CLIMATE ACTION FACT SHEET

Energy

Generate and increase the use of clean electricity

PURCHASE, GENERATE, AND INCRASE THE USE OF SAFE, RELIABLE, AND CLEAN ELECTRICITY AND DEVELOP ENERGY INFRASTRUCTURE

Description and purpose of strategy: Generate more safe, reliable, renewable electricity and make the electric grid more resilient to peak demand and outages. Municipalities can invest in electric infrastructure, including solar photovoltaic (PV) panels and battery storage. They can also increase the use of renewable electricity by facilitating the expansion of transmission and distribution investments, particularly for offshore wind development.

Content of fact sheet: Overview of the costs and benefits, equity implications, and state of the practice of clean electricity. Focuses on what municipalities can do for their own buildings and properties, with some guidance on residential support, as well as how they can support connections to potential offshore wind projects.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☑ Health improvement from reduced pollutants
- ☐ Increased recreation
- ☑ Lower maintenance/operational costs
- ☐ Environmental enhancement/protection
- ☐ Less damage to infrastructure
- ☐ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☐ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Intentional community engagement and siting of new projects can promote equitable outcomes. Outreach, siting, and implementation should prioritize populations that would be disproportionately impacted by infrastructure projects.

Financial benefits: Renewable energy resources are cost-competitive with conventional electric generation and often can result in increased cost stability and significant cost savings in the medium to long term.

Non-market benefits: Renewable electricity can improve health from reduced pollution, increase resilience from battery storage facilities, and increase employment opportunities from local contracting.

GHG reductions: Renewable electricity reduces GHG emissions from fossil-fuel-powered electric generation.

Ease of implementation: Many tools are available to identify sites for solar installations. Established, cost-effective implementation options include Power Purchase Agreements (PPAs), although there is still significant contracting and project management effort. However, solar projects require transmission, distribution, and storage to contribute large shares of renewable electricity.

BENEFIT COST ANALYSIS

As described below, municipalities can both generate their own renewable electricity and procure it from outside sources. In either case, renewable energy resources are increasingly cost-competitive with conventional electric generation. Renewable electricity can have additional benefits for local employment and pollution reduction. Municipalities can also incorporate energy storage, which can result in cost savings and important resilience benefits.

Solar Generation

Municipalities can generate electricity on-site with solar PV. If a PV system produces more or less electricity than the facility needs, its electricity can be sold to or bought from the electricity grid through net metering (Massachusetts Electric Power Division, n.d.).

It is important to note that not all locations are right for PV installations: PV requires a suitable surface—typically a roof, open field, or carport—with ample sunlight. The Cape Cod Commission provides a Solar Siting Tool to help identify suitable locations.

An established, cost-effective option for on-site electricity generation is the PPA, in which private developers own, operate, and maintain the PV system and sell the electricity at an established rate to the client. PPAs do not require up-front capital to implement, and can result in cost savings because private developers (unlike municipalities) can claim tax incentives for solar and battery installations (Solar Energy Industries Association, n.d.). Rates for PPAs depend on site conditions, the size of the installation, and whether the contract includes battery storage or only solar. Municipalities can also purchase PV systems outright, although this comes with high up-front costs and maintenance costs throughout the life of the system.

Renewable Electricity Procurement

Municipalities also have several choices of electricity supply from the retail market, including several renewable electricity suppliers. Options include the default plan from Eversource, plans from third-party marketplace providers (options listed on the Massachusetts Department of Public Utilities website), and community choice aggregation through the Cape Light Compact (CLC). Some electricity choices also emit air pollution, including GHG and local air pollutants.

The table below shows electricity supply costs from solar PV projects and selected providers. For solar generation, the table displays average national rates for PPAs and PPA rates from 2020 installations on Cape Cod by Cape and Vineyard Electric Cooperative (CVEC, 2023). The table also includes the total cost after accounting for the estimated damages from CO_2, NO_x, and SO_2 pollution from electricity plans with fossil-fuel-powered generators (Eversource Default and conventional marketplace plans).

ELECTRICITY COSTS FROM SELECT PROVIDERS AND SOLAR PPA

PROVIDER	SUPPLY RATE (CENTS/KWH)	TONS CO2 PER KWH	POUNDS SO2 PER MWH	POUNDS NOX PER MWH	TOTAL COST (CENTS/KWH)
Eversource default	26.18	327	0.04	0.25	28.09
Marketplace rate: conventional	12.97	327	0.04	0.25	14.89
Marketplace rate: 100% green	13.70	0	0	0	13.70
CLC 100 Green	21.80	0	0	0	21.80
CLC Local 100 Green	25.40	0	0	0	25.40
Average national solar PPA	4.57	0	0	0	4.57
Solar PPA from CVEC	7.49	0	0	0	7.49

Energy Storage

Municipal solar installations can also include energy storage, which has important resilience and cost savings benefits. Resilient electricity supply is important during extreme heat or cold events, particularly as more buildings electrify their heating systems. Municipalities should consider adding energy storage to sites used as heating and cooling centers to provide a clean, resilient source of electricity during system outages. Battery storage can yield significant savings through programs that reward using batteries to reduce overall electricity demand (Mass Save, n.d.). For large electricity consumers, battery storage can lead to additional savings by reducing electricity delivery costs from the maximum electricity demand and time-of-use charges (Solect Energy, 2020). Costs of energy storage can vary with scale and technology, but options typically result in savings. When purchased directly, storage costs over $1,400 per kilowatt hour (kWh) on average in Massachusetts (Energy Sage, 2023). As with PV systems, municipalities can implement battery storage either by direct purchases or through PPAs. PPAs have lower up-front costs, and can have lower overall costs if developers can claim tax benefits.

Community and Regional Projects

Municipalities can influence community and regional renewable energy projects by encouraging rooftop PV in communities and supporting the appropriate siting of renewable energy projects. These programs will cost municipalities time to plan and implement but can result in savings for community members, reductions in GHG emissions, and resiliency benefits. Large energy projects in the Cape Cod region (including utility-scale batteries, expanded transmission and distribution infrastructure, and offshore wind projects) will have substantial benefits for reducing GHG emissions and/or increasing system resilience. Municipal staff play a critical role in these projects by identifying sites for necessary infrastructure, which can also require community engagement to build support or avoid harming vulnerable communities. Municipalities can encourage solar PV in their communities by informing residents about options for installing PV, including information about how these programs can lower energy bills without up-front costs. The U.S. Department of Energy (DOE) offers details on how municipalities can design equitable solar outreach programs (DOE, 2022).

Additional Benefits

Renewable energy will provide employment opportunities on Cape Cod and the region overall. It is estimated that installing 0.6 gigawatt (GW) of solar capacity (the amount needed to meet 2050 Barnstable County electrification and GHG reduction goals) will translate to 9,300 additional job-years (Cape Cod Commission, 2021). PPAs that involve local developers and the CLC Local 100 Green plan both ensure that renewable energy will provide local jobs. CLC Local 100 Green includes electricity generated throughout New England.

Renewable electricity can also reduce air pollution generated from burning fossil fuels. Much of the electricity generated on Cape Cod is from renewable sources, but there is one fossil-fuel-powered generator: the Canal Generating Plant in Sandwich. Since 2010, this plant has mainly served to provide electricity during peak system demand: it often generates no electricity in a given month, but sometimes produces over 200,000-megawatt hour (MWh) of electricity per month. Before 2010, the plant was used more regularly and generated between 200,000 and 600,000 MWh per month. Local pollutants (NO_x and SO_2) from this generator cost Barnstable County around $2–$5 million per year in health impacts. A combination of renewable generation and storage could reduce or eliminate the need for fossil-fuel use at this facility, substantially reducing health damages.

EQUITY

Renewable electricity has the potential to benefit the entire population of Cape Cod. However, research finds that the benefits of renewable energy programs are not equitably distributed. Nationally, access to employment opportunities, involvement in decision-making, and access to low-carbon electricity are unevenly spread across populations and socioeconomic groups (Carley and Konisky, 2020).

If renewable energy programs are designed to increase equity, they can have important benefits such as the following:

- **Decreased energy costs.** More renewable energy options could decrease costs and reduce energy burden to vulnerable populations. A more resilient energy grid could also decrease power outages due to hazards, thus decreasing risks for populations that are at higher risk.
- **Air quality improvements.** Reduced air pollution could be particularly beneficial to vulnerable populations that are more likely to reside in areas with poorer air quality, or to people with underlying health conditions.
- **Economic opportunity.** Increased jobs related to renewable energy development could result in increased economic opportunity, particularly if there are opportunities for "green economy" job trainings and other incentives that help ensure equitable access to new job opportunities.

Optimizing Equity During Implementation

Renewable energy projects should be planned so that vulnerable communities benefit from improved infrastructure, lower electricity rates, and increased economic opportunity and do not bear greater costs from the siting of new development projects. There are well-documented disparities in the locations of energy infrastructure components (Welton and Eisen, 2019). To address them, municipalities need to carefully consider the potential impacts to surrounding communities of siting additional electricity infrastructure—and make sure they do not put disproportionate burdens on vulnerable populations. This includes siting transmission equipment for offshore wind development (CleanEnergy States Alliance, 2022). To address inequities in employment opportunities, municipalities should engage local developers for renewable energy projects, particularly ones that owned by or employ women and underrepresented races and ethnicities (Said et al., 2021).

Municipalities can also contribute to energy justice by actively and equitably promoting PV systems. Low-income residents would benefit as PV systems lower energy bills. Historically, higher-income households are far more likely to adopt community solar than low-income families, despite higher energy burden among low-income households and high rooftop solar potential in low-income neighborhoods (Said et al., 2021). This is largely due to high up-front costs, low access or information about financial incentives, and a lack of homeownership. Municipalities can promote community solar uptake by providing information about financial incentives (including tax benefits for owners of rental properties) and installation options without up-front costs. Municipalities should engage low-income residents while planning these information campaigns.

STATE OF PRACTICE

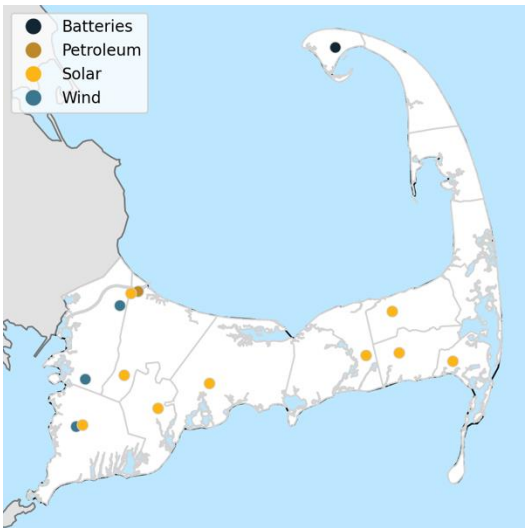
General State of Practice

Renewable electricity is widespread in the United States, including for municipal electricity supply. In 2021, 20% of the nation's electricity generation came from renewable sources (EIA, 2022). Wind and solar make up roughly half this amount, a sharp increase from less than 2% of renewable generation in 2000. The C40 Cities Climate Leadership Group identifies building-scale clean electricity deployment as the largest action cities can take to reduce emissions from energy use (C40, 2016). Cities throughout the world and the U.S. use rooftop PV systems for part of their electricity supply. Cities have also begun installing energy storage capacity for resilience and load shifting, including the City of Sterling, Massachusetts (Clean Energy Group, 2018). Costs of energy storage and renewable electricity generation are decreasing, opening new opportunities for renewable electricity and storage solutions (Kaps et al., 2021). However, even with broad deployment of rooftop PV systems, most municipal buildings still need to procure off-site renewable electricity because on-site generation is rarely strong or consistent enough to meet all electricity needs.

There are several challenges to incorporating more renewable electricity at the national scale. First is the lengthy approval process for new renewable electricity projects. There is a substantial queue of new generators waiting for approval to join the electric interconnection (LBNL, 2022). Second is the need for further transmission and distribution investment; a report by the International Energy Agency finds that transmission spending worldwide would need to triple by 2030 to meet 2050 climate goals (IEA, 2021). Additionally, the intermittence of renewable electricity will require greater capacity to store electricity or to shift electricity consumption to avoid periods of peak demand (Guerra, 2021). Current utility-scale storage solutions are costly, although technological improvements may result in more cost-effective solutions (Mauler et al., 2021). Incentivizing end users to shift consumption (including via building-scale battery storage) may be the most cost-effective way to incorporate more intermittent electricity sources into the grid.

Cape Cod Context

Solar energy and wind energy resources are found throughout Cape Cod, including some of the nation's largest offshore wind resources. The figure at right shows the location of current utility-scale electric generators in Cape Cod. All except the Canal Generating Station use either utility-scale PV, wind, or battery storage. The Outer Cape battery storage project in Provincetown is Cape Cod's only utility-scale battery storage project, brought online in 2022 to increase resilience in the Outer Cape. This project cost about $49 million and provides 24.9 MW of energy storage (Blander, 2022). Cape Cod's first offshore wind facility is in construction, with permitting of all necessary components including transmission recently completed (McCarron, 2023). Vineyard Wind first submitted state and federal permit applications for this project in 2017 (The Barnstable Patriot, 2021). Several more projects are currently pending approval in the interconnection queue, including eight utility-scale battery and solar projects and 20 offshore wind projects (LBNL, 2022).



Electric generators on Cape Cod. Source: EIA.

Residential and municipal solar facilities are found throughout Cape Cod. The Cape and Vineyard Electric Cooperative (CVEC) lists over 60 rooftop PV installations throughout the region, with the first projects in 2010 and several projects pending (CVEC, 2023).

CASE STUDY: UPPER CAPE COD REGIONAL TECHNICAL HIGH SCHOOL, BOURNE, MA

Completed in 2016, this project installed 663-kilowatt (kW) of PV panels in a parking lot shelter at a public technical high school. Upper Cape Tech partnered with Green Seal Environmental to design and permit the array, and Solect Energy financed the project, built the shelter, and installed panels. The plan was implemented through a PPA, with zero up-front costs to the school. During summer months, panels generate more electricity than the school uses. A portion of this energy is distributed to the town's Recreational Authority (Solect Energy, n.d.).

IMPLEMENTATION

To increase the use of clean energy, municipalities should take the following actions to develop energy resources for their own buildings and to promote clean energy use in the community.

REQUIRED EXPERTISE

Internal: GIS analysis, building management, public outreach, Department of Public Works staff

External: Solar design and construction

- **Determine sites to install solar PV.** Municipalities should identify rooftops, fields, or carports with plenty of sunlight as potential sites for solar PV. If installing on a rooftop, municipalities should consider the remaining useful life of building roofs to minimize disruptions to generation from roof work during the 20-year life of a PV installation. Facility condition assessments can help identify suitable rooftops. Municipalities should consider PPAs to implement installation projects. Typical procurement approaches involve putting out a request for proposals, establishing a list of prequalified vendors, inviting vendors to bid on bundles of solar sites, and choosing vendors for each bundle.
- **Consider incorporating battery storage.** Battery storage has large benefits for the grid overall, and can result in significant savings for municipal buildings. It can be most cost-effective when combined with solar PV. Implementing battery storage through PPAs can reduce up-front costs and take advantage of tax incentives.
- **Encourage community solar through public outreach.** Municipalities should conduct outreach and information campaigns to promote the adoption of rooftop PV systems in the community. To optimize equity, public outreach should include members of disadvantaged communities and inform residents of PV installation options with energy savings and low up-front costs.
- **Support siting of electric infrastructure.** New infrastructure is needed to support renewable electricity projects, including offshore wind development. Municipalities play a critical role by permitting these projects. When siting electric infrastructure, municipalities should ensure that projects do not place disproportionate burdens on socially vulnerable populations.

Below are some resources that may help implement clean energy projects.

FINANCIAL AND TECHNICAL SUPPORT	
Solar Estimate	Finds solar providers for a specific address and provides preliminary cost estimates for solar or battery + solar installation.
Cape Cod Commission's Solar Screening Tool	Identifies areas on Cape Cod that may be suitable for large-scale solar sites and those where solar sites may have an undesirable impact on natural resources or may have inadequate solar resources.
PVWatts Calculator	Tool from the National Renewable Energy Laboratory to help identify potential solar resources. Incorporates average cloud cover and some features of the solar array, such as size, angle, and array type.
Project Sunroof	Tool to identify solar panel sites, based on 3D models of roof surfaces and surrounding buildings and satellite imagery of cloud cover. Limited coverage in Barnstable County; most recently updated in 2016.
Green Communities Designation and Grant Program	Funds green energy projects for towns with Green Community designation; this includes all towns in Cape Cod except Sandwich and Barnstable (both of which are eligible to apply). Has been used to fund battery storage and solar PV projects.

ADDITIONAL INFORMATION	
Energy Switch Massachusetts	A program from the Massachusetts Department of Public Utilities to help residential and commercial customers choose between electricity suppliers. Offers cost information for various electricity suppliers, with options to sort by the amount of renewable energy offered.
Local Government Guide for Solar Deployment	A resource from the U.S. Department of Energy on how to enable community solar projects, with a focus on designing projects and community engagement to equitably distribute benefits.
Massachusetts Solar	Webpage from the Solar Energy Industries Association with an interactive map of solar companies (manufacturers, installers, other) in Massachusetts.
Cape and Vineyard Electric Cooperative	Public electricity supplier that supports development of renewable electric resources throughout Cape Cod, including the development of renewable energy sites and the purchase of electricity on behalf of municipalities.
Cape Light Compact	Public electricity supplier that administers community choice aggregation plans (including CLC Local Green). Also provides resources for energy efficiency programs.
Database of State Incentives for Renewables & Efficiency (DSIRE)	List of financial incentive programs in Massachusetts that can support solar PV installations. Many are implemented as tax savings, so tax-exempt entities like municipalities are not eligible. Private developers can typically use these incentives.
Mass Save Connected Solutions	Program that provides financial incentives for electricity customers to install battery storage facilities. Site includes details on the application process and a list of eligible technology.

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Additional climate change information and resources can be found at capecodcommission.org/climate.