Island Energy Plan 2020

- Electricity Sector Working Paper -

Introduction

In May of 2019, the Martha's Vineyard Commission established a climate action task force (CATF) to address the Island's response to the climate crisis. The task force is focused on developing plans, roadmaps, and policies in two areas: *adaptation* to the current and future challenges resulting from a changed climate, and *mitigation* – how our Island community can minimize its contribution to climate change.

Our primary mitigation response must be to minimize and eventually eliminate our greenhouse gas emissions that result from fossil-fuel energy generation and use. To develop an energy master plan, we have adopted the goals established by the Vineyard Sustainable Energy Committee (and adopted by the MVC), as delineated below:

- Reduce fossil fuel use on the Island (from a 2018 baseline):
  - 50% by 2030;
  - 100% by 2040.
- Increase the fraction of our electricity use that is renewable:
  - To 50% by 2030
  - To 100% by 2040

We then developed four high-level strategies to achieve these goals:

- Foster increased energy efficiency and conservation;
- Electrify transportation and building-related energy use;
- Ensure that the Island's electric supply (imported and locally generated) is carbon-free; and finally
- Make our electricity supply truly resilient by transforming our electricity infrastructure and establishing significant on-Island renewable energy generation capabilities.

Energy and Greenhouse Gas Baseline

In developing an energy and greenhouse gas baseline, we benefited from the obvious fact that Martha's Vineyard is an island, with clearly delineated boundaries. Our energy ecosystem includes three major sources of energy: imported electricity from the mainland grid, on-Island generated electricity, and fossil fuels transported to the Island by truck and barge.

We used 2018 data from a number of sources to build our baseline estimate. Data on imported electricity was provided courtesy of Cape Light Compact (using the Mass Energy Insight database). On-Island generated electricity was estimated using Massachusetts SREC and SMART program data for solar installations. Greenhouse gas (GHG) emissions for imported electrical energy were calculated using New England Power Pool (NEPOOL) generation mix data.

Fossil fuels reach the Island predominantly via tanker trucks transported by the Steamship Authority (SSA) and by barge through the R.M. Packer Company. Both of these organizations graciously provided approximate 2018 data for shipments of their fuels, broken down by type.

Data from these sources enabled us to establish a baseline for energy use subdivided into three main sectors: electricity, transportation [1], and building-related fossil fuel heating. The baseline is shown in the table below. All energy use is expressed in units of gigawatt hours (GWh); this is appropriate, since our long-term goals include converting all current fossil fuel use to electricity over the next two decades. Greenhouse gas (GHG) emissions are expressed in thousands of metric tons of CO_2.

	Mixed Units	GWh	kTonne CO2	
Electricity (GWh)				
Eversource	197.7	197.7	75.01	
On-Island Renewables	16.6	16.6	0.00	
Annual total	*214.4*	*214.4*	*75.01*	22.7%
Transportation (Mgal)				
Gasoline	7.08	238.60	65.21	
Diesel	3.17	119.83	32.07	
Marine diesel (SSA ferry)	1.29	43.22	14.63	
Aviation fuel	0.80	28.56	7.48	
Annual total		*430.20*	*119.39*	45.5%
Bldg HVAC (combustion; Mgal)				
Heating oil	2.70	90.45	30.63	
Propane	7.88	209.61	45.41	
Annual total		*300.06*	*76.03*	31.8%
Grand Total		**944.66**	**270.43**	

Our energy use in 2018 amounts to the entire output of a typical nuclear power plant for 40 days. In 2018, our GHG footprint, assuming an average Island population of 25,000 over the course of the year, was about 12 US tons per person. This compares to the US average of 17.6 tons, Japan's 9.9

[1] For current purposes, the transportation sector includes light and heavy vehicles, watercraft (including ferries), off-road and construction vehicles, farm vehicles, aircraft, and landscaping power equipment.

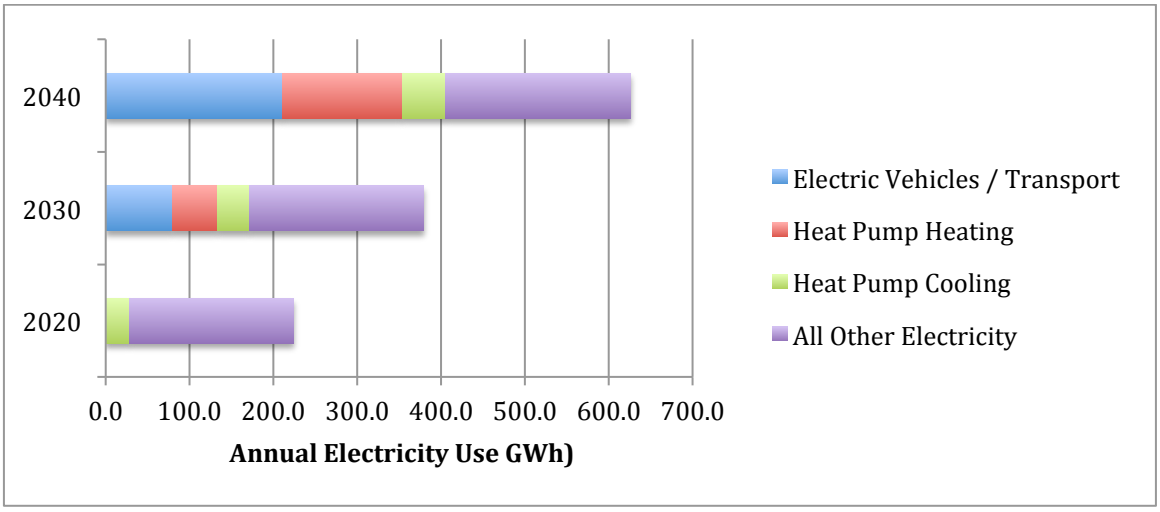
tons, and the UK's 7.2 tons. Since there is very little manufacturing on the Island and distances traveled are very small, our greenhouse gas footprint is basically comparable to the US as a whole.

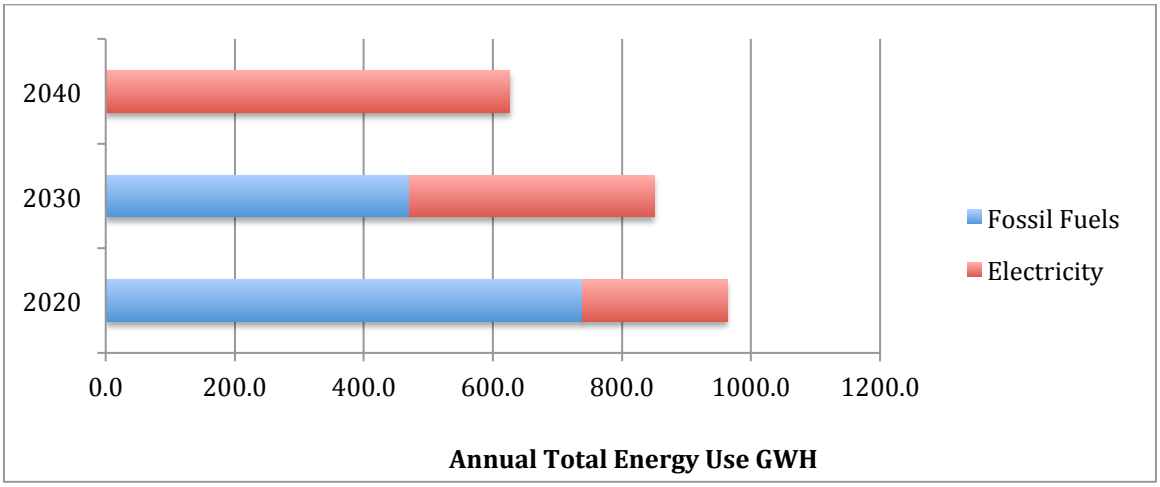
We will monitor our success in lowering our fossil-fuel-driven carbon footprint using the same methods each year.

Transforming Our Energy Use

In order to achieve the goals of the CATF, all energy-use sectors need to be electric by 2040. If accomplished, this will result in a significant increase in required electric power, while fossil fuel transportation and home heating are reduced to zero in that timeframe. There are a variety of trajectories that can accomplish this, and the CATF is developing a detailed model of the Island's energy use, population growth, and other factors.

Noting that electric transportation will be more efficient than fossil fuels in terms of on-board energy delivered to the wheels (fossil fuels: ~35% v. ~70% for EVs), and that heat pump heating is also more efficient than combustion heating, a simplistic, but conservative model can be used to analyze the growth in electric power that will be needed in 2030 and 2040. The charts below are not intended to be definitive, but do provide a best-guess sizing of the Island's electricity needs:





Key assumptions in this rough analysis include:

- Population growth of 0.6% per year
- Constant transportation miles driven per capita per year
- Housing unit growth identical to population growth
- No major additional commercial buildings

Note that electricity requirements grow by 2.8X, but overall total on-Island energy use *declines* by 35%. Also, though, even if on-Island renewable electricity increases by 10% per year, our imported (Eversource) electricity requirement will still need to double. We are exploring the ramifications of this with Eversource, but clearly a major infrastructure improvement will be required [2].

[2] The careful reader will note that the scenario modeled here does not exactly meet our goal of a 50% reduction in fossil fuel use by 2030. This is a "likely" scenario for 2030 as opposed to a "optimistic" scenario.

Energy Conservation

Reducing the amount of energy we use – conservation – is a common-sense component of a master plan for transforming our energy ecosystem. Our primary areas of improvement / energy reduction are, as with our energy use, in transportation and the built environment.

Relevant strategies include:

1. Accelerated switch to electric vehicles. EVs are more efficient than fossil-fuel cars even after the energy needed to generate electricity is included.
2. Reduction of miles driven. This is, of course, based on lifestyle and individual choice.
3. Minimizing heating and electricity use for second homes that are unoccupied for much of the year.
4. Energy efficient lighting.
5. Continued support for energy efficiency programs from Cape Light Compact and others.
6. Policy initiatives at the town and regional (MVC) levels. These initiatives center on building codes aimed at "net zero" new construction, and potentially incentives for energy efficiency in renovation projects.

Electrifying Transportation and Building Heating

Achieving the CATF's long-term energy goals requires electrification of the transportation and building heating sectors. Detailed CATF working papers are available for these areas, but key strategies include:

1. A continued information and communication program. This should provide consumers with accurate and updated information about the choices, costs, and tradeoffs for both EVs and electric heating systems (predominantly, but not limited to, air-sourced heat pumps or ASHPs).
2. Cooperative efforts with key institutional energy consumers. These include the SSA, the VTA, Martha's Vineyard Hospital, the Martha's Vineyard schools, and others.
3. Planning and construction of key EV infrastructure (e.g., charging stations).
4. Community buying programs for ASHPs.
5. Support for incentive programs to switch to electric powered transportation and building heating (including domestic hot water). The Commonwealth, the Cape Light Compact, and other organizations already offer these programs.
6. Policy initiatives, for example a commitment to town EVs and net-zero municipal buildings.

Ensuring Carbon-Free Electricity

Critics of electric vehicles (for example) note that since a not-inconsiderable fraction of our grid-supplied imported electricity is generated by gas turbine plants, electrifying transportation and building heating will not result in a zero greenhouse gas footprint. That is certainly true today, but does not need to be so in 2040.

Given the reality that a totally energy-self-sufficient Martha's Vineyard is unlikely to be either economically sensible or advisable from a resiliency standpoint, we need to rely on state-level actions to achieve a true zero-carbon supply. Fortunately, existing Massachusetts policies and anticipated future policy initiatives are consistent with major progress in decarbonizing the grid.

CATF strategies going forward should include:

1. Strong support for the offshore wind industry in New England.
2. A significant effort to increase on-Island renewable energy generation and storage to at least 40 – 50% of our needs. To accomplish this, we should plan for increasing on-site residential and commercial solar generation and storage as well as community solar gardens.
3. Pressure on our state legislature to pass the Community Empowerment Act, which would allow towns and regions to contract directly for renewably generated electricity (in our case, offshore wind).

Electric Infrastructure Resilience

The impacts of climate change will include significantly increased precipitation in our region, damaging sea level rise, and an increase in the severity (and perhaps frequency) of hurricanes and winter nor'easters. Clearly, then, as we transition to an all-electric energy ecosystem the resilience of our electricity infrastructure is a major priority, and we need to plan for support of critical services in a disaster situation.

A very significant effort will be needed to achieve the degree of sustainability and resilience that we will need. To plan and carry out this effort, the Island will need the cooperation and support of our electric distribution utility (Eversource). To that end, we have already begun a future-focused planning partnership with that company.

Some key strategy elements:

1. As in the previous section, foster and move toward significant on-Island renewable electricity generation with accompanying storage.
2. For essential services and functions, develop and construct local microgrids [3] for town buildings, essential services, and where practical, neighborhoods.
3. Added infrastructure for an increase of ~2X in grid-supplied power.
4. Support for EV charging infrastructure.
5. Advanced Metering Functionality (energy efficiency+)
6. (At least) last mile underground distribution.

Summary and Conclusions

Responding to the climate change crisis requires both *adaptation* and *mitigation*. Mitigation – reducing or eliminating the greenhouse gas emissions that are the root cause of the crisis – is achievable for Martha's Vineyard over the next two decades, at which time we will be "100% Renewable MV". An approach and high-level strategy for achieving this by the electrification of our transportation and building heating and cooling, along with the greening of the grid, has been outlined in this working paper.

This high-level strategy is not, however, a plan. Over the next several months, the task force will develop a "master plan" for energy. We will annually assess the progress we are making using the 2018 baseline described here. In addition, we plan to continue our developing partnership with Eversource and other key organizations, analyze a variety of scenarios to map out our way forward, and establish an annual plan to achieve our goals.

[3] Microgrids are local sub-grids that include some generation (e.g., solar) and energy storage that allow for graceful disconnection from a failing utility grid and thus continued operation in short or even long-term power outages.