

# Determining the Viability of Electric Vehicles on Nantucket: Executive Summary

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Project Website: <http://wp.wpi.edu/nantucket/projects/projects-2016/energy-office/>

# Abstract

The goal of this project was to assist the Nantucket Energy Office by assessing the impacts associated with an increase of electric vehicles (EVs) on the island of Nantucket. This goal was achieved by surveying public opinion and gathering key stakeholder perspectives on EV charging and growth, and EV-based public transportation. Additionally, the project group assessed Nantucket's electric vehicle charging infrastructure, usage patterns, and grid impacts. Based on the survey results and other findings, the project group developed policy and infrastructure recommendations for the Nantucket Energy Office. Among the recommendations were locations for public EV charging stations, awareness and outreach initiatives, and the further exploration of public EV transportation on Nantucket.

## **Executive Summary**

The transportation sector generated 1.8 billion metric tons of carbon emissions in 2014, which was 26% of total emissions (Hill, 2016, U.S. Environmental Protection Agency, 2014). In order to reduce carbon emissions, alternative renewable energy sources such as solar and wind based energy generation have been explored to provide energy for the transportation sector and the energy grid that supports it. Within the transportation sector, the use of electric vehicles (EVs) has grown as a sustainable alternative to internal combustion powered vehicles due to lower lifetime carbon emissions. As a result of the long term benefits of the use of EVs, many state and local governments launched initiatives to promote the ownership and responsible use of electric vehicles (MassDEP, 2016).

Nantucket, Massachusetts presents a unique environment for the possible encouragement of electric vehicles due to its fluctuating population and energy needs, and its limited electrical energy supply. In particular, Nantucket's strong tourism industry draws approximately 400,000 visitors each summer, during which time electrical energy consumption increases accordingly, with peak electrical use in the summer reaching 48 megawatts (National Grid, 2016). The coupling of high summer electrical energy demand and limited energy resources creates a challenge for Nantucket, particularly as peak electrical use has grown at a rate 5 times that of mainland Massachusetts (Nantucket Energy Office, 2016).

Given the conflicting island circumstances of high gas prices and limited electrical supply, it is important to explore the effects of using and encouraging electric vehicles on Nantucket. A key stakeholder in this study is the Nantucket Energy Office (NEO). The primary efforts the NEO is focused on includes programs to reduce energy costs, recommend energy related policies, reduce energy waste, and serve as a resource and liaison to companies like National Grid (Nantucket Energy Office, 2016).

## **Project Statement**

The purpose of this project was to study the data available on EV adoption rates, as well as EV adoption and plans by island residents and visitors, and to analyze how EV use might increase on the island in both the short term and long term. This project was also focused on determining the current state of the EV-supporting charging infrastructure on Nantucket and offer recommendations on how that infrastructure should be expanded to support growth in EVs on the island. An additional focus was exploring potential systems for electric public transportation on Nantucket. Finally, the project team attempted to predict the impacts of greater EV use on the island's energy supply, and subsequently recommend procedures to promote responsible electric vehicle charging.

## **Background**

Due to their lower lifetime carbon emissions, electric vehicles (EVs) have gained popularity as a sustainable alternative to gasoline powered vehicles. Although EVs produce more emissions when they are manufactured than gasoline powered vehicles, they generate minimal or even zero-emissions when driven. As a result, the initial emissions manufacturing deficit can be offset after 6 to 16 months of average driving (Union of Concerned Scientists, 2015). The limited emissions associated with electric vehicle driving are due to the use of carbon-based fuels in power plants, which generate the electrical power needed to charge and EV. Power generation plants operate at 40% efficiency on average whereas gasoline vehicles achieve 14%–30% percent (U.S. Department of Energy). However, the use of carbon based fuels in power plants and the resulting emissions related to driving an EV are projected to decrease based on national data from 2013 to 2015 (Union of Concerned Scientists, 2015).

Although the benefits of electric vehicle use are clear from an environmental standpoint, a variety of other factors can influence the overall challenges and benefits of increased EV use. For example, when considering whether to purchase an EV, many individuals exhibit “range anxiety,” where the customer believes that the distance an EV can travel per charge may not be sufficient for their needs. However, studies suggest that 87% of day-to-day travel can be made in an electric vehicle, and that the few exceptions to this rule are longer trips that could be made with a shared or limited-use gasoline powered vehicle (Needell et al., 2015). Electric vehicles also typically have better fuel economy and fuel availability than their gasoline powered counterparts. Although electric vehicles take longer to recharge than simply refueling a gasoline tank and charging stations are less abundant than gas stations, today most EVs can achieve 100 miles per gallon equivalent, and the number of EV charging stations is rapidly growing due to the omnipresent electric grid (Alternative Fuels Data Center, 2016).

Due to the demonstrated benefits of the use of EVs, many initiatives to promote the ownership and responsible use of electric vehicles have been launched on a state and local level. These initiatives have included monetary incentives for purchasing an EV and incentives for charging during off-peak hours. For example, the town of Braintree, Massachusetts incentivized its residents to purchase electric vehicles by offering free test drives and pre-negotiated deals with local car dealerships, making the process of buying an EV easier and the consumers more informed (Braintree Drives Electric, 2016). In addition, the Braintree town government has offered \$250 to residents for installing an approved “smart” home charger to power the vehicle overnight (Libon, 2016). On a state level, the Massachusetts Electric Vehicle Incentive Program encourages municipalities to transition to electric vehicles by providing financial incentives to local agencies that shift their fleets to electric and hybrid vehicles (MassDEP, 2016). In addition to state and local

government incentives for shifting municipal fleets to electric and hybrid vehicles, private companies such as Foothill Transit and Downtowner provide public transportation options at little or no cost to the consumer in the form of electric buses and electric midsize vehicles, respectively (Foothill Transit, Downtowner, 2016). These programs demonstrate that electric vehicles can be a cost effective and environmentally friendly form of transportation.

## Methodology

In the flowchart below, we outline the methods we used, the key stakeholders we interacted with, and the ways in which we met our objectives.

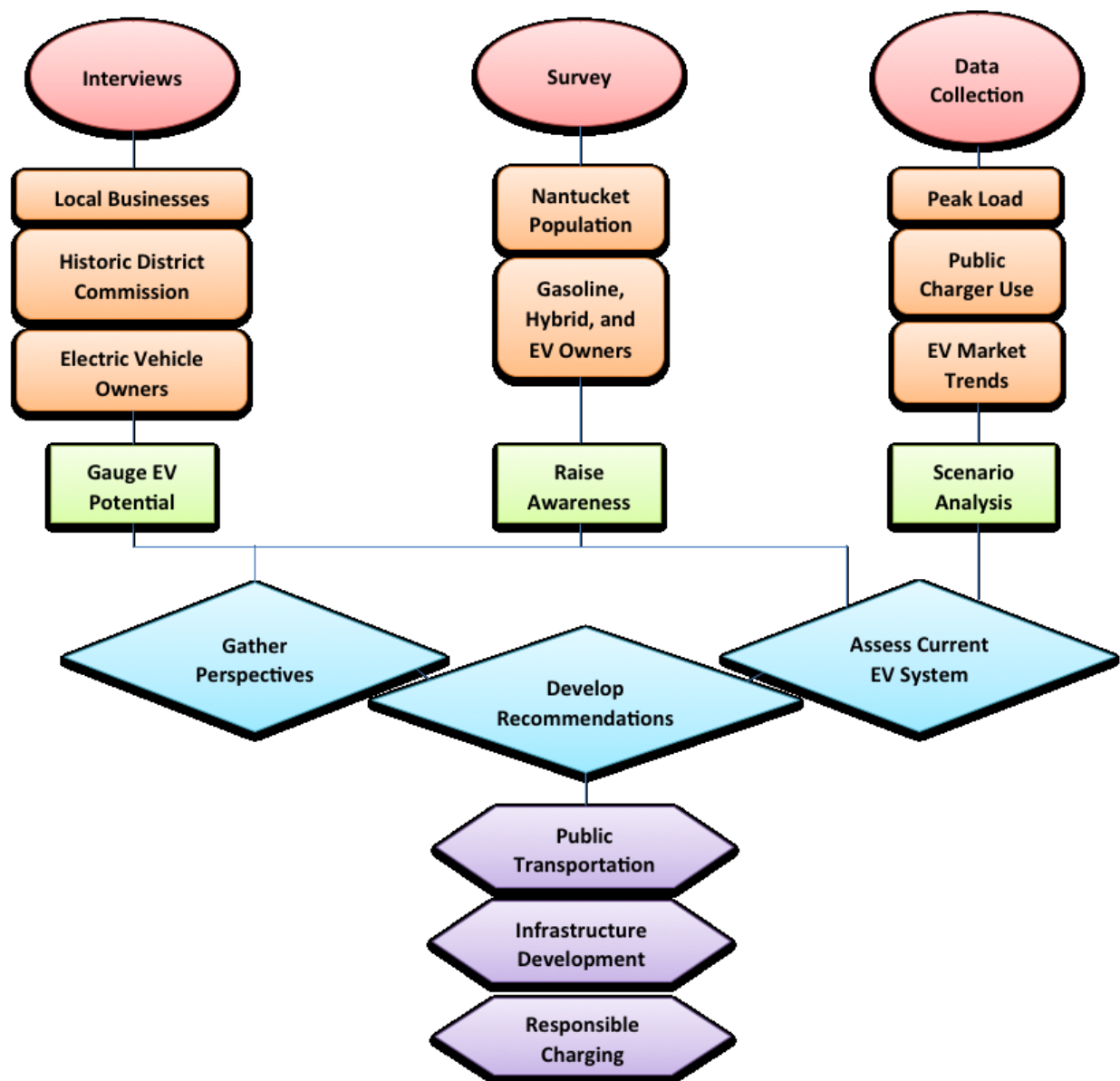


Figure I: Methodology Flowchart

As illustrated above, the primary methods used to address our project goals were interviews, an informative survey, and data collection. Interviews conducted with electric vehicle owners were used to characterize EV charging trends and assess charging sites, which addressed our first objective of assessing Nantucket's EV infrastructure and energy patterns. Perspectives from other key stakeholders such as hotels, rental companies, car dealerships, Downtowner, and the Historical District Committee were used to gain insight on the potential for growth in electric vehicle use and supporting infrastructure.

We used informative questions to make survey participants more aware of electric vehicles, peak load, and responsible charging. We also used the survey data to understand general opinion of EVs and certain trends of EV adoption specific to Nantucket.

The purpose of the scenario analysis tool was to help us better understand Nantucket's electrical infrastructure and the impact of EV charging on the Nantucket energy supply. The tool was used to illustrate growth in charger use since installation, monthly usage patterns, and grid effects, and was developed through recommendations from our advisors and research that detailed the effectiveness of this method in illustrating future effects of a perceived scenario. This tool provided insight to develop policy and infrastructure recommendations to the Nantucket Energy Office.

## **Findings**

Findings regarding electric vehicle charging were gained through a scenario analysis and interviews with electric vehicle owners, the Historical District Commission, and the Town Manager's Office. Perspectives on the growth potential of electric vehicles were gained through results from our informative survey and interviews with local businesses. Possibilities for electric public transportation systems were explored through the survey and a conversation with Downtowner, the Town Manager's Office, and our sponsor. Table I below outlines our key findings from each method:

**Table I: Methods and Related Findings**

Method	Findings
<b>EV Owner Interviews</b>	<ul style="list-style-type: none"> <li>• Current public electric vehicle charging stations have limited accessibility and convenience.</li> <li>• Range anxiety is not an issue on Nantucket.</li> <li>• People can purchase EVs for much lower costs than they think.</li> </ul>
<b>Other Stakeholder Interviews</b>	<ul style="list-style-type: none"> <li>• Challenges with installing public chargers include parking enforcement, selecting new or changed locations, and appropriate visual appearance.</li> <li>• Cape Air is an example of a successful commercial EV application.</li> <li>• The most significant challenge for renting EVs is charging time.</li> <li>• The most significant challenge to selling EVs is the cost of the equipment to the dealer needed to service them.</li> <li>• The Downtowner service is customizable based on a city or town’s needs.</li> <li>• Advertisements might not be a viable option for financing a free electric transportation service, but this issue should be explored.</li> </ul>
<b>Survey</b>	<ul style="list-style-type: none"> <li>• Many Nantucket residents prefer a vehicle with off-road capabilities.</li> <li>• The most common EV concerns are charging, range, and price.</li> <li>• Nantucket residents responded positively when provided information about EV range, cost, and incentives.</li> <li>• A majority of survey respondents favored EV public transportation on Nantucket.</li> </ul>
<b>Scenario Analysis</b>	<ul style="list-style-type: none"> <li>• The effect of EV charging on peak load is negligible.</li> <li>• Chargers Downtown see more usage than other locations.</li> <li>• Over 80% of public charger uses last less than 3 hours.</li> <li>• Public charger use has increased yearly.</li> </ul>

**Recommendations**

Below is a concise list of recommendations regarding three main topics: electric vehicle charging, electric vehicle growth potential, and electric vehicle public transportation.

**EV Charging**

1. Begin the process of installing more public electric vehicle chargers at the locations specified below, while considering available grants, new locations that the town would approve, and new public charger technology. Our top three locations are:
  - a. Proposed parking garage
  - b. Mid-island Stop & Shop

c. Downtown Stop & Shop

2. Designate a charging station for Town use only.
3. Relocate one airport charger to another location downtown (possibly make it the third charger at the downtown parking lot) and relocate the high school charger to a more convenient location in the main high school parking lot.
4. Continue to provide free electric vehicle charging.
5. Inform and encourage all EV owners to charge during off peak times.
6. If and when the effect of EV charging on peak load becomes significant, collaborate with National Grid to implement an off-peak charging initiative.

**EV Growth Potential**

1. Conduct a series of case studies highlighting successful electric vehicle use for both private owners and businesses.
2. Coordinate with potential sponsors to conduct an awareness and outreach campaign to spread information about electric vehicle incentives, charging, costs, and benefits.
3. Investigate the possibility tracking the number of electric vehicles brought to the island through Steamship Authority.

**EV Public Transportation**

1. Further investigate electric public transportation options in order to select a model that is best suited for Nantucket.
2. Coordinate between the Nantucket Energy Office, the Town Manager's Office, and the Transportation Planner to assess the process, requirements, and challenges for a successful electric public transportation system.

**Summary and Conclusion**

In this project, we have determined that electric vehicles are a viable option for Nantucket. Through our recommendations, the Nantucket Energy Office can best prepare for greater EV adoption by raising awareness of electric vehicles, improving electric vehicle supporting infrastructure, and eliminating the minimal effect of EV charging on the electrical grid. Our project may serve as an example for towns or cities that are experiencing early stages of EV adoption and wish to assess the impacts and benefits that EVs may have on their community.

Our project provides potential opportunities for future Interactive Qualifying Projects. Specifically, a project could be conducted to delve further into the issue of peak electrical load on Nantucket, which was only a small portion of our project, but itself is a large and complex issue for the island. An additional future project could also continue to aid the Town of Nantucket in exploring an electric public transportation option and relieve downtown congestion.



This project provided the team with valuable experience in conducting professional interviews, constructing and distributing a survey, and modeling a scenario using a data-driven tool. The project team gained additional skills in working cooperatively in a group and with a town government agency.