8

Addressing Climate Change

We will continue to be a model community by reducing our energy consumption and making bold transitions to rely solely on renewable sources of electricity by 2030 and renewable sources of fuel for heating and transportation by 2050. We recognize the potential adversity being brought about by climate change and will commit our resources to preparing and adapting local and regional systems and resources.

GOALS:

8-1. Hanover's programs, policies, and regulations will move the Town closer to its 2017 Ready for 100 Pledge and mitigate effects of climate change.

8-2. Municipal energy consumption will be reduced to the greatest extent practicable.

8-3. Local renewable energy generating capacity will be increased and contribute substantially to Hanover's clean energy targets.

8-4. Community-based greenhouse gas (GHG) emissions reductions will be enabled through partnerships and education.

8-5. Hanover will be more resilient to climate change.

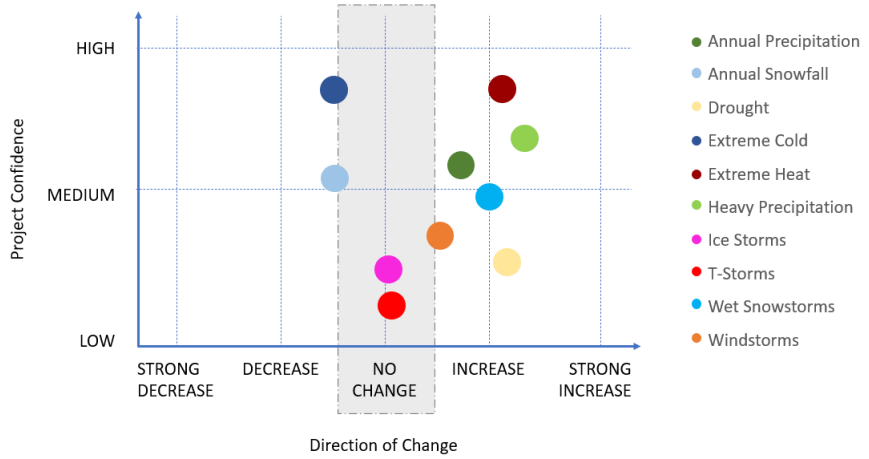
Introduction

It is scientific consensus that the Earth's climate is warming due to human activity, resulting in significant, long-term negative impacts on our communities and ecosystems. Since the beginning of the 20th century, temperatures in New Hampshire have risen more than 3 degrees Fahrenheit, with most warming occurring in the winter season. Future winter warming will have large effects on snowfall and snow cover, impacting winter recreation and native plants and animals. Annual average precipitation and the frequency and intensity of extreme precipitation events are also expected to increase, with associated increases in regional flooding.[1]

The Town of Hanover is responding to the impacts of climate change in two major ways: transitioning away from fossil fuels to reduce the generation of greenhouse gas (GHG) emissions and adapting to climate change by developing resilient municipal systems. In 2017, Hanover residents adopted a clean energy pledge to transition to 100 percent renewable electricity by 2030 and 100 percent renewable energy, including heating and transportation, by 2050. Sustainable Hanover has been charged with leading the town's energy initiative and engaging the community to achieve these goals. Resiliency is being made a consideration in all types of decision-making, from designing physical infrastructure to envisioning a future economy. Hanover's Hazard Mitigation Plan is a guide to how the town can be more resilient by reducing future losses from both human-made and natural hazards.

The town's climate goals go beyond the climate action planning happening at the state level, which is thus far inadequate for avoiding future climate disaster. Federal programs that support climate action will be critically important for advancing the Town of Hanover's climate agenda. Each of the town's sectors can access the benefits and incentives that these programs offer.

Figure 8-1: New England Climate Projections (through 2050)



Source: IPCC. Adapted from Dr. Jay Shafer

Climate Change in New Hampshire

Climate models for Hanover do not exist. The Intergovernmental Panel on Climate Change (IPCC) has synthesized research about climate change by regions of the world. For North-Eastern North America, as shown in Figure 8-1, there is high confidence that there will be an increase in both extreme heat and heavy precipitation. Greater annual precipitation and more wet snowstorms and windstorms are expected with a moderate confidence level. More periods of drought are anticipated with lower confidence. The future severity and number of ice storms and

1 NOAA National Centers for Environmental Information (2022). *State Climate Summaries 2020: New Hampshire*. Retrieved from https://statesummaries.ncics.org/chapter/nh/

thunderstorms with high winds are thought to be about the same as today. Extreme cold and annual snowfall are both expected to decrease with medium to high levels of confidence.

In New Hampshire, coastal communities face greater threats of flooding than does Hanover. Flood risk in Hanover is mapped in Figure 8-2. The Connecticut River behaves much more like a series of lakes due to the dams along its mainstem and the many flood control dams built on its tributaries. Built in 1950 to replace dams established as early as 1882, the Wilder Dam, currently operated by Great River Hydro, not only generates power but also provides an important flood control function. Flooding of tributaries in Hanover presents a risk, especially in the event of ice dams on Mink Brook, or of heavy precipitation events that may overwhelm stream banks and road infrastructure. Extreme heat events, another highly confidently expected result of climate change, can be moderated by mitigating heat islands, and ensuring that the public receives warnings about these events so their activities can be modified to present less health risk.

Climate Migration

Climate migration is the movement of people who have been displaced from their homeland due to the impacts of climate change and seek to find residence elsewhere. Climate migrants are increasingly relocating to New Hampshire and other areas of New England to avoid climate hazards like extreme heat, wildfire, and water shortages. Climate migration may lead to the expansion of Hanover's population. The town must plan properly for their arrival. This planning will likely entail investments in social services and infrastructure, as well as promoting affordable housing.

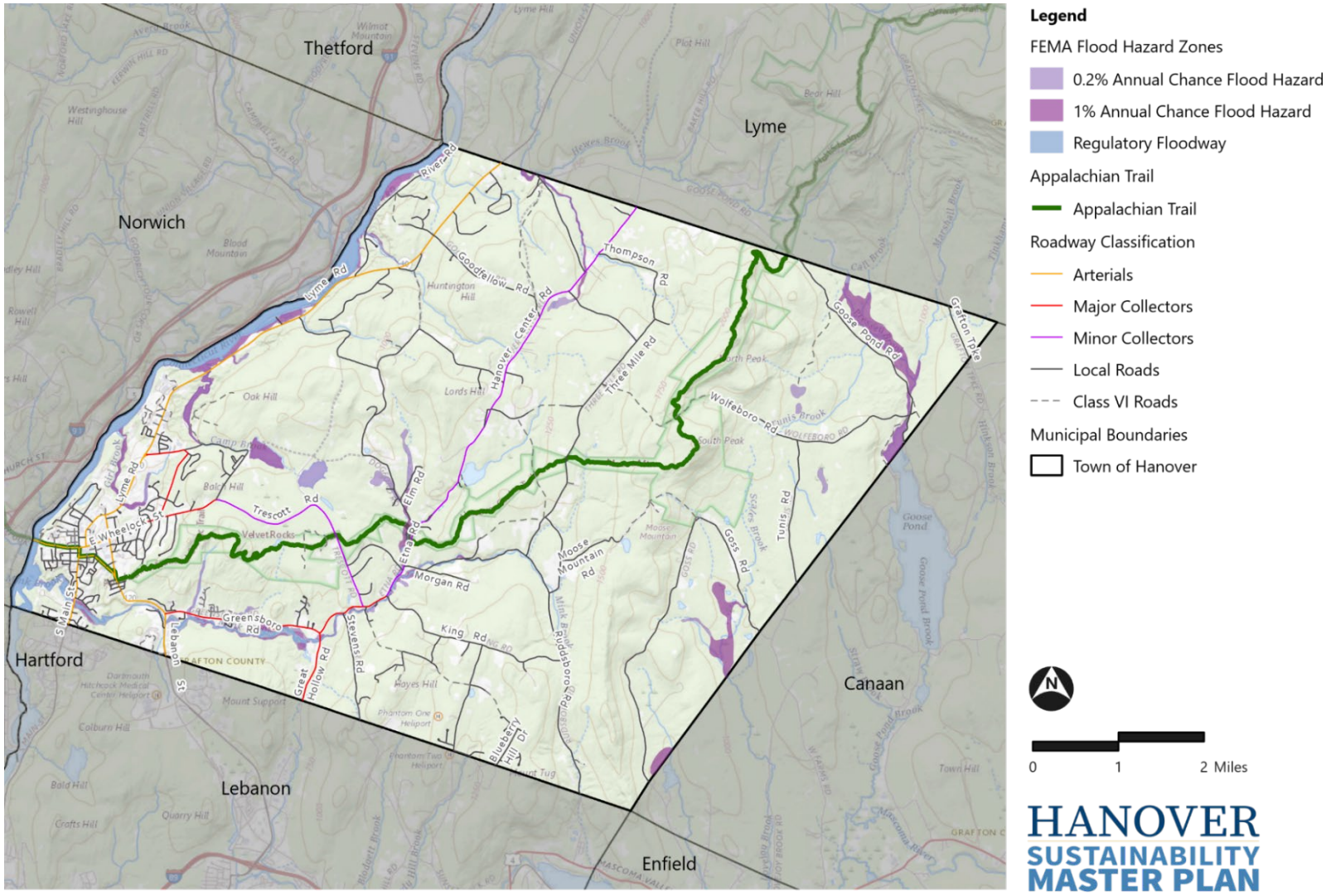
Frontline Communities

Climate change risks and impacts are not distributed equally. Likewise, implemented solutions to climate change do not always create equal benefits. Groups of people with historical social and economic inequities can be adversely affected by climate change at a greater scale than other groups, and to truly address climate change, determining those populations and prioritizing them in climate mitigation and adaptation planning is critical.

Frontline communities are the closest to and experience the worst impacts of climate change. These communities are often disadvantaged populations, such as communities of color, low-income populations, persons with disabilities, and older persons. Climate change exacerbates many existing environmental and health burdens. Extreme heat, extreme precipitation, and shifting geographic range of disease carriers will pose threats to all communities; however, these burdens will continue to fall disproportionately on frontline communities.[2]

2 *Human Health Impacts of Climate Change*. NIEHS. https://www.niehs.nih.gov/research/programs/climatechange/health_impacts/index.cfm

Figure 8-2: FEMA Flood Hazard Zones



Source: Town of Hanover, CAI Technologies - AxisGIS; National Flood Hazard Layer, FEMA

Note: Flood maps show how likely it is for an area to flood. Any place with a 1% chance or higher change of experiencing a flood each year is considered to have a high risk. These areas have at least a one in four chance of flooding during a 30 year mortgage.

Goal 8-1. Hanover's programs, policies, and regulations will move the Town closer to its 2017 *Ready for 100 Pledge* and mitigate effects of climate change.

Addressing climate change is on the agenda of nearly every town department and committee. Residents and business owners must also do what they can to support the effort. New construction is best located in municipal service areas to reduce reliance on vehicles, take advantage of transit, and make efficient use of service provisions.

Thinking about growth in the built environment or shifts to new economic activities should be considered within the context of their carbon intensity. Where are we willing to add to the carbon load and how should it be spread between the residential and commercial sectors? Looking at community-scale GHG emissions not only helps identify where emission reductions might be possible but also sensitizes decision-makers as to which projects should be pursued despite their projected carbon load. Setting net-zero standards to limit carbon-intensive development would allow changes to occur while bolstering the green economy consistent with the 2017 *Ready for 100 Pledge*.

In addition to federal and state initiatives to promote renewable energy development, education and outreach can encourage the use of electricity that has a higher renewable content than that routinely available through utilities. A local fund should be established to provide incentives for both developing renewable sources of energy and using energy that is renewably sourced. As demand for power from the electric grid increases, an evaluation of the electric distribution capacity must be undertaken to ensure its adequacy.

Land use regulations can support energy efficiency by allowing for higher-density residential use and mixed-use development, and providing protection to solar access supporting the installation of photovoltaics (PV). While sections of the Zoning Ordinance already regulate development in the floodplain, these regulations should be revisited to ensure that areas prone to flooding from more intense storms are safe. To make it easy to use micro-mobility devices and bicycles, charging and safe storage options should be required at all new multi-family, commercial, and institutional construction and expansion projects.

While a formal GHG emissions inventory has not been completed for town operations and activities, it would provide information useful to identify where reductions could take place. A similar assessment should be undertaken at the community scale.

Goal 8-1: Supporting Strategies[3]

- **Strategy 8-1.1:** Encourage higher-density mixed-use development in suitable areas and promote infill development using regulatory incentives.
- **Strategy 8-1.2:** Incentivize carbon reduction on new development projects, with exceptions (e.g., unconditioned buildings, temporary buildings, buildings meeting net-zero standards).
- **Strategy 8-1.3:** Update floodplain protections in the Zoning Ordinance to address future flooding potential.

3 Strategies accompanied by an icon are those that enable greenhouse gas emissions reduction.

- **Strategy 8-1.4:** Promote renewable energy development and green building construction. For example, through:
  - Exploring solar access laws that would protect solar energy developments from unwanted shading.
  - Offering incentives for using renewable sources of energy, such as solar and geothermal.
- **Strategy 8-1.5:** Encourage developers of new construction to achieve at least a net-zero energy standard.
- **Strategy 8-1.6:** Accelerate progress to 100 percent renewably generated electricity for all electricity users by offering, through entities like Hanover Community Power, options with higher renewable content than available through the utilities.
- **Strategy 8-1.7:** Reduce the cost of installing systems that generated renewable electricity to make it more affordable to go "green."
- **Strategy 8-1.8:** Promote the installation of charging equipment for EVs, including micro-mobility devices, and bicycle infrastructure at all multi-family residential, institutional, and commercial developments.
- **Strategy 8-1.9:** Ensure that the electric distribution capacity is adequate to handle increased loads given the move away from fossil fuels.
- **Strategy 8-1.10:** Complete a formal GHG emissions inventory for Town operations and activities.
- **Strategy 8-1.11:** Prepare a community- wide GHG emissions inventory to understand where emission reductions might be possible.

Goal 8-1: Performance Metrics

- Zoning Ordinance provisions supporting higher-density residential and mixed-use developments within the downtown area and areas connected to public transit
- Incentive to reduce carbon footprint for new development projects
- Zoning Ordinance provisions that fully address future flooding potential
- Total solar capacity (megawatt [MW]) installed and maintained within the Town
- Number of community-based buildings designed and built to a net-zero energy standard
- Percent of electricity users obtaining 100 percent of their electricity load from renewably generated electricity
- Average cost of renewably generated electricity per kilowatt hour (kWh)
- Number of new charging installations and bicycle shelters
- Number of multi-family residential, institutional, and commercial developments with installed EV chargers
- GHG emissions (metric tons carbon dioxide equivalents [MT CO2e]) from local government operations by scopes, sectors, and sources
- GHG emissions (MT CO2e) from community-scale activities by scopes, sectors, and sources
- Establishment of a philanthropic fund to provide incentives for developing renewable sources of energy and using energy that is renewably sourced

Goal 8-2. Municipal energy consumption will be reduced to the greatest extent practicable.

Hanover has been inventive and proactive in finding ways to reduce its energy consumption and its GHG emissions. The town has installed sufficient solar capacity to generate 97 percent of its electrical load. At the same time, by upgrading heating systems, the town's fossil fuel consumption has been significantly reduced. The next step to decarbonization is to electrify all space and water heating. A 2022 estimate for the conversion of all town building systems to electrified alternatives is roughly $1.25 million. In time, it is hoped that there will be no fossil fuel consuming end uses.

The vehicle fleet will be improved to zero emission vehicles as the technology matures to power heavy equipment, emergency service trucks, and ambulances. With the installation of the solar array at Grasse Road and on rooftops at many town buildings, approximately 97 percent of the town's municipal electricity load is generated in town. There are savings to be had with street lighting by converting to LED technology. Future town facility construction and expansion should be built to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standards and be net-zero or net-positive in terms of energy use.

Grasse Road Solar Array. Credit: ReVision Energy

The window and lighting retrofits at town-owned buildings should continue. Energy audits at all town-owned facilities should be kept current with annual investment in making town facilities more energy efficient. Building energy management systems that monitor, measure, and control energy use have been implemented in newer facilities at Dartmouth College and would be helpful for municipal buildings too.

Training all town staff to understand and support GHG reduction strategies can be effective. This orientation should cover everything from purchasing alternative fuel vehicles and equipment to turning off lights, recycling, composting, and reducing waste.

Goal 8-2: Supporting Strategies

- **Strategy 8-2.1:** Update energy audits at all Town-owned facilities.
- **Strategy 8-2.2:** Fund a program of deep energy retrofits.
- **Strategy 8-2.3:** Eliminate all fossil fuel-consuming end uses.
- **Strategy 8-2.4:** Adopt an LED streetlighting standard for all remaining Town streetlights, crosswalk lighting and other independently metered outdoor lighting.
- **Strategy 8-2.5:** Establish policy that requires all new public building construction and major public building renovations to be net-zero or net-positive.
- **Strategy 8-2.6:** Register and certify existing buildings above 5,000 square feet that are Town-owned to LEED or an equivalent green building rating system.
- **Strategy 8-2.7:** Conduct a needs assessment of Town-owned buildings where a Building Energy Management System (BEMS) might be beneficial to monitor, measure, and control energy use.
- **Strategy 8-2.8:** Transition the Town-owned vehicle and equipment fleet to zero emission alternatives on a schedule consistent with lifecycles and market availability.
- **Strategy 8-2.9:** Establish a policy that requires all Town entities to purchase manual or electric-powered equipment. Where feasible electric alternatives are not available (e.g., heavy equipment), identify opportunities for qualifying alternative fuels/alternative fuel retrofits under the Town's clean energy targets.
- **Strategy 8-2.10:** Train all Town staff to understand and support GHG emissions reduction strategies in the operation of all Town facilities.

Goal 8-2: Performance Metrics

- Energy use intensity (EUI) (British thermal unit [Btu] per square foot) of municipally-owned or operated buildings
- Fossil fuel EUI (Btu per square foot) of Town-owned or operated buildings
- Adoption of an LED streetlighting standard
- Number of Town-owned buildings that are certified under the LEED rating system, or equivalent
- Percent of Town-owned vehicles and equipment that are zero emission
- Percent of Town staff trained in GHG emissions reduction strategies

Goal 8-3. Local renewable energy generating capacity will be increased and contribute substantially to Hanover's clean energy targets.

While aggregated purchase of 100 percent renewable energy is an option from vendors including Community Power Coalition of NH, local renewable generating capacity is necessary to keep the supply increasing. The Zoning Ordinance has been modified to support solar PV installations as both principal and accessory uses. The town can continue to take advantage of every opportunity to create renewable energy at town-owned properties and to support those uses at appropriate sites. Figure 8-3 illustrates solar PV installations located throughout the town by their capacity.

Reliance on solar energy production is only a partial solution as energy is not generated at all times during the day. Accordingly, battery storage systems coupled with solar PV systems are becoming increasingly popular as a way to be reliant on renewable energy 24/7. Further, microgrids – or

self-contained power systems – are also being established to provide resilience to an electrical system in the event of a larger power grid outage. Many institutions, including military installations and hospitals, use microgrids today.

While the town has already created a large 1.7 MW solar PV system, this together with other roof top installations on town-owned buildings, is only enough to power current municipal operations. As more of the town's buildings and fleet transition to electric power, another solar PV project will be needed, which should include energy storage components.

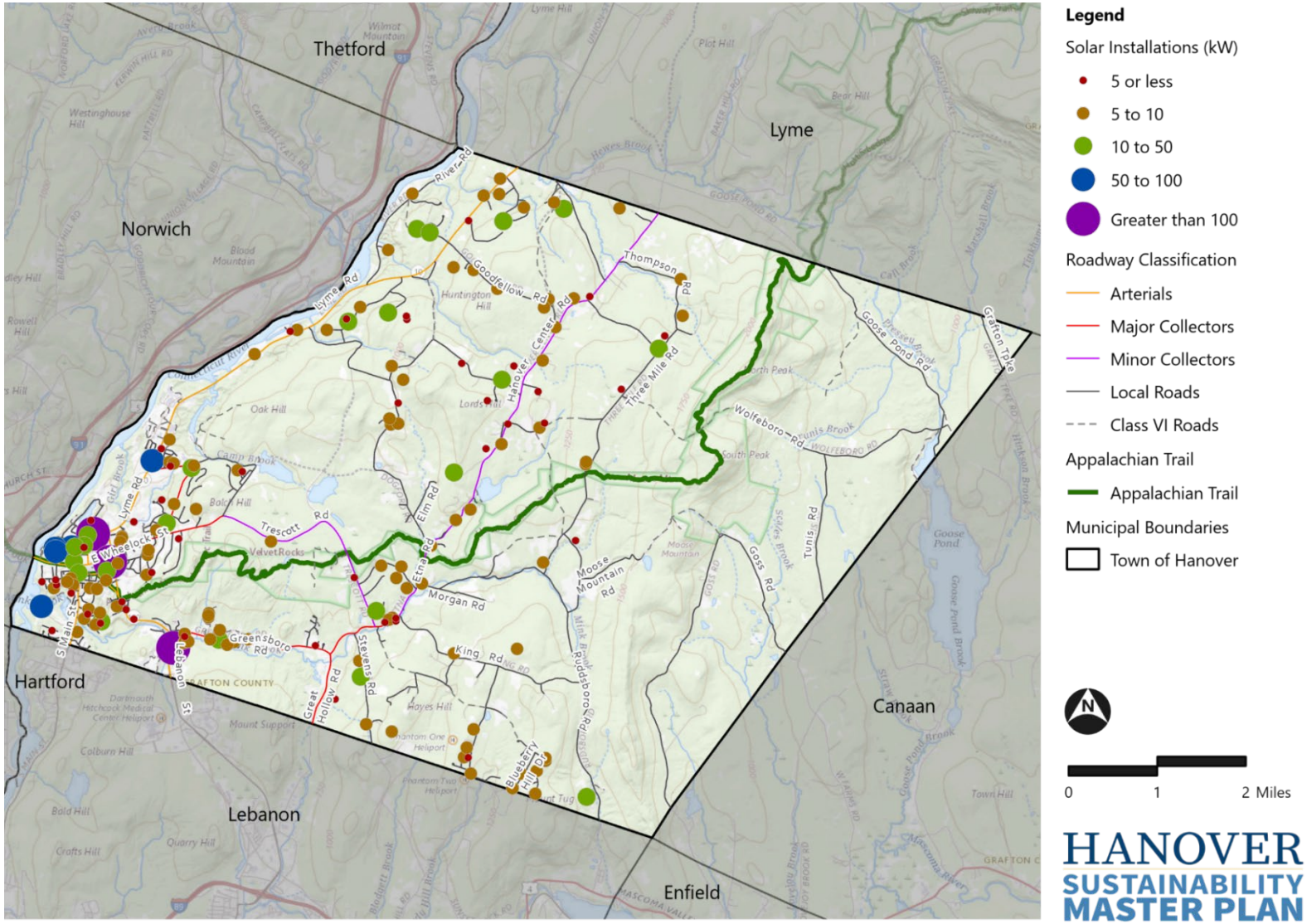
Goal 8-3: Supporting Strategies

- **Strategy 8-3:1:** Assess renewable energy generation potential for solar photovoltaics, wind energy, and geothermal projects at publicly-owned properties and other appropriate sites within the community.
- **Strategy 8-3.2:** Evaluate connecting new municipal renewable energy developments with microgrid technologies to enhance operational resilience. Encourage such developments within the private sector.
- **Strategy 8-3.3:** Invest in community-scale energy and storage projects through entities such as Hanover Community Power.

Goal 8-3: Performance Metrics

- Town-wide renewable energy assessments by generating source
- Total solar capacity and storage (megawatt [MW]) installed and maintained within the Town
- Number of public and private microgrid installations
- Total capacity of community-scale solar energy and storage projects

Figure 8-3: Solar PV Installations by Nameplate Capacity (Kilowatt [kW]) (2020)



Source: Town of Hanover, CAI Technologies - AxisGIS

Goal 8-4. Community-based greenhouse gas (GHG) emissions reductions will be enabled through partnerships and education.

Reducing GHG emissions is possible with energy efficiency measures and the shift away from fossil fuels. For many people, energy efficiency is most easily achieved by replacing appliances, upgrading existing fossil-fuel dependent heaters and boilers, and weatherizing homes in order to reduce energy demand. Weatherize Hanover, a program of Sustainable Hanover, assists property owners in physical home improvements that save heating and cooling costs and improve the comfort of their homes.

For property owners who wish to install solar PV systems, the Zoning Ordinance has been modified to allow most properties to host solar installations as permitted uses with minimal permitting. Many are motivated to make improvements if there is a financial incentive. For this reason, tax credits or rebates provided at the state level are beneficial in encouraging residents to make the shift to renewable energy. The outreach Sustainable Hanover makes to residents in terms of renewable energy education and on other sustainable practices must be supported and continued to realize GHG emissions reductions through both efficiency measures and shifts to renewable energy. Continued partnerships with local solar installers and Vital Communities are important ways to further the effort.

Goal 8-4: Supporting Strategies

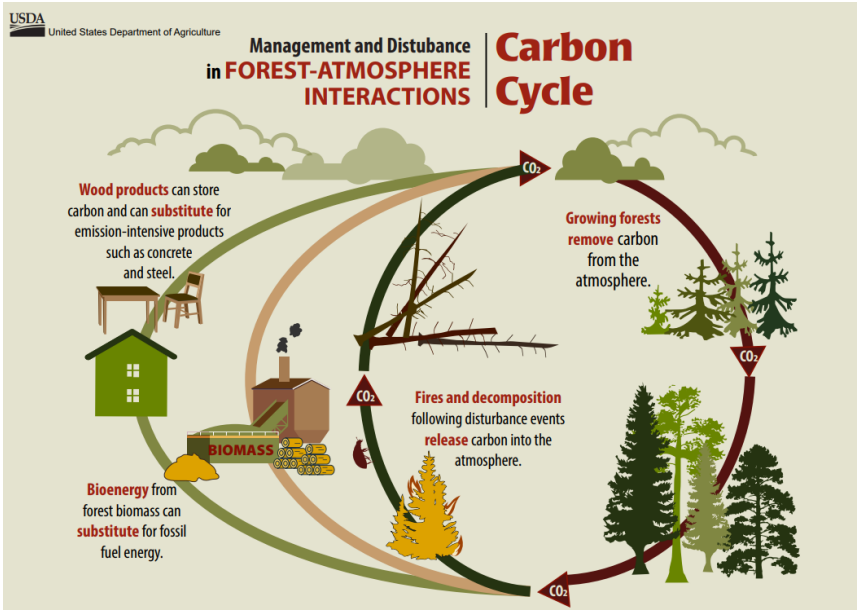
- **Strategy 8-4.1:** Centralize information on weatherization programs on Sustainable Hanover's website, with regular updates.
- **Strategy 8-4.2:** Support Hanover's largest employers and property owners in their efforts to reduce their dependence on non-renewable energy resources.
- **Strategy 8-4.3:** Advocate for state-level legislation, policies, and incentives that decarbonize the state's power supply and expand access to energy efficiency programs and technologies.
- **Strategy 8-4.4:** Educate the public about common concerns and misconceptions regarding solar PV development (e.g., light reflection, property values, etc.).
- **Strategy 8-4.5:** Promote the use of geothermal heating and cooling by providing educational materials to homeowners and businesses.
- **Strategy 8-4.6:** Monitor evolving technologies for more options to satisfy our community's energy needs with clean, renewable, safe, carbon-reducing sources of energy.

Goal 8-4: Performance Metrics

- Using building permit data, number of homes weatherized
- Number of public-facing education events on renewable energy and other sustainable practices
- Community-wide GHG emissions (metric tons CO2e)

Goal 8-5. Hanover will be more resilient to climate change.

Nobody likes the thought of being flooded or without power. Planning for resiliency is a part of achieving a sustainable future. Nature-based solutions for adapting to climate change are a win-win as they reinforce the natural system relied upon and they address a problem in a typically lower cost way. Open space lands support ecosystems that sequester carbon and protect against flooding. Low impact development relies on landscape features, such as rain gardens and infiltration trenches, to treat stormwater to improve its quality and to keep rainwater where it falls, rather than running off and creating higher peak flow volumes.



Carbon cycle. Credit: U.S. Department of Agriculture

Rain garden at the School Street Sustainability Park

Though overall rainfall is increasing, it occurs more sporadically, resulting in droughty weeks, which stresses plants and animals and increases the risk of wildfire. During intense storms, when the power supply is interrupted, people may be reliant on emergency shelters for warmth and food in the winter and air conditioning to alleviate symptoms of heat stress in the summer.

More than ever, landscaping is important in our developed areas. Plants provide shade, cooling, and in certain locations, a wind break. A sustainable landscaping policy should be implemented to help decrease emissions, reduce water requirements, and moderate heat islands. Rain gardens rely on plants to improve water quality, slow surface water run-off, and assimilate water through the roots to hydrate the plants.

Not until recently have building codes set standards for energy efficiency. Historic land use patterns have encouraged low density development,

resulting in higher than needed vehicle miles traveled as well as more impact to natural systems. Land use planning can minimize vulnerability and maximize resiliency by addressing where and how to build and removing obstacles to implementing resilient or adaptive strategies.

Currently, Hanover's Zoning Ordinance addresses floodplain protection by prohibiting development in the 100-year floodplain (with the exception of open space and agricultural uses) and includes provisions to protect wetlands and other water bodies to maintain their ecological value. There are also zoning districts specifically designed to preserve unique lands from development, such as the Natural Preserve (NP) district and the Forestry and Recreation (F) district.

Goal 8-5: Supporting Strategies

- **Strategy 8-5.1:** Invest in public green spaces to protect the community against heat waves and intensified flooding. Prioritize projects in neighborhoods with disproportionately low access to open space resources.
- **Strategy 8-5.2:** Develop a plan to install green infrastructure throughout Hanover's built environment to better absorb additional annual rainfall, minimize potential flooding events, and prepare for extreme heat and high winds.
- **Strategy 8-5.3:** Encourage and incentivize new development to implement low-impact development strategies, such as land clearance minimization and reducing impervious surfaces.
- **Strategy 8-5.4:** Require property owners to monitor and maintain drainage measures approved in site plans, such as retention facilities, swales, and wetland buffers.
- **Strategy 8-5.5:** Continue to protect Hanover's nature-based systems through conservation easements and restrictions, natural resource management plans (e.g., creating old growth forest ecosystems), and regulations (e.g., zoning for wetlands protection).
- **Strategy 8-5.6:** Develop management objectives and plans for restoring and sustaining the health of the natural environment utilizing the current natural resource assessment and existing forest-management plans for publicly-owned properties.
- **Strategy 8-5.7:** Educate the public about re-wilding and forest management plans to preserve biodiversity and create old growth forest ecosystems.
- **Strategy 8-5.8:** Conduct climate vulnerability assessments for publicly-owned assets and require that these assessments be performed for new private developments.
- **Strategy 8-5.9:** Develop enhanced flood response plans among emergency management personnel, public works, and regional/state partners.
- **Strategy 8-5.10:** Ensure resilient stormwater infrastructure for intensifying storms. Assess culverts for geomorphic capacity and aquatic organism passage. Encourage groundwater recharge.
- **Strategy 8-5.11:** Adopt a sustainable landscaping policy.
- **Strategy 8-5.12:** Develop demonstration sites to model best practices for stormwater management and sustainable landscaping.
- **Strategy 8-5.13:** Prepare the community with information on what to do and where to go during extreme weather events.
- **Strategy 8-1.14:** Annually educate residents to prepare for storm-related power outages.

- **Strategy 8-5.15:** Evaluate and expand, as necessary, the existing capacity of emergency shelters for the community.
- **Strategy 8-5.16:** Identify areas that experience flooding or are otherwise more vulnerable to climate change impacts. Prioritize funding for these areas to enhance their social, infrastructural, and environmental resilience.
- **Strategy 8-5.17:** Improve floodplain connectivity to further enhance the health of the floodplain and the ecosystems services that they provide.
- **Strategy 8-5.18:** Plan for an increase in climate migrants wishing to relocate to Hanover.

Goal 8-5: Performance Metrics

- Acres of impervious surfaces converted to pervious surfaces
- Number of green infrastructure projects
- Acres of natural working lands protected or restored
- Implementation of natural resource management plans
- Flood Emergency Response Plan
- Percent of municipal stormwater infrastructure that is future flood ready
- Number of new and existing developments within FEMA flood hazard areas
- Observed status of local flooding hotspots (e.g., no longer flooding during design floods or percent decrease in flooding events per year)
- Adoption of Sustainable Landscape Policy
- Number of demonstration sites to model best practices for stormwater management and sustainable landscaping
- Emergency Shelter Assessment
- Municipal Climate Vulnerability Assessment
- Number of public-facing education events on nature-based climate adaptation measures
- Number of public-facing emergency preparedness trainings