ENERGY & CLIMATE COMMITTEE MEETING AGENDA - REVISED

Wednesday, May 6, 2020, 8:00 AM Virtual Zoom Meeting

TO JOIN THE MEETING:

- The public may join the meeting online by visiting www.zoom.us/join and entering the Meeting ID: **536-324-592**.
- If you are unable to attend the meeting online, you may listen to the meeting by calling the toll-free # (888) 475-4499 and entering the Meeting ID: **536-324-592**.
- More info on how to access this meeting is available on the Energy and Climate Committee webpage at ci.keene.nh.us/energy-and-climate-committee.
- If you encounter any issues accessing this meeting, please call 603-757-0622 during the meeting.

Members:

Dr. Ann Shedd, Chair
Peter Hansel, Vice Chair
Terry Clark, Councilor
Jake Pipp
Ken Dooley
Cary Gaunt
Anna Schierioth
Rod Bouchard
Andrew Dey
Zach Luse
Meaghan Rafferty
Paul Roth, alternate

Staff:

Rhett Lamb, ACM/Community Development Director
Mari Brunner, Planner

1. Call to Order and Roll Call
2. Approval of April 1, 2020 Meeting Minutes
3. Energy Plan
    a. Draft priority Strategies for Thermal & Transportation Sectors
    b. Cadmus Report
    c. Draft Thermal & Transportation Context & Baseline Chapters
    d. Energy Plan Outreach Options
    e. Keene Resident Energy Cost Survey Results
4. SolSmart Program Update
5. Legislative Updates
6. New Business
7. Next Meeting: Wednesday, June 3, 2020
8. Adjourn

ENERGY & CLIMATE COMMITTEE MEETING MINUTES

Wednesday, April 1, 2020 8:00 AM Virtual Webex Meeting

Members Present:
Dr. Ann Shedd, Chair
Peter Hansel, Vice Chair
Terry Clark, Councilor
Jake Pipp
Ken Dooley
Cary Gaunt
Rod Bouchard
Andrew Dey
Zach Luse
Meaghan Rafferty
Paul Roth, alternate

Staff:
Rhett Lamb, ACM/Community Development Director
Mari Brunner, Planner
Morgan Urquia, Community Development Intern

Members not present:
Anna Schierioth

Chair Shedd began by reading the following statement regarding the authority to hold a remote meeting:

"As Chair of the Energy and Climate Committee, due to the COVID-19 novel Coronavirus crisis and in accordance with Governor Sununu's Emergency Order #12 pursuant to Executive Order 2020-04, this Board is authorized to meet electronically.

Please note that there is no physical location to observe and listen contemporaneously to the meeting, which was authorized pursuant to the Governor's Emergency Order. However, in accordance with the Emergency Order, this is to confirm that we are:

a) Providing public access to the meeting by telephone, with additional access possibilities by video or other electronic means;

We are utilizing the Webex platform for this electronic meeting. All members of the Committee have the ability to communicate contemporaneously during this meeting through the Webex platform, and the public has access to contemporaneously listen and, if necessary, participate in this meeting through dialing the following phone #: **408-418-9388** and entering access code **792 917 239**, or by clicking on the following website address www.webex.com/login/attend-a-meeting and entering the meeting number **792 917 239** and password **ECC-April1**.

b) Providing public notice of the necessary information for accessing the meeting;

We previously gave notice to the public of how to access the meeting using Webex, and instructions are provided on the City of Keene's website at: www.ci.keene.nh.us/energy-and-climate-committee.

c) Providing a mechanism for the public to alert the public body during the meeting if there are problems with access;

If anybody has a problem, please call 603-352-5440 or email at: CommunityDevelopment@ci.keene.nh.us

d) Adjourning the meeting if the public is unable to access the meeting.

In the even the public is unable to access the meeting, we will adjourn the meeting and have it rescheduled at that time."

1. **Call to Order and Roll Call**

   Dr. Shedd asked staff to explain how members of the public could participate in the meeting. Ms. Brunner gave an overview of the instructions to join the meeting, and noted that attendees are being asked to participate in "listen only" mode and turn their videos off to help keep the meeting running smoothly. Dr. Shedd called the meeting to order and roll call was conducted.

2. **Approval of March 6, 2020 Meeting Minutes**

   Vice Chair Hansel moved to accept the March 6, 2020 minutes, Councilor Clark seconded, and the motion passed unanimously by roll call vote.

3. **Energy Plan**

   a. Priority Strategy / Action Items for Thermal & Transportation Sectors

   Ms. Brunner announced the results for the priority strategies/action items from last month's thermal sector survey, which she derived from weighted averages. A total of five people responded, three committee members and two staff members. She presented the

results using a bar graph, with the highest four items highlighted in yellow and the second highest four items highlighted in blue:

> ***3.3./2.4****- Offer financial incentive program to incentivize renewable energy for residents and businesses.*
>
> ***1.9*** *-Seek grants /funding for other weatherization and energy optimization programs.*
>
> ***1.2****- Adopt a mandatory Benchmarking Ordinance*
>
> ***3.1****- Host a renewable heating and cooling campaign (e.g. "Heatsmart" campaign).*
>
> ***2.1.1****- Explore options for a renewable district heating and/or combined heat and power pilot project.*
>
> ***1.6****- Consider adopting a local amendment to the 2015 State Energy Green Code, or explore adopting a green code such as the International Green Construction Code.*
>
> ***1.7****- Launch a weatherization program such as "Window Dressers" to help residents save energy and reduce costs during the heating season.*

Ms. Brunner asked members to reflect on which strategies the City and community partners should focus on first; which strategies will move them closest to their goal; where will the resources come from to implement these strategies; and what are the co-benefits of each strategy?

Vice Chair Hansel stated that the educational piece is critical to getting everyone on the same page, both for the thermal and transportation strategies.

Mr. Pipp stated that he likes item number 1.1 as long as they add "or rent" to the end of the statement "for sale." He said he also likes the benchmarking item (1.2), but only if they make it mandatory and provide education for improvements to scale up the impact. He noted that he also likes item 1.6 to have energy codes that are higher than the minimum, however, if the codes only affect new construction the scale of impact may not be that significant. In addition, this strategy scores low on "inclusion and social equity" because many people cannot afford to buy a new house. Mr. Pipp stated that item 1.7 was more important for him because it includes those who own or rent in weatherization benefits, and the scale of impact would be higher especially in term of social inclusion and equity. He stated that item 1.9 should not sit on its own and should be bundled in with 1.7, and that they will both require funding. He stated that he rated 2.1.1 lower on the scale of impact as it just explores the option of district energy, but doesn't include any steps to make it happen. He suggested the wording be changed to include more action. Mr. Pipp noted that he rated items 3.1, 2.4 and 3.3 in the medium range as not everybody

can afford to replace a furnace, and many of those incentives are out of reach for people and he would prefer to see education at the top instead as it is highly feasible and equitable and the scale of impacts would be greater than new homes having slightly higher insulation.

Dr. Shedd stated that the educating of contractors and building incentives for heating and cooling infrastructure would cross into several of these potential strategies.

Ms. Gaunt stated that she is in favor of financial incentives as they should aim to make the program attractive to all sectors from residential, business and commercial. She said that offering financial incentive programs is one of the best avenues towards doing that. She added that they need to educate homeowners about the incentives that are out there. She agrees with Mr. Pipp that strategies 1.9 and 1.7 could be combined, and noted that maximizing weatherization is important. She suggested potential partners to engage, including the local community college, the KSC architecture program, and Antioch University. She stated that many efforts start out as optional and end up in the regulatory approach. She thinks the benchmarking ordinance should be mandatory, and she agrees that they need to require reporting energy data as well as report progress towards meeting specific goals, for example, sector specific goals leading up to City goals.

Councilor Clark asked about the mandatory benchmarking ordinance and whether the City has the authority to do that. Ms. Brunner said it is something City Council would have to adopt. To her knowledge, it is allowed in New Hampshire and there are many examples of other New England communities that have already enacted mandatory benchmarking ordinances.

Mr. Dey noted that there are existing programs that have been in place for many years for low-income weatherization programs, for example, Button Up workshops which are an opportunity for homeowners to do weatherization. He said it is important for the City to recognize the existing programs and not duplicate them. He noted there may be particular demographics that may not bell well served by the current programs that the City can help with instead. Dr. Shedd stated that there was an in-person Button Up workshop planned for last week, which was rescheduled as a virtual presentation for next week. She agrees with Mr. Dey that the City should amplify existing programs rather than duplicate them. She asked if there are any other comments about the plan for the Thermal sector.

Vice Chair Hansel commented that before they can do the mandatory benchmarking, they would need to establish a protocol for reporting as there are many different thermal measures and all of them are difficult to quantify consistently.

2. Draft Baseline for Thermal & Transportation Sectors

Ms. Brunner said she used the same process for the Transportation sector survey results (the four highlighted in yellow were the top four, and the next highest ranked items highlighted in blue). She asked for member feedback on these items.

She highlighted the top strategies:

4.1 *Advocate for more funding the state and federal level for transportation.*

2.5 *Work with the Keene School District and local bus company to encourage switch to electric school buses.*

1.2.2 *Work with Southwest Region Planning Commission and other community partners to explore options for a multimodal transportation center in Keene.*

1.2.1 *Continue to support the City Express and Friendly Bus program.*

1.1.1 *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 reconstruction of existing streets.*

1.1.2 *Pursue grants/other funding to supplement the cost of maintaining existing pedestrian and bicycle infrastructure (e.g. $5 vehicle registration fees).*

3.1 *Encourage location and concentration of land uses and urban design (i.e. follow "smart growth" principles).*

1.1.3 *Pursue grants and other funding sources to install new bicycle and pedestrian infrastructure, including sidewalks, crosswalks, multi-use trails and bicycle parking (e.g. TAP, CMAQ, MAST Complete Streets grant, RTP grant, etc.)*

Ms. Brunner asked for member feedback on the strategies.

Dr. Shedd stated that only one relates to the electrification of the transportation sector; the one related to promoting electric buses with the school district. She asked about the level of impact that type of strategy would have – is there data on how many people use the school bus?

Ms. Brunner said that Morgan Urquia, Planning intern, has been working on a baseline for the thermal and transportation sectors and can go into more specifics on the school bus fleet. However, information about the number of students that ride the bus is not available now. Staff have contacted First Student to request this information, but have not heard back.

Mr. Pipp stated that he likes strategy 1.1. and his question refers to the Complete Streets guidelines and the implementation of those guidelines for new streets. He said he cannot imagine there are many new streets. He said strategy 1.1.2 to maintain existing infrastructure for pedestrians and bikes is important, but he imagines that the City has that as a part of their budget already, so adding new infrastructure may be more important in terms of scale of impact. Mr. Pipp said there isn't much there about electrifying and it could be extended to the Friendly Bus and the City Bus program, however, that may not

make a big impact as not many people ride the bus currently. He said increasing the charging stations in public parking areas is important, as fueling for electric vehicles is not as widely accessible for electric cars as gasoline is. He said strategy 4.1 is important, and considering access and safety standards for all modes of transportation in the review of development and redevelopment proposals is also a high priority for him.

Ms. Brunner responded to the question regarding the Complete Streets guidelines. The City adopted a resolution that has set forth standards and guidelines that are not mandated; however, the City is using them whenever possible in existing construction projects. The standards are geared towards new streets. She said the City could incorporate the Complete Streets standards into the standards for construction of new roads in City Code. In addition, the City could consider applying these standards to the reconstruction of existing streets, however, it may make sense to create new standards for those because many of them have constraints that are not under the City's control, such as width and topography, that limits the types of Complete Streets treatments that can be applied.

Ms. Brunner stated that she has received a few comments and questions from the public; if there are members of the public present, they can send questions to Ms. Brunner. Mr. Bouchard left the meeting.

Ms. Gaunt said in regard to strategy 1.2.1, KSC has done a survey and the City Express bus is not well-used, and it is because they do not go where people want them to go. She would only support that item if it were tied into an evaluation of the program, including the bus routes and how they can best serve the community. In addition, many people go back and forth between Keene and Brattleboro and there are a lot of commuters who do not have an option for mass transit. Although this is not a strategy that is currently listed, she thinks that providing a transit option for commuters between Brattleboro and Keene would be helpful. She is also a big proponent of maintaining and expanding the walking and biking infrastructure. She stated that KSC faculty members and staff have inquired about creating infrastructure for EVs as they do not have any charging stations at KSC, so they should ensure that the City of Keene transportation infrastructure supports the need of walkers, bikers and those people trying to transition to EVs.

Mr. Dey stated that it is challenging to select the top priorities as many of the options were somewhat similar in their effectiveness. The difficulty in scoring is reflected in the lack of standard deviation between the options; there was also not a broad participation in scoring of these items. He said Ms. Brunner has done her best, however, views may change and adapt as part of the discussion which is the great part of participating on the committee. He said the strategies that are the most compelling to him are those listed under section 2, Accelerate the shift to electric vehicles. Compared to the other strategies within the Transportation Sector, these are relatively short-term, highly visible and achievable with clear-cut deliverables. He said he is all for electrification of transportation and he would rate accelerating the use of EVs as highly important.

Councilor Clark added that a more robust publicity campaign for the City Express Bus is important. The budget for the City Express is very low, so he would support increasing the City's contribution to the bus. He added that it is also very important to ramp up support for the electrification of the City Express and school buses as well.

Dr. Shedd said encouraging intercity transportation and improving service and ridership for the City Express Bus seem to be big themes for members.

Vice Chair Hansel stated that he agrees with the comments that have been made. He also looked at the survey from a higher perspective and tried to rank the items within each of the four categories. He said that each one of the categories is important and were selected for a reason; for example, reduce the number of vehicle miles traveled, accelerate the shift to EVs, and promote efficient growth patterns. He said he would select strategy 3.1 from the latter category as the top priority. Vice Chair Hansel noted that the City will be facing a reconstruction within the core of the City when the Arts and Culture corridor moves forward, and incorporating an intermodal transportation might be a timely thing to advocate for and is an urgent consideration for the City due to the timing.

b. Draft Baseline for Thermal & Transportation Sectors

Ms. Urquia stated that she would review the thermal sector first and then the transportation sector. For the Thermal Sector baseline, staff used data from the City's Assessing Department and started by splitting it up into three broad categories: 1. Residential units (~50% of sq. ft. heated space), 2. Commercial and industrial units (~30% of sq. ft. of heated space), and 3. Public/non-profit, government, and education units (~20% of total sq. ft. heated space). She said in each of the three categories, the goal was to organize properties by sector/sub-sector and then record properties in square footage based on heat fuel type, fueling system type, and cooling system type.

Residential sector- According to data from Assessing, 78% of residential living space is heating with heat fuel. Ms. Urquia said almost half of households in Keene are renters and that presents a challenge in convincing people to have their heating systems redone. She said the majority of people do not have cooling systems – 84% of living space is not cooled within this sector – however, that may need to change in future with the increase in high heat days.

Public, education and government sector- Ms. Urquia said that, for many buildings in this sector (59% by area of living space), the heat source is unknown. Assessing lists the heat source as "Typical" in their data system when they do not know the heating fuel type. For example, KSC's heating fuel is unknown, which represents a large proportion of the "Typical" category. This can skew the data. She was able to fill in some of the missing information by reaching out directly to organizations; for example, Ken Dooley provided data for the school system. Hot water/steam is the leading heat system type. More properties in this category have cooling systems than in the residential category (58% of living space is cooled within this sector). She noted that there is some overlap in the heating system type; for example, "hot water," "hot water/steam," and "steam" are all

listed as separate heat system types. She noted that staff will work on this and said they can look to streamline duplicate categories.

Commercial and Industrial – Ms. Urquia noted that this category includes "mixed use" properties, which means it is a building that has both residential and commercial space. The most common heat fuel is heating oil, and the most common heat system is hot air followed by hot water/steam. This sector has the highest proportion of space that is cooled (70%). Mr. Pipp asked what "Typical" means; Ms. Urquia said that the typical category for heat fuel type means "unknown."

Assumptions in data analysis- Ms. Urquia explained some of the assumptions that staff made when looking at the Assessing data. First, they decided not to use total area for buildings, because some of that space may not be heated (for example, warehouse storage space). Therefore, in this analysis, the square footage refers to living area, not total area. Another limitation of the data is that multiple heating systems are not accounted for – the Assessing data only includes the primary heat system and primary heat fuel. This leaves out wood stoves and pellet stoves, for example, that people may use as their primary heat source with a traditional boiler system as backup. She said she talked to Assessing to see if there is a way to get data on wood stoves, back-up solar thermal, and other secondary or backup systems, but there isn't a good way to get that information at this point.

Ms. Urquia also noted that the data staff received from Assessing required a good amount of analysis and checking. The data from Assessing has its own categories, so she had to go through and organize the data into the categories presented today. In addition, the Assessing categories sometimes have discrepancies/inconsistencies, so she had to go through the list and look up individual properties to figure out how to categorize them. For example, Brewbakers was listed as "charitable building" under style and "retail" under occupancy. This requires a good amount of time to go through, which brings up an issue of repeatability in this project as the margin of error will be greater because there is a level of subjectivity on the part of the analyzer. All the data is coming from the Assessing Department.

Vice Chair Hansel stated that the question of repeatability is an issue, and this points out both the important and the challenge of benchmarking with so many different fuels and building types. He asked how they will make benchmarking fair and equitable for everybody. He stated that there may not be a baseline of fuel consumption for thermal for the plan, but the plan can include how to get to a baseline in thermal moving forward.

Ms. Gaunt stated that the data shows a heavy reliance on oil, especially in the residential sector. She said this was previously the case with KSC, but they were able to partner with a regional firm to get 100% refined, used vegetable oil to replace their highly-polluting #6 and #2 heating oil. They have been very pleased in working with this company, and she is wondering if there might be interest in making this product (LR100) more widely available to customers in Keene. She said this can be a great way to get used vegetable oils from restaurants in Keene; for example, all of the used vegetable oil from their dining commons goes into their heating fuel. She said maybe they can look into how to spread

this model in Keene. Ms. Morgan replied that the most helpful things about the data is that it shows them what they are up against and can help inform the strategies.

Dr. Shedd thanked Ms. Guant for her comments. She said she agrees with Vice Chair Hansel that the issue of how to measure usage will be a challenge. Ms. Morgan said she is in favor of the mandatory benchmarking as it will provide more accurate data for heating and cooling fueling consumption, rather than deriving estimates from average house consumption.

With no more questions about the thermal data, Ms. Urquia moved on to the baseline data for the transportation sector. She shows a slide that lists the metrics used for this sector:

1: Total number of vehicles registered in Keene and # of vehicles per household
2: Fraction of total light-duty vehicle registrations that are electric or hybrid vehicles
3: Transportation Mode Share (percent who drive, walk, bike, etc) for work/school
4: Transit Ridership
5: Number of bus stops/ miles of bus route
6: Miles of bike/ped pathways maintained year round
7: Number of EV charging stations by type
8: Proportion of residents living in locations with mixed land use
9: Number of roundabouts compared to signalized intersections

Vehicles- Ms. Urquia said that this data was obtained from the NH Department of Environmental Services (NH DES). The majority of light-duty vehicles (motorcycles, passenger cars, and passenger trucks under a certain weight) are gas-powered (92%). There are 222 conventional hybrids registered in Keene, which only makes up 1% of the total registered vehicles. There are 15 registered battery electric vehicles, and 101 registered plug-in electric vehicles. The remainder are medium and heavy duty vehicles.

Charging Stations- There are only five electric vehicle (EV) chargers in Keene, and all are level 2 chargers which gives you a full charge in about eight hours. She said that there are a number of level 2 and level 3 chargers within a 30-mile radius of Keene, mostly on the Route 91 corridor in Vermont near Brattleboro and Putney.

Infrastructure- Ms. Urquia said that the next metric relates to infrastructure. The top chart shows infrastructure to help support alternatives to motor vehicle travel, including the miles of bus routes, the miles of sidewalks maintained year-round, the miles of multi-use trails, the miles of in-street bicycle lanes, and the miles of in-street shared bicycle lanes (i.e. “sharrows”). There are 39 bus stops (however, the City Express bus can be “flagged” to stop anywhere along its route). Ms. Urquia noted that the bus starts running at 8:00 AM and ends at 4:30 PM, and it takes an hour to complete the route, which gets to the discussion the group had earlier about improving the bus service to increase ridership. There are 15 enhanced crossings and 32 road crossings along bike/pedestrian paths in Keene. This data is from Will Schoefmann, the City’s GIS specialist, and from the Monadnock Alliance for Sustainable Transportation (MAST). The second chart shows the number of roundabouts compared to signalized intersections in the City. Roundabouts

help reduce pollution by improving the flow of traffic; there are currently 6 roundabouts and 20 signaled intersections in Keene. However, there are two roundabouts planned for the Winchester Street corridor. After those are built, there will be 8 roundabouts and 19 signalized intersections in the City.

Transportation mode share-Ms. Urquia said that this data comes from American Community Survey (chart on the left) and 2000 U.S. Census (chart on the right). About 73-76% of people in Keene are driving alone; 8%-11% are carpooling; about 15-70 people use public transport; 6%-8% are walking, and she is assuming that biking and scootering are captured under the "other" category (1%-4%).

Population density- Ms. Urquia referred to a chart that shows percent of properties that are within the High Density District or a mixed-use district (by number of properties, not square feet). Out of 6,485 properties assessed in Keene, 719 are in high density zones and 207 are in mixed-use zones. Census data gives us a better picture of where people work and live in in Keene. Ms. Urquia showed density maps displaying where people live in Keene (map on left) and where people work in Keene (map on right); however, she noted that many people who live in Keene work elsewhere, and many people who work in Keene live elsewhere. She showed a map from the Census site that show that 12,810 people come into Keene to work, 5,646 leave Keene each day to work elsewhere, and only about 5,240 both live and work in Keene.

Ms. Urquia stated they are still waiting for data from First Student about how many students are using the school buses to inform the electrification of the school bus fleet strategy.

Dr. Shedd asked if they are counting only light duty vehicles registered in Keene, does that leave out oil delivery trucks and City trucks?

3. Consultant Webinar Presentation- Dr. Shedd said that the energy plan consultant will be presenting tomorrow, April 2 from 12:00-1:30 pm. The link to register is on the City website and in the meeting packet. Ms. Brunner encouraged everyone who is able to attend, and noted that the presentation was originally going to be an in-person presentation. This is the ECC's chance to ask the consultant directly about the work they have been doing with the City over the past six months or so. After this presentation, the consultant will submit a final draft before the next ECC meeting, so this is the only chance ECC members will have to ask questions before the report comes out. Dr. Shedd asked if people will be able to ask questions. Ms. Brunner said that the presentation will be live; public can ask questions and they may try do some polling. They are also going to record the presentation, but it may or may not work depending on the technology the consultant uses. The consultants will also present at the City Council meeting tomorrow evening, however it will be a much shorter presentation (about 10-15 minutes, plus time for Q&A).

4. Online surveys for Residents and Businesses- Dr. Shedd said that the initial results of this survey were shared at an earlier meeting, and asked Ms. Brunner for an update.

Ms. Brunner said that this survey was a joint effort of the City and two Keene State Colleges students who will be using the results for a school project. The students will be downloading the survey responses at the end of this week to conduct their analysis. So far, 55 people have filled out the survey, which is a pretty good response. However, most responses have been from residents in the middle to upper income ranges, and the survey is trying to understand how energy costs affect all residents, including low and moderate income households that may spend a higher percentage of their income on energy. She encouraged members to complete the survey and share it with their networks. The business survey has only gotten five responses so far as they need to publicize that one more.

5. Energy Plan Outreach Options for April and May- Dr. Shedd said that this item relates to shifting community outreach efforts in light of the new coronavirus pandemic. Ms. Brunner said that the April Energy Plan workshop has been canceled due to the Covid-19 State of Emergency. The goals of that workshop were to get input on how Keene should define "renewable" in the context of the energy plan, introducing proposed strategies and doing some education about what they are, getting general feedback on strategies, and in general to provide an update on this project and make sure people are aware it is happening. She was hoping to have a discussion with the committee about ways they could continue to engage the public and get feedback using remote/virtual options. In the interest of time, she asked members to email her with ideas for outreach during the time of Covid-19. She asked members to think about how to reach those goals using electronic outreach and engagement.

6. UNH Sustainability Fellow Update – Ms. Brunner stated that the City has selected a candidate for the UNH Sustainability Fellow program. The Fellowship is intended to focus on outreach; one of the key deliverables is the visual implementation road map that will accompany the Energy Plan, so it is very important to have a draft plan ready by June 1. It is very likely that the program will be done remotely. Major milestones for the program include orientation during the week of May 25 at UNH, starting work with the City the week of June 1, midterm presentation at UNH the week of July 6, final presentation at UNH the week of August 3, and wrapping up the fellowship the week of August 10.

4. **New Business- No new business**

Dr. Shedd asked if there was any new business that committee members would like to add to the agenda for next month. No one had any new business to add to the May agenda.

5. **Next Meeting: Wednesday, May 6, 2020**

Dr. Shedd said that the Committee may be using a different virtual platform for the meeting next month. She asked members to direct questions and comments to Ms. Brunner via email.

6. **Adjourn-** Dr. Shedd adjourned the meeting at 9:32 am.

Respectfully submitted by,

Ayshah Kassamali-Fox, Minute-Taker

Reviewed and edited by Mari Brunner, Planner

Community Development Department

MEMORANDUM

DATE: April 29, 2020

TO: Energy and Climate Committee (ECC)

FROM: Mari Brunner, Planner

COPY: Rhett Lamb, Community Development Director / Assistant City Manager

SUBJECT: Keene Energy Plan Updates

RECOMMENDATION

To review the draft priority strategies for the Thermal and Transportation Sectors listed in this memo, and the following documents attached to this memo in advance of the May ECC meeting.

1. Draft "City of Keene Renewable Energy Transition Analysis" report prepared by Cadmus.
2. Draft "City of Keene Sustainable Energy Plan Outline" dated April 29, 2020.
3. Draft "Thermal Sector Context and Baseline" chapter dated April 30, 2020.
4. Draft "Transportation Sector Context and Baseline" chapter dated April 30, 2020.

BACKGROUND

I. Draft Priority Strategies for the Thermal and Transportation Sectors

At the April 1, 2020 Energy and Climate Committee (ECC) meeting, the Committee discussed which strategies/actions should be given the highest priority within the thermal (heating and cooling) and transportation sectors of the energy plan. This discussion was informed by the results of a "Strategy Prioritization Survey" that was sent out to Committee members in advance of the April ECC meeting. The following list of strategies emerged as the highest priorities within each sector, based on the ECC's discussion at the April ECC meeting.

Thermal Sector Priority Strategies

1. Adopt a "Home Energy Labeling" program for residences – Require energy efficiency disclosure for existing and new residential properties at the time a property is listed for sale or for rent.
2. Adopt a Mandatory Benchmarking Ordinance – Require building owners of certain sizes or in certain districts to report energy use data to the City.
3. Partner with existing weatherization programs to enhance public outreach and education, amplify impact, and increase capacity (NH Saves, SCS Weatherization assistance, etc.).
4. Provide education and information/resource-sharing to increase awareness and understanding of energy efficiency and efficient building design, including benefits (e.g. air quality), available incentives/ programs, etc.
5. 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, etc.

6. Offer financial incentive 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.

Transportation Sector Priority Strategies

1. 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.
   a) Pursue grants and other funding sources to install new bicycle and pedestrian infrastructure, including sidewalks, crosswalks, multi-use trails, & bicycle parking (e.g. TAP, CMAQ, MAST Complete Streets grant, RTP grant, etc.).
   b) Provide sufficient funding in the City budget to maintain existing bicycle and pedestrian infrastructure in good condition.

2. Accelerate the shift to electric vehicles and other alternative fuel vehicles.
   a) Install public EV charging stations (level 2 and fast-charge) in on-street parking areas and in public parking lots or structures.
   b) Work with the Keene School District/local school bus company and HCS (City Express and Friendly Bus) to encourage switch to electric buses.

3. Continue to support the City Express & Friendly Bus program, and consider increasing support for this program and helping to promote and expand services/routes.

4. Work with Southwest Region Planning Commission and other community partners to explore options for a multi-modal transportation center in Keene.

5. Explore intercity transit options for commuters along the Route 9 corridor between Brattleboro, VT and Keene.

6. Advocate at the federal and state level for more funding to support EVs and other alternative fuel technologies, public transportation, and active transportation.

II. Draft "City of Keene Renewable Energy Transition Analysis" report

The City's energy planning consultant, The Cadmus Group, was hired to do the following in support of the Keene Sustainable Energy Plan:

1. Prepare an overview of energy policy, trends, and local policy options and barriers (Electricity Context).
2. Conduct an analysis of the current electric load, power supply and electricity costs in Keene (Electricity Baseline).
3. Assess up to six options/strategies to achieve 100% renewable electricity, including an analysis of impacts, benefits, risks, and feasibility of each option (Strategy Analysis and Findings).

In addition to the above, Cadmus conducted two public presentations, including a 1.5-hour public presentation and a 20-minute presentation to the Keene City Council. These presentations, which were done online using virtual meeting platforms, both took place on April 2, 2020.

The attached report, titled "City of Keene Renewable Energy Transition Analysis," is the final report prepared by Cadmus for this project and will be used to help inform the baseline, context, and renewable energy strategies for the Electricity Sector within the Keene Sustainable Energy Plan.

III. Draft "City of Keene Sustainable Energy Plan Outline"

Staff have prepared a draft outline of the Keene Sustainable Energy Plan for review and comment. This outline, dated April 29, 2020, is an updated version of the outline that was shared with the ECC in August 2018. It is intended to help show how the energy plan could be organized and where the Cadmus report and other draft content could fit in to the larger document.

IV. Draft "Thermal Sector Context and Baseline" chapter

The draft "Thermal Sector Context and Baseline" chapter of the energy plan, dated April 30, 2020, was prepared by Morgan Urquia, Planning intern using data from the City Assessing Department, the U.S. Energy Information Administration (EIA), the U.S. Census, and the American Community Survey. The baseline data for this sector approximates fuel consumption using a set of assumption and localized fuel use data for the residential, commercial, and public/non-profit sectors. This is a first draft for the ECC to review and provide comment.

V. Draft "Transportation Sector Context and Baseline" chapter

The draft "Thermal Sector Context and Baseline" chapter of the energy plan, dated April 30, 2020, was prepared by Morgan Urquia, Planning intern using data from the City of Keene Finance Department, the U.S. EIA, the U.S. Census, the American Community Survey, and various interviews/correspondences with community contacts, among other sources. The metrics for this sector are limited to ground transportation of City residents; however, the strategies for this sector are intended to have a broader impact given the high percentage of out-of-town workers and visitors that travel to Keene each day. This is a first draft for the ECC to review and provide comment.

ATTACHMENTS

1. Draft "City of Keene Renewable Energy Transition Analysis" report prepared by Cadmus.
2. Draft "City of Keene Sustainable Energy Plan Outline" dated April 29, 2020.
3. Draft "Thermal Sector Context and Baseline" chapter dated April 30, 2020.
4. Draft "Transportation Sector Context and Baseline" chapter dated April 30, 2020.

DRAFT

CADMUS

City of Keene Renewable Energy Transition Analysis

April 2020

Prepared for:

The City of Keene

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Introduction and Background

Keene Renewable Energy Goals

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

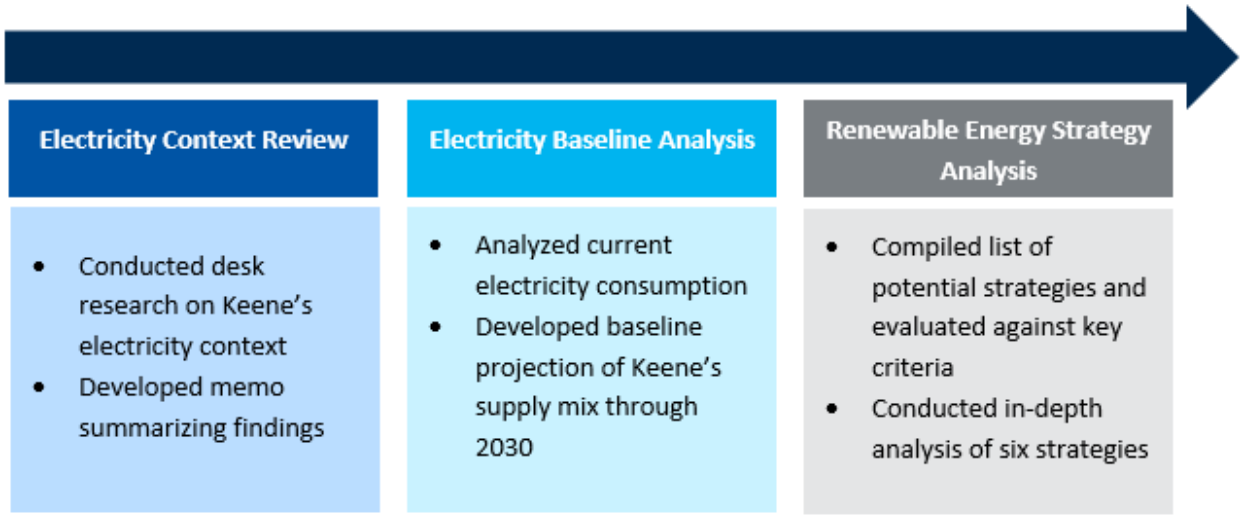
- 100% of all electricity consumed in the City will come from renewable sources by 2030
- 100% of all thermal energy and energy used for transportation will come from renewable sources by 2050

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.

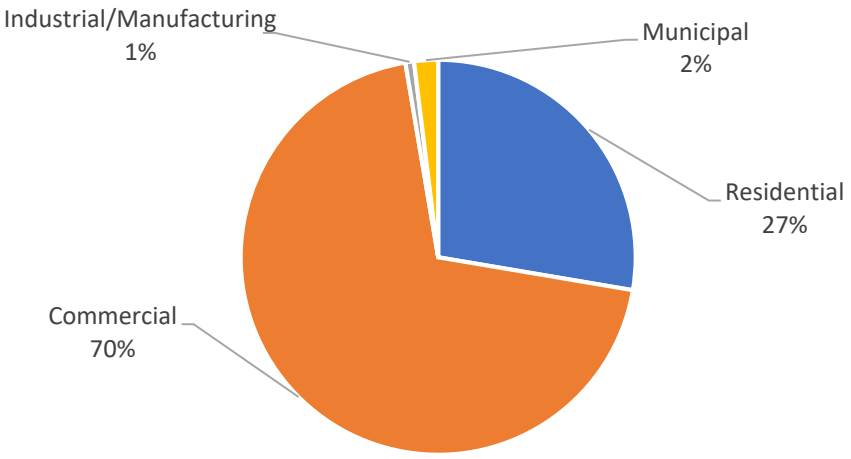
Electricity Consumption in Keene

In 2019, electricity accounts across the City of Keene consumer 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 consumed 28,930 kWh of electricity.[1]

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).

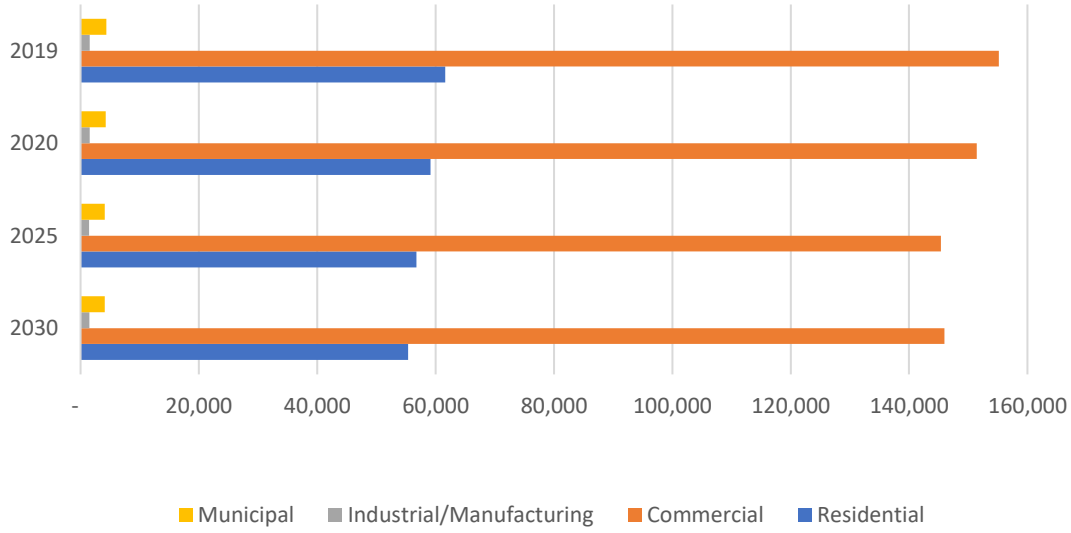
[1] Data provided by Eversource.

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]

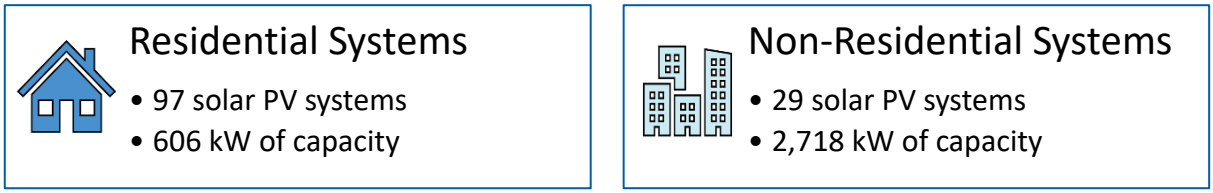


Figure 4 only includes interconnected systems and does not include off-grid systems within Keene. While distributed generation penetration is expected to grow over time, the 2030 forecast conservatively assumed the number of local renewable energy installations will stay constant over time.

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]

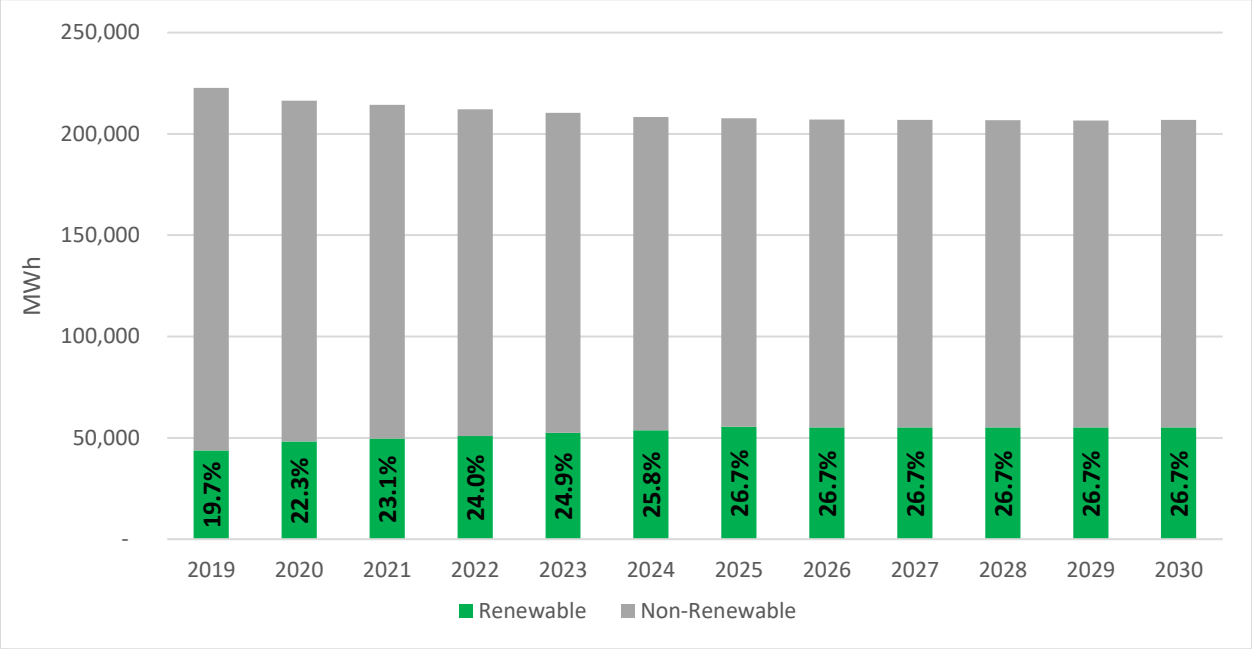
What this means for 2030

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

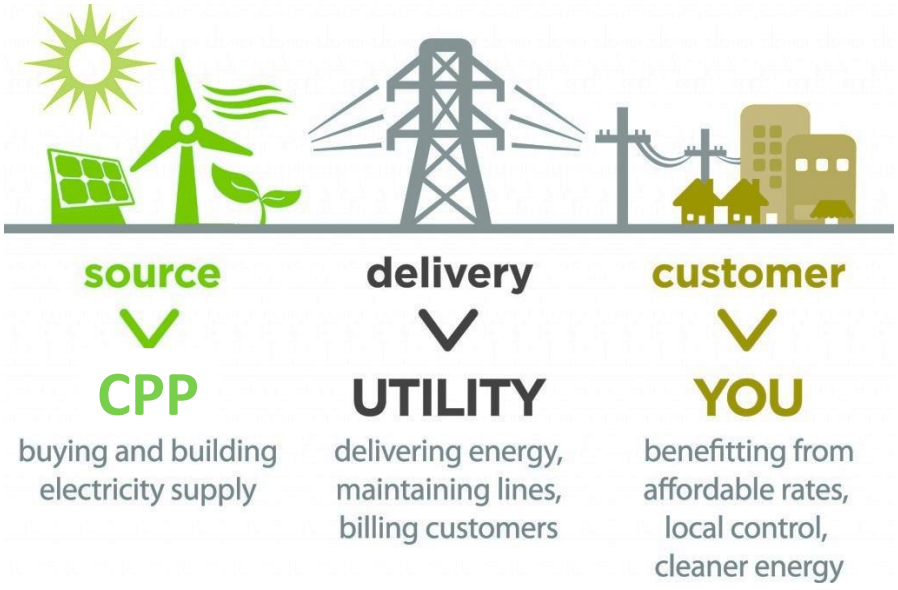
The following section summarizes key information related to each strategy, including a description, expected benefits and challenges, initial implementation steps, and examples of communities where the strategy has been implemented.

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

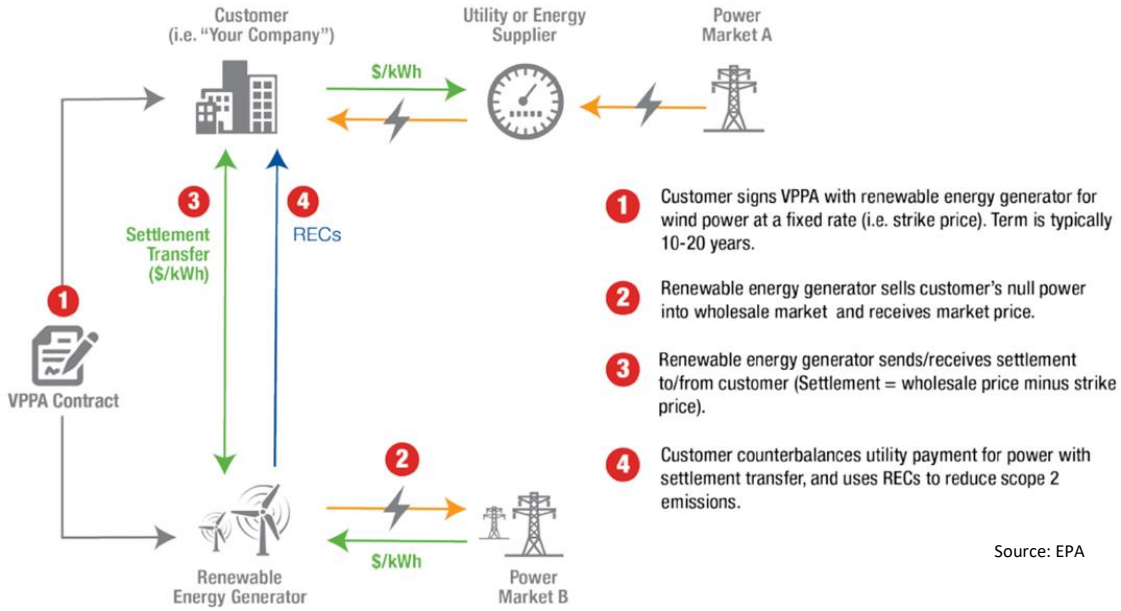
Cities and community power programs can **support the creation of additional renewable energy by entering into long-term contracts with renewable energy generators** in the form of a power purchase agreement (PPA) or virtual power purchase agreement (VPPA).

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.

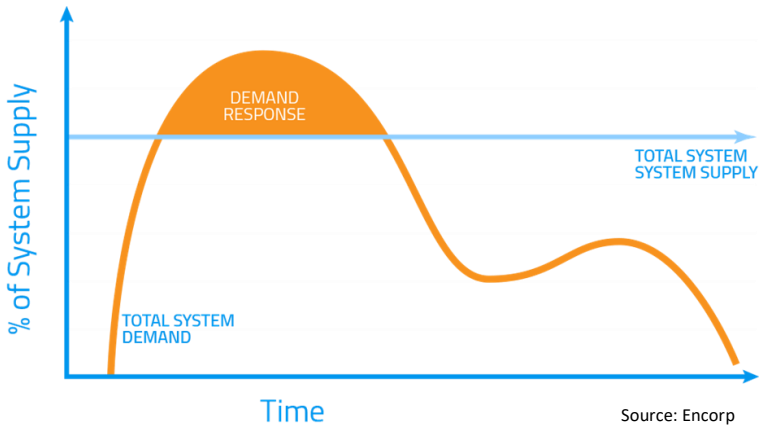
Strategy 3: Collaborate with the Utility to Develop a Pilot Battery Storage Program

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]

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.

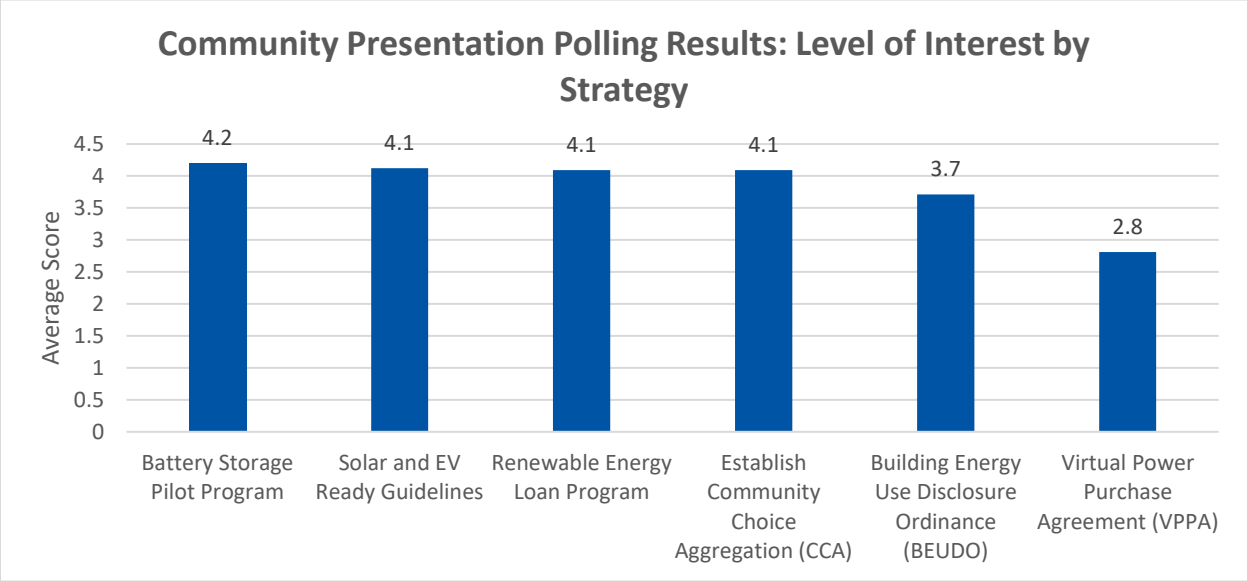
Solar and EV Readiness Reach Codes[86]: San Mateo, CA

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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CITY OF KEENE SUSTAINABLE ENERGY PLAN

Draft Outline / Table of Contents

THERMAL (HEATING AND COOLING)

Energy Context and 2020 Baseline

1. State Regulatory Context

State regulatory and incentive policy will influence whether and how the City of Keene may best carry out the recommended strategies of this Energy Plan. State policy trends suggest a current approach towards a renewable energy transition should prioritize reducing costs of energy for NH consumers, smoothing regulatory pathways and reducing compliance costs for renewable energy, lessening investment risks for renewable energy, and increasing the number of individuals and commercial businesses independently transitioning to renewable energy.[1] The following is a list of key state policies and measures that shape the renewable energy landscape in Keene today:[2]

Link program name to RSA (hyperlink) – because there will be online viewing; appendix include link and description

- **Residential Small Renewable Energy Rebate Program[3]:** New Hampshire enacted legislation in July 2008 requiring the state's Public Utilities Commission (PUC) to establish and administer a rebate program for certain renewable energy systems. There are two steps involved in the rebate application process. Rebates are awarded on a first-come, first-served basis.
- **Residential Solar Water Heating Rebates[4]:** New Hampshire offers rebates for residential solar water-heating systems. The rebate is equal to $1,500 for systems with an annual estimated output of 5.5 MMBTU to 19.9 MMBTU; $1,700 for systems with an annual estimated output of 20 MMBTU to 29.9 MMBTU; and $1,900 for systems with an annual estimated output of 30 MMBTU or more.
- **Residential Bulk-Fed Wood-Pellet Central Boilers and Furnace Rebate Program:** The New Hampshire Public Utilities Commission (PUC) offers rebates of 40% of the installed cost of qualifying new residential bulk-fed, wood-pellet central heating boilers or furnaces. The maximum rebate amount is $10,000 and the system must provide at least 75% of the home heating load needs.[5]
- **Commercial & Industrial Solar Rebate Program**: The New Hampshire Public Utilities Commission initiated a solar rebate program for non-residential applicants in November 2010. Funded by alternative compliance payments under the state's renewable portfolio standard (RPS), this program supports solar photovoltaic (PV) and solar-thermal installations. Installations must be located in the state of New Hampshire, and the facility must be served by an investor-owned utility or rural electric utility that is required to comply with the state's RPS (municipal utilities are not required to comply with the state's RPS, and therefore their customers are *not* eligible for this program). Systems owned by third parties and sited on eligible customer premises are eligible.[6]
- **Commercial & Industrial Renewable Energy Grants:** The New Hampshire Public Utilities Commission (PUC) offers grant funding for renewable energy projects installed at commercial, industrial, public, non-profit, municipal or school facilities, or multi-family residences with at least three units. The minimum award is $150,000, and the maximum award is $1 million. Eligible forms of energy include electricity or useful thermal energy generated from wind, ocean thermal, wave, current, tidal, hydrogen derived from biomass fuels or methane gas, methane gas, biomass, and hydroelectric technologies. Also eligible are geothermal ground source heat pumps, biomass, and solar thermal technologies producing useful thermal energy. Projects must utilize grant funds primarily for capital investments in new renewable energy facilities, upgrades to existing facilities to increase renewable energy production, or upgrades to existing renewable energy facilities that will qualify them as a “renewable source” for the production of renewable energy certificates (RECs) under RSA 362-F. Systems financed by third parties are generally allowed.[7]

- **Solar Easements:** New Hampshire's "solar skyspace easement" provisions allow property owners to create solar easements in order to create and preserve a right to unobstructed access to solar energy. Easements remain in effect for at least 10 years, unless otherwise stated in writing. A model solar easement form is provided in New Hampshire Statutes Section 477:49, 477:50, and 477:51.[8]
- **Business Energy Conservation Revolving Loan Fund:** The New Hampshire Business Finance Authority (BFA) administers a revolving loan program for businesses and non-profit organizations to finance energy efficiency improvements. The terms are flexible, and the BFA will work with interested applicants to customize a loan package that results in increased energy efficiency and financial savings. The initial minimum loan amount is $100,000, and an initial energy audit is required. Interested companies and non-profits should contact BFA directly for more information.[9]
- **Building Requirements for State-Funded Buildings:** New Hampshire enacted legislation (S.B. 409) in July 2010 stipulating that major construction and maintenance projects that receive state funding must meet a high-performance energy and design standard determined by the Department of Environmental Services and the Department of Administrative Services, in consultation with the Division of Historic Resources and the state's community college system. The standard, effective July 1, 2011, specifies that the building or structure can recoup the incremental costs of this requirement through reduced energy costs over 10 years.[10]
- **Standards for Municipal Small Wind Regulations and Model Ordinance:** New Hampshire enacted legislation designed to prevent municipalities from adopting ordinances or regulations that place unreasonable limits on or hinder the performance of wind energy systems up to 100 kilowatts (kW) in capacity. Such wind turbines must be used primarily to produce energy for on-site consumption. The law requires wind turbines to comply with all Federal Aviation Administration (FAA) regulations and applicable airport zoning regulations. It also includes rules and processes for the removal of out-of-service or abandoned turbines (at the owner's expense). Finally, it includes a requirement to notify immediate neighbors upon application for a building permit.[11]
- **Municipal Energy Reduction Fund**: In March 2010, the New Hampshire Community Development Finance Authority (CDFA) launched a revolving loan program to encourage the state's municipal governments to invest in energy efficiency and alternative energy. A wide variety of energy efficiency measures and alternative energy technologies are eligible, and the program is customizable, based on a municipality's needs. The CDFA also will work with municipalities to take advantage of other programs that might be available, including utility incentives and other loan programs. School districts are not eligible for this program.[12]

2. Local Providers

In contrast with the electricity sector, energy for heating and cooling comes from a much larger array of providers. There are about 10 local businesses in the area that supply the majority of heating oil to Keene customers, which is the most common fuel used to heat homes and businesses.[13] Each local company receives shipments of fuel from out-of-state or out-of-country and then delivers that fuel, whether oil, gas, and/or propane, by truck or via the local propane/air distribution system to customers in Keene. Keene has no out-of-city connected pipeline, so most fuels must be delivered by shipment to the New Hampshire coast and then driven to Keene by truck. There are no fossil fuel resources in the state so local providers are delivery services and technical resources, and not energy producers. Most heat fuels delivered to the Northeast United States are from the Mid-Atlantic region, the Gulf Region, or from Canadian drilling operations.[14]

1. Building Stock in Keene

Average profile of a residence in Keene

Residential housing in Keene ranges from 200 square foot cabins to a 126,190 sq. ft., 135-unit apartment building at the new 31 Washington Street building. A detached single-family home in Keene ranges from 420 square feet to 6,753 square feet, with the average housing being 1,578 square feet. For an attached single family home, the average square feet is similar, at 1,134 average living area. For multi-family homes with 2-4 units, the range is from 1,092 to 6,878 square feet, with an average of 2,493 square feet living area. In the 5+ unit sub-sector, which includes 5-8 units and 9+ units, the average building is 12,540 square feet.

Age of housing is also a distinct element in Keene that speaks to the possible efficiency of the average residential unit. The oldest homes in Keene were built in 1750 and the average house in Keene was built in 1945. While many of Keene's historic homes have undergone updates, older homes can still be holding on to inefficient heating systems and drafty living spaces.

What is the link between energy efficiency and home age?

As of now, there is no reliable measure for home efficiency for residences in Keene. Age of a home can be one proxy for understanding home efficiency and gauging energy waste from poor weatherization, insulation, or drafts.

As a property ages it is expected that its depreciation will increase or its remaining useful life will diminish. How a property is maintained may increase or decrease this effect. Proper maintenance like replacing worn shingles on a roof, repairing rotted siding, repairing wear and tear on flooring, and/or updating mechanical systems may help to reduce the amount of depreciation on an aging property.

(Include NEEP case study)

Source: City of Keene Housing Assessment, presented to City Council February 2020

According to US census data from 2014-2018, 53.6% of housing units occupied by the owner of that unit, meaning 46.4% of housing is renter occupied.[15] Many local assistance programs for home efficiency currently available in the state of New Hampshire require renter and owner agreement. We see as a trend in the country that landlords, builders, and owners who rent have historically perceived few incentives to invest in renewable energy because of the uncertainty of recovering their investment through higher rent.[16]

Renters and Owners: What is a Split Incentive?

From "Merging the Incentives of Energy Efficiency" by D. Edgel, et. al. from Western Washington University (2015)

The split incentive problem arises in rental units because landlords do not benefit financially from making energy-saving investments to their rental properties. The rental market fails to incentivize landlords to make efficiency upgrades, because even the thriftiest renters are unable to compare

future energy costs across potential homes.[17] Certain US national policies have sought to address this issue, specifically provisions for green leases and rental efficiency standards.

Green Leases

A Green Lease is a private, voluntary arrangement between the landlord and tenant(s) to improve the efficiency of the rental property. The lease specifies improvements that the landlord has made or will make and lists the expected monthly energy savings from such investments. The landlord then raises the monthly rental rate by some percentage of that amount (usually 75-90%), so that both parties end up with more money than they would otherwise have each month.[18]

Rental Efficiency Standards: *A case study in Boulder, CO*

Rental efficiency standards are mandatory limits to how inefficient a home may be. The first city to enact rental efficiency standards is Boulder, Colorado. The standards, titled SmartRegs, were enacted in 2011. SmartRegs set a Home Energy Rating System score that each rental home must comply with by 2019. In the meantime, the city offers energy audits at the request of current rental license holders, at which it provides potential pathways to SmartRegs compliance. Any rental property not in compliance with SmartRegs by 2019 will be refused a rental license, without which the home may not be leased out.[19]

Vulnerability

While the weekly residential heat oil and propane prices in New Hampshire have not had a huge overall increase in the last 15 years, the price of propane and oil have been unpredictable and subject to spikes in the most-needed winter months (Figure 3). On top of that, the state of New Hampshire consistently has higher than average fuel costs than the rest of the country (Figure 4). The cost inconsistency 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 in high-demand months.

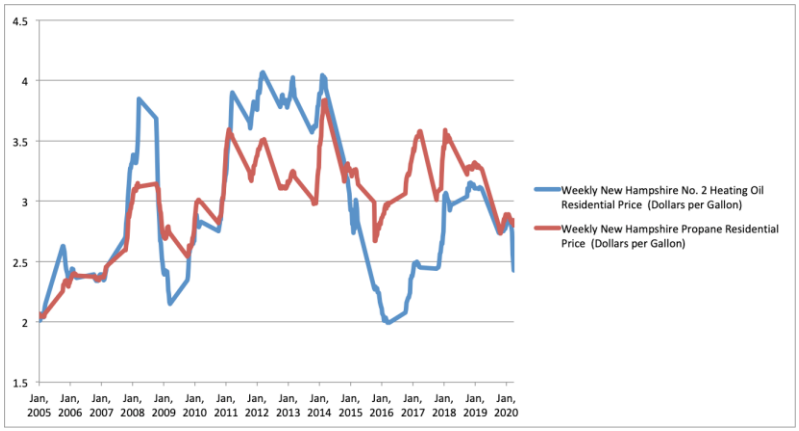


Figure 3: Weekly Residential Heating oil and Propane costs for October-March, 2005-2020[20]

As a whole, New Hampshire has higher- than-average energy costs. Natural Gas and Electricity cost residents and businesses in New Hampshire 48% to 108% more for energy services than the US Average (Figure 4). Though Keene has little natural gas fuel used in buildings, transitioning the existing

propane/air pipeline distribution system to natural gas is slowly in the works with Liberty Utilities, potentially yielding more households with access to a natural gas option.[21]

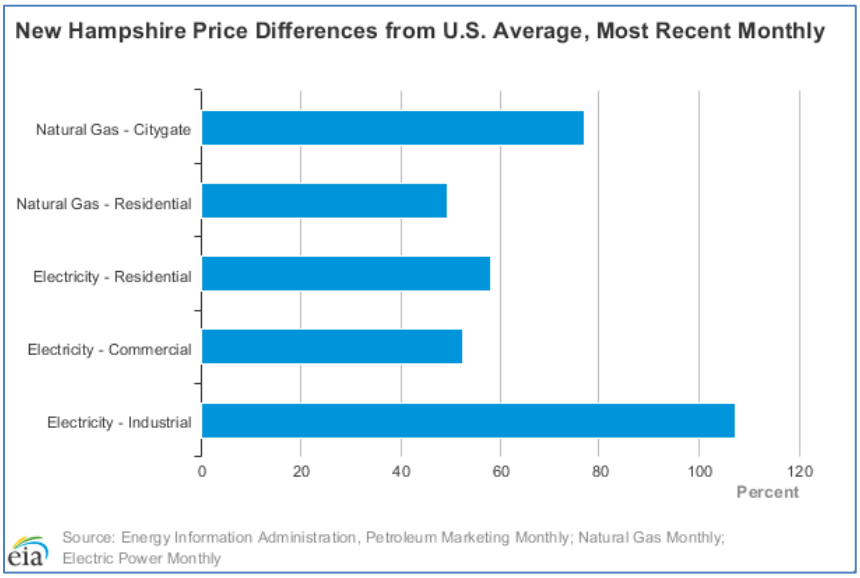


Figure 4: Percent above US-average that NH Hampshire residents pay for building costs in January 2020.[22]

2. Local policies and initiatives

- New Hampshire Saves
  - NHSaves is a collaboration of New Hampshire's electric utilities working with the New Hampshire Public Utilities Commission and other interested parties. NHsaves provides links and information on how customers can qualify for rebates and other incentives, including commercial and industrial energy efficiency options.[23]
  - 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 my this program. 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. HPwES is already working with 12 homes as of March 2020.

- Southwestern Community Services
  - *Weatherization Assistance*
    The 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.[24]

- *Heating Repair and Replacement Program*
  The 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.[25]

3. Innovative Action in Keene

1. *Project*: KSC Biofuel

Keene State College (KSC) began its transition away from fossil fuel use and storage by incorporating recycled vegetable oil at its Heat Plant back in 2016. Regionally refined (Mass.) waste "veg oil" can replace traditional heating oil, including the heavy No. 6 oil Keene State used for years. The product KSC selected is rated as a carbon-neutral biofuel. This fossil-free biofuel was gradually utilized at the KSC Heat Plant to verify that it could provide heat and hot water to a portion of the campus. Initial tests proved positive, so KSC expanded the fuel's use to heat more of the campus, eventually converting the entire heat plant to biofuel in just two years, in 2018. This conversion is essential to Keene State meeting its sustainability goals and climate commitments. The project beat KSC's goal to operate a fossil fuel-free heat plant by 2020.

Minimal upfront costs and staff time were needed use the biofuel, and the environmental benefits have already proved to be significant for the campus and the greater Keene area. KSC realized thousands of dollars in renewable energy credits, and is 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. The fuel also saved KSC thousands of dollars in its emissions permit fees issued by the state. When the heat plant used heavy oil, KSC paid over $21,000 in permitting fees annually; that cost went down to just over $2,000 once the entire heat plant was converted, a considerable benefit both to KSC and the region's air quality.

With state and federal renewable energy incentives and credits, the biofuel was procured at a cost comparable to the fuel oil that the College had used for decades. An added benefit is that KSC is able utilize its own waste oil from on-campus food service stations to make up part of the feed stock that is refined into the fuel that KSC uses at the plant. Other Keene-area businesses recycle their used grease, which is then refined to make this clean heating oil.[26]

2. *Project*: Keene Middle School Renewable Energy Infrastructure

Built in 2011, Keene Middle School (KMS) boasts impressive renewable energy infrastructure and high performance features, including a wood chip heating plant, a 30,000 gallon rainwater harvesting system, reflective roof surface, extensive daylighting, heat recovery ventilation, energy management system, and energy efficient lighting.[27] Because it meets the criteria for the Northeast Collaborative for High Performance Schools (NE-CHPS), the $35.8 million project was eligible to receive an additional 3 percent aid from the New Hampshire Department of Education.[28]

Adjacent to the SAU building is a new wood chip heating plant, which serves not only the middle school and the SAU building, but also the existing Jonathan Daniels School.[29] According to Ken Dooley, the Director of Buildings and Grounds for the Keene School District, the SAU building and Jonathan Daniels School (JD) have used almost no heating oil since the biomass plant was installed. JD and KMS both have backup oil boilers that are only used if the biomass plant fails. On average, the biomass plant burns about 1,000 tons of hard wood chips each season, which is approximately 16,800 MMBTUs per year, equivalent to 121,739 gallons of

heating oil. This indicates that over 1 million gallons of heating oil have been avoided over the 9 heating seasons that the biomass plant has been in operation.

3. *Local Climate Action Groups*

The City of Keene and the greater Monadnock area are hosts to a number of volunteer groups with missions dedicated to climate action. Groups range from university sponsored education hubs to local chapters of worldwide and national groups like the Sunshine Movement and Sierra Club.[30]

Spotlight: Clean Energy Team

The Clean Energy Team of the Monadnock Progressive Alliance launched a campaign on April 21, 2018 to transition Keene to a 100% clean, renewable energy future. Specifically, they called for 100% of energy used for electricity to come from renewable energy sources by 2030, and for 100% of energy used for heating, cooling, and transportation to come from renewable energy sources by 2050. The team spent months talking with local elected officials, local businesses and non-profits, the Greater Keene Chamber of Commerce, private citizens, Keene State College, and Antioch University to educate and to bring them on as stakeholders. In November 2018, CET members asked City Council to make a formal commitment to the 100% renewable energy goals by adopting a sustainable energy resolution. The City Council passed the resolution in January 2019. Since then, CET has worked with Keene's Energy and Climate Committee and the Community Development Department to educate the public through events, lectures, films, conversations with the private citizens, and workshops to get the word out and to elicit public input. For more information, visit www.cleanenergykeene.com.

Spotlight: Monadnock Sustainability Hub

The Monadnock Sustainability Hub works to reduce greenhouse gas emissions, accelerate the adoption of energy efficiency and renewable energy technologies, and improve energy security and resilience in our local communities. The Hub is a non-profit (501c3) connecting the efforts of local energy committees, organizations, businesses, and individuals that share these goals.

Projects have included development of the Monadnock Food Co-op's Community-Supported Solar installation, collaboration with the County Conservation District to develop a "Community-Supported Solar for Farmers" PV installation, and support for local Solarize campaigns. The Hub has also coordinated Drive Electric events and a Fast Charge Monadnock initiative to bring more electric vehicle charging to the region. Educational outreach has included sponsoring the "Clean Energy" track at the Radically Rural conference in 2019.

B. Thermal Baseline: Residential, Commercial, and Public Sectors

i. Residential Sector

What is the residential sector in Keene?

The residential sector, or where the people of Keene live, is broken down by *units-occupied* for the purposes of the Energy Plan. That means within the residential sector, we look closer at three main sub-categories to help decision makers understand energy systems in Keene.

The Residential Categories are:

- Single Family Homes
- 2-Family Home
- Multi-Family & Other

Multi-Family & Other includes sub-categories that give a finer picture of housing in Keene:

- 3-unit
- 4-unit
- 5-8 unit
- 9+ unit
- Elderly Housing
- College Dorms
- Public Housing
- Manufactured Homes
- Rooming Houses

In total, the City of Keene has nearly 7,300 residential properties (assessing data) making up 50% of the total square footage of buildings in Keene. In reference to square footage, this assessment looks at the total living-space area, not total area of a building. This means unfinished and unheated areas are not included in living-space area.

Residential Building Energy Consumption Baselines

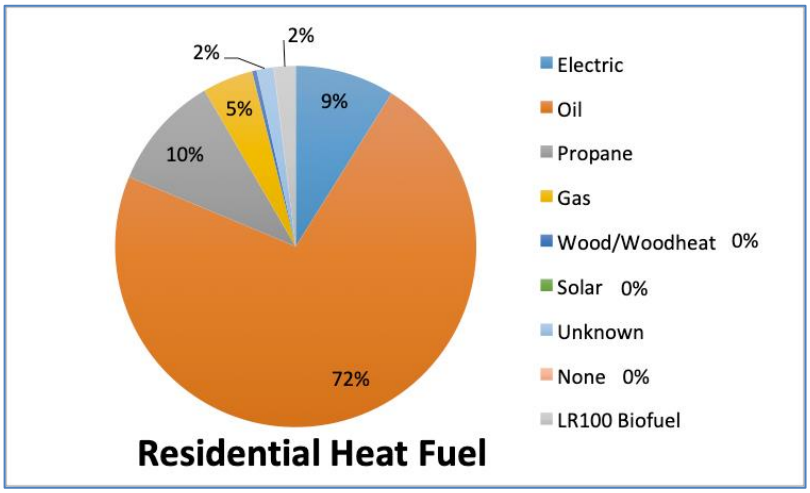


Figure 5: Residential Heat Fuel by percent of total residential buildings area (in square feet)

In Keene, almost three-fourths of the total residential area (in sq.ft) is heated by oil. According to the Energy Information Administration, more than two-fifths of all households in New Hampshire rely on fuel oil as their primary heating fuel. Because of this, residents are particularly vulnerable to fuel oil supply constraints and price spikes during the winter months when most of the fuel is burned for heating.

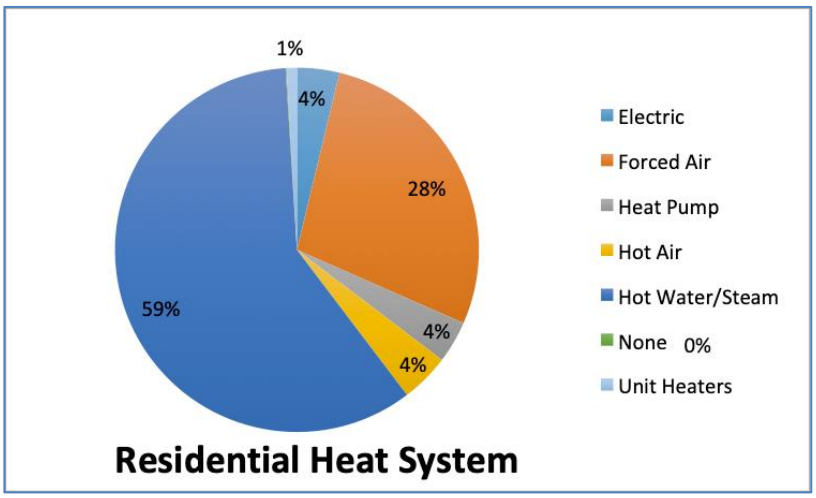


Figure 6: Residential Heat System by percent of total residential buildings area (in square feet)

Residential heating systems can correlate to house age and efficiency. Just over half of heat systems hot water/steam and almost one-third is Forced Air. Electric heating systems only make up for 4% of total heated residential area in Keene as of 2020.

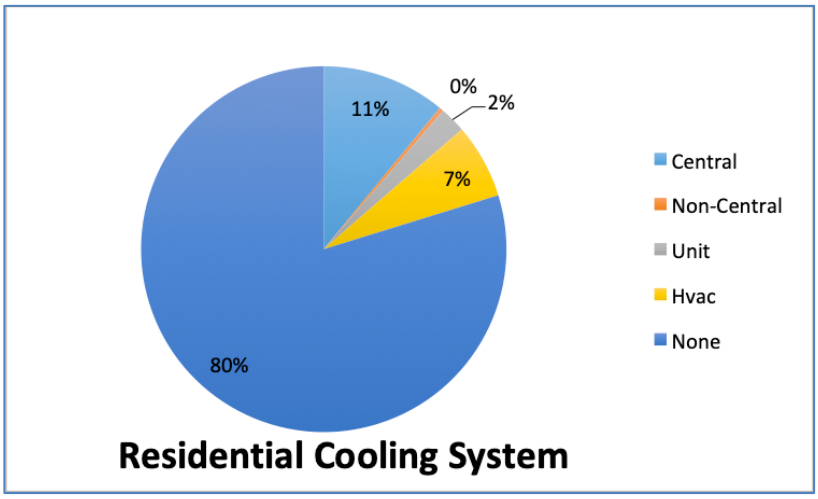


Figure 7: Residential Cooling System by percent of total residential buildings area (in square feet)

Cooling systems in the residential sector appear much less frequently than commercial or non-profit sectors. A large majority of residential units have no cooling infrastructure. Due to warming trends in the state, the EPA predicts that warming could affect the demand for AC for residential units and be an additional drain on residential energy consumption.

ii. Commercial & Industrial Sector

What is the commercial sector in Keene?

A commercial building is one that serves the primary purpose of running a commercial or industrial business. This sector also includes mix-use buildings in which commercial properties may also have attached residential units. By area (sq.ft), the commercial business sub-category makes up 75% of this sector, with 20% of the area in industrial, and just under 5% counted as mixed-use properties.

The sub-categories of the Commercial Sector are:

- Commercial Business
- Industrial
- Mixed-used

Commercial Building Energy Consumption Baselines

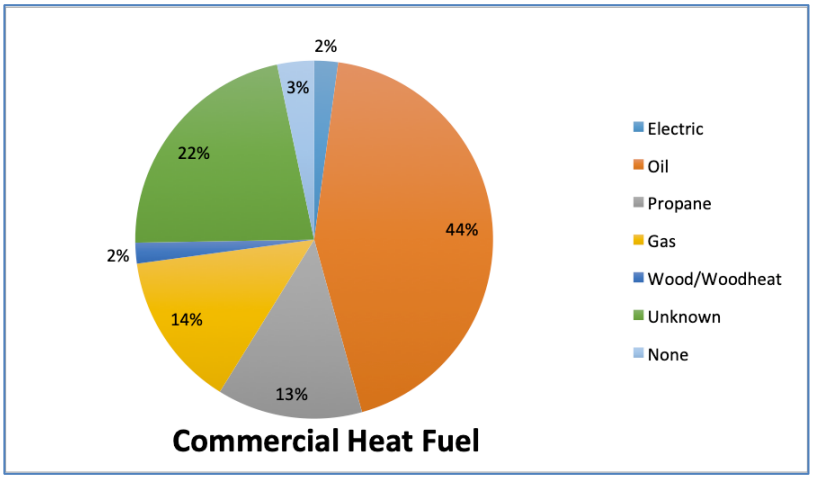


Figure 8: Commercial Heat Fuel by percent of total commercial buildings area (in square feet)

Though the commercial sector presents more of a fuel balance, oil heat fuel is common in industrial (58%), commercial (40%), and mixed-use (78%) sectors. "Unknown" accounts for a 22% overall square footage, 25% within commercial, only 4% of industrial, and 34% of mixed-use.

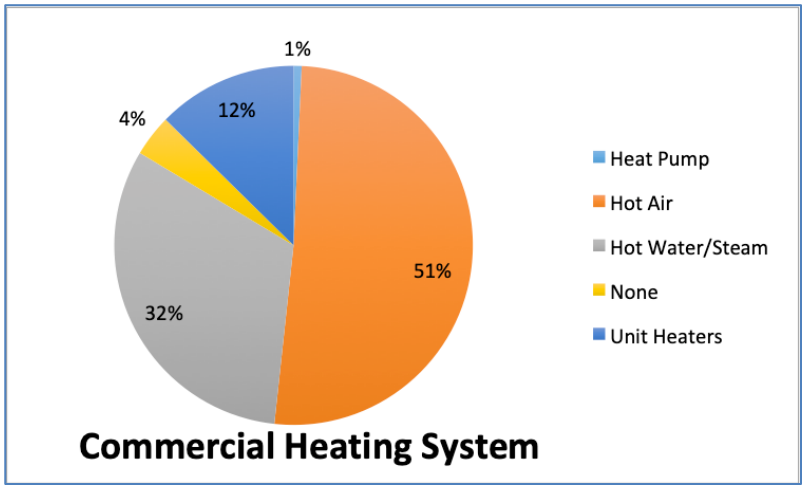


Figure 9: Commercial Heating System by percent of total commercial buildings area (in square feet)

Though all sectors had low area powered by electric systems, the commercial has no electric systems present and almost no heat pump systems according to City of Keene Assessing data. Industrial and mixed-use buildings had no reported heat pumps, and commercial buildings showed less than 1% of area with heat pumps

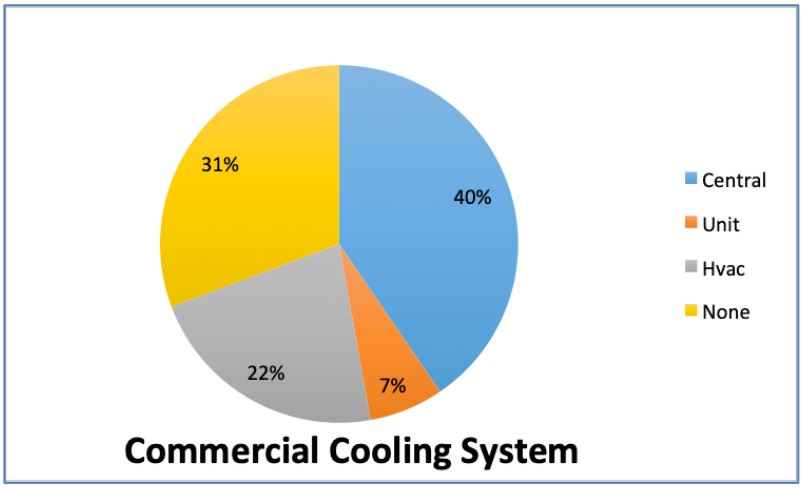


Figure 10: Commercial Cooling System by percent of total commercial buildings area (in square feet)

We see more of an even breakdown of cooling systems, with the square footage with some form of AC (69%%) being more than the space without cooling (31%). Though unlike commercial or industrial, the mixed-use units do report most units without cooling systems (46%).

iii. Public & Nonprofit Sector (incl. Education – K-12, higher Ed., etc.)

1. Heating, cooling, & electricity

What is the Public, Nonprofit, and Education (from hereon, Public/Nonprofit) sector in Keene?

The Public/Non-Profit sector of Keene envelopes a broad swath of buildings in the city, which includes charitable buildings, municipal buildings, state and national government buildings, Keene's many higher educational buildings, and the public schools K-12 within city limits. Non-profit and educational buildings are typically tax-exempt and as such the data the city collects on their energy systems is typically less complete.

Categories within Public/Non-Profit:

- Government
- Higher Educational Institutions (incl. Keene State College)
- Public Schools K-12
- Non-Profit

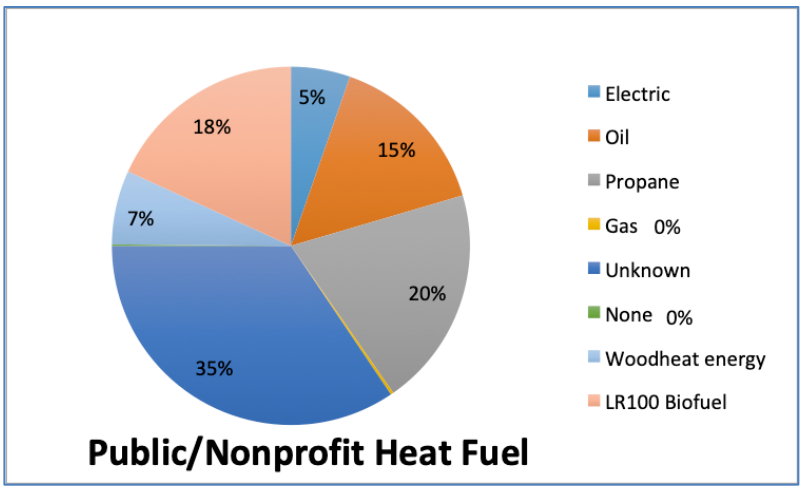


Figure 11: Public/Nonprofit Heat Fuel by percent of total public buildings area (in square feet)

The heat fuel for the public sector is largely "Unknown" (35%). In two sub-sectors do we get a better picture of the primary heat fuel: Government (propane, 48%) and Public Schools (oil, 52%). The 18% Biofuel comes from the Keene State College Biofuel conversion in 2016. It is of note that wood heat energy makes up 28% of area in Public

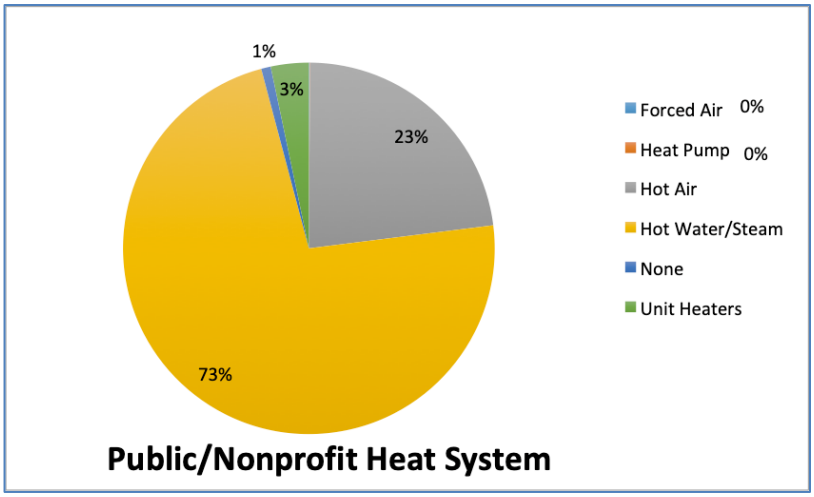


Figure 12: Public/Nonprofit Heating System by percent of total public buildings area (in square feet)

Hot Water/Steam again are the most prevalent system, making up 73% of area in the public sector. In the public sector, we see no use of electric systems, with neither electric nor heat pumps. Only a small proportion of buildings have no heating systems.

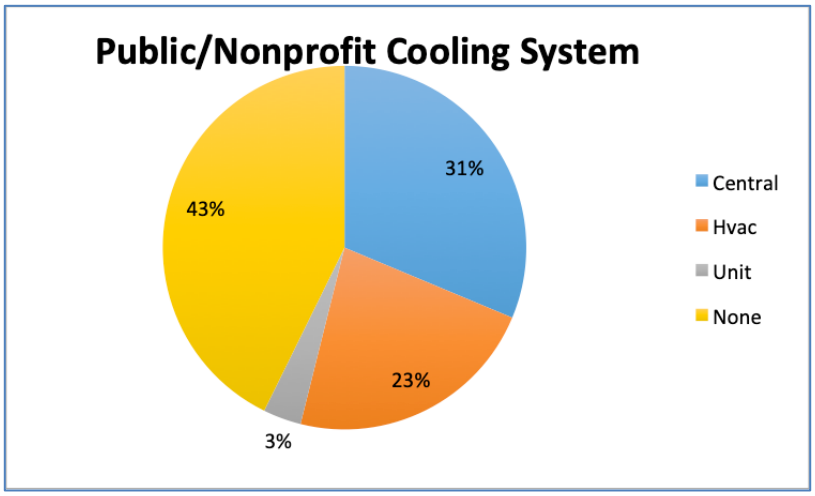


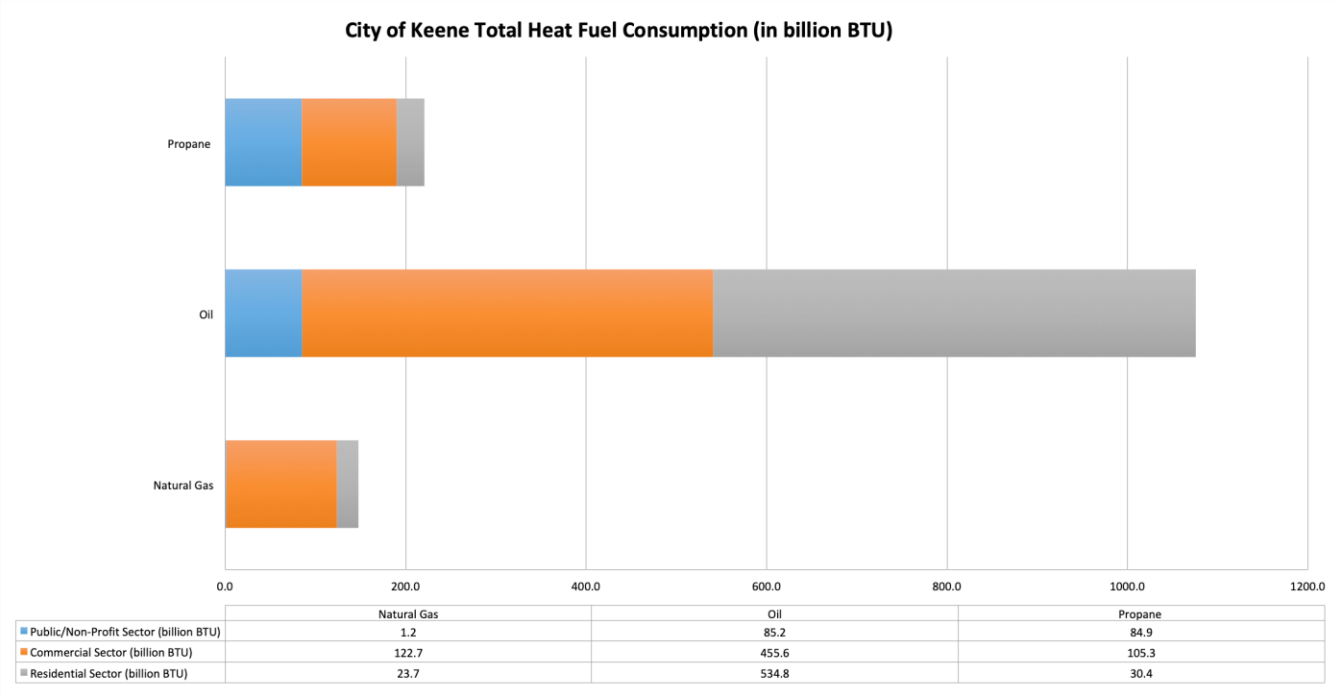
Figure 13: Public/Nonprofit Cooling System by percent of total public buildings area (in square feet)

Cooling systems were majority present in all sub-categories, except Public Schools where cooling systems of any kind only represented 3% of the total square footage. Government buildings were the sub-sector with the most cooling system prevalence, with 80% of government building area having a cooling system.

In regards to the "Unknown" properties, while major property holders were able to report heat fuel that was no provided in Assessing data, the remaining 200 buildings from across the sectors are owned by individuals, trusts, or non-profits. At the time it is not feasible to contact the individual entities for heat fuel verification.

Heat Fuel Consumption in Keene

Distribution of heating systems and heating fuels based on square footage in Keene helps us understand average consumption in the city in one year. To estimate consumption (in billion BTU) for the three buildings sectors, 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.[31] Because the electricity for heat and electricity for plug load cannot be separated, this consumption profile looks at the three most used heat fuels in Keene: oil, propane, and natural gas.



	Natural Gas	Oil	Propane
Public/Non-Profit Sector (billion BTU)	1.2	85.2	84.9
Commercial Sector (billion BTU)	122.7	455.6	105.3
Residential Sector (billion BTU)	23.7	534.8	30.4

Two methods were used to estimate Keene's heat fuel consumption for propane, oil, and gas. For residential buildings, the US EIA data for Average Site Energy Consumption in the Northeast US, recorded in million BTU per household using the fuel type, was applied to local figures for Keene. For each fuel – propane, oil, and natural gas 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: 16.4 billion BTU for Gas, 436.5 billion BTU for Oil, and 25.7 billion BTU for Propane.

For the Commercial and Public/Non-Profit sectors the estimates are also based on US EIA data, which estimates in New England (very cold/cold climate designation) 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 sum fossil fuel use in BTU; the following figures were used in calculation:

- Propane: 88 thousand BTU/square foot
- Oil: 115 thousand BTU/square foot
- Natural Gas: 96 thousand BTU/square foot

That average was multiplied by the total square footage of heated area in each given heat fuel in Commercial and Public/Non-Profit buildings.

Residential, Commercial, and Public/Non-profit consumption figures can be better understood for accuracy when they are converted to "native" units people are more familiar with. Based on average consumption, Keene buildings consume an estimated 148 billion BTUs of Natural Gas, 221 billion BTUs of propane, and 1,076 billion BTUs of Oil per year. Using the US EIA conversion table[32] that equates to:

	BTU consumption	**Conversion ratio (US EIA)**	**Total consumption/year**
Natural Gas	148 billion BTUs	1 cubic foot of natural gas = 1,036 Btu	143 million cubic feet
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

Given the nearly 7,300 assessed buildings in Keene, that could also be explained by building, bearing in mind that any average includes all sectors and a huge range of building size diversity.

	Total consumption/year	**Average consumption per building/year**
Gas	143 million cubic feet of natural gas	22,000 cubic feet of natural gas
Propane	2.4 million gallons of propane	328 gallons of propane
Oil	7.8 million gallons of heating oil	1,068 gallons of heating oil

If the average cost of #2 heating oil in New Hampshire was $2.93 in 2019, than if my building used 1,068 gallons of #2 heating oil a year, that means I would pay $3,129.77 on heating oil a year. That works out to $260.81 per month.

Keene Energy Cost Survey Results

In 2020, the City of Keene partnered with two Keene State College students to survey the city's residents to better understand how the cost of electricity, heating, and transportation impact each resident. Over 2 months, the survey reached 75 households, 68 of which were in Keene and 7 of which were in neighboring towns.

Of those surveyed, over 50% of residents paid on average between $101-300 for heating costs each month during heating season. Even so, 53% of respondents did say they had participated or their landlord participated in energy efficient upgrades and/or in a weatherization program. Most of the participants (72%) had reduced their home energy use by purchasing EnergyStar rated appliances and/or LED lights, among other actions. Just over half of respondents had weatherized their homes in the past ten years. In relation to choosing to keep their homes cooler than they'd like, 64% of those surveyed said they had done this in order to save energy.

Overall, even though participants rated their worry over heating energy costs at a 4 out of 10, many (70%) of the respondents said their heating or electricity costs had been a barrier to contributing to retirement savings or personal savings. Also ranking high, 47.5% of people said the cost of energy was a barrier to paying other bills, like groceries and 50% and 62.5% said paying for energy had been a barrier to leisure activities, like taking a vacation or participating in social activities that cost money, respectively.

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[18] (Cite MERGING THE INCENTIVES OF ENERGY EFFICIENCY by Daniel Edgel, Bret Stevens, and Martin Arpin, Western Washington University December 2015).

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TRANSPORTATION

Energy Context and 2020 Baseline

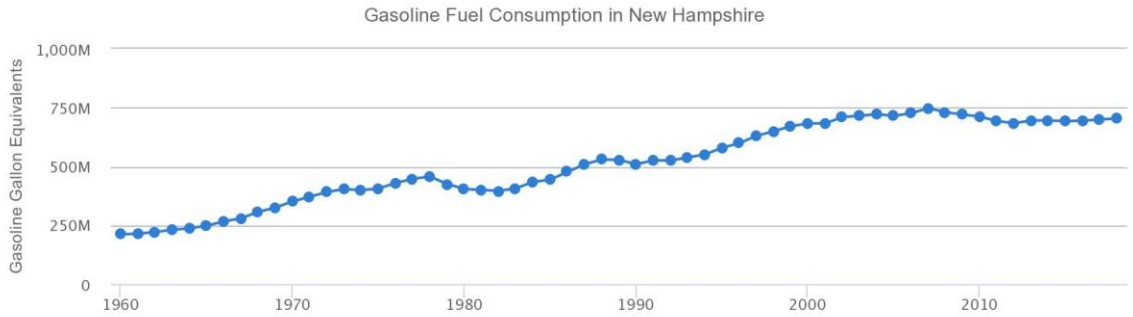
Introduction to Transportation Sector

The Transportation Sector refers to how residents travel from place to place as well as the infrastructure and related systems that support 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 for Keene residents and transportation infrastructure. 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, and as such, the transportation strategies in this plan are intended to have a broader impact.

The Transportation baseline looks at 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 factors that result from our reliance on combustion fuels.

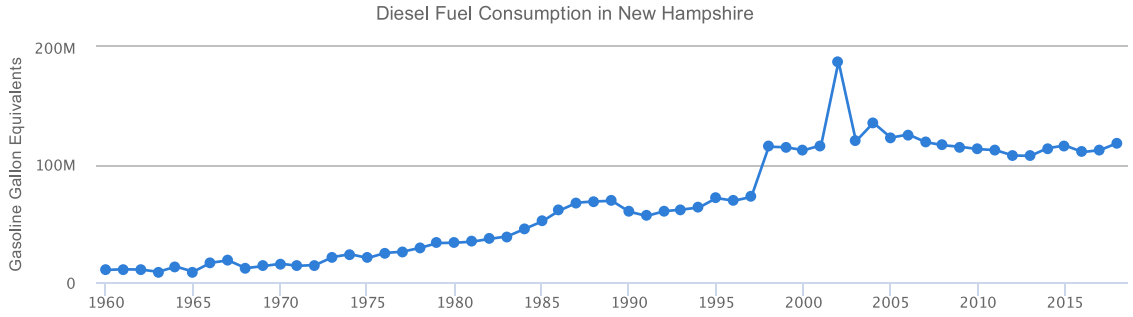
State Transportation Context

According to state averages, gasoline consumption has been on a steady rise since 1960, escalating three-fold from 250 million gallons of gasoline per year to nearly 750 million gallons per year after 2010.[1]



Gasoline Fuel Consumption in New Hampshire in Gasoline Gallon Equivalents, from the Alternate Fuel Data Center (1960-2015)

Diesel consumption in the state has had a similar, though less steady consumption trajectory, with very low reported consumption in the 1960s, to a boom in the early 2000s, to 2015 where levels evened off at about 100 million gasoline gallon equivalents consumed in diesel in the year.[2]



Diesel Fuel Consumption in New Hampshire in Gasoline Gallon Equivalents, from the Alternate Fuel Data Center (1960-2015)

The state funding trends for highways versus public transit and the mobility of people in Keene and New Hampshire today is a good reason why the transportation sector makes-up 32% of total energy consumption in the state of New Hampshire, while electricity and heating consumption from residential, commercial, and industrial sectors combined represents the other 68% of consumption, measured in BTUs.[3]

As of 2012 the state's public road system includes over 16,000 miles of roadway, approximately 25 percent of which are maintained by the State. The New Hampshire Turnpike System includes 89 miles of limited access highway, on which motorists are charged a toll. And the Statewide National Highway System includes 790 miles of the federal designated National Highway System (NHS).[4]

It is worth noting that the New Hampshire state budget does not include operating funds for transit (bus or rail), which limits resident options dramatically.[5] Funded by private and non-profit services, fixed route transit service is operated in 11 areas of the state, providing over 3.5 million person-trips per year (2009).[6] Although the current distribution of funding does not necessarily reflect demand; the success of park and ride lots and associated transit/ridesharing indicates a demand for alternative transportation, and possibly passenger rail service.[7]

1. Registered Vehicles

According to vehicle registration data from December 2019, the number of registered light-duty vehicles in Keene (19,911), and the number households estimated by the American Community Survey (9,346), means that the ratio in Keene is 2.1 cars registered per 1 household. Keene has a 1:1 ratio of car per residents over 16 years of age, which the 2017 American Community Survey estimates as 20,016 residents.[8]

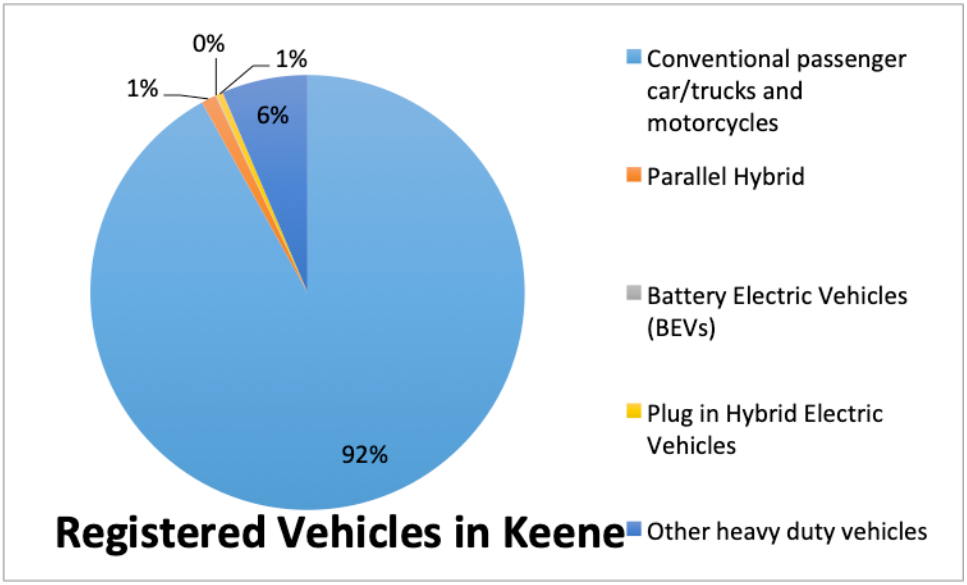


Chart shows % of total registered vehicles in Keene, as of December 2019 (Source: NH-DES)

Conventional passenger cars, trucks, and motorcycles make-up an overwhelming majority of the total vehicles registered by the city. In total, 18,500 passenger cars, trucks, and motorcycles were registered as of December 2019, making up 92% of all vehicles registered. Only 222 vehicles are conventional hybrids (1%), 101 vehicles are plug in hybrid-electric vehicles (1%), and 15 vehicles are battery-electric vehicles (BEV), or

what we more commonly refer to as electric cars. Currently, the fraction of all hybrid and BEVs to total cars in Keene is less than 2 per 100 cars in Keene (1.7 hybrid/BEV for every 100 cars in Keene).

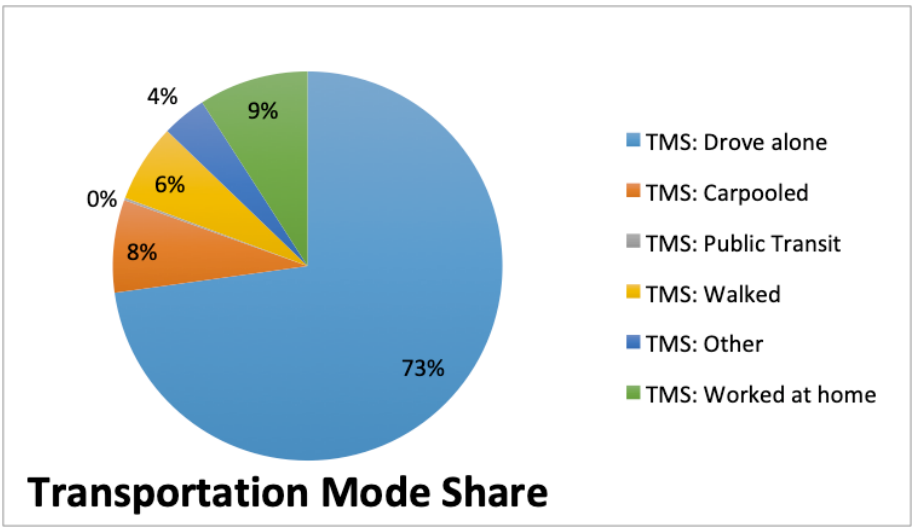
For the purposes of this plan, the focus is on alternative fuels and technologies that are currently available; however, as technology advances, there may be a shift in the market for new alternative fuels or technologies. Keene should explore other alternative technologies and fuels as they become technologically and economically feasible.

Conventional and Electric Vehicle Designation: An Overview

Conventional Passenger Car	Parallel Hybrid Vehicle (PHV)	Plug-In Hybrid Vehicle (PHEVs)	Battery Electric Vehicle (BEV)
Conventional passenger cars are motor vehicles with internal combustion engines. This includes gasoline, diesel, and flex (ethanol capable) vehicles.	Parallel Hybrid Vehicles (PHVs) are powered by an internal combustion engine and an electric motor. The electric engine uses energy stored in batteries that may recharge during breaking, also called regenerative breaking.[9] PHVs combine the benefits of high fuel economy and low tailpipe emissions with the power and range of conventional vehicles.[10]	Plug-in Hybrid Electric Vehicles 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.[11] Batteries can by charged by an outside electric power source, by the internal combustion engine, or through regenerative braking.	Battery Electric Vehicles operate on electricity alone. The batteries must be charged by an outside electric power source. Charging times vary based on how depleted the battery is, how much energy it holds, the type of battery, and the type of Electric Vehicle Supply Equipment (EVSE) being used.[12]

2. Transportation Mode Share

A combination of infrastructure, long-winters, and social norms make Keene a passenger car dominant city.



Percent of total workers 16+ (11,788, according to the American Community Survey in 2017)

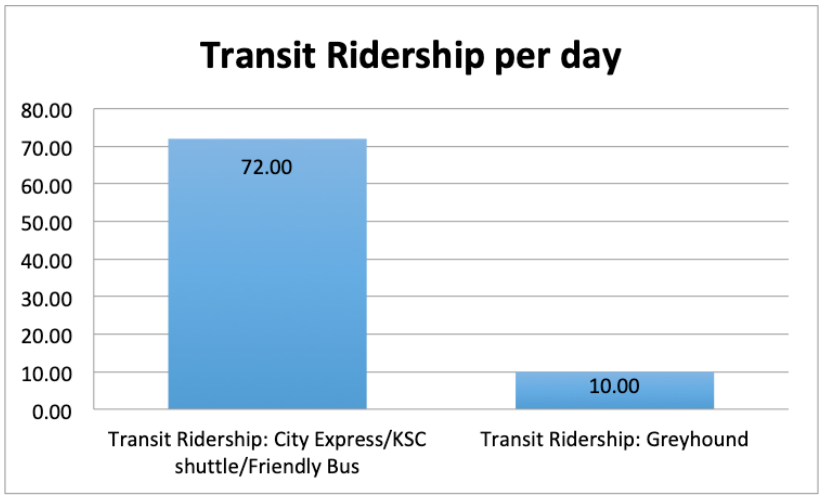
The vast majority of Keene workers over 16 years of age reported driving alone to work or school. According to Transportation Mode Share data from the American Community Survey in 2017, 73% of respondents drove alone for their commute, and only 8% carpooled.[13] Driving alone offers the flexibility desired by many commuters, and as of 2020, the city does not have a clear platform for ride-sharing or coordination for carpooling that would accommodate workers' commute and errand-related needs.

Public Transport

An efficient and well-used bus system can also help meet the needs of Keene's residents, provided the system design is informed by the population's needs and patterns of travel.

Keene is currently home to one fixed-route bus system, the City Express Bus, and a demand-response bus designated to meet the needs of people 60-years or older, the Friendly Bus. During the college school year, the Keene State Campus Community Shuttle bus is also available for Keene resident use. The City Express Bus and the Friendly Bus are both operated by Home, Healthcare, Hospice and Community Services of Southwestern New Hampshire (HCS).

The City Express service has two operating bus lines (the Red line and the Black line), which run outside of typical work hours with both lines starting at 8:00am and finishing at either 4:09pm or 5:04pm, Monday through Friday. Both routes originate and terminate at the Keene Transportation Center, and a bus runs once every hour for the respective 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.[14] Given those factors, ridership is estimated by the 2018 American Community Survey as 27 (+/-32) people per day[15] and HCS reports an average of 72 riders per day, with some fluctuation due to whether or not Keene State College is in session.

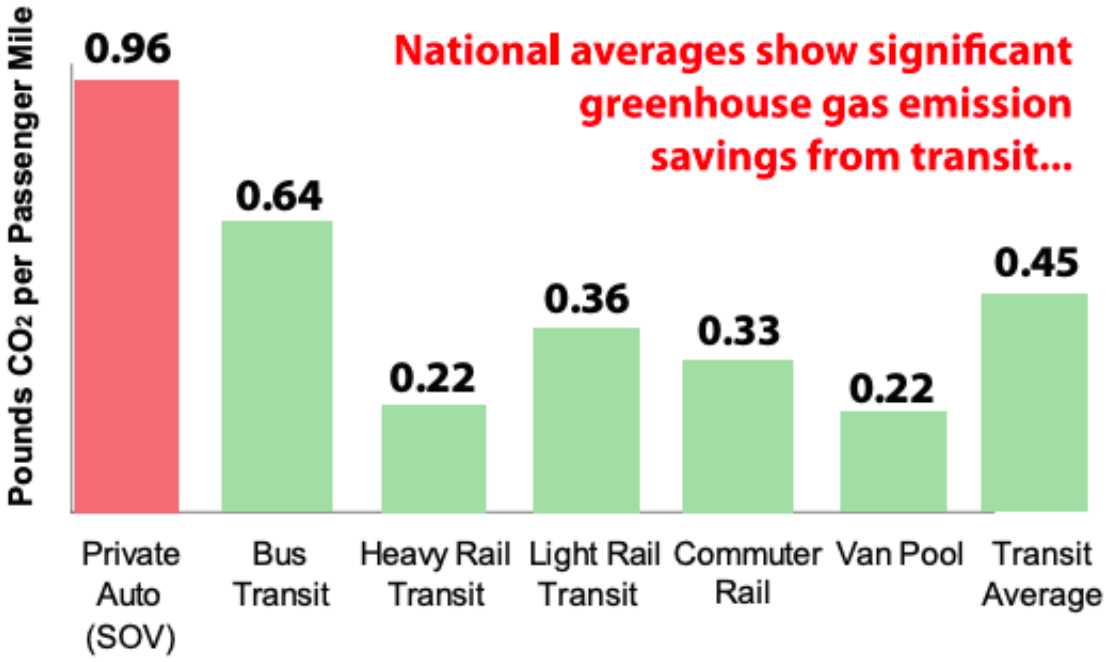


Average transit ridership per day for the two main bus services coming through Keene's Transportation Center

Two Greyhound Bus routes also come through Keene Transportation Center, heading either North to White River Junction and beyond, 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 a 5 riders getting off the bus each day.

In a 2010 report, the US Federal Transit Administration examined the national transportation sector's greenhouse gas emissions, and found that while a single-occupancy vehicle (SOV), also known as a passenger car, contributes almost 1lb of CO2 per passenger mile, bus transit contributes only 0.66lb of CO2 per

passenger mile. The City Express Bus falls under the category of "Van Pool" because it is a small bus, not a large city bus, which emits even less CO2, at 0.22lb CO2 per passenger mile.[16]



Federal Transit Administration analysis of CO2 emissions from diverse forms of transportation (2010)

I. Current policies, regulations, and incentives

1. State and Local Funding, Incentives, and Programs[17]

Diesel Emissions Reduction Grants: The New Hampshire Department of Environmental Services (NHDES) provides U.S. Environmental Protection Agency Diesel Emissions Reduction Act (DERA) funding for projects that reduce diesel emissions in New Hampshire. Funding for between 25% and 100% of eligible project costs is available for businesses, individuals, and local or state agencies that reduce diesel emissions by converting engines to alternative fuels, retrofitting exhaust controls, purchasing new vehicles, or adding idle reduction equipment.[18]

Transportation Alternative Program (TAP): TAP was created under a federal law known as Moving Ahead for Progress in the 21st Century (MAP-21) to consolidate many stand-alone programs into a single, more flexible program. Programs replaced by TAP are Safe Routes to School, Recreational Trails, Transportation Enhancement, and Scenic and Cultural Byways. TAP is a federally-funded, state-administered program that seeks to provide choices for non-motorized users that are safe, reliable, and convenient.[19] The funding breaks down to 80% federal and requires a 20% local match. In many states, the state government will provide part of the local match required for this program; however, New Hampshire does not currently put any state funding towards this program.

Recreational Trails Program: the Department of Resource and Economic Development administers the Recreational Trails Program. Recreational Trails Program (RTP) is a competitive grant program that offers funding for quality public trail projects throughout New Hampshire. Limited grants are available for motorized, non-motorized and diversified trails. Eligible projects include maintenance and restoration of existing trails, purchase and lease of trail construction and maintenance equipment, construction of new

trails, development and rehabilitation of trailside and trailhead facilities and trail linkages. Applicants may be non-profit organizations, private groups or government entities.[20]

Congestion Mitigation Air Quality Program (CMAQ): The Congestion Mitigation and Air Quality Improvement (CMAQ) Program provides funds to States for transportation projects designed to reduce traffic congestion and improve air quality, particularly in areas of the country that do not attain national air quality standards. This program is federally funded but administered by the state. The program supports investments that encourage alternatives to driving alone, improve traffic flow, and help urban areas meet air quality goals.[21]

Monadnock Alliance for Sustainable Transportation (MAST) Complete Streets Grant: This grant program provides funding for construction activities that implement an adopted municipal Complete Streets policy, and is only available to municipalities located in the Monadnock Region of New Hampshire. As of the spring of 2020, there have been three successful grant rounds, with another round of funding scheduled for 2020. Funding for this program comes from the New Hampshire Charitable Foundation "You Have Our Trust" fund.[22]

2. Federal Incentives and Programs

Qualified Plug-In Electric Vehicle Tax Credit: A tax credit is available for the purchase of a new qualified Plug-In Electric Vehicle (also called Battery Electric Vehicle, or BEV) that draws propulsion using a traction battery that has at least five kilowatt-hours (kWh) of capacity, uses an external source of energy to recharge the battery, has a gross vehicle weight rating of up to 14,000 pounds, and meets specified emission standards. The minimum credit amount is $2,500, and the credit may be up to $7,500, based on each vehicle's traction battery capacity and the gross vehicle weight rating. The credit will begin to be phased out for each manufacturer in the second quarter following the calendar quarter in which a minimum of 200,000 qualified BEVs have been sold by that manufacturer for use in the United States. This tax credit applies to vehicles acquired after December 31, 2009. For more information, including qualifying vehicles and sales by manufacturer, see the Internal Revenue Service (IRS) PEV Credit website.[2324]

Alternative Fuel and Advanced Vehicle Technology Research and Demonstration Bonds: Qualified state, tribal, and local governments may issue Qualified Energy Conservation Bonds subsidized by the U.S. Department of Treasury at competitive rates to fund capital expenditures on qualified energy conservation projects. Eligible activities include research and demonstration projects related to cellulosic ethanol and other non-fossil fuels, as well as advanced battery manufacturing technologies. Government entities may choose to issue tax credit bonds or direct payment bonds to subsidize the borrowing costs. For information on eligibility, processes, and limitations, see IRS Notices 2009-29, 2010-35, and 2012-44 or contact local issuing agencies.[25]

Improved Energy Technology Loans

The U.S. Department of Energy (DOE) provides loan guarantees through the Loan Guarantee Program to eligible projects that reduce air pollution and greenhouse gases and support early commercial use of advanced technologies, including biofuels and alternative fuel vehicles. The program is not intended for research and development projects. DOE may issue loan guarantees for up to 100% of the amount of the loan for an eligible project. Eligible projects may include the deployment of fueling infrastructure, including associated hardware and software, for alternative fuels. For loan guarantees of over 80%, the loan must be issued and funded by the Treasury Department's Federal Financing Bank. For more information, see the Loan Guarantee Program website and the Alternative Fuel Infrastructure fact sheet.[26]

3. Local Innovation

Granite State Clean Cities Coalition: Supported by the U.S. Department of Energy Clean Cities Program,[27] the Granite State Clean Cities Coalition seeks to reduce petroleum use in transportation through the use of domestically produced, cleaner burning alternative fuels and other fuel reduction strategies.[28] Jessica.Wilcox@des.nh.gov,

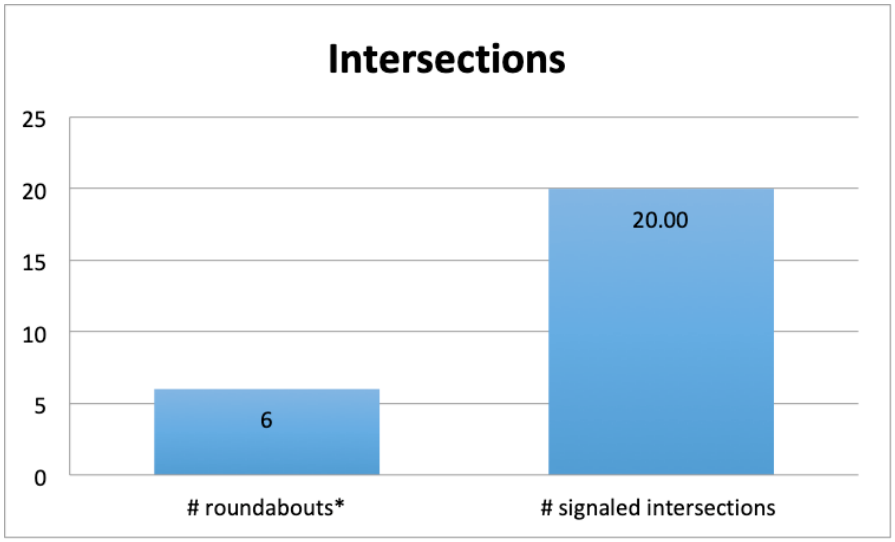
Monadnock Alliance for Sustainable Transportation (MAST): The Monadnock Alliance for Sustainable Transportation (MAST) is a coalition of organizational and individual members working to implement sustainable transportation solutions in the Monadnock Region of New Hampshire. The group, which is supported by Southwest Region Planning Commission, is governed by a Steering Committee made up of transportation stakeholders from around the region. Past and ongoing programs include Rack It Up!, a program that provided free bicycle racks to businesses, non-profits, and municipalities; annual Bike to Work Month events; the development of guidance documents, reports, and plans to help support sustainable transportation options in the region (examples include the 2016 Car Share Report and the MAST Employer Guide to Promoting Active Transportation); and the MAST Complete Streets Grant program, which was offered in 2017, 2018, and 2019.[29]

II. Infrastructure

1. Street Network

Traffic Patterns aimed at reducing CO2 emissions

As a way to reduce vehicle delay time and improve the flow and safety of traffic, the City of Keene has installed six roundabouts throughout the city at busy intersections where traffic delay, congestion, and/or safety were identified as issues. Roundabouts are circular intersections where entering traffic yields to traffic in the circle and design features, such as a smaller diameter and splitter islands, slow traffic speeds.



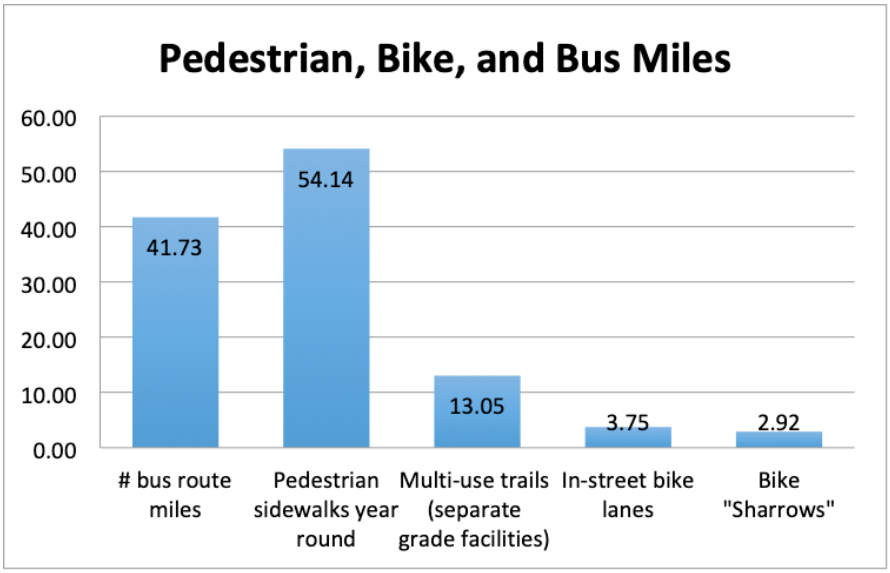
Number of roundabout and signalized intersection traffic features in Keene city limits

Compared to the 20 signalized intersections, Keene has 6 roundabout intersections as of April 2020. That total does not include 2 that are currently slated for Winchester Street in Keene.

a. Pedestrian, Bike and Transit Miles

Keene is fortunate to have several high-quality multi-use trails, with the Cheshire Rail Trail and Ashuelot Rail Trail passing right through downtown. The Cheshire Rail Trail offers a total of 42 miles of trail running

through Fitzwilliam, Troy, Keene, Westmoreland, North Walpole,[30] Keene is also home to the Asheulot River Trail and Jonathan Daniels Trails, which connect pedestrian pathways through the city. Infrastructure such as sidewalks, marked crosswalks, bicycle lanes, bicycle boxes, and other supportive infrastructure for pedestrians, bicyclists, and other "human-powered" forms of transportation improves safety and helps promote "alternative" transportation modes that do not rely on fossil fuels. Currently, 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.



Number of miles in Keene for the respective category

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 of this 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. As of 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.

Other pertinent metrics related to pedestrian and bike infrastructure:

	#
Bike Boxes	2
Enhanced crossings	15
Road crossings in bike/pedestrian paths	32
Bus stops	39

Bike Boxes

Bike Box at Central Square; Photo Credit: Mari Brunner[31]

Enhanced Crossings

Elevated Crossing at Winchester Street in Keene; Source: Google Maps

Road Crossings in Bike/Pedestrian Paths

Bike Path crossing on Emerald Street; Source: Google Maps

Bus Stops

Covered Bus Stop at Citizens Way; Source: Google Maps

b. Complete Streets Program[32]

As stated in the City of Keene Comprehensive Master Plan 2010:

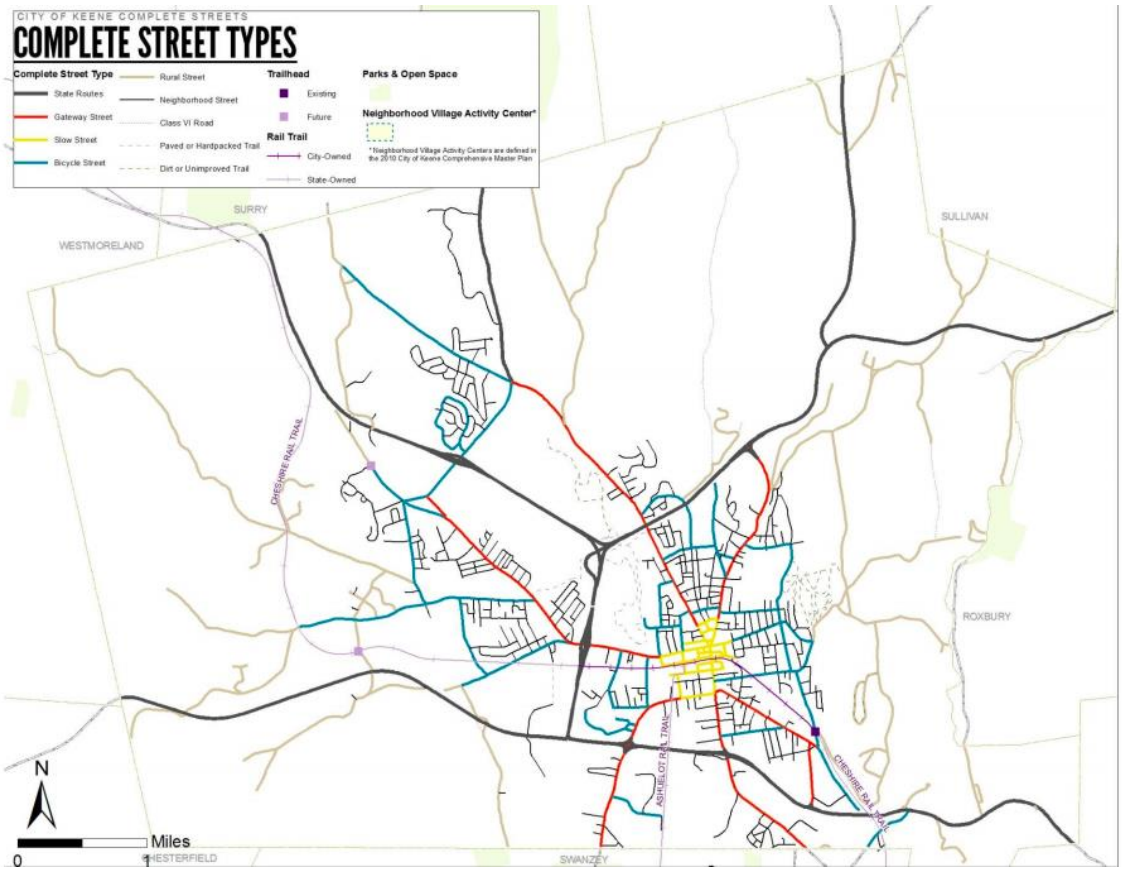
> "Members of the community expressed a desire, as part of creating Keene's walkable community, to strive for "complete streets." Complete Streets is a national program that encourages local municipalities across the country to build road networks that are safer, more livable and welcoming to everyone. Keene should make it a consistent policy to design streets with all users in mind, including drivers, public transport riders, pedestrians, and bicyclists as well as older people, children, and those with disabilities…"[33]

"Complete Streets" is a context-sensitive approach to transportation planning and design that balances the needs of all users of the transportation network, whether they are traveling on foot, by bicycle, by car, by bus, or any other mode of travel. A "complete" street incorporates design elements that emphasize safety, mobility and accessibility for those using a variety of travel modes. They can include features such as wide

and safe sidewalks or shoulders, clearly marked crosswalks, space for bicyclists to travel, places to sit, street trees, and more. They are designed to increase safety, reduce barriers for seniors and persons with disabilities, increase economic vitality, improve community health, and reduce air emissions.[34]

City of Keene Complete Streets Policy and Design Guidelines (2015)

In 2015, the City of Keene adopted a Complete Streets policy (in the form of a resolution) which makes a commitment to designing, constructing, operating, and maintaining all City-owned transportation facilities to support the concept of Complete Streets where appropriate or feasible. To support this policy, the City also adopted a set of Complete Streets Design Guidelines that establishes a Complete Street Typology system. This typology system classifies the streets in Keene based on each roadway's function and surrounding context, including right of way width, building types, predominant travel modes, and surrounding land uses. For each street type, the guidelines document 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.



An overall map from 2015 of Keene's Complete Street baseline

Slow Streets

Located within Keene's pedestrian-oriented downtown, Slow Streets are places where all travel modes are in high demand and vehicular traffic must proceed at slow speeds for safety. The rich mix of activity is facilitated by the slow speed of traffic on these streets.

Gateway Streets: Roads classified as Gateway Streets are primarily arterials streets emanating out from the City's downtown to state routes within and outside Keene. These streets contain a mix of land uses. These

streets are the primary travel corridors in the City and should be accommodating of all modes of transportation.

Bicycle Streets: This street type gives bicycles priority treatment through street improvements intended to enhance bicycle convenience and safety (e.g. bike lanes, sharrows, bicycle racks, etc.). Bicycles infrastructure is not limited to Bicycle Streets, as seen in the two previous descriptions. The goal behind cycling infrastructure is to provide a bicycle network that traverses the City and provides safe space for bike travel.

Neighborhood Streets are local streets located in medium to high-density residential areas of the City. In these areas, houses are located close together, traffic volumes and speeds are low, and the predominant land use type is residential.

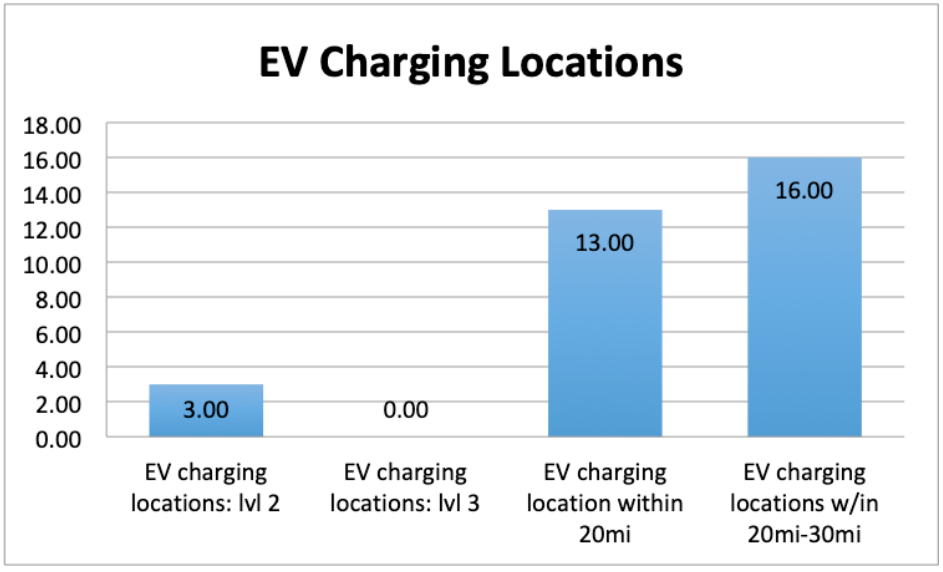
Rural Streets are local and collector streets that are located in low-density suburban and rural areas of the City. There are far distances between destinations and land use in this area is primarily residential.

Transit Overlay

Keene makes special considerations for accommodating transit vehicles and users in areas of the City that are either currently served by fixed-route public transportation services or where transit services would be ideally located in the future. Designing a Transit Overlay means coordinating the Street layers discussed above to best support a public transit system. For example a safe Transit Overlay will consider placing pedestrian crossings near transit stops or covered bicycle racks or benches located at potential bus stops.

c. EV Charging Infrastructure at Parking Spaces

Within the City of Keene there are 3 charging locations and 5 charging units. Though the 3 charging locations are open to the public, 2 of the 3 are not located in public parking areas. The City of Keene installed two Level-2 charging ports in the Commercial Street parking lot; both of those chargers are available for a parking fee of 1.49/hour as of April 2020. The other two locations in Keene are located at the Fairfield Kia Dealership (two Level 2 charging ports) and at Antioch University New England (AUNE) Campus (one Level 2 charging port).



Number of EV charging location at varying degrees of distances from Keene, NH

Although homeowners are often able to charge their electric vehicle (EV) at home, for renters and visitors to the area, the low number of public charging stations in the City of Keene may be a deterrent to EV adoption.

Commercial Street Lot charging stations in use in February 2020; Source: Plug Share[35]

The levels on the charging station broadly equate to efficiency in one charging hour. According to the US Department of Energy's Alternative Fuels Data center, an EV driver can expect the following:[36]

- Level 1: 2-5 miles of driving per one hour of charging
- Level 2: 10-20 miles of driving per 1 hour of charging
- Level 3 (also referred to as DC Fast Charging): 60-80 miles per 20 minutes of charging

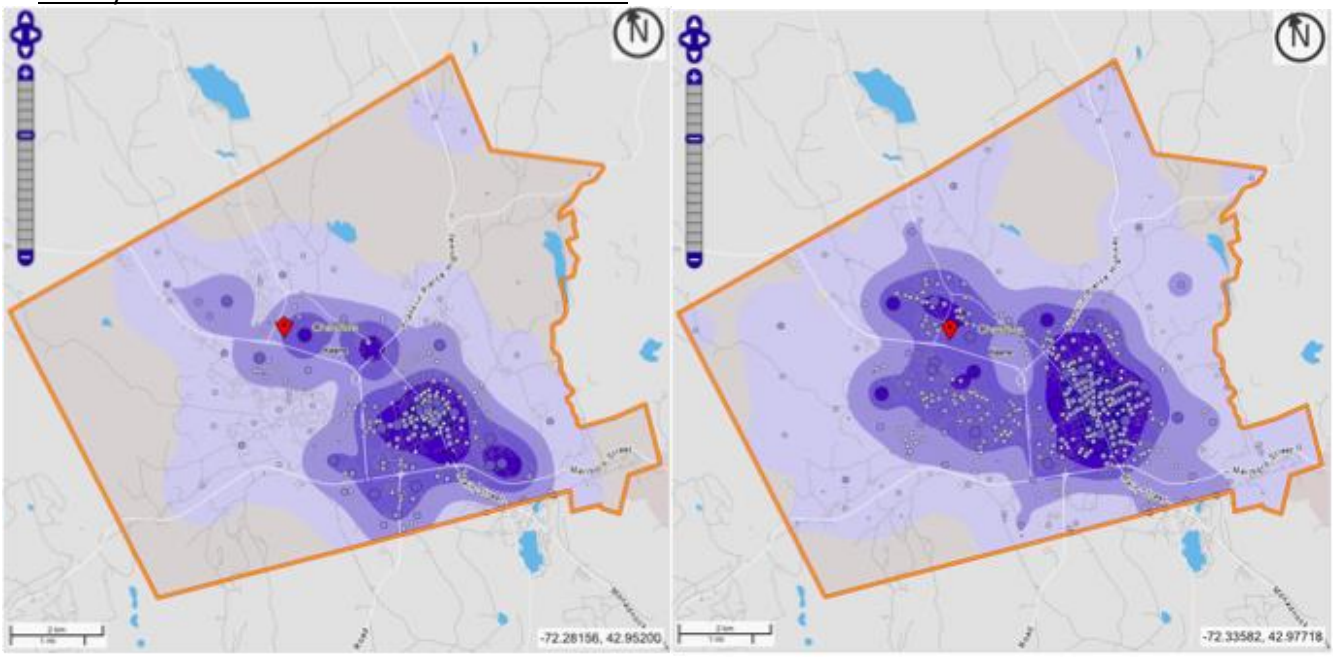
Within 20-30 miles of Keene there are a number of charging stations and charging ports, most of which are along the Route 91 corridor between Brattleboro and Putney, across the Connecticut River in Vermont. Although there are no DC fast charge stations in Keene or Cheshire County, as of April 2020 there are a number within a 30-mile radius of Keene, all along the Route 91 corridor in Vermont.

III. Land Use

Keene's residential population in mixed-use areas

According to a housing inventory that was presented to the Keene City Council in February 2020, 26% (2,628 units) of all residential dwelling units in the City are located in the Central Business (7% or 725 units), Central Business Limited (1% or 111 units), or High Density (17.4% 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 theses area with 54% of all residential buildings with Over 8 Units, and 54% of all residential buildings with 4-8 units being located in these districts.

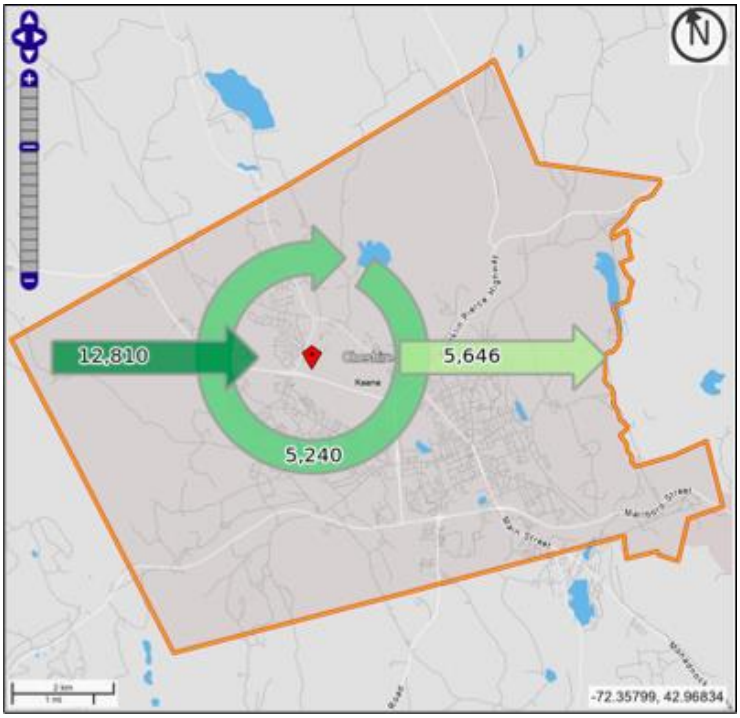
Side by side: residential centers and work centers



The census provides data on where people work (left) and live (right). The darker colors represent higher density areas, of places of work (left) or residential areas (right).[37]

At a little over 37 square miles, Keene is relatively small in area and, as seen in the population distribution maps above, has a relatively well-defined area of human inhabitance versus conservation, park, or continuously forested land.

If Keene were an insular community, this would be a glowing asset for non-passenger car travel. Given the landscape of Cheshire County, though, Keene businesses and workers are very intertwined with surrounding towns and neighboring cities.



Inflow and outflow averages of workers over the age of 16, source: US Census Bureau

Inflow and outflow is beyond the scope of the transportation sector defined by the Energy Plan, but at a basic level knowing the trends from the Census may inform strategies for the transportation sector. According to census mapping, the majority of the workforce population in Keene did not come from Keene residents; around 12,810 workers came into Keene each day for work, while 5,646 residents of Keene left the city for their jobs. That leaves 5,240 working residents of Keene who live and work in the city.[38]

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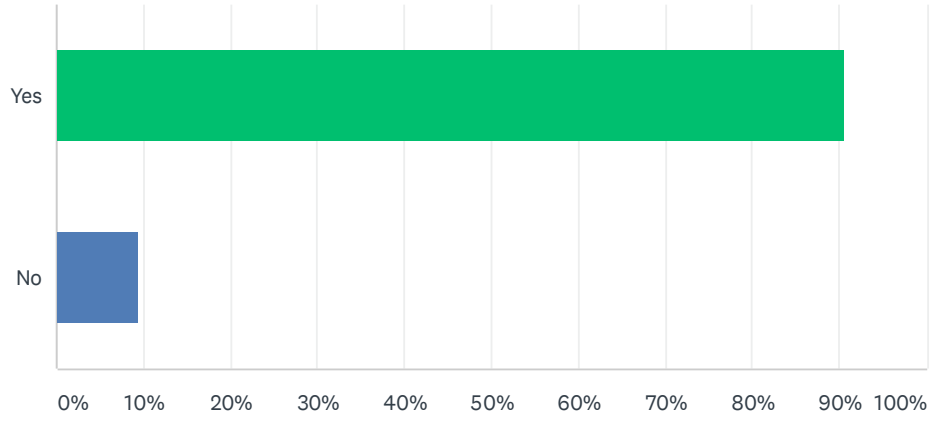
[1] https://afdc.energy.gov/states/nh
[2] https://afdc.energy.gov/states/nh
[3] https://www.eia.gov/state/?sid=NH#tabs-2)
[4] https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf)
[5] https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf).
[6] https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf).
[7] https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf)
[8] https://data.census.gov/cedsci/table?q=Keene,%20NH&g=1600000US3339300&tid=ACSDP5Y2017.DP05&layer=VT_2018_160_00_PY_D1&vintage=2018
[9] http://www.swrpc.org/files/Transportation%20Planning%20for%20an%20Uncertain%20Energy%20Future_FINAL.pdf
[10] https://afdc.energy.gov/vehicles/electric_basics_phev.html
[11] https://afdc.energy.gov/vehicles/electric_basics_phev.html
[12] https://afdc.energy.gov/vehicles/electric_basics_phev.html
[13] https://data.census.gov/cedsci/table?q=Keene,%20NH&g=1600000US3339300&tid=ACSST5Y2017.S0801&layer=VT_2018_160_00_PY_D1&vintage=2017

[14] https://static1.squarespace.com/static/57c9cc0d197aead196f1af97/t/5cf1440786f2de0001937201/1559315475747/Bus+Schedule+Three+Route_NEW+ROUTE_UpdatedJUNE2019.pdf
[15] https://data.census.gov/cedsci/table?q=Keene,%20NH&g=1600000US3339300&tid=ACSST5Y2017.S0801&layer=VT_2018_160_00_PY_D1&vintage=2017
[16] https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf
[17] https://afdc.energy.gov/states/nh
[18] https://www.des.nh.gov/organization/divisions/air/tsb/tps/msp/diesel-vehicles/dera.htm
[19] https://www.nh.gov/dot/org/projectdevelopment/planning/tap/index.htm
[20] https://www.nhstateparks.org/about-us/trails-bureau/grants/recreational-trails-program
[21] https://www.transportation.gov/sustainability/climate/federal-programs-directory-congestion-mitigation-and-air-quality-cmaq)
[22] https://www.nh.gov/dot/org/projectdevelopment/planning/complete-streets/index.htm
[23] http://www.irs.gov/Businesses/Plug-In-Electric-Vehicle-Credit-IRC-30-and-IRC-30D
[24] https://afdc.energy.gov/laws/409
[25] https://afdc.energy.gov/laws/10612
[26] https://afdc.energy.gov/fuels/laws/ELEC?state=US
[27] http://www1.eere.energy.gov/cleancities/
[28] https://www.granitestatecleancities.nh.gov/
[29] http://www.mastnh.org/recentactivities/)
[30] https://www.nhstateparks.org/visit/recreational-rail-trails/cheshire-recreational-rail-trail
[31] https://greenmonadnock.org/2017/11/16/bicycle-friendly-driver-responsible-cyclist/
[32] https://ci.keene.nh.us/sites/default/files/planning/Complete%20Streets/Complete%20Streets%20Keene%20Design%20Guidelines_071515.pdf
[33] https://ci.keene.nh.us/sites/default/files/planning/CMPprint-final-1027-fullversion_2.pdf
[34] https://smartgrowthamerica.org/program/national-complete-streets-coalition/
[35] https://www.plugshare.com/location/73374
[36] https://afdc.energy.gov/fuels/electricity_infrastructure.html
[37] https://onthemap.ces.census.gov/
[38] https://onthemap.ces.census.gov/

Q1 Do you live in Keene?

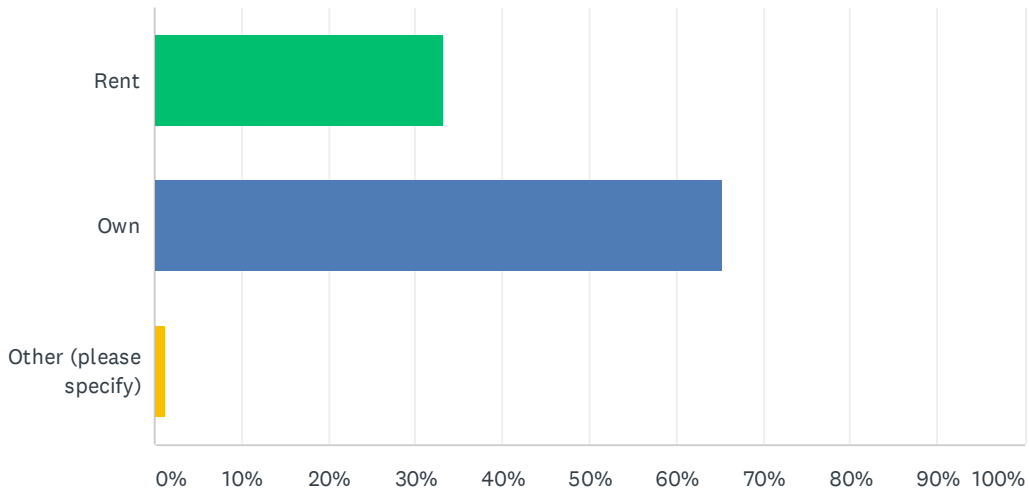
Answered: 75 Skipped: 0



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

Q2 Do you rent or own your home?

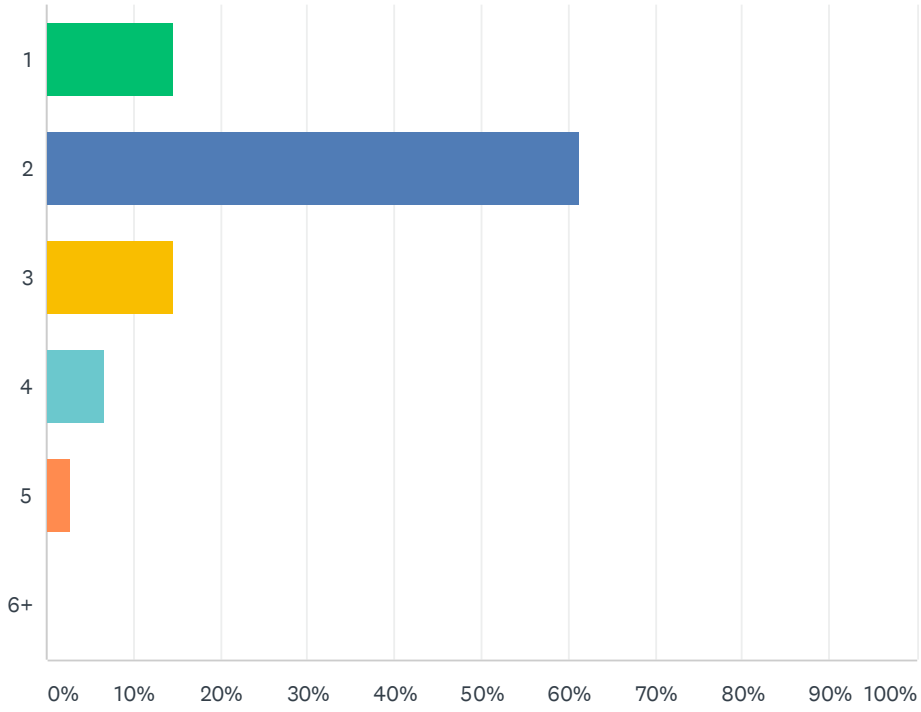
Answered: 75 Skipped: 0



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?

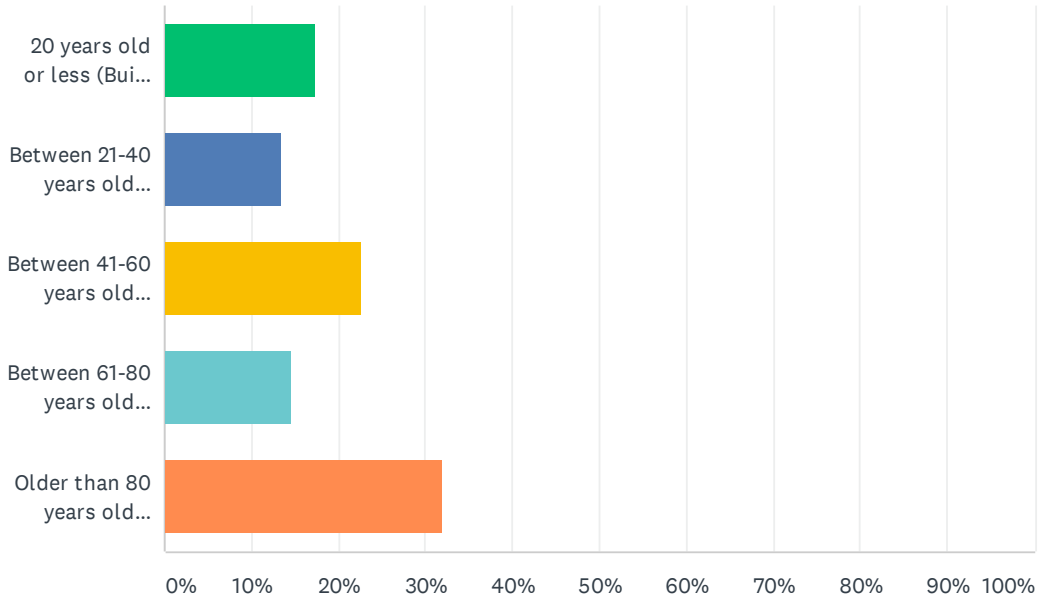
Answered: 75 Skipped: 0



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?

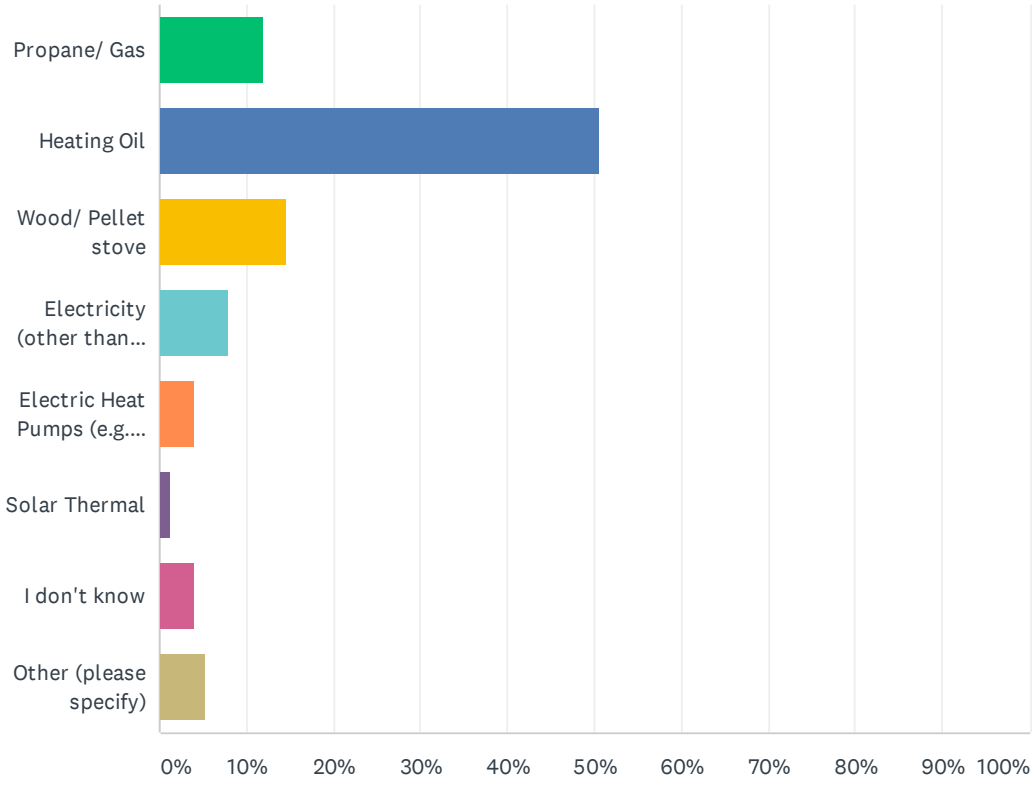
Answered: 75 Skipped: 0



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?

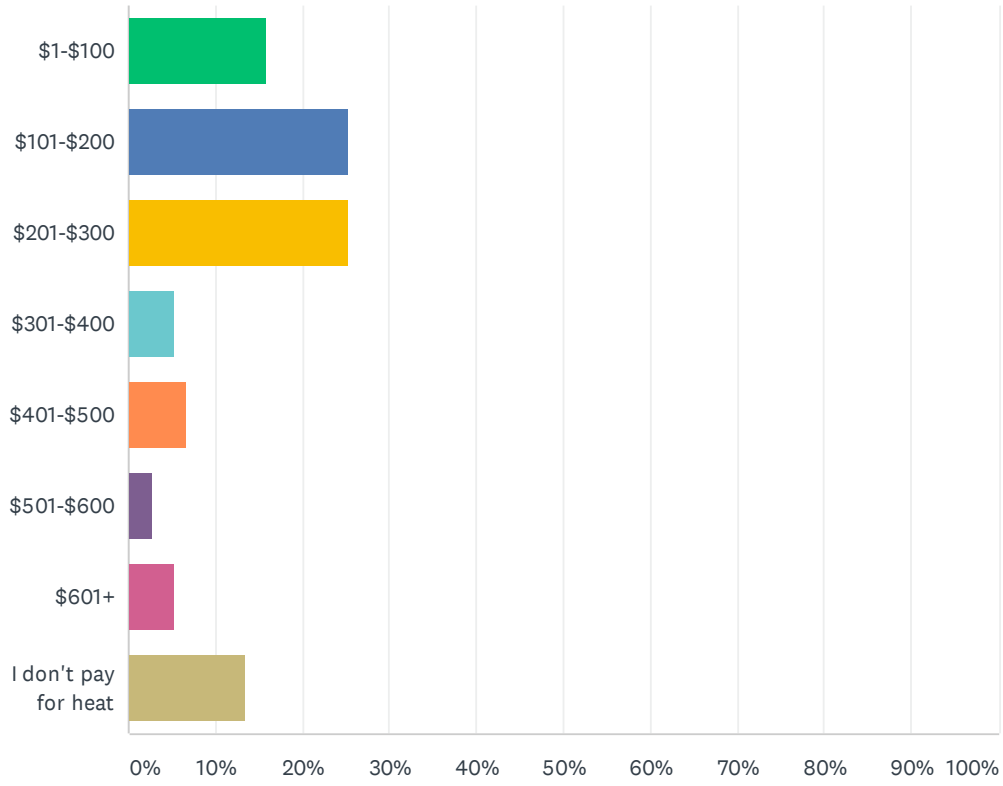
Answered: 75 Skipped: 0



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?

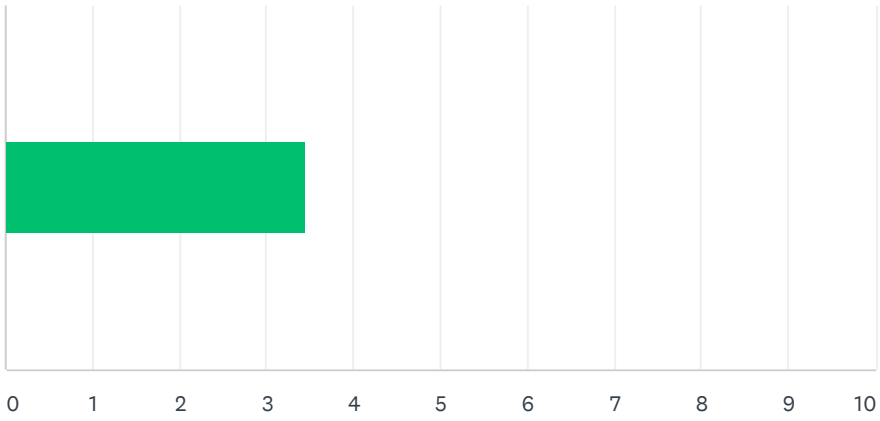
Answered: 75 Skipped: 0



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."

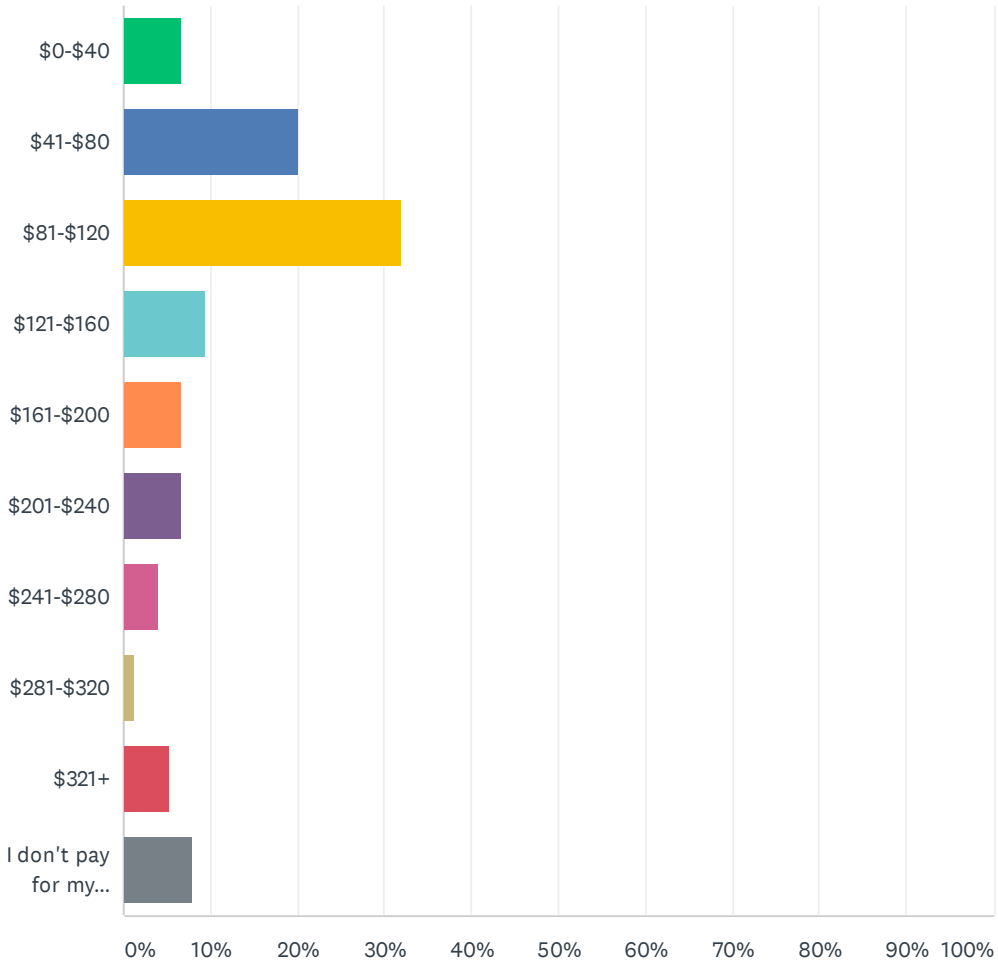
Answered: 75 Skipped: 0



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?

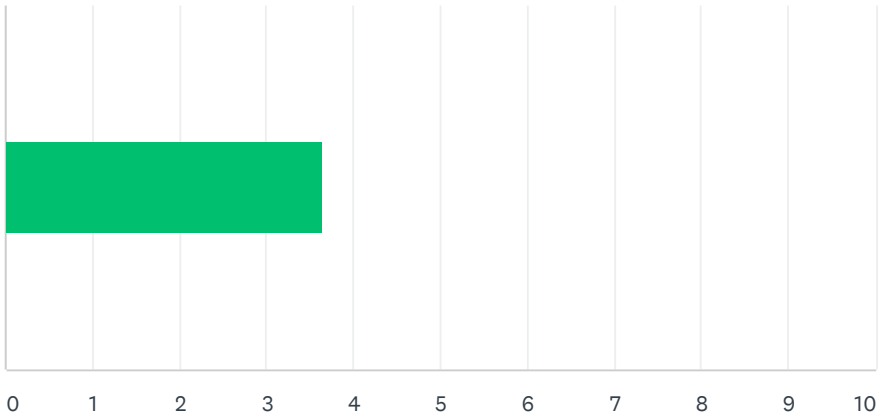
Answered: 75 Skipped: 0



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."

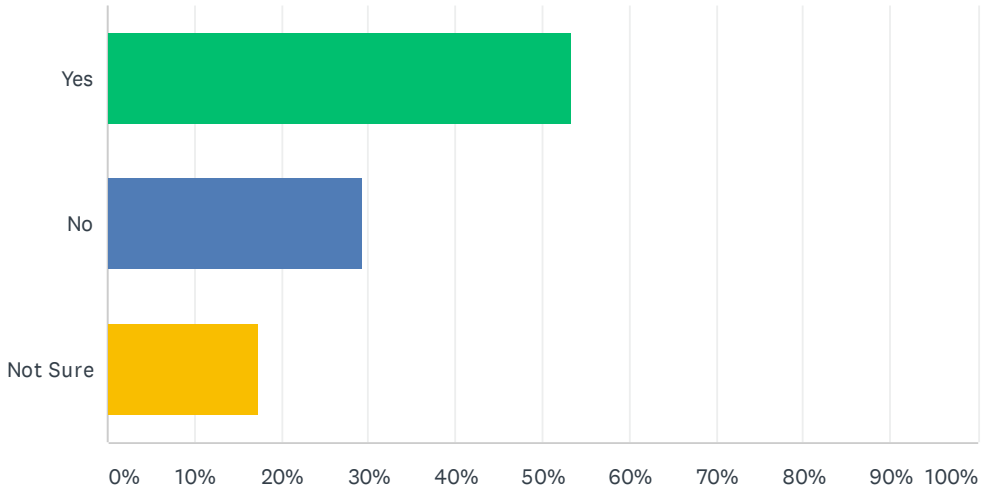
Answered: 75 Skipped: 0



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?

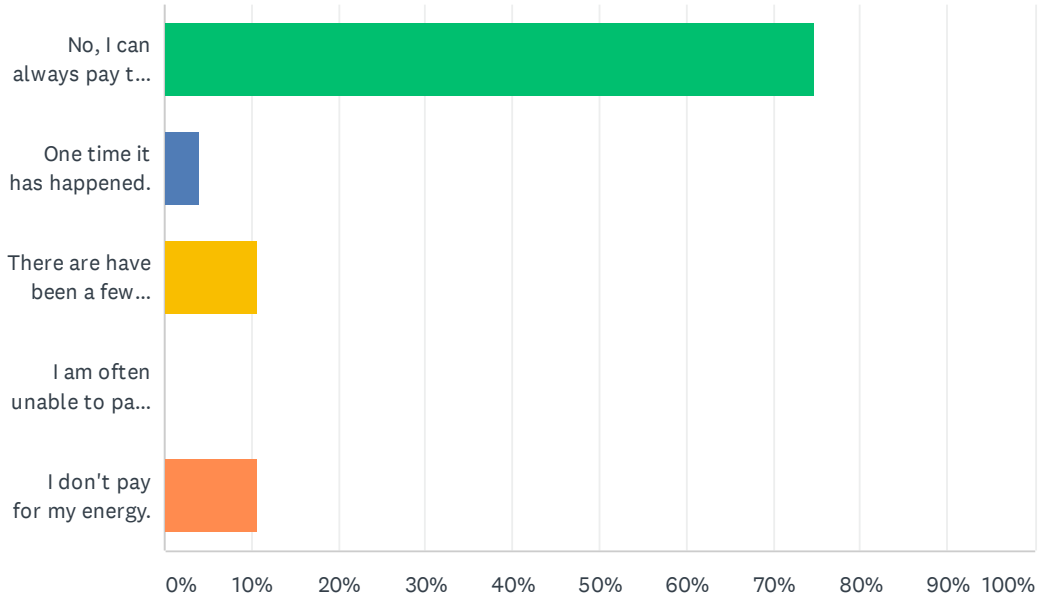
Answered: 75 Skipped: 0



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?

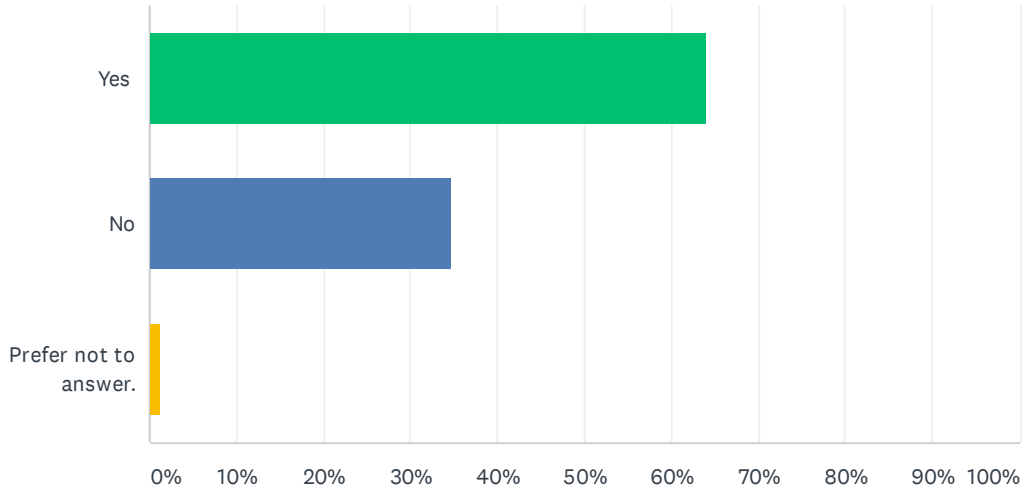
Answered: 75 Skipped: 0



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?

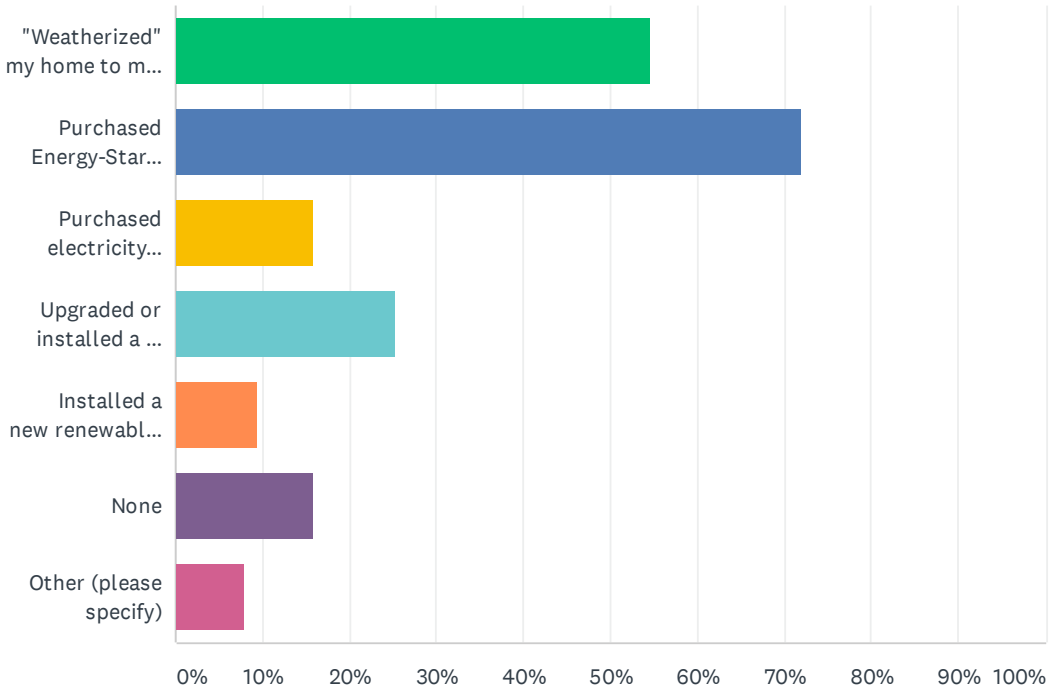
Answered: 75 Skipped: 0



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.

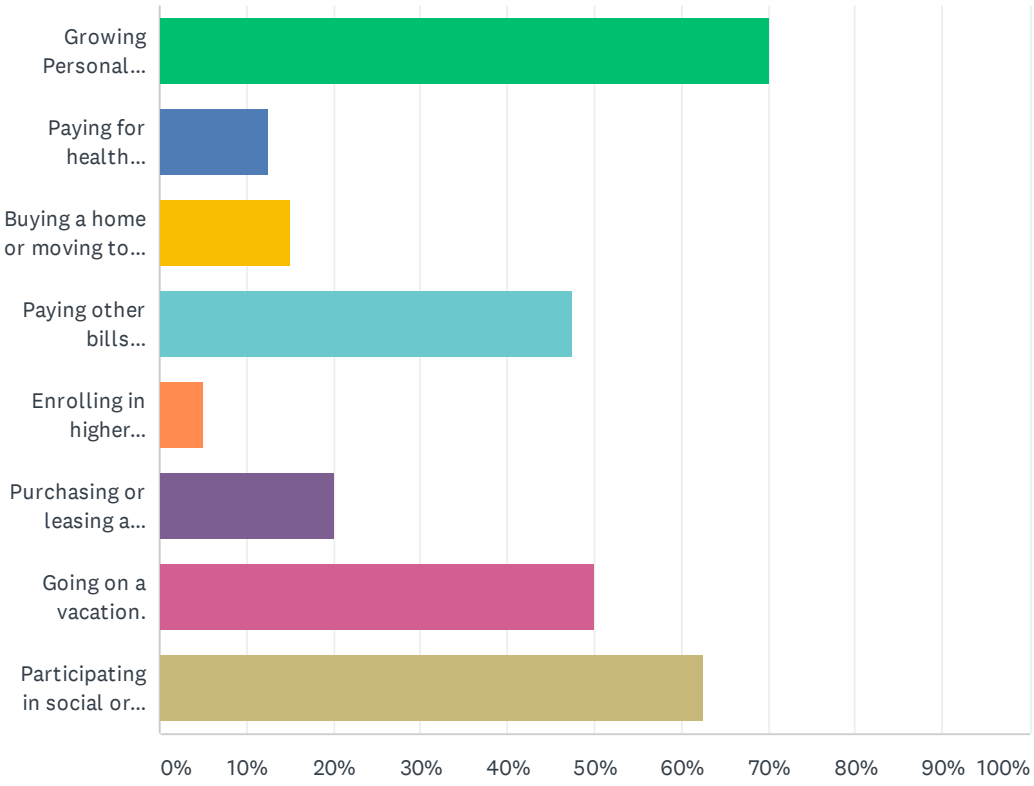
Answered: 75 Skipped: 0



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



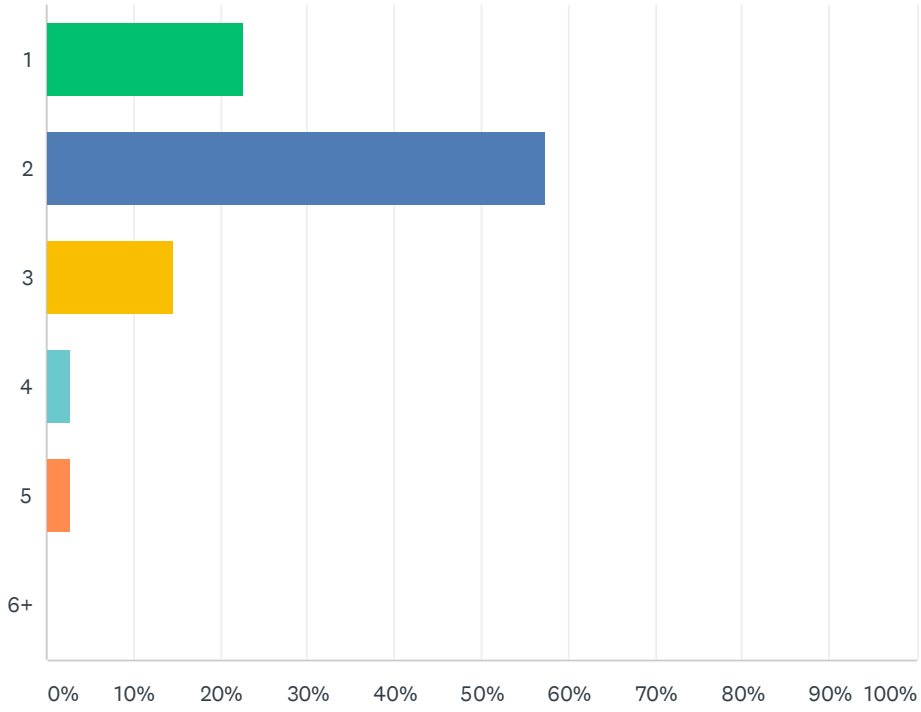
ANSWER CHOICES	RESPONSES	
Growing Personal Savings or Contributing to Retirement savings.	70.00%	28
Paying for health insurance or health care.	12.50%	5
Buying a home or moving to a higher-quality home/apartment.	15.00%	6
Paying other bills (internet, grocery, etc.).	47.50%	19
Enrolling in higher education 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?

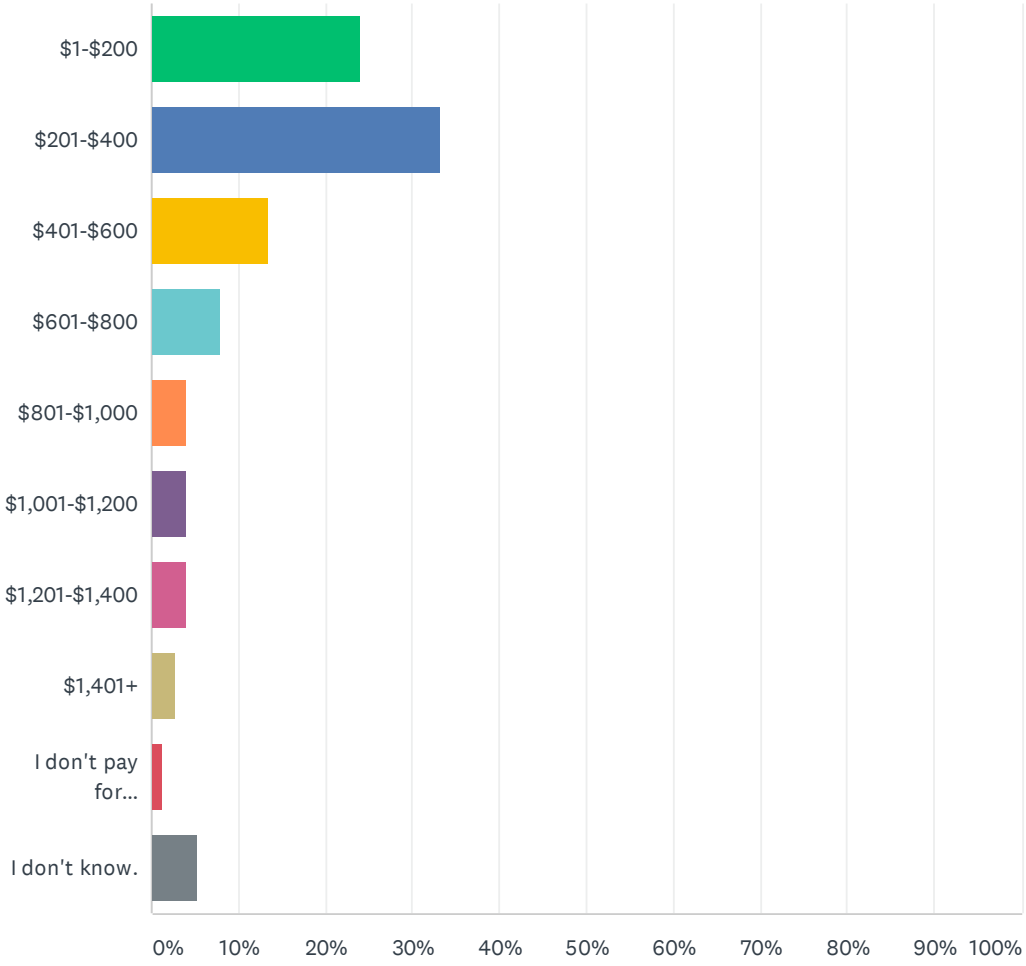
Answered: 75 Skipped: 0



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.)

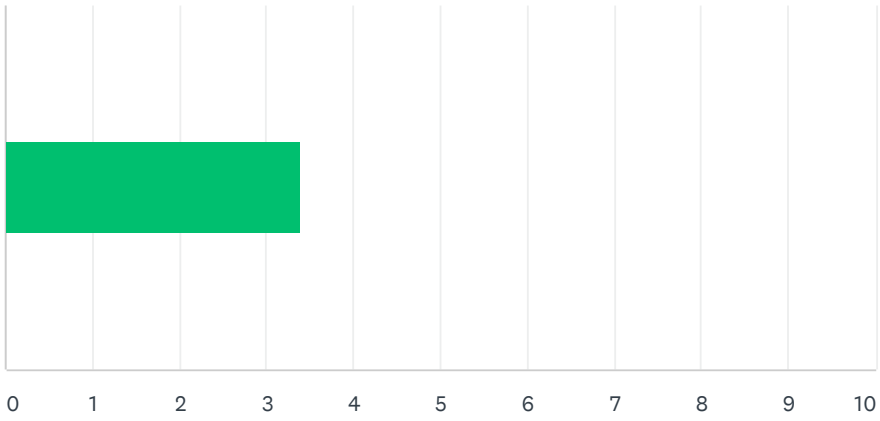
Answered: 75 Skipped: 0



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).

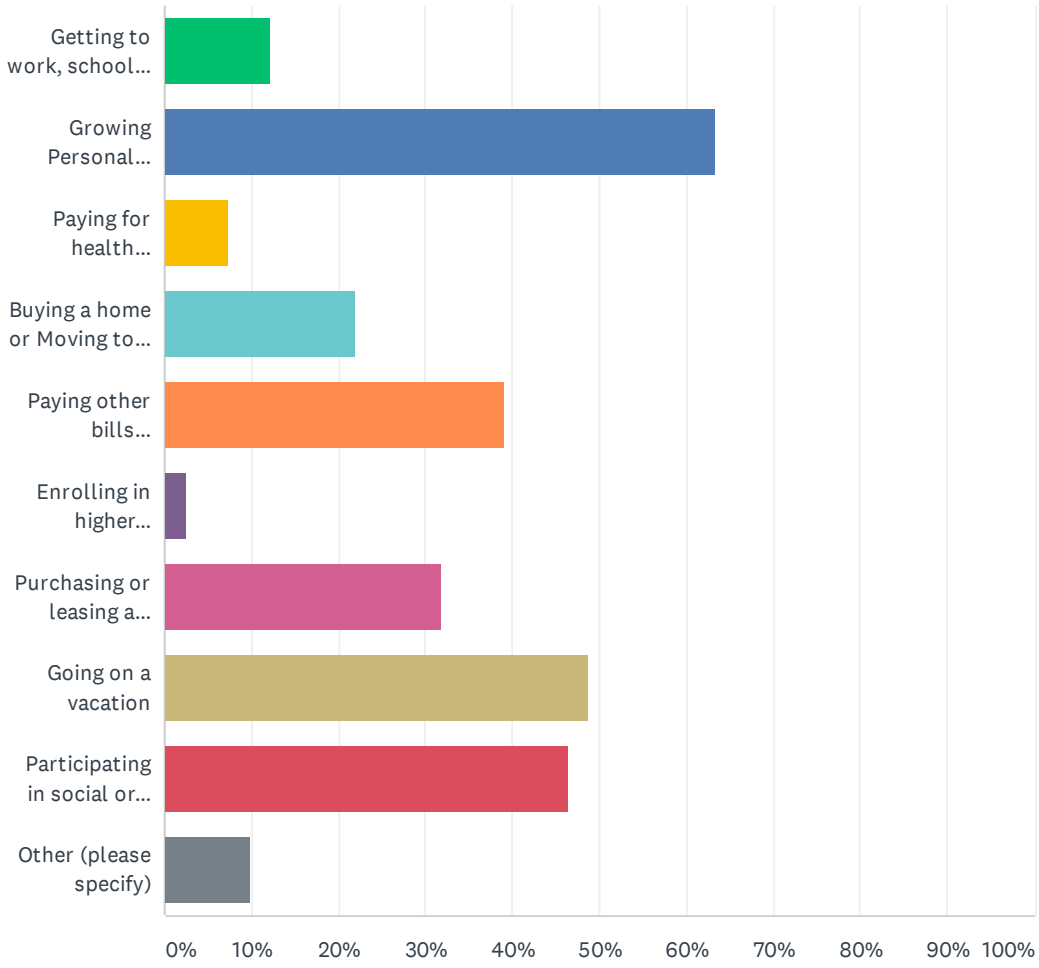
Answered: 75 Skipped: 0



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.

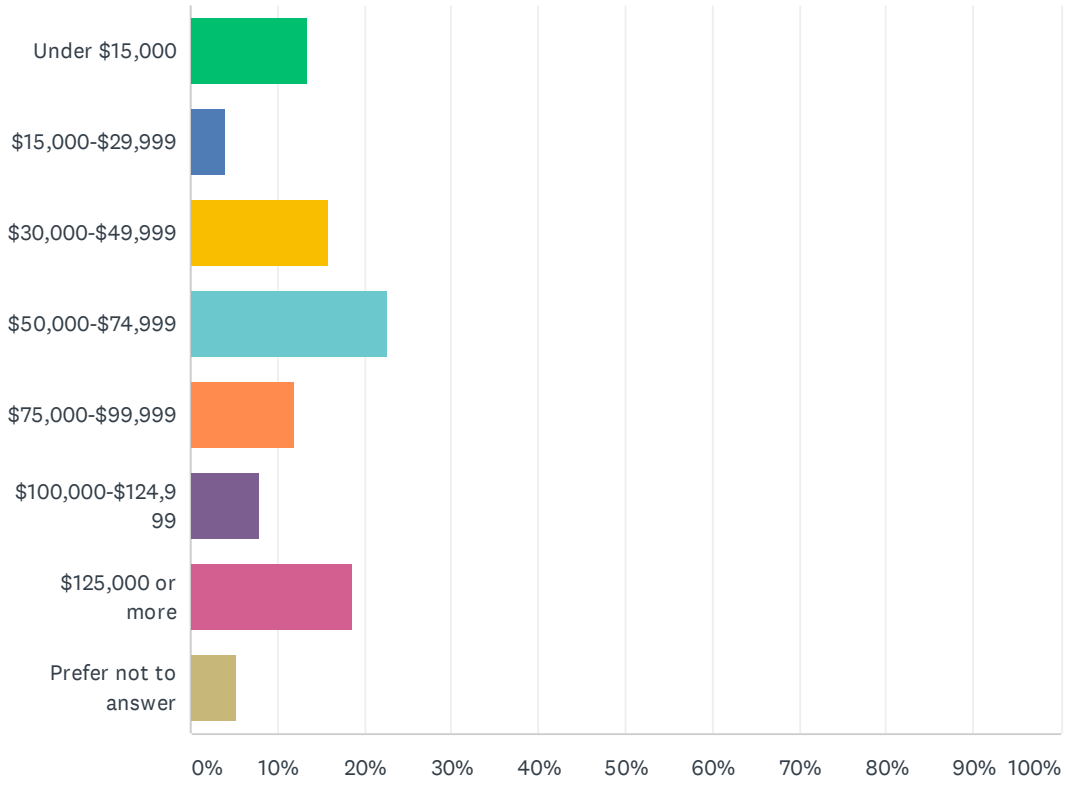
Answered: 41 Skipped: 34



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