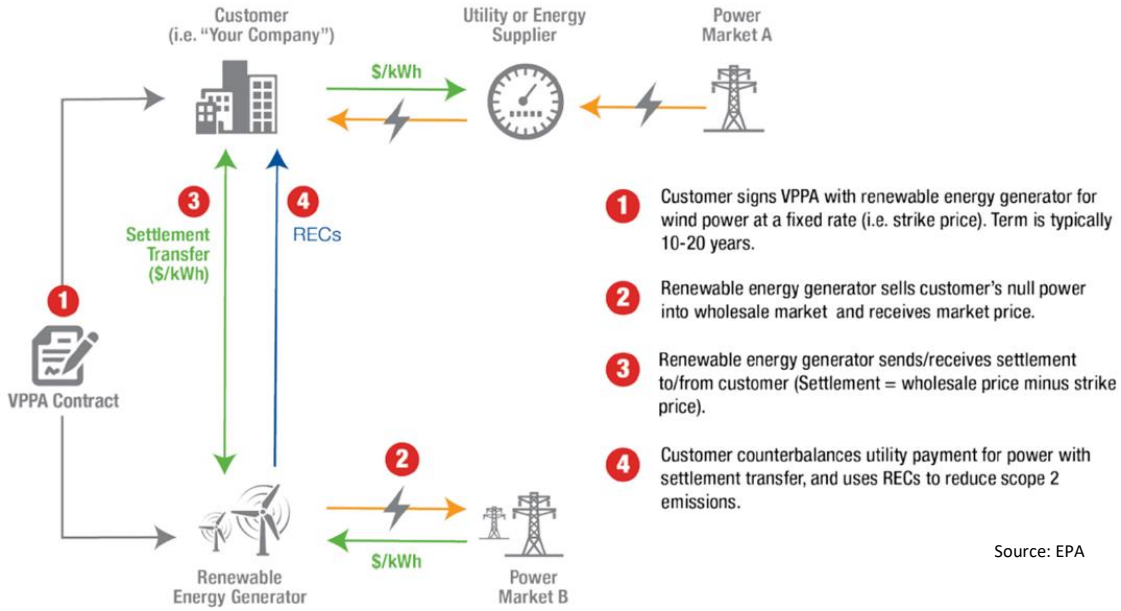
Cities and community power programs can **support the creation of additional renewable energy by entering into long-term contracts with renewable energy generators** in the form of a power purchase agreement (PPA) or virtual power purchase agreement (VPPA).

A **PPA** is a contract between a buyer and renewable energy generator where the buyer takes ownership of the electrons and RECs produced by the renewable energy project.

A **VPPA** is a financial transaction where the buyer does not own the electrons produced by the renewable energy project, but receives titles to the RECs.

Both contracting instruments, but especially VPPAs, allow both the buyer and the generator to hedge against electricity market price volatility and allow the buyer to benefit from long-term price stability. Another key advantage of VPPAs over traditional PPAs is their geographic flexibility. With PPAs, the renewable energy generator and the consumer must be physically connected to the same regional grid. However, with VPPAs, this is not the case, increasing the diversity of renewable energy generators a customer can contract with. If Keene were to launch a CPP, there are strong potential synergies between a CPP and VPPAs. Leveraging VPPAs, the City could transition their CPP away from unbundled RECs and towards bundled RECs over time, driving the development of renewable energy projects that would not have otherwise been constructed.

Figure 7: How a Virtual Power Purchase Agreement (VPPA) Works[65]



The above figure demonstrates the step-by-step process for how a VPPA works. There are a few notable takeaways from the above graphic. First, **the power market that the renewable energy generator is selling electricity into ("Power Market B") does not have to be the same as the power market that the customer (e.g., Keene CPP) is physically connected to ("Power Market A")**. In practical terms, this means that the Keene CPP could sign a VPPA with, for example, a wind farm project in Iowa that may have more favorable financial terms than a similar renewable energy project in New England. Secondly, step 3 in the above figure demonstrates the **price hedge value of a VPPA**. By entering into a VPPA, the customer (e.g., Keene CPP) locks in a fixed price, or strike price, for Bundled RECs from the renewable energy generator. If the wholesale price of electricity rises, the customer will be insulated from these price increases because of the long-term nature of the VPPA. Conversely, if the VPPA strike price is greater than the wholesale market price, the customer would pay the net difference to the renewable energy generator. In this way, the VPPA acts as a price hedge against potentially volatile future energy costs.

Keene could consider entering into a VPPA with a renewable energy generator within NEPOOL to support the development of local/regional renewables and resilience. However, it is possible that the financial terms will not be as favorable as they could be in another power market.

Keys Benefits and Challenges

Key benefits and challenges associated with engaging in virtual power purchase agreements are summarized below:

Key Benefits	Key Challenges
Supports the development of **new, additional renewable energy projects with no upfront cost**	The commitment of a small CPP program to purchase the energy **may not be sufficient to cover the financing of a project**
Provides the opportunity to **increase the community's % of electricity from renewables** without unbundled RECs	**Contracts can be complex and may be challenging to navigate** without additional legal support
Enables the community power program to **purchase large volumes of electricity** in a single transaction **from generators located across the country**	By committing revenue to a long-term project, the CPP is **limiting its ability to implement other initiatives** in that timeframe
Hedge against electricity market price volatility, **long-term price stability**, and **potential cost savings** to the community	By locking into a long-term contract, **risk that basic supply rate will dip** below CPP rate

Implementation Steps

Initial implementation steps for engaging in virtual power purchase agreements are listed below:

	Implementation Steps
✓	Customer signs a VPPA with a renewable energy generator for wind power at a fixed rate (i.e. strike price). Term is typically 10-20 years.
✓	Renewable energy generator sells customer's null power into wholesale market and receives strike price.
✓	Renewable energy generator sends/receives settlement to/from customer (settlement = wholesale price – strike price).
✓	Customer counterbalances utility payment for power with settlement transfer and uses RECs to reduce scope 2 emissions[4].

Key Examples from Other Communities

This section includes an example of how one Virginia community is utilizing a VPPA to reach their renewable energy goals.

Amazon Arlington Solar Farm: Arlington County, VA[66]

Arlington County, in partnership with Dominion Energy and Amazon, recently agreed to purchase 31.7% of the energy generated by a Dominion owned solar farm in Pittsylvania County, VA. The solar farm is projected to cover 1,500 acres of agricultural land and produce 250 million kWh annually upon completion in 2022. Procuring 31.7% of the electricity produced by the solar farm equates to more than 79 million kWh and will offset 83% of the electricity currently used by the county government to operate its buildings, streetlights, water pumping station, and wastewater treatment facility. For reference, annual electricity consumption across all of Keene is equivalent to approximately 222 million kWh. This VPPA agreement is key to Arlington County reaching the targets outlined in their Community Energy Plan, including a goal to use 100% renewable energy for government functions by 2025.

[4] Scope 2 emissions are indirect emissions from the generation of purchased energy. For most cities, the vast majority of scope 2 emissions come from electricity that is generated outside of the city boundary but consumed inside the city boundary.

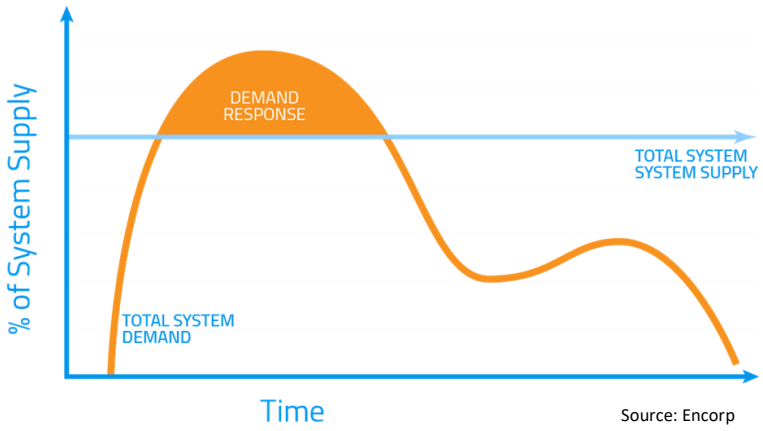
Strategy 3: Collaborate with the Utility to Develop a Pilot Battery Storage Program

Overview

This strategy involves the City of Keene establishing a close working partnership with their local utility, Eversource, to develop a pilot battery storage program. This could include efforts to collaboratively develop ideas with the utility that support battery storage initiatives and build on preexisting Eversource programs. Existing battery storage programs in other regions or operated by other utilities have utilized **rebates, demand response incentives, or a combination of the two to increase proliferation** of battery storage systems.

Battery storage is a rapidly developing technology that can be **coupled with solar and other renewable energy resources**. This strategy has the potential to significantly benefit residents, businesses, the City, and the utility by **reducing demand on the grid during peak times**. Through the strategic deployment of electricity stored in batteries during peak times, **local businesses can significantly reduce their demand charges**. Demand charges for commercial customers are based on the highest level of electricity supplied by the grid at one time during the billing period and can make up a large portion of total electricity expenses for some businesses. From an environmental perspective, the ability of batteries to reduce peak demand on the grid also **reduces the reliance on natural gas "peaker" power plants**, which generate a large amount of greenhouse gasses, to meet this peak demand. As battery costs continue to decrease over time, implementing a pilot battery storage program will position Keene well to take advantage of the environmental, cost, and resiliency benefits of modernizing the grid, which will be key in the City's efforts to achieve 100% renewable electricity by 2030.

Figure 8: How Battery Storage Helps Reduce Demand Charge Peaks[67]



The above figure highlights the costs saving and environmental potential of battery storage systems paired with solar PV. When total electricity demand on the grid (orange line) exceeds the total electricity being supplied by power plants currently on line (the horizontal blue line), electricity stored in batteries can be deployed (orange shaded region) to reduce electricity demand charges for local businesses and reduce the need for polluting natural gas power plants to come online to meet peak demand.

Keys Benefits and Challenges

Key benefits and challenges associated with this strategy are summarized below:

Key Benefits	Key Challenges
Takes advantage of **utility funding, technical expertise, and preexisting infrastructure and programs**	City not in direct control of program development and implementation + **success is largely dependent on Eversource being an active + willing participant.**
Reduces electricity costs for consumers and the utility by minimizing peak demand	Need to **identify the right points of contact** at both organizations. Partnership may require connection at the upper management/admin level.
Modernizes the grid, **boosts resilience**, and **reduces the need for gas "peaker" plants**	Utility **priorities can shift** during a project
Pilot program is a **low-cost strategy for the City** to pursue	Third-party complexity is introduced, as **battery vendors (i.e. Tesla, LG, Generac) often play a role in demand response**
Potential to expand the pilot program by partnering with other local governments, nonprofits, and businesses in the future	Keene is at the forefront of exploring battery storage pilot program models in New Hampshire, with **minimal in-state precedent to leverage**
Provides a **cleaner and cheaper alternative for back-up power**, which can be deployed to **support essential infrastructure**	

Implementation Steps

Initial implementation steps for collaborating with the utility to develop a pilot battery storage program are listed below:

	Implementation Steps
✓	**Discuss potential opportunities to partner with Eversource on a pilot battery storage program.** Given the preexisting demand response thermostat program Eversource has already made available in New Hampshire and the demand response battery storage program deployed by the utility in Massachusetts, there is already proven interest and precedent that the City of Keene can build from.
✓	**Invest in battery storage at municipal facilities through Eversource's pilot program, potentially providing City co-funding.** The City can serve as an example, showing the benefits of utilizing battery storage while reducing electricity costs and minimizing the environmental footprint of municipal operations. Installing battery storage as an alternative to diesel generators for essential infrastructure could be explored.
✓	**Seek opportunities to expand and publicize the pilot battery storage program to local businesses and residents**, leveraging strong interest in the strategy expressed during both the community presentation and Environment and Climate Committee meetings.

Key Examples from Other Communities

This section includes examples of how communities and their local utility have implemented best practices related to the implementation of battery storage technology. Utility administered battery storage incentives typically compensate utility customers in one of two ways. Demand response programs pay customers for the energy their battery contributes to the grid during periods of high demand, while other programs simply provide a rebate to customers for installing battery storage at their home or business. Examples of demand response, rebate, and a hybrid program options are explained in more detail below.

ConnectedSolutions Demand Response Program: Eversource, Massachusetts[68]

The ConnectedSolutions Demand Response Program is a program run by Eversource in Massachusetts that enables participating residents to be compensated for allowing the utility to use the energy stored in their batteries during periods of high demand on the grid. Residents with battery storage can also choose not to be enrolled in the program, saving the electricity stored in their battery as a personal back-up generator instead.

Bring Your Own Device Program: Green Mountain Power, Vermont[69]

Developed in partnership with Renewable Energy Vermont, the Bring Your Own Device Program enables participating utility customers with onsite battery storage to choose between an upfront payment from the utility or a compensation rate for demand response use. The level of compensation is determined by the size of the customer's battery storage system.

Home Battery Storage Pilot: Liberty Utilities, New Hampshire[70]

The Home Battery Storage Pilot was recently approved by the New Hampshire PUC. This program will allow residents to sign up for a home battery installation in partnership with the utility and qualify them for varying time-of-use rates.

Strategy 4: Partner with a Local Financial Institution

Overview of the strategy

Renewable energy loans, particularly for distributed solar PV systems, can help make the installation of renewable energy projects more affordable for Keene residents and businesses by **minimizing the up-front capital costs** required to complete an installation and offering low-interest, fixed rates with flexible terms. With limited renewable energy financing options currently available for residents and businesses, the City of Keene could potentially partner with a local financial institution to offer **competitive financing for renewable energy projects**. By financing projects with more capital from local banks or credit unions, Keene can **maximize the number of renewable energy installations** within the City, as well as the economic and environmental benefits associated with deployment of these technologies.

Keys Benefits and Challenges

Key benefits and challenges associated with this strategy are summarized below:

Key Benefits	Key Challenges
Increased financing access for local residents and businesses to overcome financial barriers to renewable energy adoption	**City not in direct control of program development** and implementation. Success is largely dependent on local banks and co-ops being an active and willing participant
Opportunity to **support local economy** by engaging with local banks credit unions	Keene is at the forefront of exploring partnering with local financial institutions to finance solar in the state of New Hampshire, with **minimal in-state precedent to leverage**
Equitable solution that **increases ability of low-income residents to install solar**	Potentially **high administrative burden** on City staff engage with local banks and co-ops to establish program
Established best practices to draw on for engaging with local banks and co-ops to develop similar programs	

Implementation Steps

Initial implementation steps for partnering with a local financial institution to offer a renewable energy loan are listed below:

	Implementation Steps
✓	Conduct a review of local financial institutions that may serve as a potential partner based on current or past offerings.
✓	Conduct outreach to local institutions and provide educational materials on the benefits of offering loans for renewable energy. Keene could further support private sector lending by offering to provide a loan loss reserve or credit enhancement program.
✓	In parallel, considering advocating for the expansion of existing state or regional loan offerings, such as NH Saves, to include renewable energy or energy storage offerings.

Key Examples from Other Communities

This section includes examples of other communities and organizations that have implemented innovative financing solutions to accelerate clean energy adoption.

Milwaukee Shines: Milwaukee, Wisconsin[71]

The City of Milwaukee, Wisconsin partnered with Summit Credit Union to create "Milwaukee Shines," a special loan program for city residents. With a $2 million budget, the program offers eligible customers up to $20,000 at a low-interest, fixed-rate with flexible terms. Financing can be applied to solar electric systems up to 6 kW and solar hot water systems of 1-8 panels in size. Eligible expenses include all equipment, labor, permits, and interconnection fees, as well as structural re-enforcement and re-roofing expenses, if needed.

Admirals Bank & Solarize: Multiple Locations[72]

Admirals Bank, a Boston-based bank active in lending for residential solar projects, has partnered with local governments and non-profits administering Solarize programs in Connecticut, Massachusetts, and North Carolina to provide financing options for participants. For example, during the Solarize Connecticut Durham Pilot Project, the selected installer referred customers to Admirals Bank, which worked with homeowners to put together a loan package that allowed customers to participate in the program and purchase the system. Admirals Bank Relationship Managers and Solar Financing Experts have also attended town information sessions to educate homeowners on available lending products for other campaigns they have participated in.

New Hampshire Examples

Several New Hampshire banks and credit unions offer energy efficiency loans and could potentially expand to provide renewable energy loans as well.

- BCCU[73] is a credit union with locations in Manchester, Nashua and Bedford offering energy efficiency loans.
- NHSaves[74] is a utility-run program that has partnered with local savings banks/credit unions to offer energy efficiency loans.

Strategy 5: Implement a Building Benchmarking Ordinance

Overview of the strategy

A municipal and commercial building benchmarking ordinance is an effective strategy that enables building owners to **measure the energy efficiency of their building** against comparable buildings from across the country and **identify buildings that could benefit most from energy efficiency improvements**. The vast majority of building benchmarking ordinances rely on the use of the Environmental Protection Agency's (EPA's) **ENERGY STAR Portfolio Manager**, **a free online benchmarking tool** that helps building managers track data and measure progress. Portfolio Manager allows building managers to compare their building to similar buildings using the 1-100 ENERGY STAR score. Achieving a score of 50 would be considered the median, while a score of 75 would indicate that the building is performing better than 75% of its peers and may be eligible for ENERGY STAR certification. Portfolio Manager allows building managers to compare their building to similar buildings across the country, using the 1-100 ENERGY STAR score. Achieving a score of 50 would be considered the median, while a score of 75 indicates that the building is performing better than 75% of its peers and is eligible for ENERGY STAR certification.

Through the identification of inefficient buildings, a benchmarking ordinance can be effective in **driving increased participation in already existing energy audit and energy efficiency programs**, such as those offered through Eversource. These programs can accelerate the path towards decreased energy consumption, energy cost, and GHG emissions. Many benchmarking programs feature a public disclosure component, which can have beneficial impacts such as empowering prospective tenants to make informed decisions before entering into a lease agreement. Benchmarking programs can be **voluntary or mandatory**, include energy and/or water consumption, and can be customized by square footage and building type. For example, many benchmarking ordinances have **stricter reporting requirements for larger commercial buildings** that exceed a certain square footage threshold. Some benchmarking ordinances also link the program to mandatory energy audits or energy efficiency improvements for inefficient buildings. Since over 70% of total electricity consumption in Keene is associated with commercial and municipal buildings, a benchmarking ordinance has significant potential to reduce electricity consumption in Keene's existing building stock.

Figure 9: Example Dashboard Screenshot from ENERGY STAR Portfolio Manager[75]

Source: EPA

The above image displays a screenshot of the type of information building managers would see when logging into the ENERGY STAR Portfolio Manager platform, including the building's overall energy score and trends in the energy use intensity associated with their building.

Keys Benefits and Challenges

Key benefits and challenges associated with implementing a building benchmarking ordinance are summarized below:

Key Benefits	Key Challenges
Identifies commercial and municipal buildings in Keene that could benefit most from **energy efficiency improvements**	Potential **political hurdles** associated with passing a mandatory ordinance through City Council
Drives participation in existing energy audit and energy efficiency programs offered through Eversource	Mandatory benchmarking **does not guarantee energy-efficiency upgrades** and improvements
Encourages utilization of, and recognition from, EPA's ENERGY STAR Portfolio Manager, a **free online benchmarking tool**	Potential issues with **data access, quality, and accuracy**
Opportunity for Keene to **lead by example** by benchmarking municipal buildings	**Compliance** with, and **enforcement** of, mandatory ordinance
Potential to link **financial incentives** to energy-efficient upgrades (see South Portland example below)	**Administrative burden** associated with ongoing support and management of the program

Implementation Steps

Initial implementation steps for developing a building benchmarking ordinance are listed below:

	Implementation Steps
✓	Review EPA's list of *Benchmarking Programs and Policies Leveraging ENERGY STAR*[76] to get a sense of program design, requirements, and incentives being utilized by other localities.
✓	Consider a voluntary program to precede a mandatory ordinance.
✓	Draft ordinance language and pass through City Council.
✓	Develop or enhance a webpage to host relevant resources and materials.
✓	Determine which metrics will be disclosed publicly.

Key Examples from Other Communities

This section includes communities that have implemented best practices related to implementation of municipal and commercial building benchmarking ordinances in the US. Each example includes a few key points and differentiating factors as well as a hyperlink to each ordinance. For additional examples, the EPA's ENERGY STAR program developed an interactive map[77] to track benchmarking programs in the US that are utilizing Portfolio Manager in their ordinance. All of the ordinances listed below involve mandatory reporting requirements and utilize Portfolio Manager as the primary benchmarking platform.

Energy & Water Benchmarking Ordinance: South Portland, Maine[78]

Adopted in 2017, the Energy & Water Benchmarking Ordinance in South Portland, Maine requires all municipal, school, and commercial buildings larger than 5,000 square feet to benchmark and disclose their annual energy and water consumption to the city each year. The ordinance also applies to residential multifamily buildings with more than 10 units. In order to encourage increases in energy efficiency, the ordinance mandates that each covered property subject to reporting requirements must complete a building energy audit once every five years. However, while disclosure of the building energy use and periodic audits are required, the policy does not mandate buildings to meet certain levels of energy efficiency, reach energy reduction targets, or make energy-related improvements. Typically, it's uncommon for mandatory benchmarking ordinances to offer incentives, but in the case of South Portland, they offer a $5,000 compliance incentive that can be used as a credit for future expenses stemming from city application, review, or inspection fees associated with construction or redevelopment projects at the property.

Building Energy Saving Ordinance: Berkeley, California[79]

Adopted in 2015, the Building Energy Saving Ordinance (BESO) in Berkeley, California requires that all covered buildings report their annual energy consumption. The BESO phases in reporting requirements by building size so that larger buildings over 50,000 square feet must report first in 2018 while smaller buildings, such as those below 5,000 square feet, are not required to report until 2022. Similarly, covered buildings over 25,000 square feet must conduct an energy assessment every five years while covered buildings below that threshold must only conduct an energy assessment every ten years. Berkeley also

operates an Energy Efficiency Inventive Program that complements the BESO and encourages building upgrades and improvements.

Building Energy Use Disclosure Ordinance: Cambridge, Massachusetts[80]

Adopted in 2014, the Building Energy Use Disclosure Ordinance (BEUDO) in Cambridge, Massachusetts is a time-tested ordinance that provides a wealth of resources and data that can be leveraged by those looking to create ordinances in other jurisdictions. Covered buildings include all buildings over 25,000 square feet, residential buildings with over 50 units, and municipal buildings over 10,000 square feet. Each of these building subsets are required to report energy and water usage to the city on an annual basis. The results of the reporting are publicly disclosed on a building-level basis on the Cambridge Open Data Portal. Cambridge also publishes annual reports, summary statistics, and compliance maps.

Strategy 6: Adopt Solar and EV Ready Guidelines for All New Commercial Developments

Overview of the strategy

The City of Keene can adopt solar PV and electric vehicle (EV) ready guidelines that encourage or require new developments to be built in a manner that accommodates future solar and EV charging station installations. Designing new buildings with future installations of these technologies in mind, opposed to installing them at existing buildings not designed to accommodate the required infrastructure, can significantly reduce total costs associated with the installation. For example, one study found that installing an EV charging space at an existing commercial building is 2.8 to 4.0 times more costly than installing the same EV charging space at a new commercial building.[81] Preemptively reducing cost barriers to entry for these key technologies can accelerate community-wide adoption of solar and EV charging in commercial developments. Access to EV charging, especially at the workplace, is key to the widespread adoption of EVs. This policy could also serve as a foundation for more far-reaching guidelines in the future that could, for example, require new residential buildings to also be built solar and EV ready.

Source: City of Keene

EV charging stations, like the ones pictured above at the Commercial Street parking lot in Keene,[82] will be more cost effective to install if new construction is designed to accommodate future installation by taking steps such as installing all necessary electrical infrastructure, pulling conduit and wire to the appropriate locations, and ensuring concrete work accommodates mounting of charging stations.

Keys Benefits and Challenges

Key benefits and challenges associated with adopting solar and EV ready guidelines are summarized below:

Key Benefits	Key Challenges
Reduces technical and financial barriers to solar and EV infrastructure implementation over the medium/long-term	Limited direct energy impacts expected as **the strategy does not directly generate clean energy** and is limited to the new construction market
Facilitates community adoption of EVs by increasing access to publicly available charging infrastructure	**Limited precedent**, with few examples of extensive solar and EV ready guidelines currently implemented in New England
Low-cost step for building owners, positioning them to take advantage of **lower infrastructure costs in the future**	**Additional upfront construction costs** to ensure solar and EV readiness may need to be reconciled
Several **resources outlining best practices** are already available via **SolSmart**[83] and other sources	**Administrative burden** associated with development of guidelines or ordinance.
Establishes a foundation for future action in the residential market and surrounding communities	

Implementation Steps

Initial implementation steps for establishing a Community Power program are listed below:

	Implementation Steps
✓	**Leverage the City's ability to adopt more stringent building regulations or (stretch codes).** Local governments in New Hampshire have the ability to adopt stretch codes, which can be used to implement stricter guidelines than those explicitly outlined by the New Hampshire State Building Code. Stretch codes are a tool Keene can use to require higher building standards that coincide with solar and EV readiness guidelines.
✓	**Evaluate if solar and EV ready guidelines will be a recommendation or requirement for new construction.** For example, some communities opt to make solar and EV readiness a recommendation at first, then transition to a requirement later.
✓	**Consider if Keene's solar and EV ready guideline requirements will vary based on size, function, and financial ability of the building owner.** For example, communities may require larger commercial buildings to follow building guidelines and relax the guidelines for smaller entities.

Key Examples from Other Communities

This section includes examples from communities that have implemented best practices related to the implementation of solar and electric vehicle readiness guidelines in the United States. Each example includes a few key points and differentiating factors.

Commercial Buildings Solar Requirement[84]: Watertown, Massachusetts

In 2018, Watertown's Planning Board amended their zoning language, requiring all developments greater than or equal to ten thousand (10,000) gross square feet or containing ten (10) or more residential units to include a solar energy system that is equivalent to a minimum of 50% of the roof area of all buildings. In cases where a site includes an uncovered parking structure, the structure will also be required to have a solar energy system installed.

Solar Friendly Best Planning Practices[85]: Southern New Hampshire

The Southern New Hampshire Planning Commission (SNHPC) created this resource to assist New Hampshire communities interested in facilitating solar PV adoption. This includes guidance on how to develop solar friendly land use and zoning regulations and the policies and planning practices that remove barriers to development and reduce burdensome soft costs.

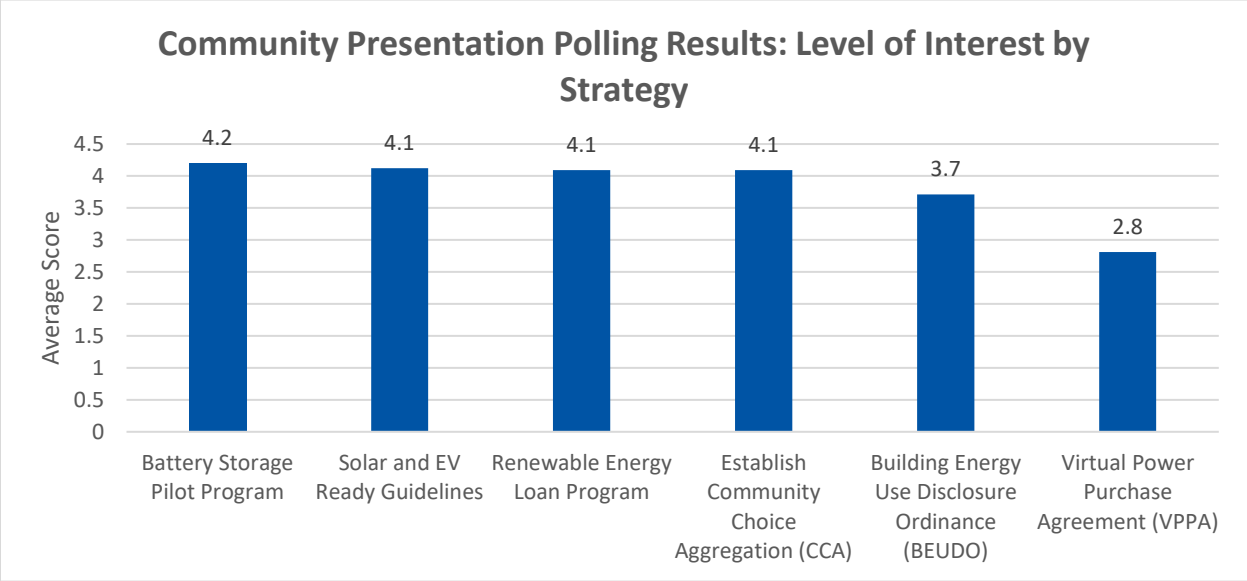
Solar and EV Readiness Reach Codes[86]: San Mateo, CA

The City of San Mateo has effectively leveraged their ability to implement reach codes to facilitate solar and EV infrastructure adoption in their community. The City requires all new construction to install a minimum size solar PV or solar thermal system in addition to requiring a minimum number of EV capable spaces or charging stations at qualifying sites. San Mateo has found that establishing minimum requirements often results in owners and developers far exceeding what is required in order to maximize cost-effectiveness.

Community Feedback

The Cadmus Team hosted a webinar entitled *City of Keene Renewable Energy Transition Analysis* on the afternoon of April 2nd, 2020 and presented a similar, condensed presentation to City Council later that evening. The community webinar provided an overview of the analysis included in this report and was open to the public, with over 30 community members in attendance. Those who joined the webinar were encouraged to actively participate throughout the presentation, with the opportunity to submit questions throughout and answer poll questions gauging their general level of interest on each of the six strategies described.

Community participants were asked to express their level of interest in Keene pursuing each strategy on a scale of 1-5, with a **score of 1 equating to a "Low" level of interest and a score of 5 equating to a "High" level of interest**. The figure below summarizes the average score each strategy received from the public polling exercise, ordered from the highest to lowest priority.



Conclusion

Keene has taken substantial action to date to support the development of renewable energy in the community and the recent adoption of the ambitious 100% community-wide renewable electricity by 2030 goal demonstrates the City's commitment to remaining a leader in climate mitigation efforts. The development of this Renewable Energy Transition Analysis lays a foundation for Keene to continue making strides towards the overarching 100% renewable electricity goal. As outlined above, Keene has multiple effective strategy options that could be leveraged to help meet this goal, while simultaneously achieving other community priorities including resilience, creating local jobs, reducing energy costs to local businesses and providing equitable access to clean electricity for all residents.

While all six strategies have the potential to drive increased reliance on renewable energy in Keene, the combination of Strategy 1 (Establish a Community Power Program) and Strategy 2 (Engage in a Virtual Power Purchase Agreement), in particular, have significant potential. The establishment of a CPP would enable Keene to offer electricity products that have a high renewable energy content to all residents and local businesses and a VPAA between the CPP and a renewable energy generator would reduce the CPP's reliance on unbundled RECs. The VPPA would ensure that the electricity products being offered to the Keene community through the CPP were driving 'additional' renewable energy products that would not have been built in the absence of the VPAA. While some residents and businesses would continue to procure their electricity from Eversource or other competitive suppliers, the City could still expect a high enrollment rate in the CPP due to competitive pricing and the "opt-out" nature of CPPs. Although still recommended for implementation, many of the other strategies detailed in this report are simply not as likely to achieve the same scale as the complimentary strategies of CPP formation coupled with a VPPA. For the four other strategies, limitations on achieving scale include reliance on partnerships and funding outside the direct control of the City (Strategy 3 and 4), programmatic focus on overall building energy goals without a direct path to increasing renewable energy supply (Strategy 5), and applicability being limited to new construction projects (Strategy 6).

Achieving a 100% renewable electricity supply is a critical step in the path towards achieving Keene's 2050 goal of having all thermal energy and energy used for transportation come from renewable sources by 2050. The two goals are directly linked – achieving 100% renewable electricity unlocks the potential for technologies including air source heat pumps and electric vehicles to be truly carbon neutral. The findings of this report provide the City with key information to support the implementation of six priority strategies, including key benefits and challenges, implementation steps, and examples from other leading communities. Next steps for Keene include reviewing and discussing the findings of this report with the Keene Climate and Energy Committee, along with other key stakeholders, to determine a course of action for implementation.

Appendix A. State-Level Incentives

Tax Incentives

- **Local Property Tax Exemption**. Local property tax exemptions vary by city across New Hampshire. For example, the City of Keene set the solar exemption to "equal the total assessed value attributed to the solar energy system."[87] Similar local exemptions can also be applied to wood heating and wind systems as well.

Rebate Programs

- **Residential Small Renewable Energy Rebate Program**. Residential solar customers are eligible for the State rebate program on a first come, first serve basis. They may receive up to $2,500, granted they complete the pre-approval and final application. This is upheld by HB 1628.[88]
- **Residential Solar Water Heating Rebates**. Residential solar water heating customers are eligible for the State rebate program on a first come, first serve basis. They may receive up to $1,900, granted they complete the pre-approval and final application. This is upheld by New Hampshire Statutes, Chapter 362-F:10 and NH PUC Order No. 25,092.[89]

Loan Programs

- **Enterprise Energy Fund Loans**. Business and non-profit owners may apply for a loan through the New Hampshire Community Loan Fund and the New Hampshire Community Development Finance Authority. Loan amounts range from $50,000 to $500,000, with interest rates between 2% and 2.5% for non-profits, and 2.75% and 4% for for-profit businesses.[90]

Appendix B. Renewable Electricity Baseline: Consumption and Percentages

Renewable Energy Mix Percentage	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Renewable	**19.7%**	**22.3%**	**23.1%**	**24.0%**	**24.9%**	**25.8%**	**26.7%**	**26.7%**	**26.7%**	**26.7%**	**26.7%**	**26.7%**
Total Non-Renewable	**80.3%**	**77.7%**	**76.9%**	**76.0%**	**75.1%**	**74.2%**	**73.3%**	**73.3%**	**73.3%**	**73.3%**	**73.3%**	**73.3%**

Renewable Energy Consumption (MWH)	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Residential	12,137	12,241	12,680	13,111	13,511	13,902	14,307	14,195	14,133	14,070	14,008	13,945
Commercial	30,563	31,347	32,394	33,342	34,406	35,372	36,634	36,583	36,612	36,641	36,671	36,781
Industrial/Manufacturing	308	316	326	336	346	356	369	368	369	369	369	370
Municipal	860	4,263	4,221	4,171	4,139	4,097	4,092	4,086	4,090	4,093	4,096	4,109
Total RE Consumption (MWH)	43,868	48,166	49,621	50,959	52,403	53,727	55,402	55,233	55,203	55,174	55,144	55,205

Appendix C. Renewable Energy Strategy Prioritization Exercise

In consultation with the City of Keene, Cadmus developed an initial list of potential strategies for the City to consider exploring in further depth. To help the City select up to six strategies to be included within the renewable energy plan, the Cadmus Team evaluated strategies against high-level criteria. Full details of this analysis are summarized in the table below:

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Establish a Community Choice Aggregation Program (municipal)	Establish a community choice aggregation	Municipal, Residents, Businesses, Organizations within City of Keene	High	Low	Low	Medium	Medium	~12 months to establish/start operating Municipal participation will depend on when current contracts expire
Establish a Community Choice Aggregation Program (Joint Office)	Work with other entities to consolidate demand and establish a community choice aggregation	Municipal, Residents, Businesses, Organizations in Keene and in the region	High	Low	Low	Medium	Medium	~12-18 months to establish/start operating Municipal participation will depend on when current contracts expire

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Virtual Power Purchase Agreements (VPPAs) by City	Agree to a contract for differences (CfD) with a renewable energy developer at a given strike price to receive the RECs from a project. The renewable energy system developer sells the energy generated into the normal power market and uses the CfD as a hedge on the variable price of power.	Municipal, and potential partners (local businesses or organizations)	Medium	Low	Medium	Medium	High	~3-6 months to identify a RE project and negotiate a contract ~10-20 year term
Host a renewable energy bulk purchasing program (e.g. Solarize Campaign)	Support solarize-style campaigns in the City to expand solar capacity	Residents, businesses, organizations in Keene or region	Low	Medium	Low	Medium	High	~8 months to organize and run a bulk purchasing campaign
Purchase Renewable Energy Credits or enter into competitive supply agreement for renewable energy	Allows municipality to purchase renewable energy that matches consumption. RECs tend to be annual purchases and competitive supply agreements tend to be short-term.	Municipal	Low	Low	Low	Medium	Medium	~2 months to identify/negotiate contract ~1-3 year contract term

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Encourage residents and businesses to purchase RECs or enter into competitive supply agreements	Encourage community members to purchase RECs or enter into competitive supply agreements.	Residents, businesses, organizations in Keene	Low	Low	Low	Low	High	If implemented - could include a marketing campaign, creation of resources (webpage, fliers, one pagers), workshops, with ongoing updates ~3 months-3 years
On-Site Generation - Direct Ownership	Install renewable energy projects on City facilities and City-owned lands; City would own the project(s) and the RECs.	Municipal	Low	Low	Medium	Medium	Low	~12-18 months to install on-site system Would be ongoing as opportunities arise for procurement.
On-Site Generation – Third-Party Owned	Generation is installed on City Property, but rather than owning the PV system, the City uses solar leasing or PPA to pay a fixed price for electricity generated by PV panels on city property	Municipal	Low	Low	Medium	Medium	Medium	~12-18 months to install on-site system ~10-20 year contract term with potential opportunity to purchase the system
Local Renewable Energy Requirements	Require renewable energy installations in certain cases, such as new construction.	Businesses	Low	Medium	Low	Medium	Medium	~3 months-1 year Largely dependent on political capital needed to pass mandate

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Adopt Solar Ready Guidelines	Encourage or require new buildings to be built in a way that accommodates future solar installations	Businesses	Low	Low	Low	Medium	High	~2-3 months to develop and encourage solar ready guidelines Adopting mandatory guidelines may take additional time
Local Renewable Energy Non-Financial Incentive Programs	The City establish programs to incentivize renewable energy for residents and businesses. Such programs could include creating local competitions where the primary incentive would be public recognition of achievement.	Residents, Businesses	Low	Low	Low	Medium	High	~12-18 months to design and run an incentive program

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Local Renewable Energy Financial Incentive Program(s)	The City establishes programs to incentivize renewable energy for residents and businesses. Such programs could include local tax rebates for renewable energy installations, tax credits, exemptions from property taxes, and zero interest and forgivable loans.	Residents, Businesses	Low	Medium	Medium	Medium	Low	Largely dependent on available capital and political capital needed. Could be 1-3 years.
Reduce permitting, zoning, and inspection barriers to Renewable Energy	The City streamlines the permitting, zoning and inspection processes so that processing time and expenses are reduced. This may include streamlining permitting processes for specific technologies that meet certain standards, and eliminating redundancies from inspection protocols.	Residents, Businesses	Low	Medium	Medium	Medium	High	~2-3 months to identify and reduce barriers through permitting, zoning, and planning improvements Timeline may vary depending on community's process for changing zoning language.

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
Lease City property for renewable energy development	Offer City property for lease to utilities or developers to host renewable energy projects.	Utility RE Supply	Low	Medium	Low	Medium	Medium	~3-12 months to negotiate land leases and contracts.
Community / Shared Solar Projects	Organize community / shared solar projects in which multiple utility customers can subscribe to community solar and benefit from lower rates	Municipal, residents, businesses	Medium	Medium	Medium	Medium	Medium	~6-24 months to identify a site, select a project developer, develop the solar array, and identify customers
Revolving Investment Program	City establishes a revolving fund where proceeds from existing RE projects are reinvested into new RE projects	Municipal (if internal), or residents/businesses if loan fund	Low	Low	Medium	High	Medium	~18-24 months to establish a fund and generate sufficient revenue to invest in RE projects (assumes capital is available to start fund) Ongoing support of RE projects
Partner with a local bank to offer a solar loan program	Create a partnership with a local financial institution to create a loan product to finance renewable energy	Residents, Businesses	Low	Medium	Low	Low	Medium	~12-24 months to develop a partnership

Strategy	Description	Targeted Impact	Scale of Impact Score	Local Impact Score	Local Environmental and Social	Inclusion and Social Equity Score	Feasibility Score	Timeline
	installations targeted at businesses or residents							
Work with the utility to develop a pilot incentive program for renewable energy or storage	Engage electric utility on providing potential incentives for renewable energy installations or energy storage by residents or businesses in Keene	Residents, businesses	Low	Low	Low	Medium	Medium	~6-12 months before a pilot program is implemented, ongoing KPI/metrics tracking
Re-establish the Ecovation Hub	Work with local colleges, vocational schools in the region to reestablish the Ecovation hub to create course content focused on renewable energy	Residents	Low	Low	Low	Medium	Medium	~12-18 months to develop a workforce training program Ongoing workforce training

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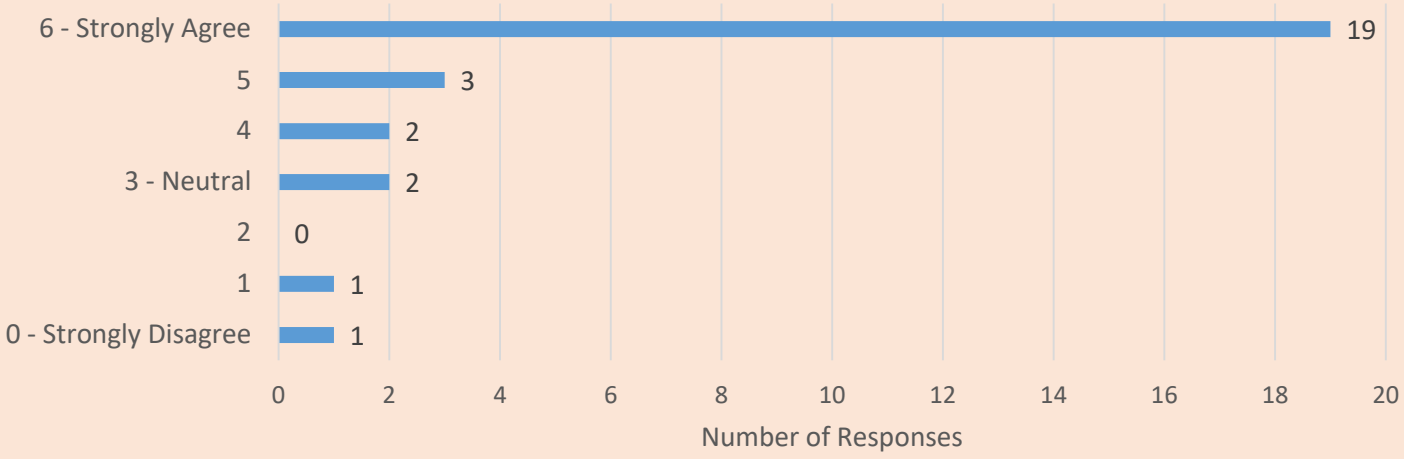
Keene Energy Plan Draft Vision Statement

In 2050, the City of Keene will be a thriving and resilient community powered by affordable, clean, and renewable energy. All electricity and energy used for heating, cooling, and transportation will come from renewable energy sources.

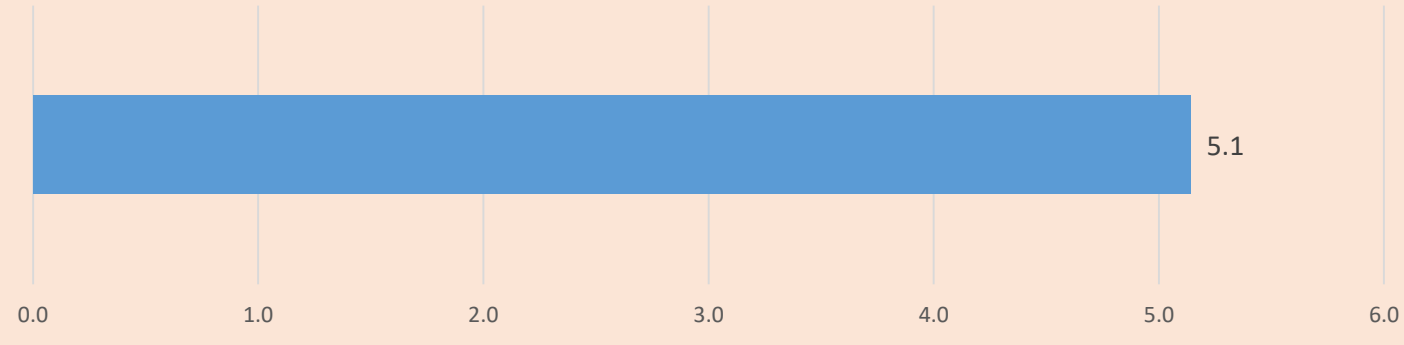
Q1: To What Extent do you Agree with the Draft Vision Statement?

Answered: 28 Skipped: 2



Q1: To what extent do you agree with the draft vision statement?

Answered: 28 Skipped: 2



Q2: Please Tell Us Why

Answered: 21 Skipped: 9

Climate change is the biggest crisis facing the planet! Renewable energy sources can put a big dent in the greenhouse gas production of the US. Also, there are MANY other environmental and health problems caused by extracting, refining and burning fossil fuels. Nuclear energy isn't a long-term solution either. Ready for 100%!
We need to switch to more sustainable forms of energy to safeguard our future, and we need to make sure no one is left out.
The idea sounds great. But I am not sure what renewable energy sources you are referring to. Solar and wind? I do support small scale solar systems. It would be great residency houses and organizations can have their own solar panels. However, personally, I am really not a fan of windmills. Very expensive just to make a windmill. Let's not forget about transporting, mounting, installing those mills, and size of area needed etc. Windmills also generate rhythmic frequencies that could disturb wildlife which eventually could force animals to migrate from the area. Can it be really affordable?
We are on our way to 100%! I see the indications in legislation being passed in neighboring NE states and in the determination of Keene's dedicated volunteers to innovate and find solutions that are accessible to everyone (not just the rich!).
I believe this is an appropriate, achievable and beneficial vision and direction for Keene's energy future. We recognize the environmental and economic benefits of achieving these goals and have already as a community realized some of this potential and the opportunities seem to be growing. It is critical to end our reliance on fossil fuel. We need to make sure this is accessible for all.
Statement lacks clarity on economic impact to citizens, and equity for all. How will taxes be affected? They cannot go higher to achieve these goals.
It is vital that we protect our environment, both for human health purposes and to preserve the natural ecosystems that we have left. Keene is poised as a small city to lead as an example of sustainability and renewable energy in New England
I have a problem with the expectation that "all" electricity and energy will come from renewable energy sources. Property owners should decide for themselves what is most appropriate for their situation.
There are way too many reasons to mention- For future generations and as a person with asthma, this could mean cleaner air to breathe making me a healthier individual in my community.
Dealing with climate change actively and with citizen support is vital. As a city we should be striving aggressively toward this goal. My only wish would be that we do so more quickly, by say, 2030 or 2035. 2050 seems like it may be too late to make a difference given what we are already seeing in terms of climate change variations.
Don’t use the word “all”. It’s too ideological and leaves no room for practical solutions that don’t fit perfectly into this narrow framework.
I am all for this, hence strongly agree. However, 2050 is a few decades away. What are the milestone goals we need to meet each year or every five years that will add up to this broad vision?

Q2: Please Tell Us Why

Answered: 21 Skipped: 9

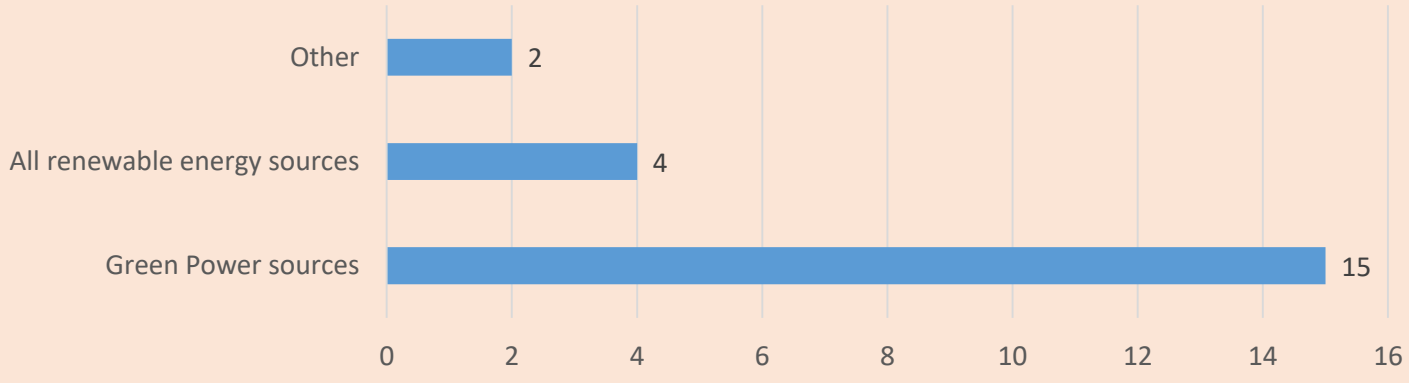
Fossil fuel will run out eventually anyway and it's polluting our world and creating havoc with our atmosphere!
Need something in there about energy efficiency and energy conservation. You probably think it's implicit, but people need to be constantly reminded of the importance of ee & ec first and foremost.
I like it, though I think the last sentence could be revised a bit, I might go with something along the lines of "All of our daily energy needs will be met by utilizing renewable, carbon-free sources."
Keene has always been on the forefront of change and this is another positive change for the City.
Excellent, succinct vision consistent with the 100% resolution.
The quicker we move, the better for all.
I don't think forcing private citizens to have to use renewable source for all heating / cooling will make Keene a destination for people to make "home". People like choices and less government telling them what they have to do.
Renewable energy is the only way! I also hope that it will happen before 2050.
Nuclear isn't "renewable", but it is clean. And efficient. I agree with the general premise.

How should Keene define Renewable Energy?

Keene's Energy and Climate Committee recommends defining "renewable" energy in the Energy Plan as green power sources. How do you think the Energy Plan should define "renewable"?

Q1: How Should Keene Define Renewable Energy?

Answered: 21 Skipped: 0



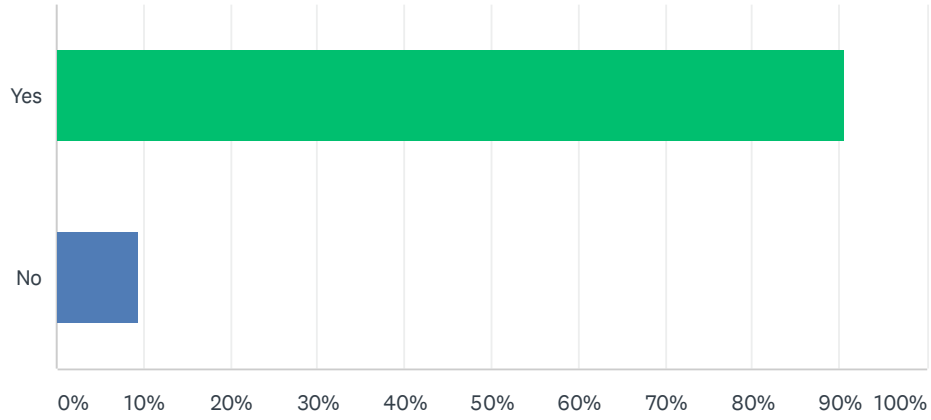
Q2: Please Tell Us Why

Answered: 12 Skipped: 9

I am choosing a compromise position because we need to get this done quickly. I would rather see only "green power" sources but I don't believe they will come on line in time to deal with the climate crisis. The others can be "bridge" fuels. And MSW isn't going anywhere, we may as well use it.
The intent is to lower environmental impact not shift it
The priority is to heal the damage we have done to our world's ecosystems and its inhabitants. Large hydropower and municipal solid waste have the capability to do more damage.
Large hydro produces a lot of electricity but has detrimental effects on the environment. Municipal solid waste is not clean energy. While we have to get rid of our waste, I don't think the energy should be considered "green" just because it is, in a sense, renewable.
There are methane releases associated with flooding large land areas for large hydro. Energy efficiency is not included in the choices, but it is the greenest of them all. Landfill gas is good in limited industrial application (like Keene did with the DPW), but should not be used to expand residential gas usage since the supply is very limited.
I'm fine with the 2nd choice - as long as we're not considering destroying the environment or putting up miles of line such as the Northern Pass project in order to access these other sources. If that's what you're meaning, then the first choice please. Local is best - we have more control and there is far less transmission. NO NUCLEAR!
Because I believe it is critical that we carefully consider the environmental impacts of our energy choices. While some renewable sources of energy may be accessible and perhaps more affordable, we need to be so mindful of the immediate and longterm environmental impact and costs. - therefore I favor the definition of "renewable energy from green power sources.
Need all angles to achieve the goal quickly and learn from new experiences
Support "right-sized" projects
Why be so narrow minded and limited to energy sources that are far more expensive? Green energy is far from perfect. For example, wind energy impacts birds and solar is unreliable without battery technology. The batteries themselves are considered hazardous waste. Nuclear is considered clean and sustainable. https://www.energy.gov/ne/articles/3-reasons-why-nuclear-clean-and-sustainable#:~:text=Nuclear%20is%20a%20zero%2Demission,byproducts%20emitted%20by%20fossil%20fuels. Why is that completely disregarded?
Municipal solid waste implies a trash burning plant. No matter where situated nor how technologically advanced, such a facility will emit pollutants such as heavy metals, particulates and co2. I can't imagine that is what the people want or need in this day and age. Large hydro is also controversial. Studies show high level of mercury resulting from massive dam projects. Construction of these projects destroys large areas of natural environment. These projects are often imposed against the will of local, often native people. And construction still continues. Lets not contribute to more demand for new large hydro projects.
Landfill gas is still releasing methane and other gases into the atmosphere.

Q1 Do you live in Keene?

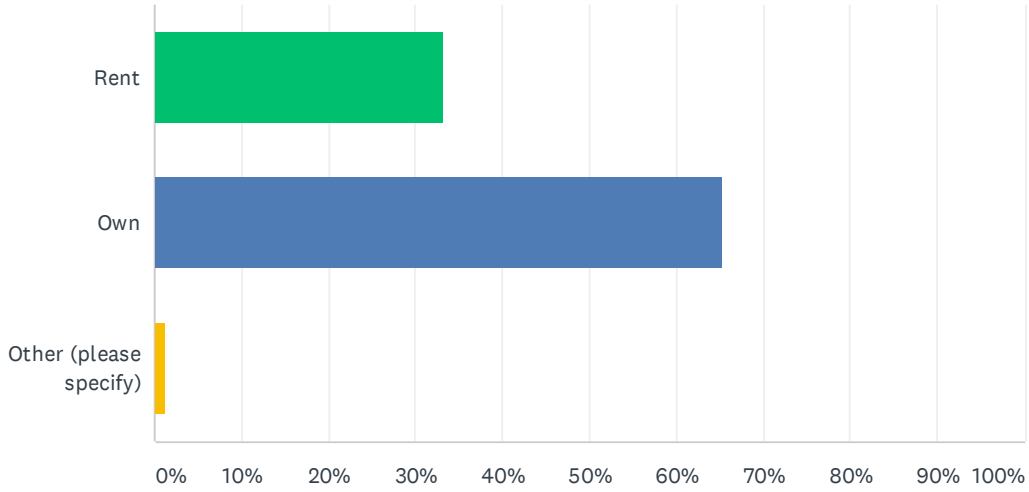
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	90.67%	68
No	9.33%	7
TOTAL		75

Q2 Do you rent or own your home?

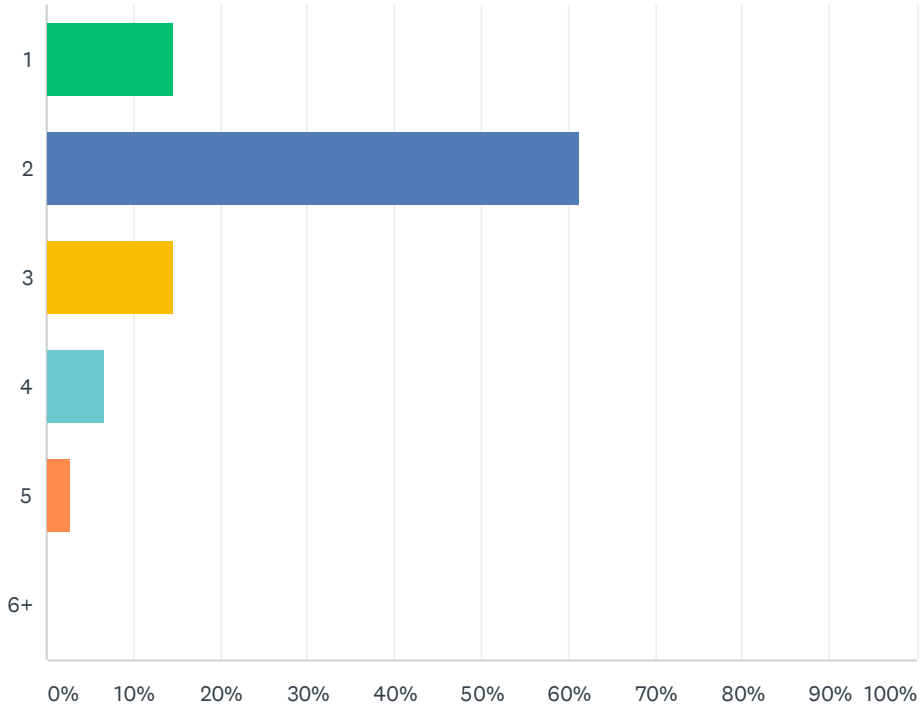
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Rent	33.33%	25
Own	65.33%	49
Other (please specify)	1.33%	1
TOTAL		75

Q3 How many adults live in your household?

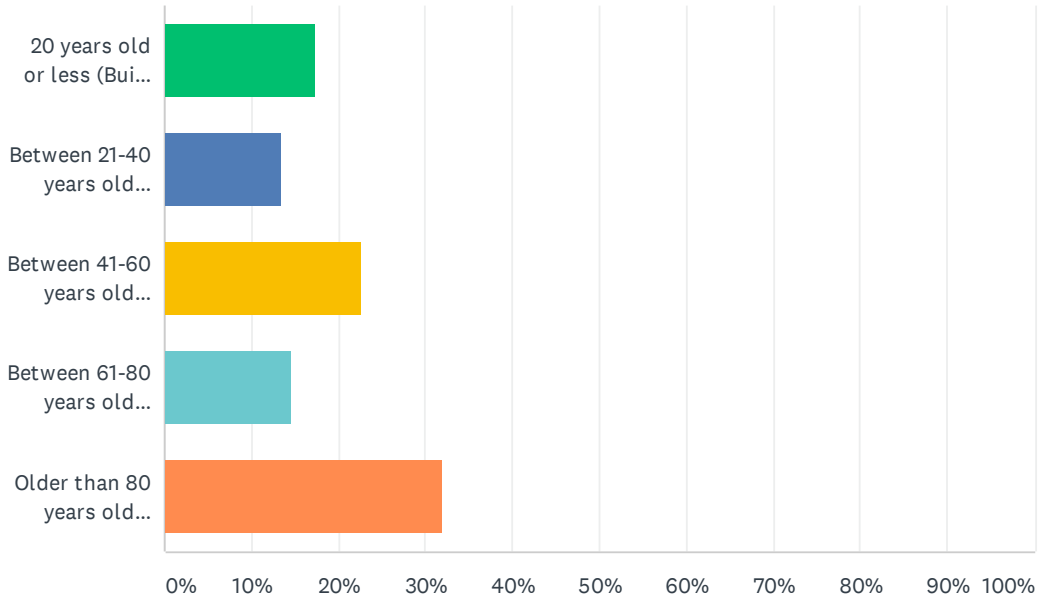
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
1	14.67%	11
2	61.33%	46
3	14.67%	11
4	6.67%	5
5	2.67%	2
6+	0.00%	0
TOTAL		75

Q4 To the best of your knowledge, how old is your home, condo, or apartment building?

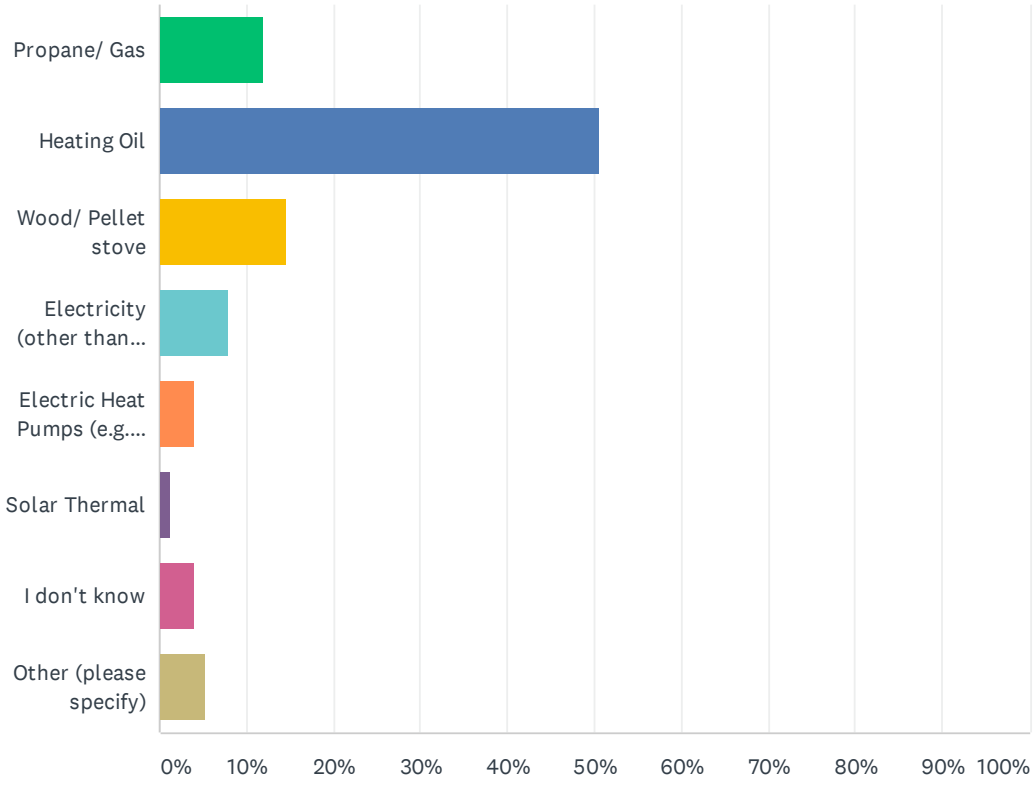
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
20 years old or less (Built 2000 or later)	17.33%	13
Between 21-40 years old (Built 1980-1999)	13.33%	10
Between 41-60 years old (Built 1960-1979)	22.67%	17
Between 61-80 years old (Built 1940-1959)	14.67%	11
Older than 80 years old (Built 1939 or earlier)	32.00%	24
TOTAL		75

Q5 What fuel or energy source do you primarily use to heat your home?

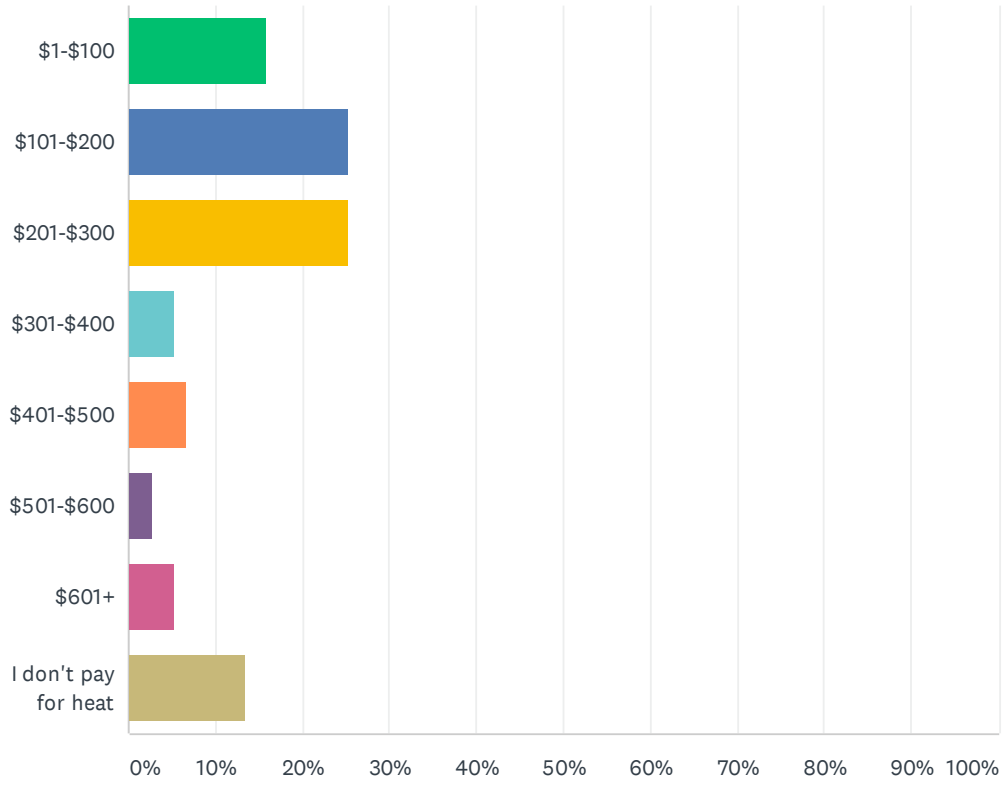
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Propane/ Gas	12.00%	9
Heating Oil	50.67%	38
Wood/ Pellet stove	14.67%	11
Electricity (other than heat pumps)	8.00%	6
Electric Heat Pumps (e.g. mini splits)	4.00%	3
Solar Thermal	1.33%	1
I don't know	4.00%	3
Other (please specify)	5.33%	4
TOTAL		75

Q6 On average, about how much does your household spend per month to heat your home during the heating season?

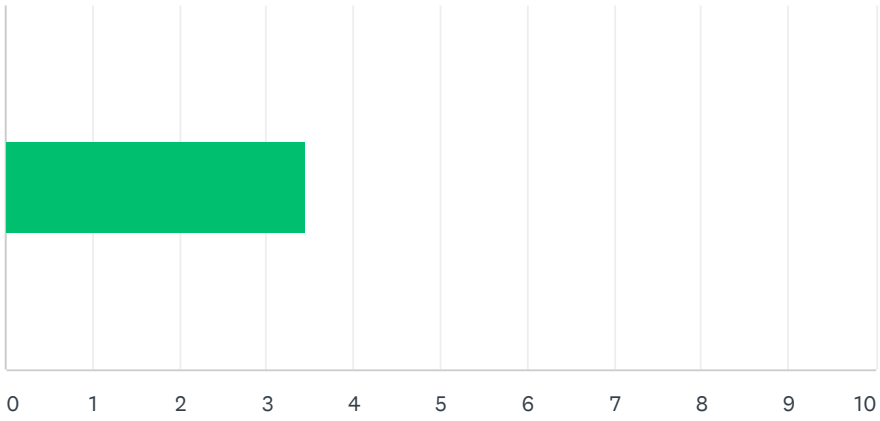
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
$1-$100	16.00%	12
$101-$200	25.33%	19
$201-$300	25.33%	19
$301-$400	5.33%	4
$401-$500	6.67%	5
$501-$600	2.67%	2
$601+	5.33%	4
I don't pay for heat	13.33%	10
TOTAL		75

Q7 Using the slider below, please indicate how concerned you are about the cost of heating your home. If you do not pay for heating, please select "Not at all concerned."

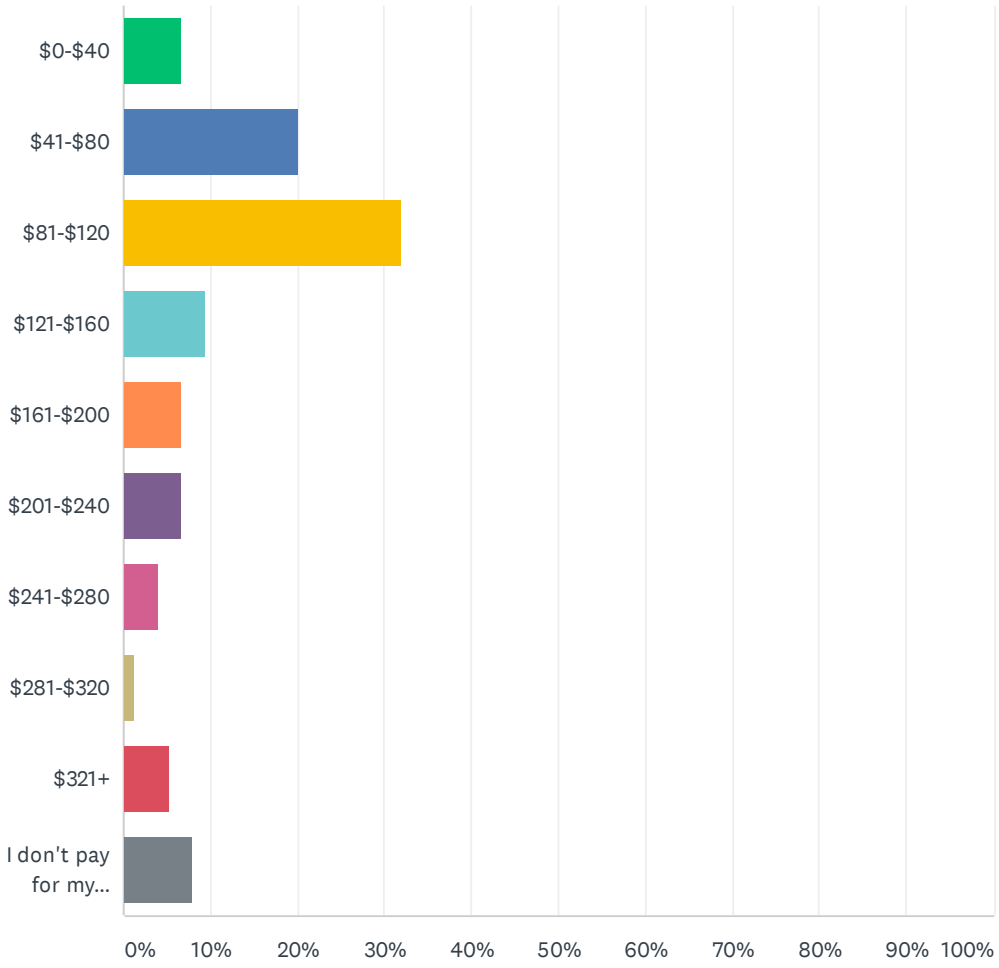
Answered: 75 Skipped: 0



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	3	259	75
Total Respondents: 75			

Q8 On average, about how much does your household spend per month on your electricity bill?

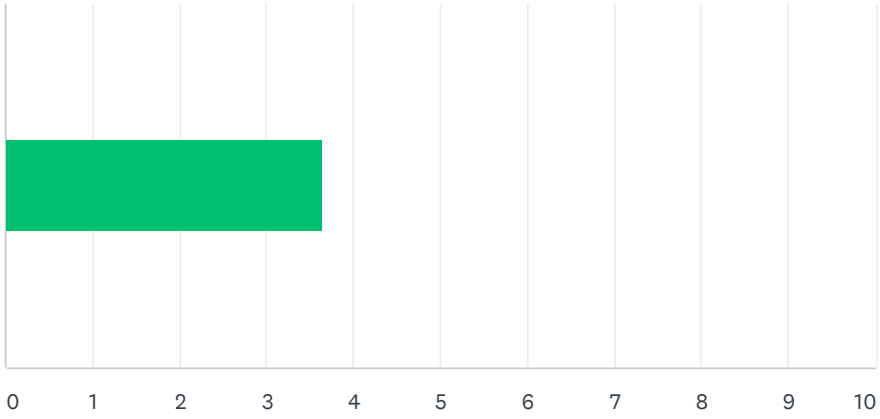
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
$0-$40	6.67%	5
$41-$80	20.00%	15
$81-$120	32.00%	24
$121-$160	9.33%	7
$161-$200	6.67%	5
$201-$240	6.67%	5
$241-$280	4.00%	3
$281-$320	1.33%	1
$321+	5.33%	4
I don't pay for my electricity bill	8.00%	6
TOTAL		75

Q9 Please indicate how concerned you are about the cost of electricity. If you do not pay for electricity please select "Not at all concerned."

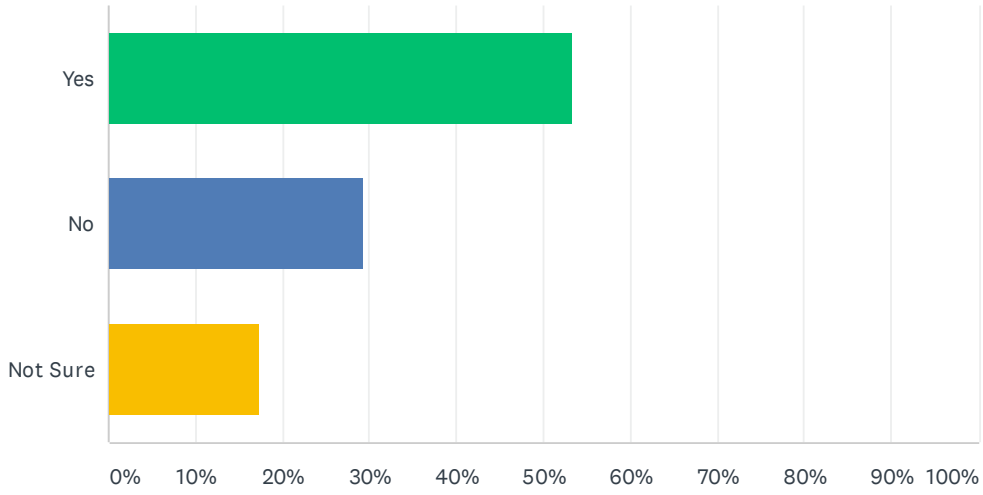
Answered: 75 Skipped: 0



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	4	273	75
Total Respondents: 75			

Q10 In the past ten years, have you or your landlord/property manager made any energy efficient upgrades or participated in a weatherization program to reduce energy use and/or save money?

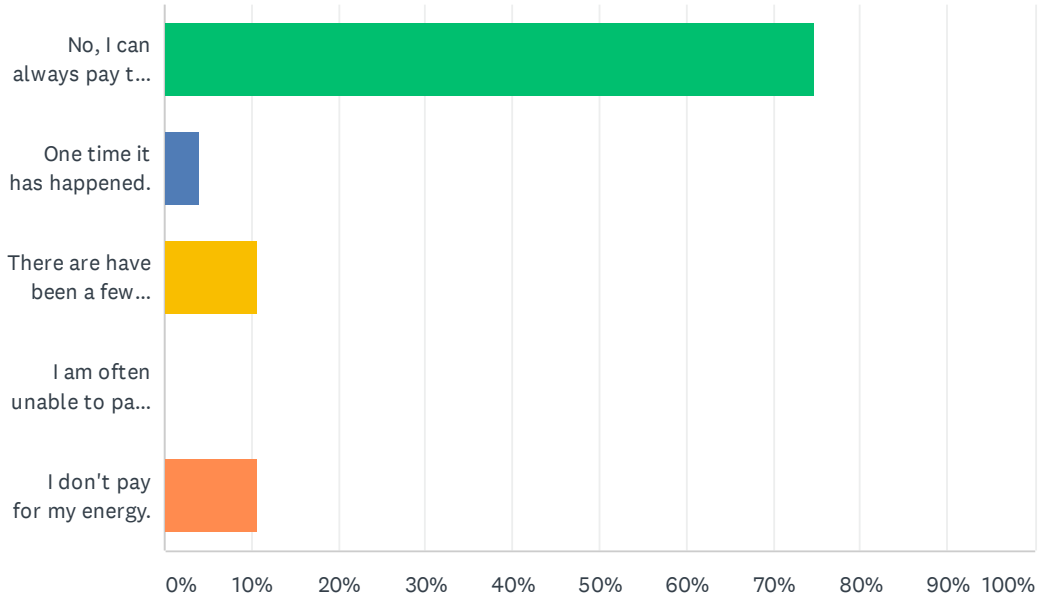
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	53.33%	40
No	29.33%	22
Not Sure	17.33%	13
TOTAL		75

Q11 Are you sometimes unable to pay your energy bills?

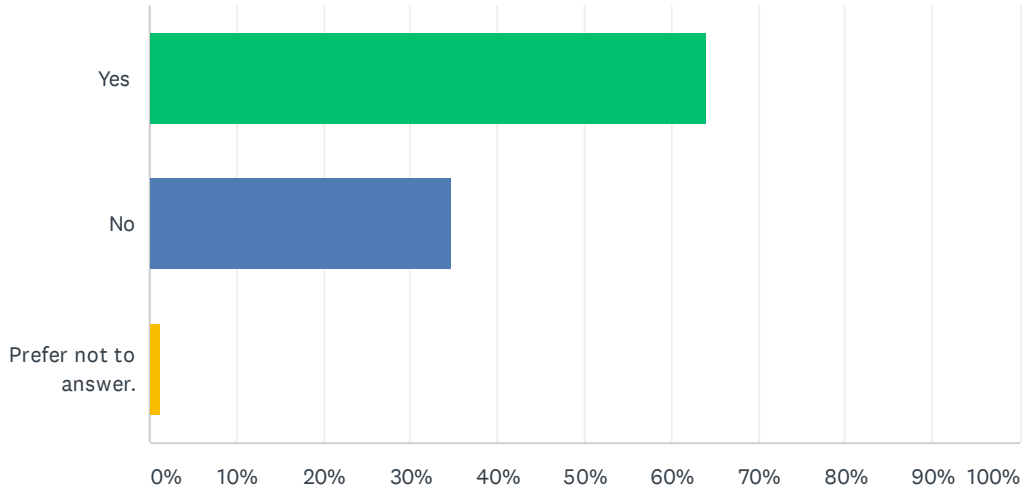
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
No, I can always pay the energy bills.	74.67%	56
One time it has happened.	4.00%	3
There are have been a few times.	10.67%	8
I am often unable to pay my energy bills.	0.00%	0
I don't pay for my energy.	10.67%	8
TOTAL		75

Q12 Do you sometimes keep your house cooler than you'd like to save energy?

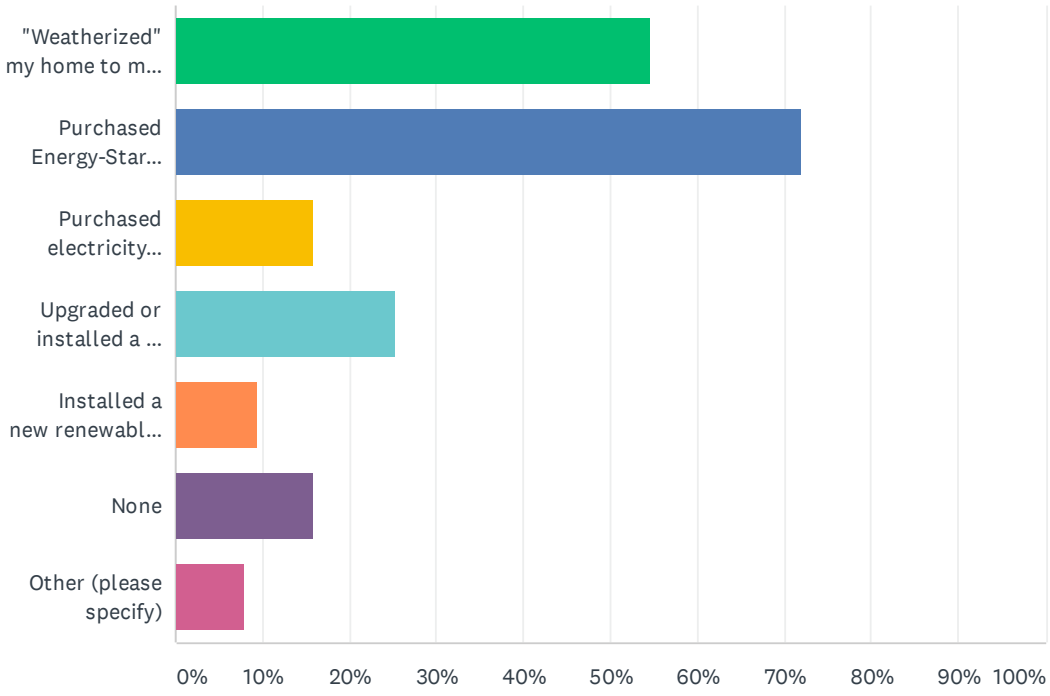
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	64.00%	48
No	34.67%	26
Prefer not to answer.	1.33%	1
TOTAL		75

Q13 In the past ten years, have you done any of the following to reduce energy use and/or reduce energy cost? Check all that apply.

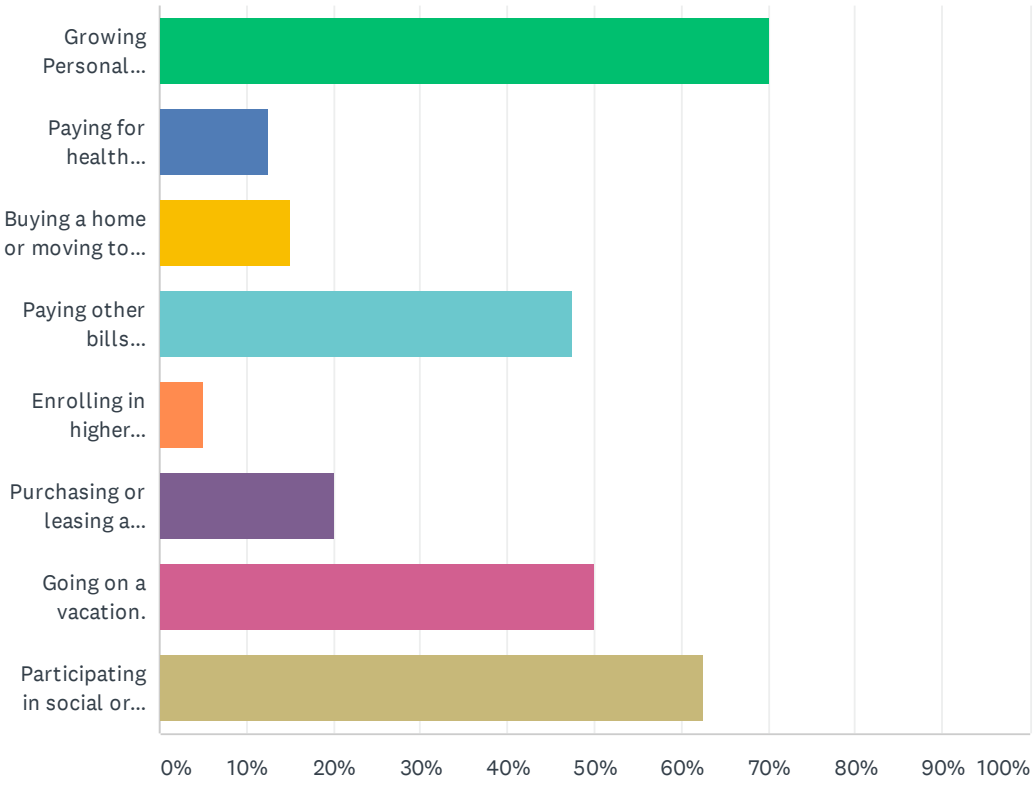
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
"Weatherized" my home to make it more resistant to cold weather (e.g. added insulation, storm windows, seal gaps, etc.)	54.67%	41
Purchased Energy-Star rated appliances and/or LED lights.	72.00%	54
Purchased electricity through a competitive energy supplier.	16.00%	12
Upgraded or installed a new heating system.	25.33%	19
Installed a new renewable energy systems (e.g. solar panels, solar hot water).	9.33%	7
None	16.00%	12
Other (please specify)	8.00%	6
Total Respondents: 75		

Q14 Has the cost of energy (electricity and heating) been a barrier to any of the following for you or your household? Please check all that apply.

Answered: 40 Skipped: 35



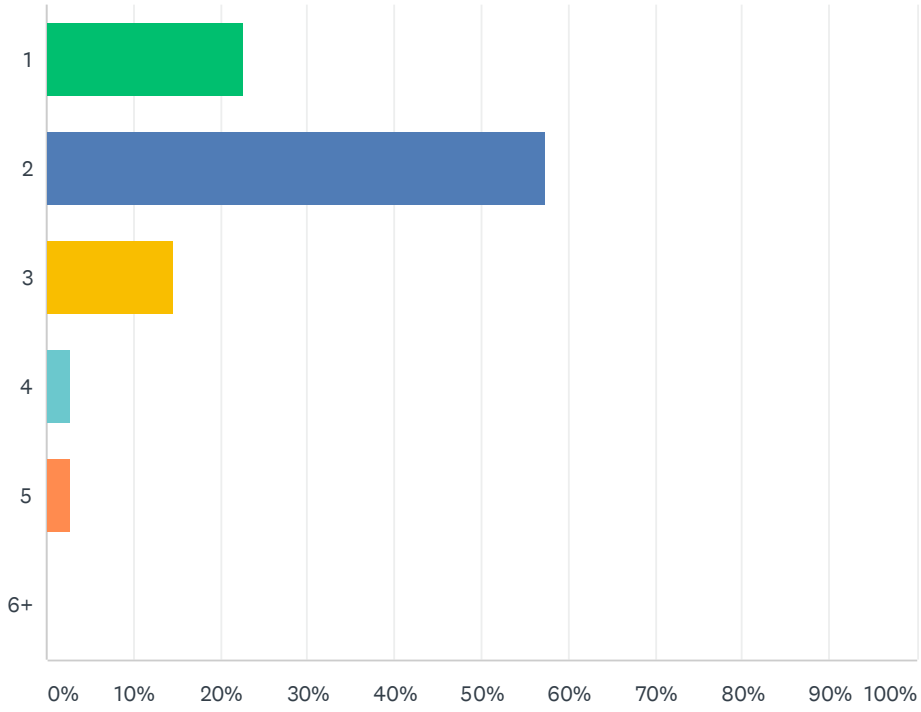
ANSWER CHOICES	RESPONSES	
Growing Personal Savings or Contributing to Retirement savings.	70.00%	28
Paying for health insurance or health care.	12.50%	5
Buying a home or moving to a higher-quality home/apartment.	15.00%	6
Paying other bills (internet, grocery, etc.).	47.50%	19
Enrolling in higher education or a vocational training program (you or a dependent).	5.00%	2
Purchasing or leasing a vehicle.	20.00%	8
Going on a vacation.	50.00%	20
Participating in social or recreational actives that cost money (e.g. movies, eating out, joining an athletic club, playing a game of golf, summer camp, etc.)	62.50%	25
Total Respondents: 40		

Q15 Please provide additional information or comments regarding the cost of energy (heating and electricity) and its impact on you and/or your household below.

Answered: 22 Skipped: 53

Q16 How many automobiles does your household own or lease?

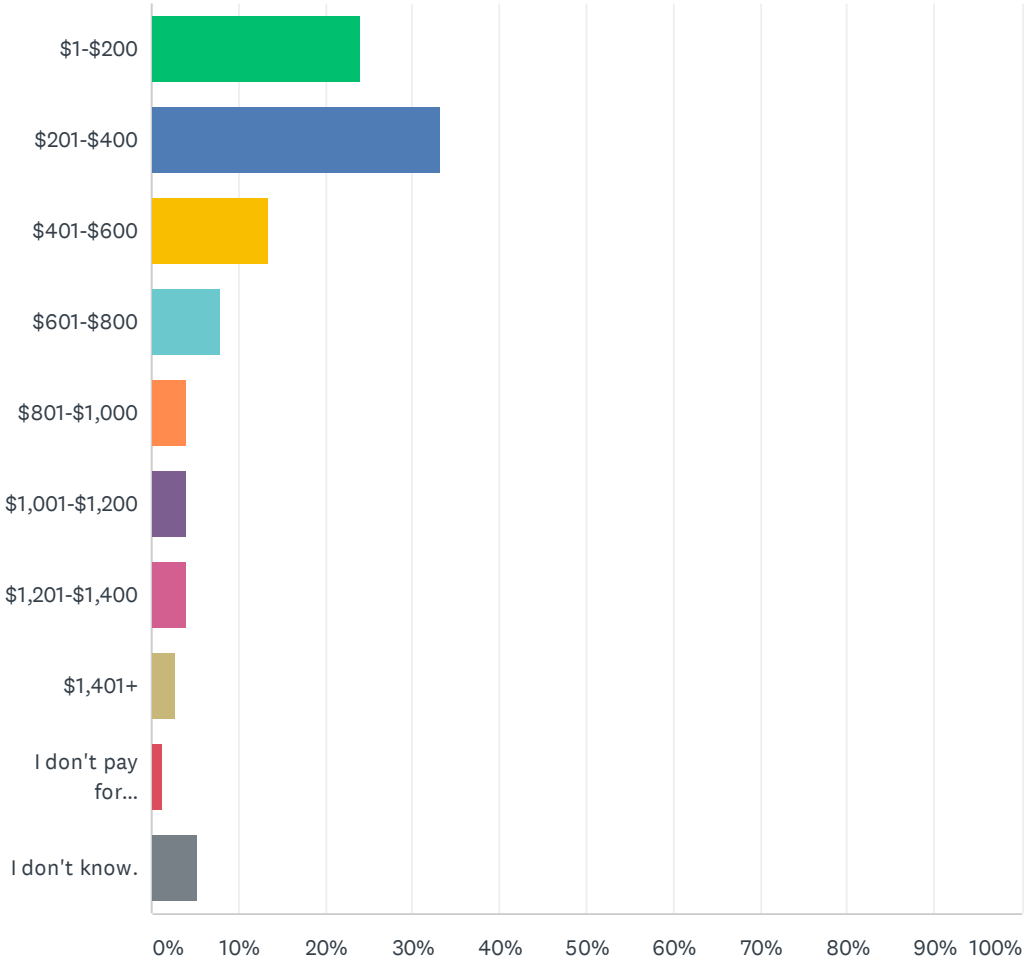
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
1	22.67%	17
2	57.33%	43
3	14.67%	11
4	2.67%	2
5	2.67%	2
6+	0.00%	0
TOTAL		75

Q17 On average, about much does your household spend per month on transportation? (For example car payments, automobile insurance, oil changes, gas, bus passes, train tickets, plane tickets, etc.)

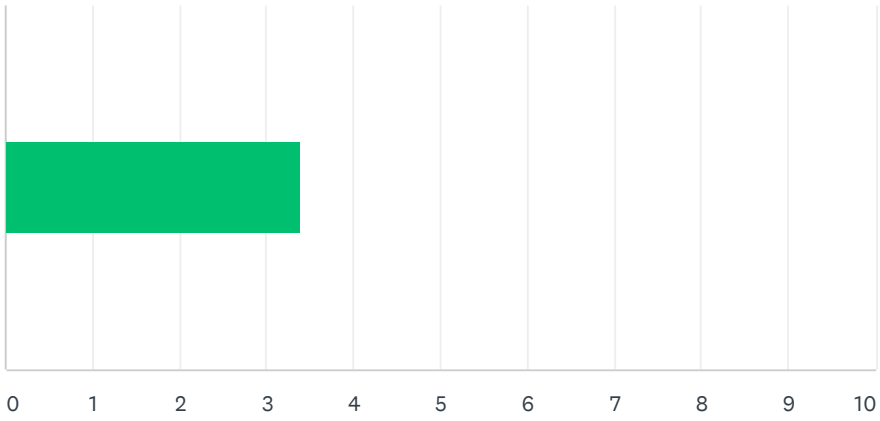
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
$1-$200	24.00%	18
$201-$400	33.33%	25
$401-$600	13.33%	10
$601-$800	8.00%	6
$801-$1,000	4.00%	3
$1,001-$1,200	4.00%	3
$1,201-$1,400	4.00%	3
$1,401+	2.67%	2
I don't pay for transportation.	1.33%	1
I don't know.	5.33%	4
TOTAL		75

Q18 Using the slider below, please indicate how concerned you are about the cost of transportation (including cost of owning and maintaining a vehicle, if applicable).

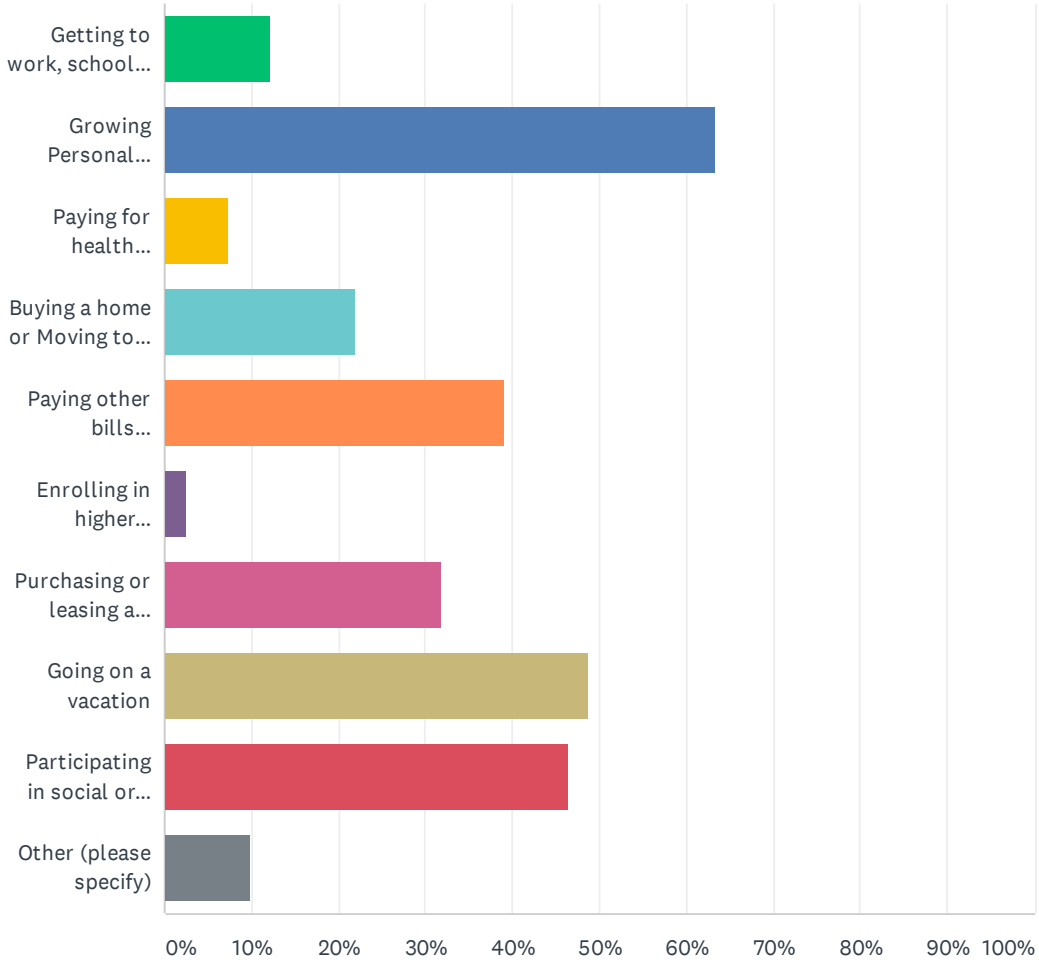
Answered: 75 Skipped: 0



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	3	254	75
Total Respondents: 75			

Q19 Has the cost and/ or availability of transportation been a barrier to any of the following for you or your household? Please check all that apply.

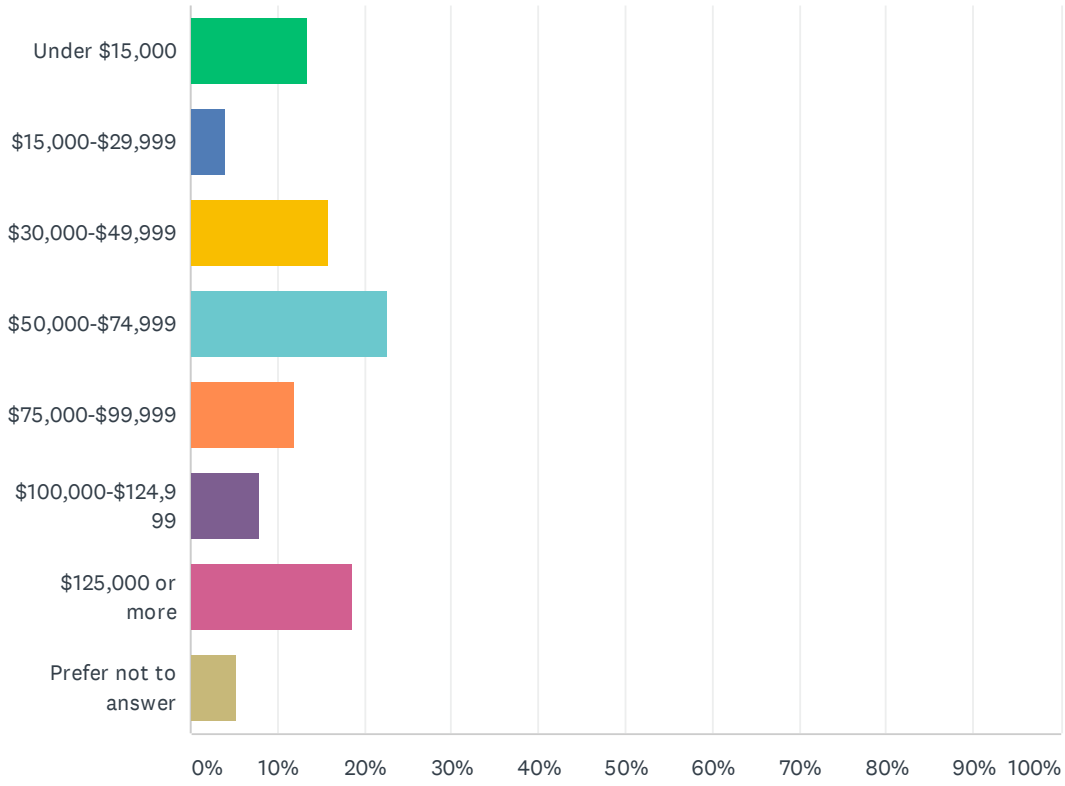
Answered: 41 Skipped: 34



ANSWER CHOICES	RESPONSES	
Getting to work, school, medical appointments or other appointments	12.20%	5
Growing Personal Savings or Contributing to Retirement savings	63.41%	26
Paying for health insurance or health care	7.32%	3
Buying a home or Moving to a higher-quality home/ apartment	21.95%	9
Paying other bills (internet, grocery, etc.)	39.02%	16
Enrolling in higher education or a vocational training program (you or a dependent)	2.44%	1
Purchasing or leasing a vehicle	31.71%	13
Going on a vacation	48.78%	20
Participating in social or recreational activities (e.g. movies, eating out, joining an athletic club, playing a game of golf, summer camp, etc.)	46.34%	19
Other (please specify)	9.76%	4
Total Respondents: 41		

Q20 Please indicate your gross (before taxes) annual household income. (Note: this information will not be associated with any personal / identifying information, and will be kept confidential.)

Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
Under $15,000	13.33%	10
$15,000-$29,999	4.00%	3
$30,000-$49,999	16.00%	12
$50,000-$74,999	22.67%	17
$75,000-$99,999	12.00%	9
$100,000-$124,999	8.00%	6
$125,000 or more	18.67%	14
Prefer not to answer	5.33%	4
TOTAL		75

Q21 Please provide any additional information or comments regarding the cost of transportation and its impact on you and/or your household below.

Answered: 18 Skipped: 57