Energy Committee Strategic Plan

Town of Sandwich, NH

Written, compiled and edited by Sandwich N.H.'s Master Plan Energy Chapter Writing Committee (ECWC) September 1 -- December 14, 2020

Significant portions of this report have been taken verbatim or paraphrased, with permission, from the City of Concord's 100% Renewable Energy Goal Strategic Plan.[1] Other verbatim and paraphrased segments from other sources are noted with appropriate footnotes.

Chapter 8 - Energy

I. OVERVIEW

"It's now more profitable to save the world than to ruin it."

-- Hal Harvey, CEO of Energy Innovation[2]

At the March, 2020 Sandwich Town Meeting, residents voted to commit:

"to a goal of 100% reliance on renewable sources of electricity by 2030 and for all other energy needs, including heating and transportation, by 2050.[3] *The intent of this goal is to protect the well-being and health of our citizens by practicing and promoting energy conservation, ensuring food, water and heat security, by being fiscally responsible and by keeping energy dollars in the local economy. We can, by actively shifting towards renewable energy, end dependence on subsidies for fossil fuels and address the threat of global climate change on a local, state and national level. This article reaffirms Warrant Article 53*[4] *, passed at the March 13, 2007 Sandwich Town Hall Meeting."*

[1] City of Concord's 100% Renewable Energy Goal Strategic Plan, July 31, 2019
http://www.rathlaw.com/wp-content/uploads/2019/08/Strategic-Plan-CEEAC-Final-Draft-7-31-19.pdf
[2] Solar Power Is Sustainable for the Economy, Too, Wired, April 4, 2020.
https://www.wired.com/story/affordable-solar-power-sustainable-economy/
[3] Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments, (Oct. 10, 2018)
https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/
[4] Annual reports Town of Sandwich, New Hampshire, 2006, Page 73.
https://archive.org/details/annualreportstow2006sand/mode/2up

Town of Sandwich Energy Goals

2030: 100% reliance on renewable sources for electricity
2050: 100% reliance on renewable sources for all other energy needs, including heating and transportation

The purpose of the Sandwich Master Plan Energy Chapter is to build on the work of the Town Energy Committee established in 2007 and to provide a blueprint to go forward in planning for the challenges of the future. It builds on the concept that the town should control its own destiny to the extent that it can.

Having locally produced energy sources ensures we have backup electricity if the bigger grid should fail plus the costs would become more predictable and less reliant on national and international variables.

Moving toward electric vehicles and locally produced energy to power them will ensure Sandwich will be on the move should gas and oil supplies dwindle because of disruption of supply chains or national emergencies.

In the end, locally controlled energy supplies are more resilient and sustainable and with each passing day more cost effective. Here is a summary of this chapter:

1. It will outline how the 2030 and 2050 warrant article goals (the Goals) can best be achieved.
2. Since the 2020 Warrant Article 21 is an extension of the March 2007 Warrant Article 53, the town selectboard or planning board should revive the Sandwich Citizen's Energy Committee, by appointing new members.
3. If fully implemented, the Goals will substantially reduce, but will not eliminate, Sandwich's community-wide greenhouse gas (GHG) emissions. Additional actions, beyond those contemplated in this plan would be needed to reduce Sandwich's GHG emissions to net zero. The plan does not address all aspects of sustainability. It is intended to be a living document and will need to be updated on an ongoing basis.
4. It identifies four central components that are essential for successful implementation: (1) revive the Energy Committee (2) dedicate time and resources for the town staff and boards to implement appropriate action steps (3) ensure that town policies align with the Goals and strategies and (4) increase public awareness and engagement.
5. The strategies used in this energy chapter are based on 2020 technologies. In the future, cleaner Earth friendly innovations may require reevaluation and possible strategic changes to accomplish our 2030 and 2050 goals.

II. HISTORY OF AN ENERGY PLAN IN NEW HAMPSHIRE AND SANDWICH

- March 2007: Sandwich Town Meeting: Authorized the formation of a Sandwich Energy Committee whose mission was:

  > *To promote energy conservation and the use of renewable resources for municipal, business and home use for the townspeople of Sandwich.*

- December 2007: A state executive order created a Climate Change Task Force.[5] Sandwich, in a 2007 Town Meeting warrant article, adopted the New Hampshire Climate Change Resolution, along with 163 other communities across the state. The resolution supports efforts to address the issue of climate change, including the establishment of a program to require reductions in US greenhouse gas emissions and the creation of a national research initiative to develop sustainable energy technologies.
- 2008**:** The NH Legislature adopted an amendment to the state *Planning Enabling* Legislation RSA 674:2 III, stating that a town's Master Plan may include: *"An energy section which includes an analysis of energy and fuel resources, needs, scarcities, costs, and problems affecting the municipality and a statement of policy on the conservation of energy."*[6]
- March 2009: *The New Hampshire Climate Action Plan [7](NHCAP)*, a plan for New Hampshire's Energy, Environmental and Economic Development Future is released. This recommends maximizing energy efficiency and increasing renewable and low-CO2-emitting energy sources to curb energy consumption and greenhouse gas emissions.

- 2007-2013: The Sandwich Energy Committee's (SEC) accomplishments:

  > 1. Public Outreach: Many energy educational and conservation projects between 2009-2013.
  > 2. Fire Station: 13.310KW solar installation completed, delivering close to 100 percent of the station's needs after one year.[8]
  > 3. Town Garage: 9.36KW solar installation completed.[9]

- 2012: Incandescent street lamp bulb replacement by LEDs was voted down.[10]
- March 2020: the Town passes Warrant Article #21 for 100 percent renewables by 2030 for electricity and 100 percent renewables for all other power, including heating and transportation, by 2050.

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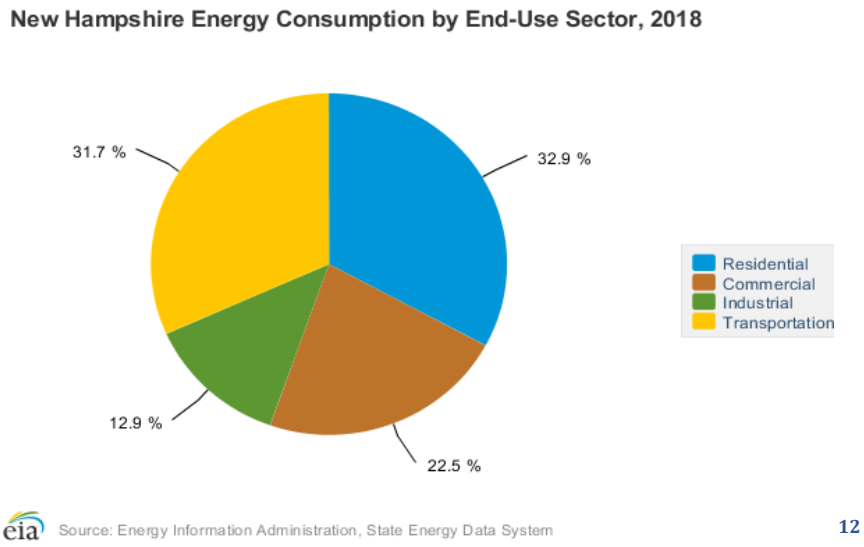
[5] Preparing for Climate Change in New Hampshire, Georgetown Climate Center, March, 2009 https://www.georgetownclimate.org/adaptation/state-information/new-hampshire/overview.html
[6] Title LXIV, Planning And Zoning, Chapter 674, Local Land Use Planning And Regulatory Powers, Master Plan, Section 674:2, http://www.gencourt.state.nh.us/rsa/html/lxiv/674/674-2.htm
[7] https://www.georgetownclimate.org/adaptation/state-information/new-hampshire/overview.html
[8] Sandwich Town Report, 2011, pg 8.
[9] Sandwich Town Report, 2011, pg 91.
[10] Sandwich Town Report, 2012 pg. 48.

- January 2021: Joe Biden becomes president with a pledge to invest in clean energy. So the first four years of this report might provide excellent funding and legislative opportunities for Sandwich to move forward with a clean energy agenda.

III. THE ENERGY LANDSCAPE IN NEW HAMPSHIRE

In 2020, 90 percent of the state's energy comes from petroleum, nuclear, natural gas and coal. The remaining 10 percent comes from renewable sources which are dominated by wood and hydroelectric.[11]

1. State Energy Supply and Demand



[12]

2. New Hampshire Electricity

Since 1997, the nonprofit ISO-NE (Independent System Operator of New England) has acted as the air traffic controller of managing the flow of the supply and demand of electricity for the New England states. It also helps administer wholesale markets and provides grid and market planning for the future.[13] Currently, the overall New England market for electricity is largely shaped by market forces, principally: 1. the region's heavy reliance on natural gas for electricity production, 2. the retirement of numerous older coal, oil, and nuclear plants and 3. the substantial imports of bulk electricity from Hydro Quebec.[14]

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[11] New Hampshire, Overview, EIA Dec. 11, 2020 https://www.eia.gov/state/?sid=NH#tabs-1
[12] https://www.eia.gov/state/?sid=NH#tabs-2
[13] New Hampshire 10-year State Strategy, Page 6, April 2018 https://www.nh.gov/osi/energy/programs/documents/2018-10-year-state-energy-strategy.pdf
[14] Boscawen Master Plan , Chapter 10 Energy, March 6, 2018, https://www.townofboscawen.org/sites/g/files/vyhlif4166/f/uploads/final_energy_chapter_adopted_03.06.18.pdf

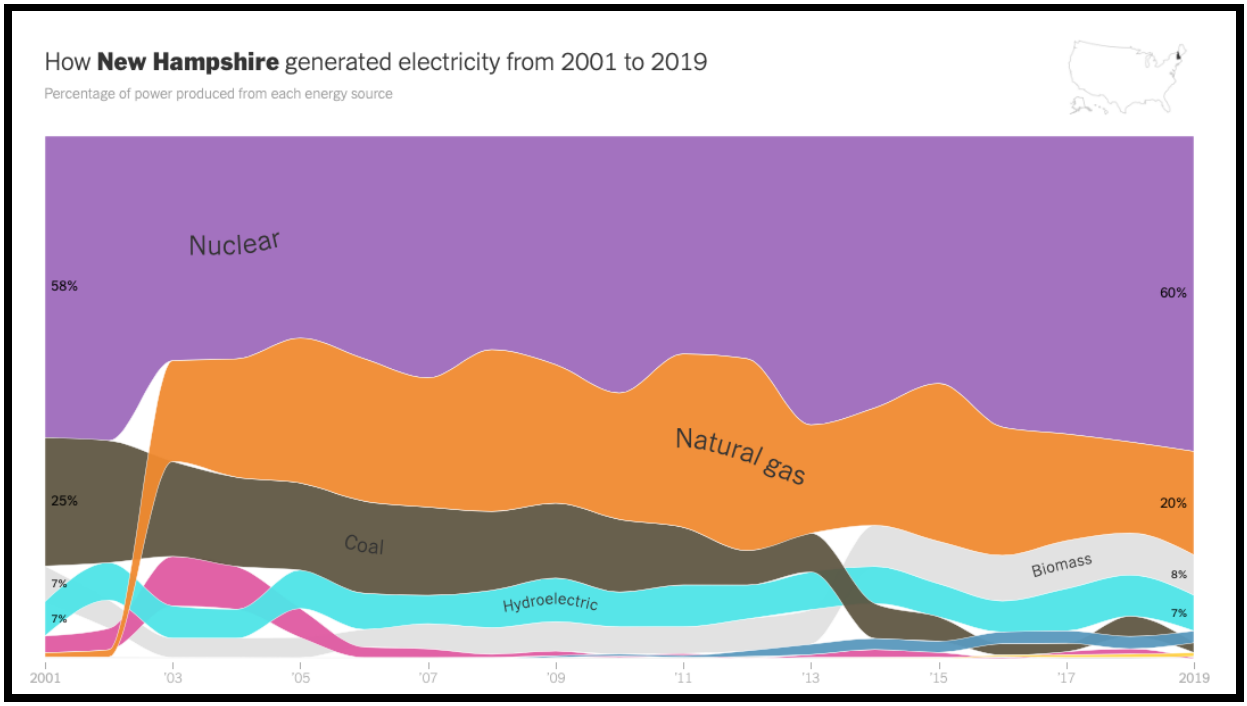


Chart above is a screen shot from The New York Times[15]

New Hampshire's electric power generation sources change year by year. Indeed, the state is mandating that 25 percent of the electricity sold to customers comes from renewable resources by 2025. For in-depth information refer to the New Hampshire section of the US Energy Information Administration (EIA) website. Here is a 2020 snapshot from that report:

- "New Hampshire has the third highest electricity rates in the contiguous United States. The main components that make up the cost of electricity **are generation, transmission, and distribution and each, are more expensive in New England than the US average**."
- Seabrook's nuclear reactor has for decades provided the majority of the state's electrical generation, including 61 percent in 2019. Natural gas generated electricity has stayed steady at about 20 percent over the past 15 years.
- More than two-fifths of the natural gas consumed in New Hampshire is used for electricity generation.
- Coal fired plants 20 years ago generated 25 percent of the state's electricity. Now they have dwindled to less than 2 percent. [16]
- In 2020, some 17 percent of New Hampshire's electricity generation came from renewable resources. Most of the state's renewable generation comes from biomass -- the burning of wood or other organic matter-- and hydroelectric power.

[15] How Does Your State Make Electricity?, New York Times (Oct. 10, 2020) https://www.nytimes.com/interactive/2020/10/28/climate/how-electricity-generation-changed-in-your-state-election.html

[16] How New Hampshire generated electricity from 2001 to 2019, New York Times (Oct. 10, 2020) https://www.nytimes.com/interactive/2020/10/28/climate/how-electricity-generation-changed-in-your-state-election.html

- Wind turbines and small-scale (less than 1-megawatt) solar energy facilities supply the rest of the renewables. [17]The state has additional renewable energy potential from winds along its Atlantic coastline and its northern mountain ridges. New Hampshire also has the potential for solar to support utility-scale projects.[18]

IV. SANDWICH AND ITS ENERGY USE

The Town of Sandwich's 100 percent renewable energy goals for 2030 and 2050 are part of a much larger clean energy, cost efficiency and energy independence movement driven by small towns, cities and private companies across the US and nations worldwide.

Our vision is a community that supports and preserves its rural character while looking for opportunities to improve economic development, reduce municipal expenditures and promote efficient development that embraces renewable energy. Sandwich's energy policies, building standards, transportation and land use development plans can have a direct impact on the community's vitality and long term sustainability.

There are four sectors of end-energy use consumption that we will address: 1. residential 2. transportation 3. municipal and 4. commercial and non-profits. Because of the rural character Sandwich, the residential sector consumes about 45 percent of its energy, with transportation claiming the next highest percentage. This Energy Chapter encourages conservation measures, increased use of renewables and promotion of increased use of non-fossil fuel vehicles.

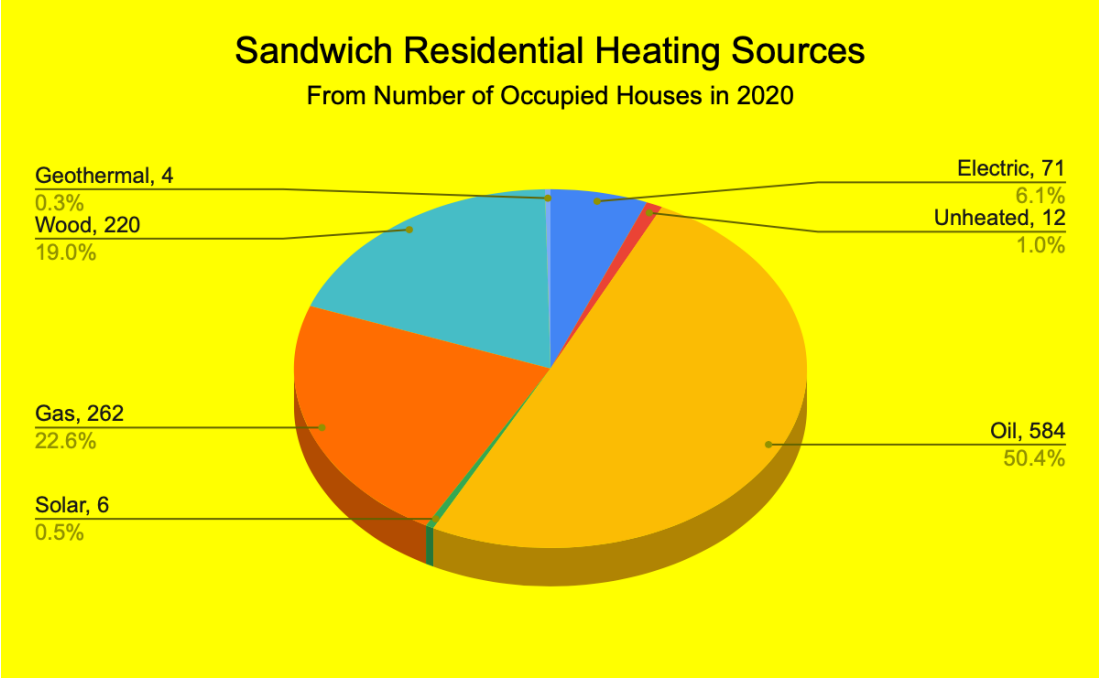
Town leadership has already begun in the past decade, to set an example by implementing a cost effective and clean energy plan for town buildings, vehicles and street lighting.

This action oriented Energy Chapter identifies current benchmarks for the town's energy use and strategies that will assist us in reaching these goals.

[17] U.S. Department of Energy, Energy Efficiency and Renewable Energy, WINDExchange, Wind Energy in New Hampshire, accessed June 20, 2020.

18 https://www.eia.gov/state/analysis.php?sid=NH

1. Residential Heating Energy Use in Sandwich 2019



The sources and percentages in the pie chart above can serve as baseline benchmark figures with which the town can measure its clean energy progress over the next ten years.

In 2020 fuel oil (petroleum) provided 50 percent of residential heating needs, gas 23 percent and wood 19 percent. Ten homes were reported to have used solar and geothermal for home heating.

Residential Renewable Energy Installations in Sandwich as of 2020:

Hot Water & Electricity	Number of Installations
Photovoltaic	137
Wind	3
Heating	
Geothermal	4
Total Installations	144

Renewable Energy Installations: Between 2010 and 2020 there were 78 solar installations in Sandwich and 59 installations prior to 2010 for a total of 137. There are three wind and four geothermal installations. [19]

Wood For Heating and Best Practices of Forestry Management

Eighty-six percent of the town land area is forested.[20] 28 percent are in the White Mountain National Forest. Of the approximately 35,000 acres of privately owned forests in Sandwich - except for the approximate 4,000 acres owned by conservation groups - 10,000 acres are actively harvested.

With sustainable yield management practices, the remaining 21,000 acres offer potential for energy production for heating. Because the forest plays an essential role in capturing and storing carbon, sustainable yield practices are needed to ensure that there is no net increase in CO2 emissions from burning wood. This is based on the logic that harvesting wood can be done at a rate no greater than the rate at which trees would mature, die and emit CO2 as they decompose on the forest floor.

Carbon sequestration can be augmented by encouraging town residents to reduce wood consumption by insulating homes and using high efficiency fireplace inserts, stoves and boilers. Every landowner with forests in Sandwich would do well to understand best practices of forestry management.

2. Transportation Energy Use in Sandwich

Transportation is the second largest sector for energy consumption in Sandwich.

Vehicle Types Registered in Sandwich, 2020

FUEL TYPE	VEHICLES
Gasoline	**1,727**
Diesel	**136**
Hybrid Electric/Gas	**40**
Electric	**4**
Plugin Electric/Gas Hybrid	**1**
Methanol	**1**
TOTAL	**1,909**

[19] Records from Town Hall as of October, 2020.
[20] Rick Vanderpoll, October, 2020, based on updated ‘current use’ conversions used in the 2011 Natural Resources Chapter.

There are three approaches that can be taken to lower the amount of energy used in transportation: (1) reduce the number of miles that everyone travels on a daily, weekly or monthly basis; (2) use other forms of transportation that are less energy intensive including rail and buses that connect cities and airports and (3) most importantly make the transition from fossil-fuel vehicles to EVs, as their costs drop, battery technology improves and the needed charging station infrastructure is built.

3. Municipal Energy Use in Sandwich

Municipal energy use is far less than that of the residential or transportation sectors. Nonetheless, municipal energy improvements can showcase how well-researched and implemented energy improvements can affect a building's performance[21].

The municipal buildings and transportation energy usage for 2019 is listed below under the Goals section entitled: Pursue Cost-Effective Energy Efficiency Projects Early and Often.

4. Commercial Sector Energy Use in Sandwich

Since many businesses are small and often one person operations, benchmark numbers are hard to compile. However, cost savings and efficiency strategies, when appropriate, could be appealing to commercial enterprises especially the Sandwich Business Group, which in 2020, represented 51 businesses.

V. ENERGY SOURCES AND CLEAN ENERGY TECHNOLOGY

Fuel supplies for electricity, heating and transportation will change over the lifespan of this Energy Chapter. Here is a mostly verbatim 2020 snapshot taken from the US Energy Information Administration (EIA) website, along with other cited sources, listing the fuels used in New Hampshire (for current updates refer to the EIA website) [22]:

1. Fossil Fuels

Petroleum: Petroleum fuels include gasoline, kerosene, and diesel oil. Although refined petroleum products account for half of the state's total energy consumption, New Hampshire does not produce or refine crude oil nor does it have any crude oil reserves. [23]

New Hampshire petroleum usage is among the highest in the nation on a per capita basis, in part because of the state's frigid winters. More than two-fifths of all New Hampshire households rely on fuel oil as their primary heating fuel.The transportation sector accounts for almost two-thirds of the petroleum consumed in New Hampshire.[24]

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[21] 2011 Energy Chapter, pg 8-9, # 6 under MEAP report.
[22] https://www.eia.gov/electricity/state/newhampshire/
23 https://www.eia.gov/state/analysis.php?sid=NH

[24] https://www.eia.gov/state/analysis.php?sid=NH

Natural Gas: Natural gas is a relatively clean burning fossil fuel. Burning natural gas for energy results in fewer emissions of nearly all types of air pollutants and carbon dioxide (CO2) than burning coal or petroleum products to produce an equal amount of energy. [25] New Hampshire does not have any natural gas reserves or production and receives natural gas by pipelines from Canada, Massachusetts and Maine. More than two-fifths of the natural gas consumed in New Hampshire is used to generate electricity. New Hampshire is the fourth-lowest state in per capita natural gas consumption, in part because most of the state, including Sandwich, does not have any natural gas distribution infrastructure. [26]

Coal: There are no coal reserves or coal mines in New Hampshire, but the state has two of the three coal-fired electricity generating stations still operating in New England—Schiller at Portsmouth and Merrimack at Bow. Coal-fired power plants play an important role in providing power on high demand days, especially in winter, when demand for natural gas for both heating and electricity generation outstrips supply. Merrimack is a much larger coal-fired power plant, but it is used only intermittently. Keeping the coal plants online between high demand periods adds additional costs to our overall electricity bills.[27]

2. Nuclear Power

Nuclear power reactors do not produce air pollution or carbon dioxide emissions while operating and are therefore considered 'clean' forms of energy, unlike fossil fuel-fired power plants. However, the processes for mining and refining uranium ore and the making of reactor fuel all require large amounts of energy.[28] Nuclear plants are difficult to site, expensive to build, present unique security issues and generate nuclear waste. Only two nuclear power plants operate in New England. That being said, nuclear power is the most reliable continuous source of electricity.

3. The Renewables

Wind, solar, and hydroelectric systems generate electricity with no associated air pollution emissions. Geothermal industrial plants and some biomass systems emit small amounts of air pollutants, though total air emissions are far lower than those of coal- and natural gas-fired power plants.[29]

Renewable energy comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keep shining and blowing, water keeps running, even if their availability depends on time and weather. It is 'green' energy in that it gets replenished on its own on a human

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[25] Natural Gas and the Environment, US Energy Information Administration, Sept. 24, 2020 https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php

[26] https://www.eia.gov/state/analysis.php?sid=NH

[27] Coal Train Protesters Target One of New England's Last Big Coal Power Plants, Inside Climate News, Jan. 4, 2020 https://insideclimatenews.org/news/04012020/coal-train-blockade-climate-protest-new-england-power-plant-merrimack-350-massachusetts-new-hampshire/

[28] Nuclear Explained, Nuclear power and the environment, Dec. 11, 2020 https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php

[29] Benefits of Renewable Energy Use, Union of Concerned Citizens Published Jul 14, 2008 Updated Dec 20, 2017 https://www.ucsusa.org/resources/benefits-renewable-energy-use

timescale. Non-renewable energy is one that takes millions of years to form and gets depleted with use, like coal and petroleum.

Having said that, in 2020, no energy source is 100 percent renewable. All energy sources require finite materials that are not renewable in the manufacture of their infrastructures. Nonetheless, when you consider that the net emissions, operation and maintenance are carbon free, renewables are less destructive to the environment than fossil fuels. As innovation and efficiency improve in the building of the infrastructure for clean energy sources, their use will grow. In 2019, renewable energy sources accounted for about 11 percent of total U.S. energy consumption and about 17 percent of electricity generation.[30]

As new technologies develop to bring us closer to true 100 percent renewable energy, the information and strategies in this Master Plan will need to be modified.

1. Solar Energy: Solar energy is derived by capturing radiant energy from sunlight and converting it into heat, electricity, or hot water. Thanks to continued technological advances solar energy costs have fallen 90 percent in the last 10 years and is now cost-competitive with conventional energy sources.

2. On-Shore Wind Power: The cost of generating energy from on-shore wind turbines has fallen by 70 percent in the last 10 years and is by some measures already the least expensive form of new electricity generation. It is among the fastest growing utility-scale renewable energy technologies in the country.[31]

3. Off-Shore Wind: These wind resources are abundant with the potential to deliver large amounts of clean, renewable energy to fulfill the electrical needs of cities along U.S. coastlines where they are most needed. It is currently more expensive than on-shore wind energy, but the cost of off-shore wind has fallen dramatically since the first US-based off-shore wind farm began operation off Block Island at the end of 2016.[32] Hundreds of megawatts of offshore wind capacity are in development off the southern coast of Massachusetts including capacity goals of 1,600 MW by 2027 and 3,500 MW by 2035. [33] Off-shore wind's potential for further technological improvements and additional cost savings is substantial.

4. Hydropower or hydroelectric energy: Uses the power of flowing water through turbines to generate electricity and is one of the cleanest and most renewable of all energy sources. This proven reliability benefits the national electric grid by supporting other renewable energy sources with its ability to be stored for peak electrical demands. It is one of the oldest methods of

[30] FAQs, How Much Of U.S. Energy Consumption And Electricity Generation Comes From Renewable Energy Sources?, EIA, 2019 https://www.eia.gov/tools/faqs/faq.php?id=92&t=4

[31] Onshore Wind Energy, National Park Service, Oct. 17, 2016 https://www.nps.gov/subjects/renewableenergy/onshorewind.htm.

[32] Top 10 Things You Didn't Know About Offshore Wind Energy, U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Oct. 8, 2020 https://www.energy.gov/eere/wind/articles/top-10-things-you-didn-t-know-about-offshore-wind-energy

[33] Eastern U.S. States Have Plans For 19.3gw Of Offshore Wind Capacity, Institute for Energy Economics and Financial Analysis, Aug 23, 2019 https://ieefa.org/eastern-u-s-states-have-plans-for-19-3gw-of-offshore-wind-capacity/

harnessing energy. Until 2019, when it was replaced by wind power,[34] hydropower was the largest source of total annual U.S. renewable electricity generation.

5. Geothermal: Geothermal energy is a renewable energy source because heat is continuously produced inside the earth. People use geothermal heat for bathing, to heat and cool buildings and geothermal plants generate electricity.

Installing a geothermal heating system in buildings involves placing a series of pipes underground, where the temperature is consistent year-round. Tapping into the earth's subterranean temperatures will provide heat in the winter and cooling in the summer. It will also save households up to 65 percent in annual energy costs, compared to traditional heating and cooling methods. By using the earth's heat rather than through the combustion of fossil fuels, greenhouse gasses and other air emissions are greatly reduced.[35]

6. Hydrogen: Hydrogen like electricity, is an energy carrier that must be produced from another substance. Hydrogen can be produced—separated—from a variety of sources including water, fossil fuels or biomass and used as a source of energy or fuel.[36]

Perhaps due to its abundance, we sometimes forget how useful hydrogen is. From being used in the very first internal combustion engines as an inflammable fuel, to powering flight by airships, hydrogen has once again taken center stage in mankind's quest for energy sources, in the form of fuel cell application. [37]

7. Ocean: The ocean contains an enormous amount of energy that we have only recently started to harness. Wave power technology takes advantage of ocean swells generated by strong winds. Tidal power technology harnesses the energy in the movement of the tides, which are a result of the combined gravitational effects of the moon and the sun.

Ocean power is not yet widely deployed globally, but is a growing market with research underway in several countries, including Australia, Canada, the USA and the UK. [38]

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[34] Wind Has Surpassed Hydro As Most-used Renewable Electricity Generation Source In U.S., EIA, Feb. 26, 2020 https://www.eia.gov/todayinenergy/detail.php?id=42955 Feb. 26,2020

[35] Geothermal explained, *Geothermal energy and the environment, EIA, Dec. 11, 2020* https://www.eia.gov/energyexplained/geothermal/geothermal-energy-and-the-environment.php

[36] Hydrogen explained, EIA, *January 21, 2020* https://www.eia.gov/energyexplained/hydrogen/

[37] Fueling the Future of Mobility, Executive Summary, Paragraph 2, 2019 https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/finance/deloitte-cn-fueling-the-future-of-mobility-en-200101.pdf paragraph 2.

[38] Harnessing the power of the ocean, Australian Academy of Science, Dec. 11, 2020 https://www.science.org.au/curious/technology-future/ocean-power

8. Biomass: Biomass energy is created for heat or converted into electricity or processed into biofuel,[39] from: wood, crops, landfill waste, biogas such as ethanol and animal material.[40] All are renewable materials. The organic material must be converted to usable energy through one of many processes, including combustion, gasification and anaerobic digestion. However, by burning wood and through the industrial exploitation of forests, carbon release is immediate, but it takes decades or even centuries to replace trees to absorb the same amount of carbon released; the current decline of our forests is not sustainable.[41]

4. Other Clean Technologies

1. Mitigation and Sequestration Technologies: Capture, mitigation and sequestration technologies are on the horizon to reduce, remove or recycle carbon dioxide, methane and other pollutants before or after they reach the atmosphere.[42] For example, EcoLine Power Partnership uses methane gas produced at Rochester's waste management landfill to power 85 percent of Durham's UNH campus needs.[43]

2. Energy Storage: This technology is critical to electric vehicles and is increasingly becoming integral to solar and wind energy storage, mitigating the intermittency of those sources. Storage also has the potential to save energy costs by reducing peak loads and avoiding the need for electricity transmission projects. As investment dollars move into small and commercial-scale energy storage systems, they are rapidly improving and becoming less costly. The most frequently used form of energy storage, the lithium ion battery, has declined in price by 84 percent between 2010 and 2018, however zinc, sodium sulfur, hydrogen fuel cells and others are also being developed as alternatives to traditional lithium batteries.[44]

VI. THE URGENT NEED FOR ACTION ON CLIMATE CHANGE

It now makes economic sense to move to 100 percent renewable energy and to have an energy policy which reflects the urgent need to combat climate change.

New Hampshire has already experienced many negative impacts of climate change, including rising temperatures, shorter winters, more extreme weather events (e.g., short-duration/high precipitation events), drought[45], sea level rise, respiratory illness from air pollution and heat, spread of infectious disease (e.g., Lyme disease) and threats to the well-being of our native wildlife (e.g.,

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[39] Renewable energy explained, EIA , Dec. 11, 2020 https://www.eia.gov/energyexplained/renewable-sources/
[40] Biomass Energy, National Geographic, Dec. 11. 2020, Page 1
https://www.nationalgeographic.org/encyclopedia/biomass-energy/
[41] Five Reasons The Earth's Climate Depends On Forests, The Climate and Land Use Alliance, Dec. 11, 2020
https://www.climateandlandusealliance.org/scientists-statement/
[42] CCS Explained, UK CCS Research Center, Retrieved Dec. 14, 2020 https://ukccsrc.ac.uk/ccs-explained/
[43] Landfill Methane Gas Now Powering UNH, Seacoastonline.com, May 31, 2009
https://www.seacoastonline.com/article/20090531/NEWS/905310334
[44] Beyond lithium: alternative materials for the battery boom, PowerTechnology, Nov 14, 2019
https://www.power-technology.com/features/lithium-battery-alternatives/
[45] Drought and Climate Change, NH Fish and Game, Retrieved Dec. 14, 2020,
https://wildlife.state.nh.us/climate/drought.html

fish, moose, loons). If action is not taken, these negative impacts will become more severe in the future and pose a serious threat to our local economy and our way of life.[46]

VII. POSITIVE OUTCOMES FROM BEING PROACTIVE

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

- **Job Creation and Workforce Development.** By some measures, energy efficiency and renewable energy employ three times more American workers than the fossil fuel industry. Clean technology jobs are growing at a rate faster than jobs in the overall economy and will likely continue to do so. In 2018, Massachusetts, for example, had over 110,000 clean energy workers, representing 3.1 percent of the state's overall workforce (the second highest percentage by state in the country). Offshore wind alone is expected to create tens of thousands of jobs in the Northeast.[47]
- **Reduced Energy Costs.** Energy conservation and efficiency are the first and best sources of energy cost reductions. New renewable energy installations are outcompeting fossil fuel generation on price and will soon become less expensive to build and operate.
- **Stable Energy Prices.** Unlike fossil fuel, renewable energy is not subject to commodity market price fluctuations. By contrast, fossil fuel prices are volatile and cannot be locked in over the long term.
- **Local Control & Energy Independence.** Generating and buying more locally-generated renewable energy increases local control over energy supply.
- **Better Health Outcomes and Reduced Health Costs.** Use of energy efficiency, renewable energy and clean transportation avoids harmful air emissions, which positively affects human health and significantly reduces health care costs. A study by Lawrence Berkeley Lab found that wind and solar power in the U.S. reduced smog and particulate emissions (soot) by over a million tons between 2007 and 2015, helping to avoid 7,000 premature deaths. Those avoided deaths, and other avoided public health impacts, saved our country an estimated $56 billion.[48]
- **Avoiding Damage Caused by Climate Change and Associated Costs**. Researchers, examining the economic impact of climate change on the environment and property, conclude that climate change will cost trillions of dollars annually.

VIII. THE TIMING IS RIGHT FOR POSITIVE CHANGE

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[46] Climate Change And Human Health In New Hampshire: An Impact Assessment, Sustainability Institute University of New Hampshire, 2014 https://www.dhhs.nh.gov/dphs/climate/documents/climate-change-human-health.pdf

[47] Construction of Offshore Wind Farms Could Create More Than 75,000 New Jobs, Says Report from CAP and the New Jersey Work Environment Council, Center for American Progress, April 2, 2018 https://www.americanprogress.org/press/release/2018/04/02/448703/release-construction-offshore-wind-farms-create-75000-new-jobs-says-report-cap-new-jersey-work-environment-council/

[48] The Climate And Air-quality Benefits Of Wind And Solar Power In The United States, Nature Energy, August 2017, https://www.nature.com/articles/nenergy2017134

Current and continuing innovations indicate achieving the 2030 and 2050 goals are realistic and doable, starting now in 2021. Here are some indicators and trends:

- The U.S. can reach 90 percent clean electricity by 2035, dependably and without increasing consumer bills (the technology will be available, but will require policy changes).[49]
- The United States, beginning in 2020 was on track to produce more electricity from renewable power than from coal for the first time.[50]
- With the growth of EV sales, Internal Combustion Engine vehicle sales will start to decline beginning from 2024 onwards.[51]
- Electric vehicles are likely to be as cheap as conventional cars by 2025. [52]
- Amazon purchased 100,000 custom electric delivery vehicles from electric vehicle maker Rivian. It plans to have 10,000 on the road by 2022, and 100,000 by 2030.[53]
- California, a bellwether state, recently passed a landmark rule requiring "More than half of trucks sold in the state must be zero-emissions by 2035, and all of them by 2045."[54]
- New Hampshirites buying an electric vehicle (EV) in 2020 rather than a combustion based vehicle would save $8,341 over the 15-year lifetime of the EV.

IX. STRATEGIES AND ACTION STEPS FOR ATTAINING ENERGY GOALS IN SANDWICH

The purpose of this section of the Energy Chapter is to provide benchmarks, strategies and action steps to meet the warrant article goals of efficient and renewable energy by 2030 and 2050.

Its execution will mostly be in the hands of The Energy Committee, which will have the authority to establish its own volunteer subcommittees.

Goal # 1: Pursue Cost-Effective Energy Efficiency Projects Early and Often

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[49] 2035 Report: Plummeting Solar, Wind, and Battery Costs Can Accelerate Our Clean Energy Future, UC Berkeley's Center for Environmental Public Policy -- https://www.2035report.com/press/

[50] In a First, Renewable Energy Is Poised to Eclipse Coal in U.S., New York Times, May 13, 2020 https://www.nytimes.com/2020/05/13/climate/coronavirus-coal-electricity-renewables.html

[51] New Market. New Entrants. New Challenges. Battery Electric Vehicles, Deloitte, Retrieved Dec. 14, 2020 https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/manufacturing/deloitte-uk-battery-electric-vehicles.pdf

[52] Economist: Electric vehicles likely to be as cheap as conventional cars by 2025, Yale Climate Connections, January, 2020 https://www.yaleclimateconnections.org/2020/01/economist-electric-vehicles-likely-to-be-as-cheap-as-conventional-cars-by-2025/

[53] Amazon Just Revealed Its First Electric Delivery Van Of A Planned 100,000-strong Ev Fleet — See How It Was Designed, Business Insider, Oct 8, 2020 https://www.businessinsider.com/amazon-creating-fleet-of-electric-delivery-vehicles-rivian-2020-2

[54] New Rule in California Will Require Zero-Emissions Trucks, New York Times, June 25, 2020 https://www.nytimes.com/2020/06/25/climate/zero-emissions-trucks-california.html

This goal encourages municipal operations, businesses, nonprofits and individual residents to seek ways to make upgrades to structures and apply energy saving techniques.

Strategy #1 Benchmark Municipal Energy Use

The first step toward maximizing energy efficiency is carefully documenting current energy consumption and using that information as a baseline for future change and progress. Each year, ideally at the annual Town Meeting, a data driven progress report should be presented to the town's residents, using the benchmarks as milestones to demonstrate progress toward reaching the town's 2030 and 2050 energy goals.

The Energy Committee will provide baseline data starting in 2022, and if the data is available, retroactively to 2020. Then the town can monitor its usage at least yearly going forward.

The EPA offers free technical assistance and training for municipal staff using Energy Star EPA Portfolio Manager.[55] Portfolio Manager is a freely available online software tool that combines user-input building energy usage information and historical weather data to produce an Energy Usage Intensity (EUI) value from 1-100 that can be used to compare a building's energy usage against the average energy usage of similarly situated peer buildings. Small towns like Deerfield, N.H., population 4,500, have successfully used Portfolio Manager as a way of tracking and reporting out to their citizens about municipal energy use. Partnerships with NHEC and Eversource can streamline energy use/cost data access and analysis.

Strategy #2. Prioritize High Impact Municipal Energy Efficiency Upgrades

In addition to moving toward reaching the renewable energy goals for 2030 and 2050, the town leadership should set a goal to reduce its municipal energy consumption by 2025. The first task is to conduct a comprehensive review of its most recent audit of municipal facilities, update it as needed and implement recommended upgrades. Based on the audit, the town government leadership can prioritize, budget for and implement energy efficiency projects. Any cost analysis should include not just purchase and installation, but also long-term costs and potentials for savings.

Strategy #3. Address Easy To Fix Cost Effective Municipal Projects Immediately

The municipal audit will help identify easily fixable, energy efficiency projects. Among the first two would be to implement LED streetlight conversion and implement smart networked lighting in municipal buildings and facilities. Others may become obvious during the audit review.

Implement a buying strategy of Energy Star[56] equipment and other environmentally sensitive office products. Also, implement policies to encourage "thoughtful" consumption of equipment and office products.

[55] https://www.energystar.gov/buildings
[56] What is Energy Star, https://www.energystar.gov/about

Strategy #4. Prioritize Low/Moderate Income Energy Efficiency Upgrades

There are a significant number of low/moderate income households in Sandwich. Sandwich energy subsidies and Woodshare are available for residents in need. No one feels the pain of monthly energy bills more than people with limited/modest incomes, and none would realize more benefit from a reduction in their energy bills.

One challenge to overcome is that low-income tenants generally lack both the legal right and the economic means to implement energy efficiency measures in the dwellings they occupy. So, a key to success is encouraging or incentivizing landlords to implement energy saving measures. The Energy Committee can explore and promote resources available for low income households, including NHSaves, the Tri-County Community Action Partnership which serves Carroll County and the Weatherization Assistance Program, for which comprehensive information is provided in the 2020 edition of its manual.[57]

Strategy #5. Examine Economy of Scale Potential for Reducing Costs and Improving Townwide Energy Efficiency

At the local level, Sandwich can consider enacting a number of policies that incentivize and maximize energy efficiency. One example is the Property Assessed Clean Energy (PACE)[58] program, which, via RSA 53-F[59], provides incentives for participants to finance energy efficiency and renewable energy projects over the projects' lifetimes.

The town government also could help facilitate a comprehensive energy reduction plan for home owners and community buildings, such as the Benz Center, Wentworth Library and Sandwich Children's Center.

It could also work with the Sandwich Business Group to help fulfill its mission to "Provide Sandwich and Associate businesses and organizations with a variety of resources and material support to grow, thrive and sustain themselves."

Strategy #6. Facilitate Community-Wide Energy Efficiency Improvements Through Public Education

The Town can facilitate community-wide energy efficiency improvements by engaging in public education efforts, including workshops on NHSaves Button Up, PACE, solar panel installation,

[57] New Hampshire Weatherization Assistance Program, Policies And Procedures Manual, 2020 Edition https://www.nh.gov/osi/energy/programs/weatherization/documents/wap-policies-and-procedures-2020.pdf
[58]NH C-PACE OEP Planning & Zoning Conference, June 4, 2016 https://www.nh.gov/osi/planning/resources/conferences/spring-2016/documents/c-pace-maslansky.pdf

[59]Title III, Towns, Cities, Village Districts, And Unincorporated Places, Chapter 53-f, Energy Efficiency And Clean Energy Districts http://www.gencourt.state.nh.us/rsa/html/III/53-F/53-F-mrg.htm

transitioning to EVs, Fed and state tax incentives and exemptions and purchase options for Energy Star appliances and other products.

Encourage educational workshops on recycling and composting in order to divert the amount of salvageable solid waste and organic matter going into landfills. Also hold workshops on the proper methods of disposing residential and commercial waste at the Sandwich Recycling Center.

Sandwich and public utility companies can also encourage conservation through "online data sharing." For example, if a homeowner or business institutes an innovative solution to reduce energy, it could share that information with everyone on the Sandwich Board.

Sandwich could encourage the InterLakes School District to establish energy and conservation related curricula in the high, middle and elementary schools. The New Hampshire Energy Education Project (NHEEP), among others, offers services including teacher professional development, in-class workshops for students and curriculum resource kits.

Strategy #7. Develop Local Policies to Encourage Energy Efficiency.

- The Planning Board will review renewable energy best practices recommended by bona fide municipal planning resource agencies and streamline and clarify processes amenable to residents and commercial enterprises interested in renewable-friendly construction, renovations or additions. That would include an audit of the town's existing Master Plan, Zoning Ordinances, and other town policies for inconsistencies with the 2030 and 2050 energy goals and then move to correct those inconsistencies.
- The town should also review statewide code policy and laws. The New Hampshire Public Utility Commission Sustainable Energy Division manages "the statewide energy code program, for residential and commercial buildings "[60] and provides best practice and updated code compliance information. A subcommittee of the Sandwich Energy Committee could track that information.
- Where appropriate, the Committee may propose that the Town of Sandwich take a public position on pending legislation.

Strategy #8 Identify Innovation and Improvement Revenue Sources

There are opportunities for the town to receive funding for innovative and established conservation, efficiency and renewable energy programs. The New Hampshire Community Development Finance Authority, for example, provides funding opportunities for (1) advancing new ideas, concepts and innovations (2) planning and development phases (3) implementation stages and (4) building comprehensive, community-based networks to ensure long term buy in and engagement that is often needed for ultimate success.[61]

[60] Sustainable Energy, Energy Codes, NH Public Utility Commission https://www.puc.nh.gov/Sustainable%20Energy/SustainableEnergy.htm EnergyCodes@puc.nh.gov

[61] Community Development Finance Authority, How We Help https://nhcdfa.org/how-we-help/

For many projects, the town will need outside funding to achieve any or all of the four stages above. The best chance for outside funding success is from funding sources that advance the town's goals, while also advancing the funders' goals. Seeking funding is very competitive and the funder needs to demonstrate that they have used their finite funding well; so, strong proposals written specifically for each funder provides the best chance of fundraising success.

The years 2020 to 2024, could provide special funding opportunities if President Biden's energy infrastructure campaign promises come to fruition. Having shovel ready projects in hand may well increase chances of funding success.

The Committee should:

- Build a database of grants and other funding opportunities that would help offset the costs of the town's 2030 and 2050 renewable goals.
- Watch for clean energy and energy efficiency Request for Proposals (RFPs) from funders.
- Develop a plan for writing applicable state, federal, utility, industry and philanthropic grants as they become available.
- Prepare "Shovel Ready" plans to quickly capitalize on time sensitive funders' Request for Proposals (RFPs).

Each of the goals will be accompanied by a checklist like the one below, to help facilitate and keep track of progress in meeting the goals by fulfilling each goal's strategies.

Strategy #1. Benchmark Municipal Government Energy Use with EPA Portfolio Manager			
1. Sign up for and take advantage of free technical assistance and training for municipal staff using ENERGY STAR EPA Portfolio Manager.			
2. Partner with NHEC and Eversource to streamline energy use/cost data access and analysis.			
3. Make an annual data-driven progress report for the 2030 and 2050 renewable energy goals.			
Strategy #2. Prioritize High Impact Municipal Government Energy Efficiency Upgrades			
1. Review comprehensive energy audit of municipal facilities,update as needed.			
2. Based on audit, town leadership will prioritize, budget for and implement energy efficient projects.			
Strategy #3 -- Address Easy To Fix Cost Effective Municipal Projects Immediately			
1. List easily achievable projects with milestone dates for completion.			
2. Implement LED streetlight conversion			
3.Implement smart networked lighting controls in municipal buildings and facilities			
4. Implement an Energy Star, energy saving buying strategy			
5. Implement policies to encourage "thoughtful" consumption of equipment and office products			

Strategy #4. Prioritize Low/Moderate Income Energy Efficiency Upgrades				
1. Identify local, county, state, federal and utility led programs that provide resource help for low/to moderate income residents; include renters and landlords.				
2. Decide which programs would work best for the renters and landlords and publicize that information.				
Strategy #5 -- Examine Economy of Scale Potential for Reducing Costs and Townwide Energy Efficiency Opportunities				
1. Seek a comprehensive energy reduction plan that would include residences, community buildings, such as the Benz Center, Wentworth Library and Sandwich Children's Center				
2.Work with the Sandwich Business Group to identify ways to advance its mission via energy efficiency and cost cutting.				
Strategy #6. Facilitate Community-Wide Energy Efficiency Improvements Through Public Education and Partnership with NHSaves Program.				
1. Conduct public education sessions like NHSaves, on financial incentives programs and on recycling and composting.				
2. Encourage best practice data sharing				
3. Recommend integrating clean energy learning opportunities in local and regional school curriculums.				

Strategy #7. Develop Local Policies to Encourage Energy Efficiency			
1. Audit town's existing Master Plan, Zoning Ordinances, and other town policies for inconsistencies with the 2030 and 2050 goals and then move to correct those inconsistencies.			
2. Review statewide code policy and laws for best practices and compliance information.			
3. Track energy efficiency related legislation.			
4. Advocate for energy related legislation that would benefit the town.			
Strategy #8. Identify Innovation and Improvement Revenue Sources			
1. Build a database of clean energy funding sources that would offset costs of the town's 2030 and 2050 renewable goals.			
2. Watch for clean energy and energy efficiency Request for Proposals (RFPs) from funders.			
3. Develop a plan for writing applicable state, federal, utility, industry and philanthropic grants as they become available.			
4. Prepare "Shovel Ready" plans to quickly capitalize on time sensitive funders' Request for Proposals (RFPs)			

Goal #2 Transition to Renewable Energy Sources for Electricity

Strategy #1. Transition Sandwich Municipal Electricity Consumption to 100% Renewable Electricity at the Earliest Opportunity

To help achieve the community-wide 100 percent renewable electricity goal of 2030, the town should consider moving municipal electricity consumption to more renewable energy sources. This would set a visible and powerful example for the rest of the community, signaling that the transition to renewable energy is feasible and already underway.

An interim option towards municipal 100 percent renewable energy is to purchase Renewable Energy Certificates (RECs). NHEC and Eversource provide the option, via their respective Electric Choice[62] and Choose An Electric Supplier[63] programs. The town should consider this interim option, while still pursuing a transition to a more localized, renewable energy grid, with its associated positive local economic, energy security and health benefits.

The Town should investigate solar energy potential for all its municipal properties and to determine if that potential can be expanded to generate electricity to meet other community energy needs as well.

Strategy #2. Work closely with New Hampshire Electric Co-op (NHEC)

NHEC, a user/member owned energy utility, serves more than 900 of Sandwich's approximately 1,050 residences or about 87 percent of the total. NHEC has the goal that by 2025, at least 25 percent of the power purchased by its members will be generated by renewable resources.[64] We, in Sandwich, as members of NHEC, can influence a faster rate of transitioning to renewable energy goals by using our voices as advocates for sustainability.

Most of the remaining 13 percent of the Sandwich homes are serviced by Eversource, which in December 2019, set a goal of becoming carbon neutral in its own corporate emissions by 2030.[65]

In 2020, a coalition driven mostly by a Sandwich led grassroots movement got three broadband friendly NHEC board of director members elected and started a petition drive which was instrumental in getting the NHEC into the broadband business. It would be nice to see the same effort emanating from Sandwich to persuade NHEC to be more aggressive and creative in developing an all renewable policy. From 2020 to 2023 three of its board members will be from

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[62] "Electric Choice and Competitive Power Suppliers," New Hampshire Electric Co-op https://www.nhec.com/electric-choice/

[63] Choose A Supplier, Eversource https://www.eversource.com/content/nh/residential/my-account/billing-payments/electric-supplier-info

[64] "Our Plan," {New Hampshire Electric Co-op, https://www.nhec.com/our-plan/

[65] "Commitment To Clean Energy & Carbon Neutrality," Eversource, https://www.eversource.com/content/nh/about/about-us/about-us/our-future-is-clean-energy/commitment-to-clean-energy-carbon-neutrality

Sandwich and nearby towns, so the Town will have energy-renewable-friendly connections to NHEC management.

Strategy #3. **Be an Information Resource for Sandwich Residents and Businesses Seeking to Self-Generate Renewable Power**

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

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

- What local contractors install solar projects?
- What is the approximate range of cost of installing solar?
- What local permits are required to install solar?
- What federal, state, regional and local incentives are available?
- What financing arrangements are available and what are the long-term savings benefits?

The Energy Committee, another town entity or perhaps an affiliated organization like the Lakes Region Planning Commission can develop a one-stop site providing a wealth of solar information, including answers to the questions above.

In addition, workshops like Solar 101 could be hosted and, perhaps, more ambitious undertakings like a communitywide Solarize Campaign[66] can be developed.

Strategy #4. **Investigate Community Power (Municipal Aggregation) Potential**

In 2019, Senate Bill 286[67] went into effect enabling all state municipalities and counties, including Sandwich and Carroll County, to initiate local or regional Community Power (also known as municipal aggregation) programs. According to Clean Energy NH[68]:

> Under Community Power programs, local governments can procure and provide electricity to their residents and businesses on a competitive basis. By bypassing outdated regulations and legacy technologies, Community Power programs can harness private-sector innovation to lower costs for customers and provide other energy services.

Here is more from Clean Energy NH:

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[66] Solarize Campaigns, Solar Crowdsource, Retrieved Dec. 14, 2020 https://www.solarcrowdsource.com/how-it-works-solarize/

[67] http://gencourt.state.nh.us/bill_status/billText.aspx?sy=2019&id=1053&txtFormat=html

[68] "Community Power," Clean Energy NH, https://www.cleanenergynh.org/municipal-aggregation

> The first step for a local government to implement a Community Power program is for the local governing body – select board, town council, city council, or county commission – to form an electric aggregation committee to develop a Community Power Plan.

Sandwich could develop a Community Power program singularly, with Carroll County, the Lakes Region Planning Commission or with other municipalities.

Once the Community Power plan has been finalized it must be approved for implementation by the local government's legislative body (e.g., town meeting vote).

The Town might consider purchasing a municipal membership in Clean Energy NH ($250 in 2020) to fully capitalize on its resources.

Goal #2: Transition to Renewable Energy Sources for Electricity			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1. Transition Sandwich Municipal Electricity Consumption to 100% Renewable Electricity at the Earli Opportunity			
1. As an interim step, muncipal goverment purchases all of its electrity from NHEC and Eversource alternative 100% renewable Electric Choice sources.			
2. Investigate solar energy potential for all its municipal properties and to determine if that potential can be expanded to generate electricity to meet other public, nonprofit, commerical and residential energy needs.			
Strategy #2. Work closely with New Hampshire Electric Co-op (NHEC)			
1. Work closely with NHEC management and its board members to persuade NHEC to be more aggressive and creative in developing an all renewable energy supply policy.			
Strategy #3. Be Information Resource for Residents & Businesses Seeking to Self-Generate Renewable Power			
1. Decide which Town of Sandwich entity or affiliated entity can best provide renewable energy information to optimize renewable transition for the entire community			
2. Develop a one-stop solar information resource.			
Strategy #4 Investigate New Community Power (Municipal Aggregation) Potential			
1. Form a subcommittee to investigate feasiblity of Town of Sandwich becoming a Community Power municipality.			
2. Consider Town purchasing an annual Clean Energy NH municipal membership			

Goal #3. Transition to Clean Energy Transportation and Alternatives

Given Sandwich's rural character, use of private vehicles as the dominant mode of transportation is unlikely to change. Right now for many Sandwich residents getting a gas refill requires a round trip that will burn a gallon of gas. This plan presents recommendations for ensuring that appropriate

infrastructure, such as electric vehicle charging stations, will be available to facilitate widespread adoption of "Clean Vehicles."

"Clean Vehicles" include all vehicles that emit no gases other than water vapor. This includes both electric vehicles (EVs) and hydrogen fuel-cell powered vehicles (FCVs). Right now in 2020, the EV revolution is underway, but FCVs may have a larger role in the future.

As EVs improve their range, charging stations become more ubiquitous and battery prices continue to decrease, as referenced earlier, full EVs will replace internal combustion engines (ICE) over time.

When estimating how much clean renewable energy the town will need in the future, it should take into account the electrical power needed for new modes of transportation. For example, a community solar array might not be economically feasible in 2020 based on the town's electricity usage but with the advent of EV charging stations, the added electrical load might make the array economically feasible.

According to town records for 2020, there were 1,727 gasoline-fueled, 136 diesel-fueled, 40 hybrid electric, one electric (EV) and one methanol-fueled vehicles.

Strategy #1. Prepare for the Installation of EV Charging Infrastructure

EVs require charging stations. Permanent or seasonal residents can charge their vehicles at their homes. However, the Town needs to plan for and facilitate the building of a charging infrastructure for tourists and others passing through or doing business in Sandwich. Charging stations might be set up in Center Sandwich village, restaurant parking lots, trailheads, etc. What types of chargers, where they are located, who builds them, owns and operates them, and how they are regulated will be determined by a combination of market forces along with planning, facilitation, permitting and oversight by the Town's Select, Planning and Zoning boards.

Pre-planning for future charging infrastructure could save the Town money through efforts such as installing conduits when roads are being excavated.

Outreach to businesses and nonprofits will help ensure the infrastructure meets the needs of the broader community.

Strategy #2. Transition Town-Owned Vehicles to Clean Transportation

Baseline Benchmark: Town Vehicles in 2020 -- All are powered by internal combustion engines.

AUTOMOBILES/VEHICLES

Year	Model	Value	Type	Dept	Manufacturer
2020	Tahoe 4WD	55000	Cruiser	Police	Chevrolet
2020	CV515	98000	Truck	Public Works/Highway	International
2020	Dump Truck	160000	Truck	Public Works/Highway	International
2020	Dump Truck	160000	Truck	Public Works/Highway	International
2019	Ram 1500	22000	Auto/Pickup	Parks & Rec	Dodge
2016	Tahoe 4WD Model CK15706	43000	Cruiser	Police	Chevrolet
2016	Sierra 3500 4WD	50000	Truck	Public Works/Highway	GMC
2016	7300 Dump Truck w/plow	152000	Truck	Public Works/Highway	International
2012	F550 Dump Truck	55338	Truck	Public Works/Highway	Ford
2009	CX75 track excavator	62500	Truck	Public Works/Highway	Case
2002	Vibratory Roller	39995	Truck	Public Works/Highway	SV210
1996	4 Tracks 300 All Terrain	4399	Tractor	Fire Department	Honda
1994	250	40000	Truck	Public Works/Highway	Brush Bandit

Year	Model	Value	Type	Dept
2020	Case Backhoe	102000	Backhoe	Public Works/Highway
1999	John Deere 544H Loader	98950	Loader	Public Works/Highway
1998	John Deere Grader	156787	Grader	Public Works/Highway

Fire Department Equipment

Year	Model	Value	Type	Manufacturer	FireApparatusType
2014	Pumper Fire Truck	380000	Fire Apparatus	KME/International	Fire Pumper
2005	Pumper	425000	Fire Apparatus	KME	Fire Pumper
2002	Truck	100000	Fire Apparatus	Ford F550	Fire Brush Trucks
1994	Pumper	350000	Fire Apparatus	Mack/Pierce	Fire Pumper
1931	Fire Truck	10000	Fire Apparatus	Ford	Antique
1971	M35A2 Forestry Vehicle	35000	Truck	Fire Department	AM General
2014	Expedition	37800	Cruiser	Fire Department - Chief's	Ford
2017	F550 Rescue Truck	180000	Truck	Fire Department	Ford

The town vehicles account for at least half of municipal energy use. A comprehensive fleet audit should assess the cost effectiveness of retaining, repairing or replacing existing vehicles based on their energy consumption and Total Cost of Operation (TCO) over their projected years of use by the town.

The town's vehicles can mostly be categorized as light vehicles, for example police cruisers, pickup trucks, 4-wheel drive SUVs, and heavier vehicles, including the town's snowplows, graders, backhoes and fire trucks. Neither category is being mass-produced as EVs in 2020. However, the light vehicles are expected to be mass produced before 2025 and the heavier ones soon afterwards.

The Total Cost of Operation of EVs will soon be competitive with the internal combustion engine vehicles in the town's fleet. All future fleet buying decisions should consider this coming seachange. As an interim step, the town might consider short term leases in anticipation of new market opportunities for clean energy vehicles.

Some new EV vehicle costs might also be subsidized by grants and federal programs, including monies from the Volkswagen Settlement Fund[69], distributed by the NH Department of Environmental Services.

It is also important to evaluate other ways to reduce fuel usage within the vehicle fleet, including analyzing routes and anti-idling systems and policies.

Strategy #3. Encourage InterLakes School Districts to Transition School Buses to Clean Transportation

In total, Inter-Lakes has 14 regular bus routes, 3 special transportation routes and 1 vocational bus route. All buses are leased from First Student. Three school buses service Sandwich. In 2020, it cost approximately $64,000 to operate each full sized bus. The district requests that buses are no more than eight years old.

Electric school buses are being developed by several established and well-known school bus manufacturers, but the costs in 2020, even using Total Cost of Operation analysis, are still too expensive relative to combustion vehicles. As more are produced, thanks to purchases by early adopters, for example California, we can expect to see prices drop, making a transition to EV buses cost effective and energy efficient.

The charging infrastructure for these school buses is likely to be specialized and require significant power, so planning and engineering should take place well in advance of the fleet transition. The buses' batteries, when solar power becomes more dominant, can be used as emergency sources of backup power.

Strategy #4. Encourage and Facilitate the Transition to Electric Vehicles for the Private Sector.

It is important to emphasize that the transition to EVs will be driven by economics and market forces, and not by Town mandate. Once it has become clear that EVs are less expensive than combustion vehicles and charging is not an impediment to their purchase, the transition will rapidly accelerate as referenced above. The Energy Committee can help keep the public informed about the advantages of clean powered vehicles through educational outreach, vehicle demonstrations, and website information. Providing the public with information about available charging infrastructure, tax advantages, subsidies, regulations, cost savings and clean air benefits will all be critical.

The town should consider property tax adjustments for on-site solar generation to include EV chargers for the public use.

[69]"Volkswagen Settlement," New Hampshire Office of Strategic Initiatives https://www.nh.gov/osi/energy/programs/vw-settlement.htm

Strategy #5. Ensure EVs Are Powered by Renewable Energy and Minimize Costs of Charging

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

To mitigate the effects of these increases in electricity use, we will want to encourage NH electric utilities to implement "smart" metering and Time of Use (TOU)[70] rates, in order to incentivize EV owners to charge their vehicles in off-peak, low demand times, such as after 9:00 PM. Some have proposed that using more electricity at night could actually *reduce* overall kWh rates because the significant fixed costs of the grid would be spread out throughout a 24-hour period where electricity is being sold, rather than the typical 16-hour period.

Analysts are also predicting that the battery packs in EVs will someday play a role as an energy storage system, and could be used to collect energy when it is cheap and give it back to either the home or to the grid during periods when electricity is more expensive. Imagine the schools' fleet of buses's batteries being available as movable power sources during energy emergencies.

Strategy #6 Reducing Miles Driven and Energy Used

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

Here are some time-tested methods to reduce miles driven and energy used:

- Walking, bicycling, motorcycling
- Foot/cycling routes: with the advent of motorized bicycles, the town might reconsider mapping out safe cycling/walking routes and paths to recreational centers like the town beach and connecting commercial centers in Center Sandwich, North Sandwich, Moultonborough and Tamworth villages.
- Car-pooling: particularly for regularly scheduled trips to work, school and events.
- Combining multiple errands and trips into one.
- NH Rideshare Program[71]: Source for transportation alternatives including carpool matches, transit mapping options including park and ride lots nearest you.
- NH DOT Rail and Bus Transit[72] have park-and-ride lots around the state for when commuting longer distances.

[70] "Time of Use (TOC)," Sunrun, https://www.sunrun.com/go-solar-center/solar-terms/definition/time-of-use
[71] Frequently Asked Questions, NH Rideshare Program, NH Department of Transportation https://www.nh.gov/dot/programs/rideshare/faq.htm
[72] "Park & Ride Locations, NH Rideshare Program, NH Department of Transportation," https://www.nh.gov/dot/org/aerorailtransit/railandtransit/index.htm

- Establishing a no-idling policy to reduce vehicle emissions, and/or purchase technology such as idling retrofits.

A longer term approach to reducing vehicle travel is to promote more compact, mixed-use forms of land development that enable people to live, work and shop within walking distance of their home or business. The U.S. Department of Transportation's Federal Highway Administration (FHWA) data[73] showed that in 2018 a record-setting 3.225 trillion vehicle-miles were traveled in the USA, an increase of 12.2 billion miles over the previous year. The Urban Land Institute[74] emphasizes that with compact development, people drive fewer miles, lower their costs, improve health and reduce emissions.

The town should be proactive and examine what would work best to reduce miles driven and energy used. Its decision making partners should include recreation groups, commercial enterprises, agriculture interests, environmental organizations and similar entities.

Strategy # 7. Buy Local

Localize Food Buying: Right now the closest place from Center Sandwich Village that provides food shopping morning, noon and evenings is about 17 miles and a 30-minute round trip drive. That's a lot of time, energy and cost spent. The gas cost for $50 of grocery shopping adds an approximately 5 percent expense. The cost is much higher if one were to incorporate the real cost of operating a car, including gas, insurance, depreciation, tire wear etc. The federal government in 2020 estimated that the cost to be about 50 cents a mile.——

Once at the supermarket, there are also hidden packaging, refrigeration and transportation costs of items shipped from locations around the country and the world. All the more reason to think local.

Plenty of local farmers in Sandwich and nearby towns have self service farmstands for their produce, meats and eggs. The Sandwich Creamery has its own ice cream and cheese and the Tamworth and Sandwich Farmers' markets provide locally sourced foods. It's a model that seems to work. The community should support the preservation of high value agricultural soils in land protection efforts to preserve working farms.

In addition to farmers there is a long list of local businesses and services from potters to lawn maintenance to restaurants all of which help circulate dollars locally while helping advance clean energy goals.

The Town of Sandwich should encourage local enterprises that support the production and sale of local goods and services that will help the town reach its 2030 and 2050 energy goals.

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[73] "Strong Economy Has Americans Driving More than Ever Before," Press Release, US Department of Transportation https://www.fhwa.dot.gov/pressroom/fhwa1905.cfm

[74] "Land Use and Driving, Urban Land Institute "https://uli.org/wp-content/uploads/ULI-Documents/Land-Use-and-Driving-Low-Res.pdf

Goal #3: Transition to Clean Energy Transportation			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1. Prepare for the Installation of EV Charging Infrastructure			
1.Form a committee to research and plan for EV infrastructure, including members or input from town's planning, zoning and other code oversight boards			
Strategy #2. Transition Town-Owned Vehicles to Clean Transportation			
1. Conduct a comprehensive fleet audit, assessing each vehicle's clean energy efficiency and cost effectiveness.			
2. Begin planning for and make fleet buying decision based on the imminent EV revolution.			
3. Monitor federal and other subsidies to help offset costs.			
4. Ensure all personnel are aware of efficiency and energy conservation best practices when using town vehicles.			
Strategy #3. Encourage InterLakes School Districts to Transition School Buses to Clean Transportation			
1. Encourage InterLakes School District to transition school buses to clean energy and anticipate EV infrastructure needs.			
Strategy #4. Encourage and Facilitate the Transition to Electric Vehicles for the Private Sector			
1. Provide public information sessions to help residents and businesses prepare for an EV future.			
2. Consider property tax adjustments for on-site solar generation to include EV chargers for the public use.			

Strategy #5. Ensure EVs Are Powered by Renewable Energy and Minimize Costs of Charging			
1. Provide information to aid town government, businesses and residents to minimize EV costs and maximize energy savings.			
Strategy # 6. Reducing Miles Driven and Energy Used			
1. Promote time tested methods of reducing miles driven			
2. Map walkable and bicycle friendly paths and roadways			
3. Establish an anti-idling policy			
4. Consider zoning policy changes to include long term compact, mixed forms of land development.			
Strategy # 7. Buy Local			
1. Promote the production and sale of local goods, foods, services that will help the town reach its 2030 and 2050 energy goals.			
2. Establish supports for the preservation of high value agricultural soils in land protection efforts to preserve working farms			

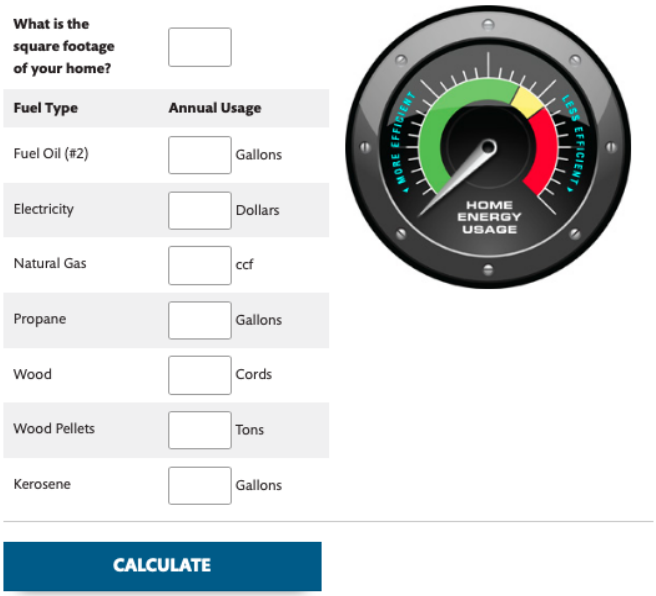
Goal IV. Develop Thermal Energy Alternatives

Sandwich has committed to two milestones in the quest for 100 percent reliance on renewable energy sources: (1) 2030 for all electricity and (2) 2050 for all our heating and transportation. This section will address the 2050 goal of heating and cooling buildings.

As with electricity, reduced demand for our heating/cooling needs can be achieved through conservation and increased energy efficiency. Home, business and municipal audits, as discussed earlier, can help determine a building's energy deficiencies. Agencies like NHSaves can provide low cost audits and detailed plans for thermal conservation upgrades. The online comparison tool developed by Efficiency Maine[75], partly shown in the screenshot below, can help in estimating annual heating and cooling costs. It also offers a similar tool for home water heating systems.

[75] Calculate Your Home's Energy Efficiency, Efficiency Maine https://www.efficiencymaine.com/at-home/savings-calculator/

Calculate Your Home's Energy Efficiency



Emerging renewable thermal technologies will continue to reduce heating and cooling costs and greenhouse emissions. Examples include: geothermal, biomass, biogas, hydrogen gas and solar thermal. Renewable heating, ventilation and air conditioning (HVAC) systems can be used in conjunction with existing fossil fuel-based systems or can completely replace a traditional heating system. By 2050, if we meet our goal, all fossil fuel systems will have been replaced.

Here are some trends and innovative solutions that might be applicable to Sandwich:

Geothermal: Geothermal technology harnesses the heat generated by the Earth. There are three main types of geothermal heating systems: direct use geothermal, enhanced geothermal, and ground-source heat pumps. In New Hampshire, ground-source heat pumps are already in use, and 1,230 new systems are installed each year.[76] Heat pumps are used in both single-family residences and in public and commercial facilities.

Biomass: Biomass is fuel that is created from organic materials as explained earlier. Burning biomass creates air pollution and can cause a sweeping array of health hazards.[77] As of this writing in 2020, there are cleaner and better renewable thermal energy technologies emerging.

[76] Hongoltz-Hetling, Innovation, Or Just Hot Air? Heat Pumps Gain Popularity in Cold Weather Climates, Mar. 25, 2018, https://www.vnews.com/Heat-pump-report-16048079

[77] Health Groups to Congress: Burning Biomass is Bad for Health, The Natural Resources Defense Council (NRDC), Sept. 14, 2016 https://www.nrdc.org/experts/sasha-stashwick/health-groups-congress-burning-biomass-bad-health

Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen (anaerobically), primarily consisting of methane and carbon dioxide. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Another advantage of biogas generation is the production of organic fertilizer.[78]

Solar Thermal: Solar thermal is different from photovoltaic solar panels, which directly convert the sun's radiation to electricity. There are two main types of solar thermal systems for energy production—active and passive. (1) Active systems require moving parts like fans or pumps to circulate heat-carrying fluids. (2) Passive systems have no mechanical components and rely on design features only to capture heat (e.g. greenhouses). Solar water heaters can be used in conjunction with conventional heaters and can reduce a typical heating bill by 50–80 percent.[79] The New Hampshire Renewable Energy Fund currently, in 2020, offers rebates for both residential and commercial/industrial solar thermal projects.[80]

Hydrogen Gas: Hydrogen gas (H2 gas) can be used for heating buildings just as natural gas is used, as explained in detail above.

Thermal Delivery Methods

In addition to using renewable sources, there are also several design strategies that can be used to reduce emissions from HVAC systems. These strategies include electrification, cogeneration and district heating.

Electrification: The electrification of heating and cooling systems can supplement or replace fossil fuel systems with electric heat pumps. Heat pumps use less energy than fossil fuel-systems to heat the same amount of space, thus reducing emissions. Emissions are reduced even further if the electricity used to run the heat pumps is generated from renewable sources, making it the most promising way to reduce heating and cooling emissions.

Cogeneration: or Combined Heat and Power (CHP) involves producing electricity from current fuel sources, (such as natural gas, biomass, coal, or oil). Cogeneration *captures the excess heat* which would otherwise be wasted (wasted heat typically makes up 2/3 of the energy input to generate the electricity). In 2016, there were 17 cogeneration facilities in New Hampshire, including hospitals, colleges and universities, government buildings, commercial buildings and other sites.[81] While cogeneration in the U.S. is mostly used in large facilities, it is also possible to use it in the home. This is known as residential cogeneration or "micro CHP," and is more prevalent in Europe and

[78] Advantages and Disadvantages of Biogas, Homebiogas, (Dec. 2, 2020) https://www.homebiogas.com/Blog/141/Advantages_and_Disadvantages_of_Biogas
[79] New Hampshire Public Utilities Commission, Renewable Energy Technologies (Dec. 2, 2020), https://www.puc.nh.gov/sustainable%20energy/RenewableEnergyTechnologies.html
[80] New Hampshire Public Utilities Commission, Renewable Energy Fund (Dec. 2, 2020) https://www.puc.nh.gov/sustainable%20energy/RenewableEnergyFund.html
[81] U.S. Department of Energy, The State of CHP (last accessed Mar. 11, 2019), https://www.energy.gov/sites/prod/files/2017/11/f39/StateOfCHP-NewHampshire.pdf

Asia. However, some analysts are predicting a growth in residential cogeneration in the U.S. in the next several years.

District Heating: In a district heating system, heat is generated in a central location and then distributed to a network of buildings using insulated pipes. A district heating system can produce heat more efficiently than a single-building heating system thus reducing emissions, and can also utilize renewable technologies that might not be cost effective for individual building owners to install. District heating is popular on university campuses, and is also used effectively in downtown areas.

Strategy #1: Research renewable thermal sources for Town Facilities

Long term planning should include studying long term cost benefits and environmental gains for heating and cooling systems. For example, when considering a new heating system for town hall and other facilities, possibly consider electric heat pumps with a future plan for a town solar array.

Strategy #2: Facilitate residential and commercial transition to renewable thermal resources

Provide informational resources for renewable heating/cooling systems for homes and businesses including developing and keeping an updated list of renewable heating solutions and contractors, holding workshops and possibly having green tours of local buildings.

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

In 2020 the Town of Sandwich had some 50 new home building applications, which indicates a trend of more people moving to town. Energy efficient construction should be encouraged. Cluster housing provides opportunities for co-generation and district heating as defined on page (page number to be added in final planning board edit) above.

Goal #4: Develop Thermal Energy Alternatives			
Proposed Actions	Time Frame	By Whom	Notes
Strategy #1. Research renewable thermal sources for town facilities			
1 Research renewable thermal sources for town facilities.			
Strategy #2. Facilitate residential and commercial transition to renewable thermal resources.			
1. Provide informational resources for renewable heating/cooling systems for homes and businesses .			
Strategy #3. Explore opportunities for co-generation and district heating			
1. Explore opportunities for co-generation and district heating.			