Electric Vehicle Tourism in New York State

Final Report

New York State Energy Research and Development Authority

June 2015

Report Number 15-15

NYSERDA's Promise to New Yorkers:

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Mission Statement:

Advance innovative energy solutions in ways that improve New York's economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

Cover Image: NYSERDA

Electric Vehicle Tourism in New York State

Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, NY

Adam Ruder
Program Manager

Prepared by:

WXY architecture + urban design

Adam Lubinsky Ph.D, AICP
Managing Principal

Paul Salama, AICP
Senior Urban Planner

and

Barretto Bay Strategies

Paul Lipson
President

Luis Torres
Lead Consultant

and

Energetics

Bryan Roy
Senior Energy Analyst

NYSERDA Report 15-15 NYSERDA Contract 39140 June 2015

Notice

This report was prepared by WXY architecture + urban design in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

NYSERDA makes every effort to provide accurate information about copyright owners and related matters in the reports we publish. Contractors are responsible for determining and satisfying copyright or other use restrictions regarding the content of reports that they write, in compliance with NYSERDA's policies and federal law. If you are the copyright owner and believe a NYSERDA report has not properly attributed your work to you or has used it without permission, please email print @nyserda.ny.gov.

Acknowledgments

This report relies heavily on the cooperation of individuals representing organizations and interests relevant to the success of this study of electric vehicle tourism for the Lower-Hudson Valley and Catskills. The authors would like to thank the following individuals for sharing their experience and insight:

John Markowitz & Evan Kolkos, NYPA

Lee Alexander, Scenic Hudson

Steve Bate, Long Island Wine Council

Richard Bottali, Peter Bass, Philip Petillo, Steven Brusca, Donna Haynes, Peter Ramos & Todd Lange, Metro-North Railroad/MTA

Paul Carlucci, Villa Roma

Frank Castella, Charlie North, Audra Gerty & Gloria Cukar, Dutchess County Regional Chamber of Commerce

Herb Clark, Sullivan County Visitors Association

Judy Dalessandro & Erich Schiller, Hyatt House, Fishkill

Anthony Davidowitz, Storm King Arts Center

Tim Dexter, City of Beacon

Joseph DiStefano and Josephine Bentivoglio, Town of Middletown

Freda Eisenberg, Sullivan County Planning Commission

Colleen Emery, Sullivan Renaissance

Jim Fox & Sharon Lodge, US Military Academy Visitor Center

Robert Friedman, Enterprise Holdings

Sean Fruin, The Free Ride San Diego

Evadne Giannini, Hospitality Green

Jean Guinup, Simon Premium Outlets

Susan Hawvermale, Orange County Tourism Office

Ashley Horvat, Oregon Department of Transportation

Maureen Kangas, Poughkeepsie Grand Hotel

Cheryl & Rick Landers, Landers River Trips

Christa Lemler, Thayer Hotel

Victoria Lesser, The Old North Branch Inn

Ross Levi & Sam Filler, Empire State Development Corporation

Robert McAlpine, The Roundhouse at Beacon Falls

Larry McAuliffe, NYMTC

Shannon McSweeney & Rick Martinez, Bethel Woods Center for the Arts

Eric Miller & Valerie Valente, Journey Inn B&B

Pat Moore, Beacon Chamber of Commerce

Tadhg O'Connor, BMW of North America

Linda Obrizok, Quality Inn, Hyde Park

Steven Patton, Bear Mountain Inn

Randy Resnick, The Sullivan

Alan Rosenblatt, Ecce B & B

Carol Rozell, Best Western Plus at The Falls

Monte Sachs, Catskills Distillery

Asaf Selinger, Hertz

William St. Clair, Vision Fleet

Joe Tinari, Fosterdale Motor Lodge

Table of Contents

Acronyms and Abbreviations

AOR	Area of Responsibility
BEV	Battery (only) Electric vehicles
BW	Bethel Woods Center for the Arts
CO2	Carbon Dioxide
DC Fast Charger	Direct Current Fast Charging Station
Enterprise Holdings	US-based parent company of Enterprise Rent-A-Car, National Car Rental, Alamo Rent a Car and Enterprise CarShare
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment, i.e. Charging Station
GEM	Global Electric Motorcars
GreenPass	New York State Thruway Discount E-ZPass for Hybrids and Electric Vehicles
ILNY	I Love NY
kW	Kilowatt
LEED	Leadership in Energy & Environmental Design
LIWC	Long Island Wine Council
LRT	Lander's River Trips
MTA	Metropolitan Transportation Authority
MNR	Metro-North Railroad
MPGe	Miles per Gallon Gasoline Equivalent
PHEV	Plug-in Hybrid Electric Vehicles
SHO	Second Home Owner
SKAC	Storm King Art Center
TEPCO	Tokyo Electric Power Company
US PIRG	United States Public Interest Research Group
USMA	United States Military Academy

Executive Summary

Emerging trendlines in travel and transportation preferences among all drivers, and especially Millennials, offer policymakers and clean transportation advocates a timely and compelling opportunity to introduce new technologies to the tourism marketplace. Principal among them is plug-in electric vehicle technology, which is poised to address consumers' emerging appetite for innovation, lower cost, and enthusiastic embrace of low-emission transportation.[1]

This study examined the feasibility, business modeling, and potential environmental impacts for electric vehicle (EV)-based tourism in the Hudson Valley and Catskills regions of lower New York State. The project engaged three principal stakeholder groups: Metro-North Railroad; carshare and car rental services; and businesses in the hospitality sector intrigued by the emergent eco-traveler market and interested in attracting EV early adopters and aspirational early adopters to their locations. The study drew support from an Advisory Committee composed of both primary and secondary stakeholders, including the New York Power Authority, the Dutchess County Regional Chamber of Commerce, the Sullivan County Visitors Association, and Hospitality Green, a sustainability consulting firm serving the tourism industry in the area.

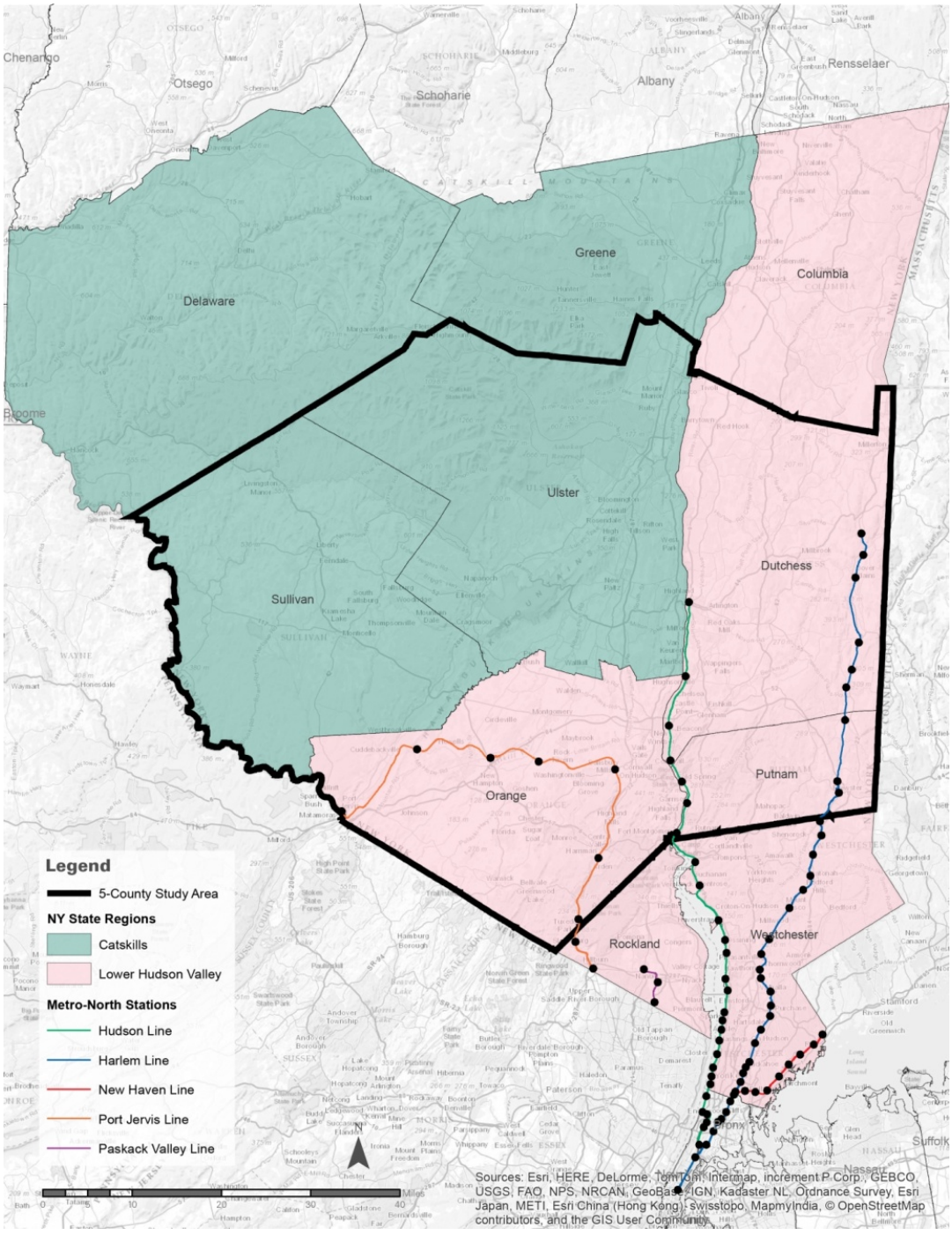
The study team undertook the following activities:

- Interviewed destination and lodging operators that are positioned to serve the early EV adopter market and that will benefit from growing their share of the downstate tourism market.
- Identified the commuter rail hubs offering the best access to these locations.
- Mapped routes aimed at optimizing potential electric vehicle supply equipment (EVSE) availability and instilling "range confidence" in drivers.
- Developed two possible EV tour packages aimed at both day-trippers and the weekend getaway market.
- Examined models for business and marketing relationships linking carshare services, Metro-North Railroad (MNR), and the destination operators.
- Developed a mockup mobile app for trip planning.
- Crafted a business and operational model aimed at optimizing the EV driver experience while hedging the financial risk for the EV operator.

[1] Millennials in Motion, http://www.uspirg.org/sites/pirg/files/reports/Millennials%20in%20Motion%20USPIRG.pdf Fourth annual gen Y automotive survey, http://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-man-automotive-2012-deloitteautomotivegen-y-executive-summary-092613.pdf

Beyond the clear and well-established environmental and energy independence benefits that broadened EV usage confers, this study holds that the counties of the lower Hudson Valley and Catskills region can and should leverage the spending power and interests of EV early adopters—as well as aspirational adopters—to benefit the regional economy (Figure S-1). By promoting strategic EVSE deployment and encouraging the development of EV-friendly locations within range of targeted MNR stations and carshare/car rental services, state and local governments can begin to assemble the supportive EV ecosystem essential for attracting early adopters and re-branding the region as an eco-friendly and tech-savvy destination of choice.

Figure ES-1. The Five Counties of The Catskills and Lower Hudson Valley Comprising the Study Area



1 Helping Tourism Re-Emerge in the Hudson Valley

A robust four-season tourism industry in the lower Hudson Valley and Catskills is a long-held goal of policymakers and economic development practitioners in the region. Identifying and building new metropolitan constituencies for travel and tourism within Sullivan, Ulster, Orange, Putnam, and Dutchess counties is a key consideration when weighing new approaches to fortifying the tourism market—a sector that declined dramatically in Ulster and Sullivan counties and that is only now recovering from four decades of decline. The challenge ahead, according to Sullivan County's Planning Commissioner Freda Eisenberg, is to build upon "the remnants of a tourism economy that we want to revive."[2]

Emerging as a rising economic driver in the five county study area, spending by weekend visitors and other tourists in the region is considerable and growing. For example:

- Tourism in the Catskills is today a nearly $1 billion industry, which supports nearly 16,000 jobs. Transportation represented 4% of total traveler spending in the region in 2010; spending at retail locations and service stations for fuel and other items represented up to 17% of the total spend.[3]
- Tourism in the Hudson Valley is a $3.2 billion industry, which supports over 52,000 jobs. Transportation represented 21% of total traveler spending in the region in 2013; spending at retail locations and service stations for fuel and other items represented up to 20% of the total spend.[4]
- Fairweather Consulting's July 2014 study of tourism in western Sullivan and Orange Counties, *An Estimate of Tourism Visitation to the Upper Delaware Scenic Byway* pegged the direct and indirect economic impact of tourist spending at up to $32.5 million by as many as 341,060 annual visitors to the river towns along the Delaware River.[5]

---

2 Freda Eisenberg, personal communication, 8/1/2015.

3 http://catskillcitizens.org/learnmore/nystourismimpact-catskills.pdf

4 http://www.rocktourism.com/images/pdf/NYS-Tourism-Impact-Hudson-Valley-2012.pdf

5 http://www.upperdelawarescenicbyway.org/info/UpperDelawareTourismcount072014.pdf

2 Guiding Assumptions

This study is informed by three core assumptions that have guided the team's research—one specifying the optimal target market for EV tourism, a second identifying car rental and carshare services as key validators of emergent technologies, and a third establishing the centrality of an "ecosystem-wide" approach to addressing the challenge of range anxiety, which is the concern that consumers will not be able to drive as far as they need to in their EVs.

2.1 Guiding Assumption 1: Market Development and Wooing the Millennials

Key to the success of any efforts to bolster the tourism market, attract new tourism, and embed EVs in the hospitality sector will be courting Millennials, the 77.4 million Americans born after 1982 who now constitute the largest discrete age cohort in the U.S. A number of studies have documented the Millennial appetite for innovation, preference for public transportation over owned automobiles, and enthusiastic embrace of the sharing economy. "Millennials have been early adopters of new technologies and practices," according to *Millennials in Motion: Changing Travel Habits of Young Americans and the Implications for Public Policy*, an October 2014 study conducted by the US PIRG Education Fund and the Frontier Group. "From social media to bikesharing, young Americans have consistently been the first to embrace new technologies and tools with the potential to shape transportation behaviors," the report explains.[6]

Various consumer preferences documented by pollsters and demographers make Downstate Millennials an ideal target market for an EV tourism strategy in the five-county study area. Such research has found that Millennials in the U.S. are more likely to be "multi-modal" in their transportation habits than previous generations of Americans. Millennial travelers and commuters, perhaps more financially restricted than previous generations, are accustomed to combining multiple modes of transportation to reach a destination and are routinely utilizing several types of transportation over the course of a day or week. The American Public Transportation Association's 2013 survey of Millennials residing in six urban

[6] Millennials in Motion, http://www.uspirg.org/sites/pirg/files/reports/Millennials%20in%20Motion%20USPIRG.pdf

areas, *Millennials & Mobility: Understanding the Millennial Mindset*, found that 69% of respondents reported using multiple transportation modes to reach a destination "at least a few times per week." Respondents in the six cities studied averaged a remarkable three modes of transportation per multi-modal trip.[7]

2.2 Guiding Assumption 2: Carshare Services as Key Technology Validators

Because of current range constraints on most commercially available EVs (averaging 70-80 miles as detailed in Appendix A), this study posits that a robust linkage between MNR commuter stations and carshare services active in the region will be a critical component of any near-term efforts to increase EV usage in the regional tourism marketplace.

Further, it is expected that rental and carshare services, will play a crucial and collaborative role in building market acceptance for battery-powered vehicles, because they have historically served as effective validators and early champions of new vehicle technologies. By introducing the curious and the intrepid to vehicle models that lack broad market acceptance, rental firms can boost sales and leasing of these models and EVs overall, ushering them into the mainstream. EV-based car-sharing services, such as Autolib and Car2go operating in France and North America respectively, exhibit this potential.[8]

Data collected from rental firms with EVs featured in their fleets demonstrate the tentative but still uneven acceptance of EVs by renters. A recent Bloomberg report noted shorter than typical rental periods for EVs; Enterprise Holdings, for instance, cited a figure of 1.6 days as the average EV rental versus 6-7 days that is typical for conventional vehicles. Although the Bloomberg report cited clear consumer interest in renting EVs, customer concerns about range limited the appeal of the vehicles:

> 'People are very keen to try it, but they will switch out of the contract [into a standard gasoline vehicle] part way through,' Lee Broughton, head of sustainability at Enterprise, told Bloomberg. 'Range anxiety makes them think they can't get to a charging station.' [9]

---

7 Millennials and Mobility, http://www.apta.com/resources/reportsandpublications/Documents/APTA-Millennials-and-Mobility.pdf

8 Car2go currently runs a non-EV operation in Brooklyn, NY.

9 Electric Car Rentals Stalled in U.S. by Range Anxiety, http://www.bloomberg.com/news/articles/2013-10-13/electric-car-rentals-stalled-in-u-s-by-range-anxiety

2.3 Guiding Assumption 3: Range Confidence and Assembling the EV Ecosystem

To best address the range anxiety that Enterprise and other operators have observed and to increase the likelihood of a successful EV tourism approach, the study team posits that public and private sector actors must collaborate on assembling a supportive EV ecosystem in the region. At a minimum, this ecosystem should include a robust network of EVSE, highly visible EVSE signage, in-vehicle and mobile apps to identify optimal routes, EV-friendly destinations, and nearby charging opportunities. This information is especially important for people who may be unfamiliar with EVs and new to the limited ranges they offer.

This assumption is bolstered by the findings of Tokyo Electric's (TEPCO) 2009 fast-charging study, in which TEPCO personnel based in Yokohama were issued EVs to perform routine duties across their office's area of responsibility (AOR; Anegawa 2009). In the first phase of the study—which began in 2007—the TEPCO employees seldom ventured beyond the center of their service area and routinely returned to their depot with a remaining battery charge of over 50%. Some swapped their EVs for conventional vehicles each afternoon.[10]

When TEPCO surveyed the personnel about their driving habits and reluctance to travel beyond the center of the AOR despite ample charge availability, the employees reported that their driving behavior was influenced by the location of the one available fast charging station—the unit located at their depot. When an additional DC fast charger was deployed to the center of the AOR, the average distance logged each month surged from 203 km to 1,472 km, while the average battery charge level dropped well below 50%. This suggests that the mere presence of DC fast charge availability inspired greater use, even if actual use of that infrastructure remained stable.

This study has drawn inferences from these findings that have informed the team's approach to constructing a supportive EV ecosystem for renters. Key among them—availability of "peace of mind" charging that is mapped and well-marked will inspire "range confidence," increase the intensity of use of these vehicles, and help ensure successful implementation of an EV tourism pilot.

---

[10] Development of Quick Charging System for Electric Vehicle, http://www.indiaenergycongress.in/montreal/library/pdf/322.pdf

A safer option for reluctant car rental agencies could be to provide plug-in hybrid electric vehicles (PHEVs) rather than 100% electric-powered battery electric vehicles (BEVs), as a more appealing option for drivers not yet ready to fully rely on electric capacity and range. This strategy would fit with New York State's overall goal of maximizing electricity-powered miles. However, experience with previous PHEV car rental efforts has shown that drivers of these vehicles will predominantly treat the PHEV as a gasoline car, relying on gas stations rather the EVSE. In that case, the rationale for providing incentives and benefits to "green" drivers breaks down.

3 Market Conditions for Plug-In Electric Vehicles

Nearly 120,000 EVs—representing both PHEVs and BEVs—were sold in the U.S. in 2014, a 23% increase over the prior year and a remarkable 128% over 2012 sales. Between 2011-2014, a total of 286,824 EVs were sold in the U.S.[11] In 2014, the most popular EV, the Nissan Leaf, sold over 30,000 units, representing at least 25% of the reported domestic EV sales.[12] In New York State, EV numbers have grown from approximately 1,000 to more than 10,000 over the same period.[13,14] Additionally, the statewide initiative ChargeNY, aims to facilitate the installation of up to 3,000 EVSE by 2018.

Studies completed by the University of California at Berkeley, Global EV Outlook, ECOtality, and the Center for Automotive Research all predict an annual growth rate of 20% in EV sales, pointing to 2015 sales of approximately 144,000 vehicles.[15] Despite demonstrated and rapidly growing consumer interest in the technology, however, few car rental and carshare fleets feature EVs and those that do limit availability to a small number of markets. Enterprise, for instance, currently offers EV rentals in Austin, Baltimore, Hawaii, Seattle, Portland, Orlando, and 12 locations in California, but none in the New York metro area. For Enterprise, the allocation of EVs appears to be demand-driven. According to Bob Friedman, Enterprise's director of sales, "we don't have customers asking for it" in the New York market.[16] Hertz also offers EVs in selected markets but Asaf Selinger, the company's project manager for electric vehicles, pointed to an "insufficient inventory" of EVs as an obstacle to greater deployment in the New York metro area.[17] It is further hampered by car manufacturers refusing to offer their EV models at discounted rates, as is normally done for sales to rental car companies.

---

11 http://insideevs.com/monthly-plug-in-sales-scorecard/

12 Nissan Leaf Sets New Annual Record For U.S. Electric Car Sales, http://www.greencarreports.com/news/1096118_nissan-leaf-sets-new-annual-record-for-u-s-electric-car-sales

13 New York has risen from 1,000 in early 2012, to more than 10,000 plug-in vehicles on the road today, http://www.nypa.gov/Press/2014/091914.html

14 New York State Vehicle, Snowmobile and Boat Registrations lists 4,641 EV registrations in New York State: https://data.ny.gov/Transportation/Vehicle-Snowmobile-and-Boat-Registrations/w4pv-hbkt

15 Electric Vehicle Sales and Future Projections, http://evtc.fsec.ucf.edu/reports/EVTC-RR-01-14.pdf

16 Interview with Bob Friedman, 10/20/2014.

17 Interview with Asaf Selinger, 9/9/2014.

4 Electric Vehicle Tourism Precedents

EV tourism has developed in a few select cities in the U.S., in addition to its emergence in other countries such as Canada and Japan. These initiatives vary in their implementation; some act as an EV rental service, while others simply consist of a network of charging stations. The functioning of each program depends on the base service, operating organization, and whether it is a private or public entity. They can also vary in the types of vehicles they deploy—some EV tourism programs feature BEVs while others may also use PHEVs, which use both batteries and gasoline to move vehicles.

The following sections give examples of various initiatives that feature different business models and operational approaches to EV tourism.

4.1 Existing EV Packages

4.1.1 EV Rental Programs

Several EV rental services provide packages or special discounts and amenities for EV drivers. Two notable examples are Drive Electric Orlando (Florida) and Okinawa Electric Vehicle Rental Service (Japan). Special EV rental packages may include perks such as global positioning system-based mapping systems that offer custom EVSE searches and free charging and car-hotel packages (Orlando).
EV rental programs are able to target a large potential customer base, as they cater to both local and visiting tourists. The service can be attractive to people who are accustomed to renting cars while on vacation, as well as for business travelers, particularly if their firm has sustainability guidelines that encourage use of alternative fuels and technologies. EV rental services that do not provide a charging station network can develop partnerships with hotels, restaurants, or other institutions with parking that also have EV charging stations available to their customers.

Drive Electric Orlando is an EV rental program that leverages existing tourism in the Greater Central Florida Area, the largest car rental market in the country. Though the program does not include any of its own branded charging stations, it has established numerous partnerships in the travel and tourism

industries, including 28 hotels and three theme parks. Thanks to these partnerships, Drive Electric Orlando customers can benefit from free parking and charging at hotels, free valet parking, and complimentary registration for the CLEAR Lane inside Orlando International Airport.[18]

Some programs offer special packages and discounts to attract more users. These incentives can encourage people who are accustomed to renting cars while on vacation to consider an EV option. In Kyoto, Japan, 27 temple sites offer discounted admission to visitors arriving in an EV. Other packages consist of discounted nights in hotels or free event admissions.

4.1.1.1 Charging Station Network Programs

These programs are mainly intended for EV owners and include:

- West Coast Green Highway (Washington State, Oregon, British Columbia, and California).
- Hawaiian Electric Vehicle Network.
- Sun Country Highway (Canada).

Some features of these programs include:

- Suggested itineraries.
- Roadside assistance.
- Free or discounted charging at partnering locations.

These programs rely to a lesser degree on car rental services that may have EVs available in their vehicle fleets. Oregon, California, British Columbia and Washington State are part of the West Coast Electric Highway, a vast charging stations network along Interstate 5 and other highways. These states collaborate on the program, which aims to bring in EV tourists from inside and outside the network. The charging network caters to existing EV owners or tourists seeking to rent EVs from private companies. North Central Washington Economic Development District created a reference called Plug-In NCW (www.pluginncw.com) to educate drivers about EVs and to provide information about charging stations, EV travel itineraries, and ways to get involved in EV initiatives.

[18] Drive Electric Orlando, http://driveelectricorlando.com/

Charging station network programs also help organize and promote one-time events such as Oregon's Plug & Pinot EV tour and tasting and the E-Mazing Race. Plug & Pinot EV, for instance, took place from April 22-27, 2014. It involved four charging station-equipped wineries, which offered free tastings for EV owners and users. The E-Mazing Race, which took place from September 29 to November 1, 2014, challenged EV users to visit Sun Country Highway charging stations to collect the most points in a one-month period. Serious competitors have the opportunity to win valuable prizes and discounts.

In the near term, all these programs aim to encourage EV tourism by demonstrating that tourist sites can be easily and affordably visited with an EV. Over the long-term, however, these efforts may also serve to encourage EV ownership—by validating the technology to the curious and the intrepid, but especially by facilitating greater access to EV charging stations. Car manufacturers themselves can and should play a significant role in the development of these programs since they offer a highly visible means of promoting the efficiency and ease of EV usage.

4.2 Destination Types

Each EV program enables its customers to reach specific locations of interest. To market to certain customer types, EV travel programs have three approaches:

- Suggest specific itineraries with multiple destinations.
- List key locations with charging stations without specifying a route.
- Provide a map of the program's charging station network, leaving customers to freely plan their route.

These destination categories are typically served by EV tourism initiatives:

- **Entertainment/tourist attractions –** Theme parks (Disney World, Sea World, Universal Orlando Resort), shopping malls, leisure centers, wineries, museums, performing arts centers, and covered bridges.
- **Natural sites –** mountains, coasts, beaches, gorges, and rivers.
- **Leisure –** hotels and restaurants.
- **Business tourism –** convention centers, central business districts, research parks, efficiency hotels.
- **Transportation –** airports and highways.

The first two categories — entertainment/tourist attractions and natural sites — are difficult to fully equip with charging stations. Entertainment/tourist attractions would benefit from charging stations in nearby parking lots, but may also experience extremely high demand for charging. At nature sites, it is challenging to establish the supporting electrical infrastructure in remote areas. In both cases, it is important that the charging stations are strategically located—both to facilitate ease of use and to ensure cost-effective installation for the destination operator. In all destination categories, charging stations should be located in venues in which people typically visit long enough to gain an appreciable charge. This placement is especially important if the charging station offers only a "trickle charge," and is not able to recharge EVs rapidly. Destinations with typical "dwell times" of two hours or more are ideal.

4.3 Communication and Marketing Challenges

In any EV tourism deployment scenario, efforts must be made to communicate key information to current and potential EV users. For example:

- **"Range anxiety" and EV charging station coverage** – New customers often worry about insufficient recharging infrastructure, and fear the inability to recharge their EV while out driving. Websites, maps, and smartphone and dashboard apps are useful in providing a full list of charge stations throughout the country.
- **EV usage benefits** – EVs are extremely beneficial for the environment, but to increase use, customers should be informed about specifics pertaining to reduced energy consumption and environmental impact. It is also important to promote the direct monetary savings from EV use, in terms of refueling and maintenance as well as special discounts and packages for hotels, entertainment.
- **Partnerships** – Partnerships can translate as credibility to customers. Partners can provide free charging stations or other discounted products or services to further entice new participation.
- **Information accessibility** – Well-designed websites can be instrumental in attracting new customers. Plug-In NCW's website displays information pertaining to EV itineraries, events, and EV promotion projects in a manner that is clean and easy to understand. It also provides information about the fiscal benefits to owning an EV.
- **The mechanics of charging** – Informing new EV users about the types of charging stations and plugs they are likely to encounter, typical charge times, and payment methods is an essential communications task for any EV tourism effort.

5 Proposed Destination Clusters

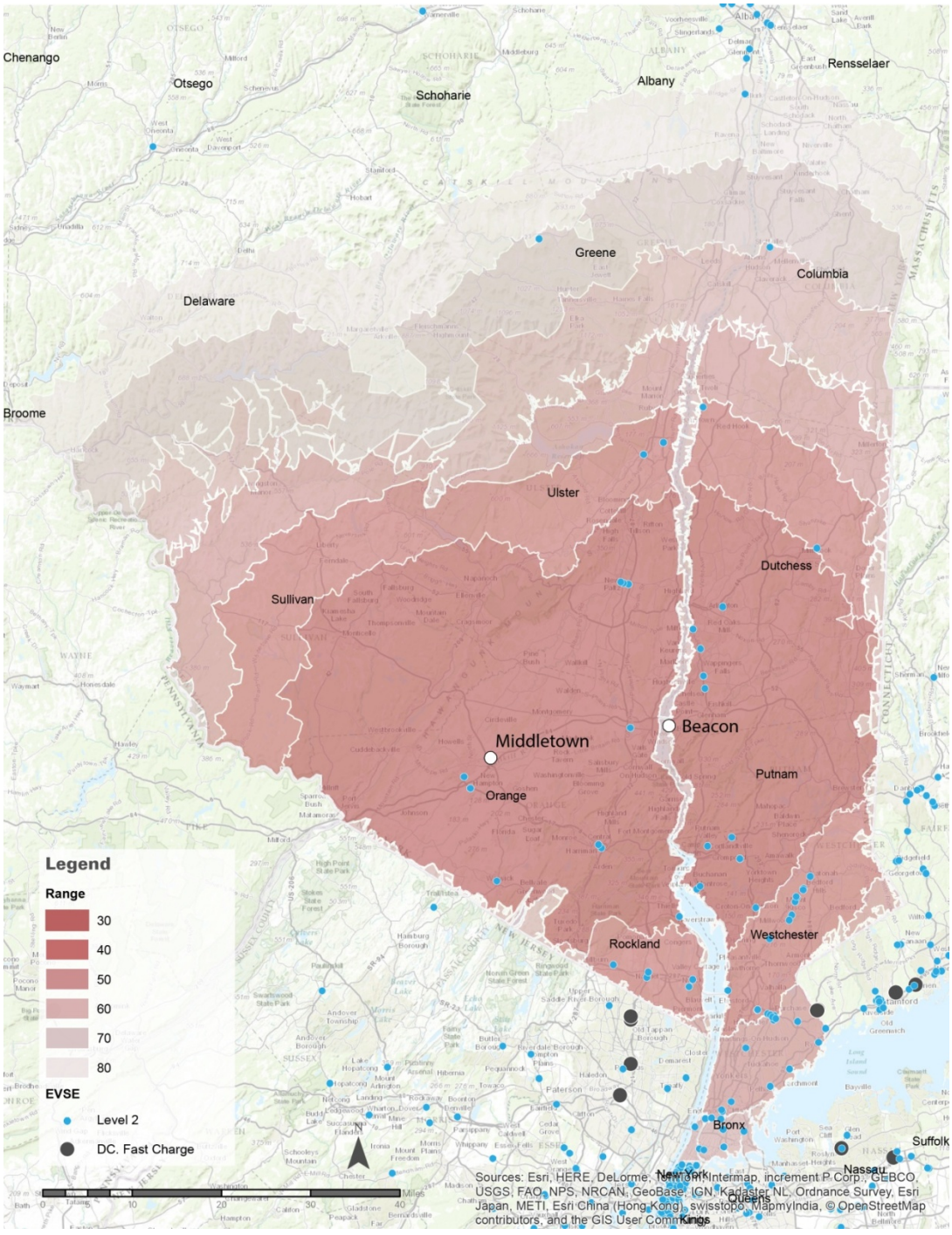
The study team sought to directly address the range anxiety challenge by plotting an emergent EV ecosystem designed to support early adopters and aspirational early adopters in two principal destination clusters. By mapping likely destinations for EV tourists and proposing charging spots and EV-friendly routes, an EV tourism plan can mitigate the uncertainty typical among drivers new to the technology. If implemented, such a plan when supplemented by a regional charging network, would seek to replace the EV user's range anxiety with range confidence.

The two proposed destination clusters are:

- Lodging and leisure destinations within a 70-mile radius of the **Middletown** station on MNR's Port Jervis line, which includes the Rock and River Cluster in Sullivan County.
- Lodging and leisure destinations within a 70-mile radius of the **Beacon** station on MNR's Hudson line, which includes Arts and Inns Cluster in the counties of Orange and Dutchess.

Venues were selected based on their capacity to rebrand and repurpose themselves as EV destinations for the early adopter market. Through interviews and research, the study team sought to gauge the depth of interest and inclination of the owner-operators of these potential host sites. A map of the EV coverage areas around Middletown and Beacon are shown in Figure 1, and a map of the destination clusters can be found in Figure A-2 in the Appendix.

Figure 1. Electric Vehicle Coverage Area for Ranges of 30-80 Miles and Existing Public EVSE



5.1 *Rock and River* Destination Cluster: Lodgings and Attractions

This cluster is focused on destinations in Sullivan County, including emerging destinations such as Bethel Woods and the Upper Delaware River towns of Narrowsburg and Calicoon. Several trends suggest that an EV tourism market can be cultivated in the region: new eco-inclined boutique hotels catering to Millennial travelers, continued growth of destinations along the Route 97 Scenic By-Way, and plans for a new casino and resort complex in Monticello. A select number of potential *Rock and River* destinations are profiled as follows.

The Sullivan is a 70-room boutique hotel and conference center in Rock Hill, NY, 21 miles northwest of the Middletown MNR station. The Sullivan draws visitors to local attractions such as the **Bethel Woods Performing Arts Center**. The hotel accommodates up to 1,000 guests in its catering and conference facilities, and often attracts 3-day weddings onsite. Located a mile north of Bethel Woods, **Catskills Distilling Company**, **Dancing Cat Saloon, Stray Cat Gallery**, and **The Store Next Door** form the nexus of a destination retail micro-climate that greatly enhances the environs of Bethel Woods.

Villa Roma is a family-owned and operated resort and conference center located 50 miles west of the Middletown MNR station. The property features hotel rooms and time-share units, as well as 40,000 square feet of meeting and event space for up to 1,000 conference-goers. According to Vice President and Managing Director Paul Carlucci, a busy summer weekend at Villa Roma can draw up to 300 hotel guests and 1,100 time-share customers.[19] Carlucci estimates that nearly 80% of his visitors reside in the New York metropolitan area. The resort also features an 18-hole golf course; an array of pools, saunas, and Jacuzzis; and three nightlife venues on the premises. Villa Roma touts its sustainable practices on its website and Carlucci reports that the resort is certified by the Green Concierge Certification Program of Hospitality Green.

Lander's River Trips (LRT) is a family-owned and operated business with eight "launch and land" locations and three campgrounds along the Upper Delaware River in western Sullivan County. LRT offers raft, canoe, kayak, and tube rentals, as well as tent and RV camping experiences to visitors. Skinners Falls in particular is an extremely popular destination for rafting and tubing enthusiasts. Ample parking areas and a new electrical service in the lot at its Narrowsburg campground and launch site help

[19] Paul Carlucci, interview, 8/1/14.

position LRT to serve the early adopter EV market. According to Rick Lander, president of LRT, EV tourism "might be something unique that can drive new visitors to us and to the area." Lander describes the typical customer as between 25–35 years old and hailing from the New York City area, noting that the annual three-day Mysteryland Festival at Bethel Woods might provide fertile ground for testing EV carshare and rental scenarios because "they have the right demographic" for the early adopter market.[20]

Ecce Bed & Breakfast is a five-room inn perched on a cliff above the Upper Delaware River in Barryville, NY. Located 45 miles west of Middletown, visitors traveling to Ecce by rail generally rent vehicles near the Middletown station. However, the majority of guests use only one mode of transport to reach the inn: vehicles operated from customer point of origin to destination. Often, these vehicles are Zip Cars secured from a Manhattan location or rentals from a car rental agency based at a New York City airport. Alan Rosenblatt, Ecce's owner-operator, reports that Ecce's guests are typically 40-60 years old and hail from NYC.[21]

Bethel Woods Center for the Arts (BW) is a museum, performing arts venue, and historic site located on 800 acres adjoining the location of the1969 Woodstock Festival, where sustainability is a guiding value for BW and its staff. The museum is a LEED-certified building and BW installed charging stations and hosted 10 BMW Mini E electric vehicles in 2009 for a year-long pilot sponsored by the local revitalization group Sullivan Renaissance. According to Shannon McSweeney-LeMay, senior director of marketing, communications, and events, BW's current marketing efforts are focused on reaching more Millennials and generating more traffic from Downstate markets. BW's visitor profile has remained fairly consistent since its 2006 opening: 20-30% of visitors are from Sullivan and Orange counties while New York City tourism is at less than 10%. Overcoming gaps in the transportation network is an ongoing challenge for BW. A primary concern of McSweeney-LeMay's is making it easier for visitors from New York City to visit the facilities. On offering at the Middletown station, she commented, "From a marketing perspective, it's a good fit." And electric vehicles might hold a special appeal for BW's current visitor base: "Even if you look at our older boomers, people would be disposed to green things. Woodstock fans are disposed to green actions," McSweeney observed.[22]

---

20 Rick Lander, interview, 1/6/15.

21 Alan Rosenblatt, interview, 8/19/14.

22 Shannon McSweeney-LeMay, interview, 11/3/14.

BW relies on Coach Bus Lines to transport visitors from New York City, Middletown, and Ridgewood, NJ directly to the venue. BW also partners with Rolling V, a local transportation partner that provides a shuttle service from the Monticello racetrack on concert days and transportation to and from **The Sullivan** on beer and wine festival days. On nonconcert days, however, travel from New York City and other Downstate points of departure are complicated by gaps in transit availability. Bus service from the Port Authority terminal to Monticello followed by a $20 cab trip to BW renders travel expensive and complicated for the mass transit user.

BW's parking facility includes 900 paved spaces for museum and concert visitors and a designated co-branded lot set aside for Harley Davidson motorcycles. The three-year sponsorship agreement with Harley Davidson offers a potential model for engagement with car rental and carshare firms seeking co-branding with BW and designated locations for charging infrastructure. This opportunity will be explored in the final section of the study.

5.2 *Arts and Inns* Destination Cluster: Lodgings and Attractions

This cluster is focused on destinations in Orange and Dutchess counties, including iconic Hudson Valley locations such as the Bear Mountain Inn, the U.S. Military Academy at West Point, and the Storm King Art Center. Clusters of eco-inclined destinations, an absence of convenient trans-Hudson transportation options, and a shared visitor profile between the area's principal cultural institutions are conditions that suggest an EV tourist market can be cultivated in the region. A select number of potential destinations are profiled as follows.

Woodbury Common of Simon Premium Outlets is one of the largest shopping malls on the East Coast. The facility is located in Orange County, 50 miles northwest of Manhattan, with over half a million people using mass transit to reach Woodbury each year, primarily bus. Many visitors are international tourists visiting New York City who want to take advantage of the discounted shopping offerings. Simon's Vice President of Marketing-Northeast Jeane Guinup estimates that the typical international shopper spends seven hours at the property, with many staying overnight at one of several hotels, and desiring to explore beyond. Guinup believes that international tourists and young professionals would be interested in EV rentals, particularly for day trips to Woodbury incorporated into an MNR package that would both enhance MNR ridership and build tourism at Woodbury. At the time of writing, Simon was in the midst of constructing a new parking garage at the mall, which could present opportunities for installing charging infrastructure.[23]

The City of Beacon in Dutchess County features Victorian architecture, collectible shops, art galleries, museums and fine dining, as well as parks and trails along the Hudson River. Beacon, the "the Soho of Dutchess County," is located on Metro-North's Hudson line, offering visitors and residents relatively convenient access from Grand Central Terminal and Poughkeepsie, as well as Newburgh across the river. A primary destination for visitors is **Dia: Beacon**. Housed in a former Nabisco printing factory re-cast as a contemporary art museum, Dia has almost 300,000 square feet of exhibit space and houses many important permanent art collections from the 1960s to the present. Dia states that it contributes over $12.5 million annually in economic activity to the region and welcomes over 75,000 visitors annually,

[23] Jeane Guinup, interview, 8/15/14.

many of whom hail from New York City, especially young professionals from Brooklyn. Dia also offers "Community Free Days" for residents of neighboring New York State counties. The museum is a short distance from Beacon station; most visitors arriving by train walk to the museum. For drivers, Dia has a modestly-sized parking lot with ample free weekend parking at the Beacon station.

West Point, site of the United States Military Academy (USMA), overlooks the Hudson River from a bluff 55 miles north of New York City. According to the USMA Visitors Center, it handles about 200,000 visitors each year. However, the overall number of visitors to West Point is significantly higher when including those who do not pass through the Visitors Center but attend academy football games and special ceremonies. Many tourists currently arrive in charter buses, but those visitors that use rail typically book tickets to the Beacon, Cold Spring, and Garrison MNR stations. The parking at the Visitors Center is open to the public, but is extremely limited. Parking lots on the main campus of the academy are more ample but are subject to security checkpoints; therefore, publicly accessible charging would be a challenge on the campus itself. However, the Village of Highland Falls maintains its own municipal lots across the street from the campus. Enterprise Rent-a-Car operates a location at the academy that is utilized largely by cadets and staff.

The Bear Mountain Inn at Bear Mountain State Park is situated in rugged mountains near the west bank of the Hudson River. The park features a large play field, shaded picnic groves, lake and river fishing access, a swimming pool, Trailside Museums and Zoo, hiking, biking, and cross-country ski trails. The Perkins Memorial Tower atop Bear Mountain affords spectacular views of the park, the Hudson Highlands, and Harriman State Park. The inn itself has 15 luxury rooms, 15 parking spaces designated for guests, and a full service spa. The Bear Mountain Inn's operators also manage the Overlook Lodge, another hotel in the park that has 24 rooms and 80 parking spaces. With rustic cottages located throughout the park, the total number of guest rooms is 63. According to Steven Patton, the inn's manager, about 70% of guests are in their mid-20s to late 30s, while 20% to 30% of guests are older. Day travelers typically use mass transit (MNR) to Peekskill and Garrison stations or the Shortline Bus while weekend visitors tend to drive.[24]

[24] Steven Patton, interview, 8/14/14.

Storm King Art Center (SKAC), one of the world's leading sculpture parks**,** welcomes visitors from around the world. It is located only one hour north of New York City by car where its pristine 500-acre landscape of fields, hills, and woodlands provides the setting for a collection of more than 100 carefully sited sculptures created by some of the world's most acclaimed artists. In 2014, SKAC hosted approximately 130,000 visitors and has doubled its tourism volumes over the last four years. Approximately 64% of visitors are from New York State; 16% from New Jersey; and 5% from Connecticut. Of the New Yorkers, about 27% are residents of Manhattan; 20% hail from Brooklyn; 12% from Westchester; and 11% from Orange County. Visitors using MNR typically book tickets to Beacon and pay a $20 cab fare to reach SKAC from the Beacon station. Storm King and Dia:Beacon have reciprocal membership offers and share many of the same visitors—often on the same day. At the time of this study, Anthony Davidowitz, director of legal affairs and operations at SKAC, noted that Storm King was in the midst of a master planning process and he expressed interest in incorporating planning for EV charging into the site's master plan.[25]

[25] Anthony Davidowitz, interview, 8/14/14.

6 Instituting a Pilot

Field-testing an EV tourism pilot in the Catskills and Lower Hudson Valley presents several key challenges. The operational challenges include: (1) meeting minimum revenue requirements for the carshare or car rental operator, (2) designating parking spaces for EVs in meager or competitive lots adjoining rail stations, destinations, and lodgings and properly equipping them with EVSE, and (3) ensuring continuous ease-of-use for the renter from booking to vehicle return. However, the cultural challenge of inspiring confidence and overcoming unfamiliarity with the technology among both renters and destination and lodging operators is perhaps greater than any single operational concern.

6.1 Car Rental Break-Even Scenarios and the Public Sector Hedge

First and foremost among the operational challenges are the financial considerations of the participating carshare or car rental operator. Enterprise Rent-a-Car and Hertz Rent-a-Car were interviewed for this study and each offered their own break-even revenue scenario for an EV business model. The figure ranged from $1,100 – 1,500/month. Rates of utilization are a key consideration when modeling a tourism-driven approach, because fluctuations in use due to season, day of the week, and even weather are variables that must be weighed and ultimately hedged by the operator. A more detailed breakdown of costs can be found in Appendix A.

Even under an optimistic scenario of four weekend rentals per month from Memorial Day to Veterans Day, the rental car operator will require either significant subsidy or additional revenue to meet its minimum break-even threshold. Seasonality is of particular concern to the operators, given the cost of transporting vehicles to other markets once high season subsides. But even during periods of peak summer demand, it is assumed that weekend rentals will represent the majority of bookings, leaving the vehicles idled during the weekdays.

One hedging strategy explored under the study would involve the deployment of subject EVs by municipal governments Monday through mid-morning Friday during the summer tourist season. This car sharing approach, already used by New York City government,[26] would enable the operator to achieve a high rate of utilization (ensuring up to 18 days of guaranteed use per month) and provide a financially viable model to serve the tourism industry. In off-peak months, the operator would continue to be compensated for the asset by the municipality.

[26] ZipCar, http://www.nyc.gov/html/dcas/html/employees/zipcar.shtml

In interviews with the Mayor of Middletown, NY and the acting City Administrator of Beacon, NY, the study team explored various joint usage and car-sharing scenarios with both officials. Beacon's City Administrator Tim Dexter saw merit in converting the capital expense of new vehicle acquisition to a fixed monthly operating cost and did not foresee great difficulty in implementing a vehicle share program. Dexter indicated that the City expects to replace several vehicles in April 2016 and could consider EVs to meet its needs.[27]

Joseph DeStefano, the Mayor of Middletown, also saw opportunities in the car sharing model, suggesting that Middletown's code enforcement officers and assessors could utilize EVs and observing that the its modest five-square-mile footprint lent itself to EV deployment for various municipal functions. In this scenario, managing the mechanics of the transition between drivers, prepping the vehicles for weekend users, as well as maintenance would in all likelihood fall to the car rental operator. A local footprint within short walking distance of rail stations and a mobile workforce would aid an operator in successfully implementing such a strategy. [28]

[27] Tim Dexter, interview, 11/25/14.

[28] Joseph DeStefano, interview, 12/30/14.

6.2 Assembling the EV Ecosystem, Addressing the Infrastructure Finance Challenge

Assembling a robust ecosystem of charging infrastructure at EV-friendly destinations is absolutely crucial to the success of any EV tourism pilot. In many locations evaluated for this study, however, parking spaces are at a premium and allocating pavement close to an electrical panel to facilitate EVSE installation means eliminating high-value spaces for conventional vehicles. At West Point, where vehicle counts often outstrip the number of available spaces, and the Bear Mountain Inn, which has only 15 spots designated for guests, restricting spaces for EVs would come at a convenience cost to other guests and might not be justifiable at the launch of a pilot. Difficulties in designating and enforcing "EV-only" spots may argue for non-exclusive EV parking at these locations. Recommendations for EV infrastructure by location type are in Appendix A.

Obstacles to financing EVSE installation are more challenging. Nearly all destination and lodging operators interviewed for the study agreed that the installation of charging equipment could add value to their marketing campaigns, help diversify their customer base, and bolster the services they offer to visitors. But none expressed interest in self-financing the purchase and installation of this equipment. Existing subsidies are unlikely to cover all aspects of installation, though a potential pilot could address this challenge in several different ways. Targeted public subsidies for the hospitality sector to prepare for EV tourists offer one obvious pathway. But other viable financing models can also be considered, including third party financing by lenders such as Key Equipment Finance, which has pioneered a 100% financing model for the hardware, software, installation, and maintenance required for successful EVSE deployment.

A third approach could involve a co-branding strategy with a car rental or carshare operator or even a car manufacturer. The surface lots at Bethel Woods offer one intriguing model for consideration. The venue's parking facility includes 900 paved spaces for museum and concert visitors including one co-branded lot designated for Harley Davidson cycles. The three-year sponsorship agreement with Harley Davidson offers a potential model for engagement with car rental and carshare firms seeking co-branding opportunities and new customer pipelines. A co-branding agreement might call for the car rental operator to underwrite the cost of EVSE installation and maintenance in exchange for exclusive use of branded spaces for its customers. Such an arrangement would offer the customer preferential parking and access to charging equipment while providing the venue with charging infrastructure and designation as an EV-friendly destination.

6.3 Ensuring Ease of Use with the EV Tourism App and Local Partnerships

Managing the multistep process of booking rail, car, and lodging reservations can be facilitated through the implementation of an integrated travel app for EV tourists. The app can offer the added benefit of plotting potential routes, highlighting charging station locations, and incorporating discounts—building off those described in Section 7—and other special offers in the two destination clusters. Meshing these diverse elements on the back-end may, however, be a challenge.

In addition to the development of an app and the engagement of a motivated car rental or carshare operator, robust local partnerships will be extremely helpful in sustaining a successful pilot and troubleshooting difficulties that may arise. Designating and supporting a local tourism group or visitor's center in each destination cluster will help strengthen linkages to local destinations, suggest routes, negotiate deals, and provide a level of program oversight that is essential to the success of any new and largely untested venture in the hospitality space. In the *Rock & River* cluster, the Sullivan County Visitors Association is well-positioned to serve in that capacity, while the Dutchess County Regional Chamber of Commerce may be best suited to support the *Art & Inns* cluster for a pilot.

As previously noted, program oversight and management is crucial to ensure a uniformly high-quality visitor experience and to provide early and ongoing support to destination operators. This support should take the form of a robust interface between participating partners, including car rental services, destination and lodging operators, charging network/power provisioner, and MNR. Oversight and management activities may include but are not limited to the following:

- Monitoring performance and operation of charging equipment and communicating with charging network operator to ensure continuity of service and speedy repairs when needed.
- Ensuring that EV tourism app and associated maps are continuously updated and improved to reflect new partnerships and realities on the ground.
- Marketing the app and the EV tourism approach to new destination and lodging operators.
- Promoting the program to tour operators, travel associations, and travel agents.
- Managing public relations and press outreach for the initiative.
- Re-certifying participating destinations annually to ensure that they are providing any agreed upon discounts and convenient access to functioning charging infrastructure.
- Convening periodic calls and fostering continuous communication between car rental service, destination and lodging operators, charging network/power provisioner, and MNR.

6.4 Segmenting the EV Tourism Market

Instituting a pilot for a service with little documented consumer demand will require careful targeting to key market segments. While the details of each destination cluster will largely determine consumer profiles, a pilot can and should target the following travel consumer sub-categories:

- **Wine/Beer/Spirit enthusiasts** – A resurgence in artisanal brewing, distilling, and fermentation activities throughout the State, spurred by changes to State policy, has yielded a number of new taproom and tasting destinations in the Catskills and lower Hudson Valley. Wine-related tourism injects an estimated $410 million into the State economy each year and in 2013, New York State's 353 wineries hosted 5.29 million visits.[29] Although the Finger Lakes Region is the top wine producing area in the State,[30] the Lower Hudson Valley is home to dozens of wine, beer, and spirit destinations in the study area, especially along the Shawangunk Wine Trail, the Hudson Valley Wine Trail, and the Hudson Valley Beer Trail.
- **"Deliberate" and "Opportunistic" food travelers and local agriculture supporters –** The popularity of destinations like the Culinary Institute of America in Hyde Park reflects the sustained marketing power of culinary tourism. The emergence of similar destinations such as Blue Hill at Stone Barns in Tarrytown and Peekamoose in Big Indian demonstrates burgeoning interest in the "farm-to-table" ethos and the embrace of local product. According to the *American Culinary Traveler*, a 2013 report conducted on behalf of the World Food Travel Association, 39 million Americans are "deliberate" culinary travelers—meaning they will plan their travel around culinary destinations—while another 35 million are classified as "opportunistic," meaning that food destinations are important but ancillary considerations they when a travelers chooses a leisure-time destination.[31]
- **Hikers/outdoors enthusiasts** – Locations like Mohonk Mountain House and Stone Arch Bridge Historical Park draw outdoor recreation enthusiasts from throughout the New York metropolitan area. In New York State alone, outdoor recreation generates $33.8 billion in consumer spending and an estimated 53% of New Yorkers participate in outdoor recreation activities each year. [32]

---

29 http://www.governor.ny.gov/sites/governor.ny.gov/files/archive/assets/documents/Beer_&_Wine_Summit_Final_April_2014_FINAL.PDF

30 The Finger Lakes Region is the top wine producer and home to the most wineries. The North Fork of Long Island is another key wine producing area of the state. Both areas deserve future study around EV tourism. http://culinarytravel.about.com/od/wineryreviews/tp/New_York_State_Wineries.htm

31 http://mandalaresearch.com/images/stories/Culinary_Download/FREE_DOWNLOAD_American_Culinary_Traveler_Report.pdf

32 https://outdoorindustry.org/pdf/OIA_OutdoorRecEconomyReport2012.pdf

- **Cultural tourists** – An estimated 76% of all leisure travelers in the U.S.—126.9 million Americans—can be classified as Cultural/Heritage travelers, or those who took part in a cultural activity "on their most recent trip or in the last three years."[33] Venues such as Dia:Beacon and Storm King are compelling and likely destinations for Passionate cultural/heritage travelers, the 13% of leisure travelers—an estimated 23 million Americans—who plan their travel around proximity and access to leading cultural destinations.
- **Second-Home Owners** – Both Freda Eisenberg, the Sullivan County Planning Commissioner, and Rick Lander, president of Lander's River Adventures,[34] cited second-home owners (SHOs) as a key potential market for short-term EV use. A 2008 SHO study commissioned the Sullivan County Division of Planning and Environmental Management identified 10,085 SHOs along with 6,200 others who owned vacant property in the county but who resided elsewhere. The study included findings from a survey of 1,379 Sullivan County SHOs responding to questions about travel patterns and frequency of vehicle trips during their stay in the county. A majority of survey respondents indicated a primary residence in the five boroughs of New York City or Nassau County and a preference to travel to visit their second homes on weekends. [35] Nearly 60% of Sullivan County SHOs travel to their second homes on Fridays and more than half make the trip in the afternoon, a period of peak congestion on area roadways in the warm weather months. A still larger percentage depart for their primary residences on Sunday afternoons, presumably adding to the weekend traffic on major arteries, such as Routes 17 and 17B.[36]

6.5 Addressing Space Challenges near Metro-North Stations

A key element of the proposed EV ecosystem will be parking and charging locations at or adjacent to selected MNR stations. Metro-North is especially motivated to advance zero emission car travel in conjunction with the use of its commuter rail service. According to Peter Ramos, manager of Parking and Station Amenities Unit, Customer Service & Stations Department of MNR, "some of the key program goals for Metro-North are: (1) to ensure Metro-North is the primary mode of choice for travel in the service territory; (2) to facilitate a continuous uninterrupted ride to Metro-North customers from their trip origins to destinations beyond the railroad station; (3) to encourage use of environmentally-friendly

---

33 http://www.travelindustrywire.com/article71829New_Findings_in_____Cultural___Heritage_Traveler_Study.html

34 Freda Eisenberg and Rick Lander, interviews, 8/1/2014 and 1/6/2015.

35 http://webapps.co.sullivan.ny.us/docs/dpem/resources/secondhomeownerstudy.pdf

36 Ibid

vehicles such as gas-electric hybrid vehicles (not a requirement, however); (4) to generate revenue/benefits to Metro-North; and (5) to promote off-peak ridership/leisure travel through cross marketing and developing travel packages connecting rail and car rental options within the Metro-North service area and beyond."[37]

Securing parking spaces for rental or carshare EVs is not, however, without complications. A car rental or carshare operator using an MNR station parking lot to conduct business would need to be selected through a competitive bidding process. MNR recently issued a request-for-proposal to expand and improve upon the rental vehicle services currently provided at select commuter rail stations. Enterprise currently holds the license to operate at selected MNR stations but an entirely different vendor could ultimately be selected through the competitive RFP process. An ideal scenario would be for the requirements of an EV Tourism program to be folded into that concession agreement.

Use of publicly accessible charging stations at MNR stations is another complication. Pursuant to its funding agreements with NYPA and NYSERDA, MNR plans to begin installing charging equipment at selected commuter rail stations—including Beacon—but these stations will be available to the general public on a first–come, first-serve basis. It is unlikely that the existing funding agreements would permit MNR to repurpose the charging equipment for use by a private entity such as a car rental firm, though operationally, the typical users of an EV tourism program might not in fact overlap in their use of these spaces with weekly users.

Lastly, while MNR owns most of the lots commuters use for parking at or near its stations, it relies on its partner, LAZ Parking, to operate the lots. This relationship requires cooperation from LAZ to implement infrastructure and service changes at MNR parking locations. Any additional infrastructure improvements to Beacon or Middletown MNR lots to facilitate EV car rental services would require approval from LAZ, who may be unwilling to set aside EV-designated spaces, given the potential reduction in value of those spaces. One possible solution to this challenge is to utilize nearby lots controlled by other willing partners such as municipalities, county governments, or private entities. One example of such a location is the Beacon Welcome Center, operated on municipal property on a site across the street from the Beacon MNR station.

---

[37] Questionnaire response, 1/19/15.

6.6 Consumer Cost-Benefit Analysis

The case for the Downstate consumer renting a vehicle—either EV or conventional—beyond city limits is already strong. Weekend car rentals at a Manhattan location can cost the customer up to 8 times what they would pay for a comparable model at locations in the Hudson Valley. Even fees for 48 hours of Zipcar usage for a vehicle picked up in New York City can cost a member nearly five times what a he or she would pay for a comparable model rented from a Hudson Valley agency. (See Table A-7 in Appendix A.) The renter typically enjoys a sizeable price advantage by utilizing an Upstate location.

A sample scenario is instructive. On the weekend of October 4 – 5, 2014, a compact picked up from Hertz's W. 34th Street location for a weekend rental would cost the renter $412.37 for 48 hours. Depending on route length and route selection, fuel and tolls can add another $44.40 to $58.72 to weekend transportation costs. Averaging these two figures yields an overall transportation cost of $463.93 for the weekend renter.

Using conservative, low-utilization assumptions and anchored by the rental companies' estimated average revenue goal of $1,300/month, weekend EV rental costs of $325 for a 48-hour period are not unreasonable. Factoring in round-trip transit fares to Middletown or Beacon will add $34 – 36 to the traveler's budget, two full battery charges at $0.10 per kilowatt-hour another $5.60, and the Bear Mountain Bridge toll a final $1.50. The total overall transportation cost to the EV traveler would be $368.10, which is a savings of $95.83 over a traditional ICE rental. These estimates do not assume any savings from discounted lodging and destination fees, New York State Thruway "GreenPass" discounts, nor potential benefits to the traveler from free charging that might be used as an inducement by lodging and destination operators. But based on overall transportation costs alone, before any other benefits are considered, EV rentals for Downstate visitors can clearly be cost-competitive with conventional vehicles rented within city limits. Ensuring the competitiveness of this strategy necessitates that the renter experience be as seamless and simple as possible.

6.7 Potential Benefits

The benefits of an EV Tourism implementation as described in this report would fall into a few categories: environmental and EV adoption.

To assess these benefits, some assumptions about a roll out must be made. For example, given current rental patterns for the Lower Hudson Valley, EV Tourism implementation would operate each weekend between Memorial Day and Veterans Day, which comes to 25 weekends. The pilot fleet may total 16 EVs, and a utilization rate of 75% after build out time is a reasonable rate. Finally, if the pilot fleet is shared with municipalities, the EVs would be in use 50 weeks a year.

The environmental benefits of a pilot can be calculated in terms of gallons of fuel saved and CO_2 emissions eliminated covering the same route with a conventional car versus a round-trip train trip plus an EV route. For pilot roll out described using routes to cover the example routes for Rock & River and Arts & Inns, over one year the fuel saved would total 2,670 and 2,030 gallons, respectively, and CO_2 eliminated would total 55,920 and 52,920 pounds, respectively. Using EVs as municipal fleet vehicles during the work week would save an additional 7,420.8 gallons of fuel and 120,160 pounds of CO_2 eliminated. These calculations are further detailed in Appendix A.

An implementation of this sort can drive EV adoption in several ways: providing users an EV driving experience, providing charging infrastructure at locations near the home and at destinations, and increasing general EV visibility. These factors combined could induce between 5 and 8 new EV purchases by the public per EV/EVSE set in the EV Tourism implementation.

Giving drivers opportunities to experience EVs through rentals or ride-and-drive events—colloquially known as getting butts in seats—is noted from industry experience as an effective tactic for increasing EV adoption, [38] though measures of this impact are unclear. The Experience Electric campaign in San Francisco estimates an 8% conversion rate for test drive participants: "8% of all the test drive participants ultimately purchased and/or leased an EV in the two to three month period after attending an event."[39] No comparable figure exists for EV rental or carshare programs, though EV rentals provide a much more immersive experience, potentially suggesting a higher conversion rate. Conversely, this pilot would primarily target non-car owners, so the conversion rate would be diminished. Applying the 8% rate equates to two EV purchases per year for each EV available in the program, assuming renters are distinct.

---

38 http://www.pevcollaborative.org/sites/all/themes/pev/files/150320_RFP_2015_Ride%26Drives_FINAL.pdf

39 Workplace Charging Plug-In Electric Vehicle Ride and Drive Webinar, February 26, 2015. http://energy.gov/eere/vehicles/workplace-charging-plug-electric-vehicle-ride-and-drive-webinar-video-text

Those who do not have regular access to electricity in an off-street parking spot are known as garage orphans. This group is most likely to be compelled to purchase an EV if a well-sited EVSE is made accessible. A study of garage orphans found that 40% would be much more likely to purchase an EV if provided such space.[40] An EV-only space at a train station would fall under this category, though given that EVSE at train stations—serving commuters during the week—can only accommodate one EV per day, the EV associated would be between 1 and 2 purchases per EV/EVSE pair.

Finally, the impacts to EV purchasing from increased visibility and destination EVSE are harder to assess, with few relevant studies being conducted. Certainly, given the minimal market penetration of EVs in the study area (Figure A-2 in Appendix A), there is an opportunity to significantly increase EV exposure and enable comfortable EV operations for new owners. This effect may lead to between 2 and 4 EV purchases, assuming Destination EVSE are installed at a number equivalent to the EVs in the pilot.

[40] http://www.commerce.wa.gov/Documents/Demand-EVSE-Access-Garage-Orphans-Survey2012.pdf

7 Alternative Scenarios: Existing Tourist Packages with Potential for EV Integration

In New York State, an EV tourism approach could be embedded in a number of other existing efforts that seek to develop and extend tourism beyond New York City. The Metropolitan Transportation Authority (MTA) offers numerous packages to its customers by way of MNR called "Deals & Getaways."[41] It features more than 30 different packages for varying interests, people, ages, and family situations. Activities include art/museums, culture, history, shopping, outdoor activities, and food/drink. Additionally, some packages include accommodations, seasonal events, and discounted car rentals. All packages start with MNR transportation, ranging from $20 to $200 per person depending on the activity, with special tickets that can be purchased at regular Metro-North kiosks.

As discussed in Section 6.5, MNR currently has a relationship with Enterprise. Customers renting vehicles through MNR's package website[42] benefit from having an Enterprise representative bring the vehicle directly to them at one of 23 stations (with all 5 MNR routes represented). In addition, customers will receive a 10% discount when using the special Metro-North code when booking online or over the phone. However, some stations are served by Enterprise branches with limited hours (some are closed on Sundays), which certainly discourages weekend or Sunday trips.

Amtrak has similarly developed a discount for travel within New York State. During certain seasons, rail tickets to Niagara Falls, Lake Placid, and the Adirondacks are discounted 15% off the full adult rail fare. Discount is valid to/from all cities within New York State, also includes travel from New York State and St. Lambert, Canada.

The Long Island Wine Council (LIWC) offers several packages catering to wine tourism. In collaboration with Delta Airlines, Avis, and Budget, LIWC developed a promotion called "90 Point Wines – 90 Minutes Away" that offers various discounts for customers. Travelers who book tickets on Delta Airlines are entitled to special savings on local travel packages within Long Island Wine Country, and Avis and Budget customers receive up to 25% off car reservations. Additionally, all customers are

41 http://web.mta.info/mnr/html/getaways.htm

42 http://web.mta.info/mnr/html/enterprise.htm

eligible to receive free wine tastings at over 20 participating wineries, 10% discount of hotel rooms 20 participating hotels, and a free glass of Long Island wine with purchase of an entrée at eight participating restaurants. This program was funded by the Regional Economic Development Council, which supports local efforts to help achieve economic growth and development goals in the region.[43]

I Love NY is another organization that offers special promotions for tourists within New York State. The ILNY website features an extensive search engine to locate deals within every major tourist region in the State. Promotions range from hotel room stays, outdoor activities, food/drink tours, museum visits, and more.

The Free Ride, a no-cost shuttle service operating in the Hamptons and select locations around the country, is fully funded through advertising. Billing itself as an immersive brand experience, the Free Ride uses modified GEM electric vehicles to transport riders to local hotspots. The GEM EVs are best suited for low-speed, short-distance rides, connecting multiple destinations within a concentrated area. The free service could link strong and vibrant downtowns—such as Beacon—with nearby MNR stations, enabling those arriving via public transportation to reach local sites without having to use a taxi or rent a vehicle.

[43] https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/REDCAwardsBooklet2014.pdf

8 Conclusions

A neat alignment of factors—including the growing diversity and affordability of new electric vehicle models, the rise of ecotourism, and emerging trend lines in millennial travel preferences—all point towards an opportunity for New York State to pilot an EV tourism strategy for a reviving tourism market in the Catskills and lower Hudson Valley.

The nearly 120,000 plug-in electric vehicles sold in the U.S. in 2014 represent the leading edge of a rapidly maturing technology, offering drivers greater choice and range than earlier entrants into the market. What is missing for the early adopter, the Millennial traveler or the ecotourist is a supportive EV ecosystem and robust public charging network to bolster range confidence and encourage use.

This study holds that a careful and judicious application of public sector resources, private investment, and mobile app technology can address most anticipated barriers to the marketplace for the EV tourism model. Promoting attractive destination clusters and forging creative, strategic partnerships linking carshare or car rental operators, municipal governments, and tourism promotion groups could spark the emergence of a viable ecosystem that supports not only EV tourism but broader EV adoption in lower New York State.

For the towns and villages of the Catskills and the lower Hudson Valley, the potential borne by this approach to technological transition has wider implications for branding efforts and market development. By defining themselves as EV-ready and tech savvy, these communities can become destinations of choice for sought-after segments of the tourism market. And by embracing change rather than discounting it, they can capitalize on a powerful shift in consumer behavior that offers the promise to help revive flagging economies and drive the region forward.

8.1 Future Considerations

Implementation of a successful EV tourism pilot will, first and foremost, require the active engagement of lead agencies on the ground in the targeted counties—entities with the relationships, the local knowledge, the reach, and the credibility to launch and sustain a nontraditional tourism strategy. Their principal tasks will be to assemble the charging ecosystem and manage the marketing, rollout, and operations of the project. This study has identified two viable entities well-positioned to fill this role: Sullivan County Visitors Association and the Dutchess County Regional Chamber of Commerce.

Next steps for these lead agencies in any implementation scenario would include:

- Identifying a car rental partner and convening a short-term planning process with MNR and the rental firm.
- Identifying likely EV parking and pickup locations near targeted MNR stations.
- Negotiating with property owners, if necessary, for parking spaces and permissions to install EVSE.
- Securing public and private investment to manage the pilot and build out a robust EVSE network at key locations in the targeted counties.
- Engaging with various provisioning firms to identify an operator for the charging network.
- Negotiating with lodging and destination operators for preferential pricing for EV tourists.
- Helping to select contractors and ultimately troubleshoot installations at parking lots and at lodging and destination operators in the target area.
- Selecting an app developer to design and develop a platform to facilitate bookings, wayfinding, and preferential pricing for EV renters.
- Collaborating with MNR, the car rental firm, and lodging and destination operators to craft an EV tourism marketing campaign and launch the app.
- Troubleshooting rollout, maintenance, and interfacing with all parties to ensure safe and satisfactory operations.

Appendix A

A.1 EV Tourism Precedents

Table A-1. Key Facts and Statistics about pre-existing EV tourism initiatives

	Drive Electric Orlando	West Coast Green Highway	Sun Country Highway
Location	Orlando, FL	Washington, Oregon, British Columbia and California	Canada
Type of service	Rental Service	Charging station network	Charging station network
How did it start?	Parquet Public Affairs was in charge of on-the-ground planning in Orlando while Electrification Coalition did the overall policy. Officially launched in September 2013.	Washington, Oregon, and California were among 6 states selected to participate in "The EV Project", a $230 million U.S. DOE project to spur electric vehicle ownership and infrastructure.	Private initiative aiming to create the longest green highway of the world, linking the west and east coasts of Canada
Type of organization	Partnership between Orlando rental car agencies, hotels, and tourist attractions	Partnership between Washington, Oregon, California and British Columbia, and the private sector	Sun Country Highway, private company
Number of installed sites	300 stations (sites), 10 fast-chargers	WA: 1000 level-2 chargers & 28 fast chargers OR: 800 level-2 chargers & 27 fast chargers	500 stations in North America (Canada + USA)
Benefits & results	N/A	Won the Environmental Excellence Award	Named the world's Best Automotive Solutions Company in 2014

Table A-2. Additional exemplars include

	Okinawa AEC Electric Vehicle Rental Service	Alpmobil	Hawaiian Electric Vehicle Network
Location	Okinawa, Japan	Swiss Alps, Switzerland	Maui, Hawaii
Type of service	Rental service	Rental Service	Rental service + charging station network
How did it start?	Originally proposed by professors from the Department of Systems Innovation at the University of Tokyo, the EV rental service aims to improve environmental sustainability of tourism on the island	Effort to encourage green tourism in the Alps. Provides EVs and rental packages for guests, encouraging them to visit natural sites by EV instead of ICE cars	Hawaii is working to comply with President Obama's goal to align the state's commitment to go beyond 40% renewable energy in the electrical power sector by 2030, and the federal and state policies to reduce carbon footprint.
Type of organization	American Engineering Corporation (AEC), private company	Member of Association Alpmobil, private company	Partnership between the state of Hawaii and U.S. Dept. of Energy
Number of installed sites	27 fast-charging stations (sites)	60 electric cars	158 stations (sites), 13 fast-chargers
Benefits & results	Low fleet utilization rate – 10.6% in 2012 (target: 20%)	Reduction in emissions, increased tourism activity	N/A

A.2 Metro-North Railroad travel packages

Table A-3. Sample of packages that are available with the purchase of a Metro-North ticket

Activity	Price	Package Details
Woodbury Common Premium Outlets	Train Ticket only	• Shopper Shuttle from Harriman Train Station to and from Woodbury Commons • Complimentary VIP Coupon book with store discounts
Westchester Trails Bike Rental	adults/children $39.00; seniors 65 & over $36.00	• Bike rental for Westchester Trails – option to bike anywhere • Many points of interest along the way
Boscobel House & Gardens	adults $36.25; seniors $28.00; children range $28.25 to free	• Visit to Boscobel House: enjoy docent-led tour of the lavishly-furnished 1808 mansion, hike the woodland trail, etc.
Culinary Walking Food Tours, Downtown New Haven	Ages 13 and over $72; seniors $66.50	• Three options: Theatre District Tour, On 9 Tour, and Canal Quarter Tour • Tours last 4 hours, all food & drink tastes included
Empire Cruises in the Heart of the Hudson Valley	Adults $47.50; seniors $41.50; children range $40.50 to free	• 2-hour sightseeing cruise along the Hudson River in the heart of Hudson Valley
Foxwoods® Resort Casino	adults $47.50; seniors $43.00	• Free bus service to casino • Includes $10 food or free buffet and $15 Bonus Slot Play

Table A-4. Sample of hotel/travel deals available for Metro-North travelers

Shuttle service available from train station to hotel in most cases.

Hotel Package	Price	Package Details
Yonkers Hampton Inn & Suites by Hilton	$131/$181 per night for single/double occupancy	• One round-trip rail tickets • Free shuttle service from Yonkers train station
Clarion Hotel and Suites, Hamden	Starting at $230/night	• 2 round-trip Metro-North tickets for New Haven Station • Complimentary upgrade to a Suite (based on availability) • Bottle of Champagne in room • Breakfast for 2 at Willoughby's Coffee Lounge in hotel lobby • Four tickets to the Peabody Museum • Scheduled transportation to/from New Haven train station
Madison Beach Hotel	Starting at $239/night, Sun-Thurs	• Overnight accommodations in a Water View room • Two round-trip Metro North and Shore Line East train tickets • Continental breakfast for 2 • A 20% discount in The Wharf and Sounds of the Sea Spa
Courtyard by Marriott, Stamford Downtown Beach Package	$159/night, double or single occupancy	• Complimentary admission to the beach (a $20 value). • Complimentary transportation (Hotel Shuttle) to/from the Stamford Metro North Station, beaches and hotel. • 2 complimentary beach towels. • Round-trip rail tickets from your boarding station
Malouf's Mountain Sunset Campground	$157-$213, 2-night stay, double room	• Round-trip rail fare from your boarding station • Round-trip shuttle service from the train station to the trail head and 10% off the price of your campsite
Mohonk Mountain House	$297 per person, double occupancy	• Breakfast, lunch, dinner, afternoon tea/cookies, and most resort activities. • Complimentary tour of historic Mohonk Mountain House • Complimentary tennis, fitness/yoga classes, guided hikes, winter sports and Wi-Fi • Round-trip Metro-North tickets for Poughkeepsie Station • Free shuttle to/from Poughkeepsie train station

A.3 Pre-Existing NYS travel packages Adaptable to EV Tourism models

Table A-5. Visitor packages offered by the Long Island Wine Council

One is redeemable year-round, and the other two are date-specific.

Hotel Package	Price	Package Details
Vine Time Getaway	$499/person	• 2-night stay in a premium room at their #1 rated B&B • Breakfast included, 2 dinners for 2 at a choice of their finest North Fork area restaurants • All day tour of Long Island Wine Country wineries & vineyards (vineyard walk, barrel tasting) • Transportation for the winery tour in a van • Lunch at one of the wineries
Taste North Fork	Free, but features individual deals at local wineries	• November 8 & 9 2014 • Free hop-on hop-off shuttle service circulating throughout the North Fork connecting wineries and the region's historic hamlets • Special tastings and events, discounts • Live music at the wineries • Special events/offers in hotels, B&B, inns, restaurants, shops, attractions
Wine Camp 2014 & 2015	$1,299/person	• Premium wine country accommodations for 3 evenings • Sep 8-11, 2014 and Apr 16-19, 2015 • Interactive learning sessions • Complimentary wine tasting • Dinner& breakfast included, lunches in the vineyards • Food and Wine pairing event • A case of 12 bottles of wine • Hands-on learning experiences in the vineyards and wine cellars

Table A-6. Sample of packages available on the I Love New York website

Hotel Package	Price	Package Details
The Andrew Hotel - multiple packages offered (Long Island)	$429 for 2 nights	• Discounts to participating Great Neck restaurants & retail stores • 2 Roundtrip LIRR tickets (off peak) • Continental breakfast for two, complimentary Wi-Fi
Hampton Inn-Fishkill (Hudson Valley)	Market rate	• Package includes deluxe accommodations with breakfast and a $50 VISA/MasterCard gift card at time of check-in.
Golf Package at Malone Golf Club - Holiday Inn (Upstate NY)	Midweek - $284.00 Weekend - $314.00	• Includes 2-night accommodations, 2 days of unlimited golf at the Malone Golf Club with many extras, including guaranteed 1st round tee times each day, use of golf cart for 1st round of golf each day, use of golf cart for first round of golf each day, club storage and bag tag with a short clinic by a PGA professional.
384 Art Passport Package (Fingerlakes)	$265 for 1 night	• Premium King Suite with 2 Passes to the Memorial Art Gallery, 2 Passes to Rochester Contemporary Art Center, $100 Gift Card to Restaurant Nikko
Button's Creekside Farm B&B (Fingerlakes)	$200 per person	• Feature bread making and jam-making lessons • Includes both classes, tours, one night lodging at the farm and breakfast & lunch.
Grand View Motel (Adirondacks)	$109 1st night/ 2nd night FREE	• 2nd night in hotel free • Fish, bike, hike discount special

A.4 Examination of EV Tourism Scenario Costs

Table A-7. Weekend Hertz Car Rental and Zipcar Carshare Cost Comparison[44]

Location	Compact	Full Size
Manhattan, 403 Lafayette St	$453.61	$469.43
Manhattan, 34th St between 8th/9th Ave	$412.37	$426.76
Manhattan, 184th St	$115.06	$127.04
Brooklyn, 906 Union St	$179.81	$208.58
Jersey City, Harborside Financial Center	$110.76	$123.69
Middletown, County Road 78	$73.86	$95.30
Poughkeepsie, IBM Road	$90.54	$111.98
Kingston, Ulster Avenue	$54.24	$74.58
Tarrytown, Doubletree Hilton	$80.50	$94.70
Newburgh, Route 17 K	$100.07	$121.51
Zipcar (multiple NYC locations)	$261.32	$316.48

[44] Hertz price does not include gasoline and insurance. Zipcar price includes both.

Table A-8. Subway and Train Ticket Costs per Person

	Roundtrip Subway Fare	Off-Peak Roundtrip Train Fare	Total
Grand Central to Beacon	$ 5.50	$ 30.50	$ 36.00
Penn Station to Middletown	$ 5.50	$ 29.25	$ 34.75

A.4.1 Fuel Costs and Tolls

A gallon of regular formula gasoline averaged $3.44 in New York in October 2014. [45] In subsequent sections of this appendix, the amount of gasoline used for the Beacon and Middletown trips are estimated at 11.6 and 13 gallons, respectively. These figures equate to total fuel costs of $39.90 and $44.72, respectively, for the whole trip.

Several toll crossings and barriers are en route to the destination clusters including the George Washington, Tappan Zee, and RFK Bridges. Tolls range from $4.50 to $14.00 depending on time of day and usage of E-ZPass.

A.4.2 Carshare Membership Costs

Operationally, carshare is a more attractive option for potential EV Tourism program operators because of reduced staffing. However, carshare programs typically require membership beforehand and provision of an activation token or entry device. Fees for these programs are listed in Table A-9.

[45] New York Gasoline and Diesel Retail Prices. http://www.eia.gov/dnav/pet/PET_PRI_GND_DCUS_SNY_M.htm

Table A-9. Carshare Membership Costs

	Application Fee	Annual Fee
Zipcar	$ 25	$ 60
Hertz 24/7	-	-
Enterprise CarShare	$ 25	$ 40

A.4.3 Average Discounts at Metro-North Getaway Destinations

From calculations of the existing Metro-North Getaway packages in the previous section of the appendix, the available hotel discounts range from $59 to $504 per weekend. The average discount for destinations is $7.40 per person.

A.5 Electric Vehicle Charging Stations for Tourist Destinations

A.5.1 Charging Station Types

Electric vehicle (EV) charging stations, also referred to as electric vehicle supply equipment (EVSE), are classified by charging power and the type of power delivered (alternating current [AC] or direct current [DC]). The charge time for each vehicle varies depending on the battery capacity, the battery state-of-charge (how "full" the battery is at the time of charging), and the EV or EVSE charger throughput. The Society of Automotive Engineers (SAE) J1772 connector is the established standard for EVSE vehicle plugs, offering important safety and shock-proof design elements. The SAE J1772 "Combo" connector model accommodates AC Level 1, AC Level 2, and DC Fast charging.

AC Level 1 equipment uses 120 volts AC (VAC) input power to provide up to 1.9 kW (2-5 miles) of electric range per hour of charging time. EVs typically have a portable AC Level 1 EVSE that can plug into a typical household three-prong outlet. The EVSE can also use a dedicated 20 amp outlet, or an EVSE unit can be permanently installed at the charging location. AC Level 1 EVSE does not have monitoring, payment, or management capabilities.	***AC Level 2*** equipment uses 240 VAC or 208 VAC (commercial and industrial) input power to provide up to 19.2 kW (10-20 miles) of electric range per hour of charging time. AC Level 2 EVSEs require a permanently installed unit connected to a dedicated electrical circuit. Most AC Level 2 charging stations offer connectivity to a charging network that secures the plug until properly activated, manages payments, and monitors the energy use.	***DC Fast Charging*** equipment uses DC power from an off-board charger to charge vehicle batteries. Power levels range from 24-120 kW to provide an 80% recharge in 20 minutes. These units require a 480 VAC input because the high power demand can incur significant electricity demand costs, which varies by utility. EV models use different connectors (SAE J1772 Combo, CHAdeMO, and Tesla), but not all EVs, especially PHEVs, can accept a DC Fast charge option.
AC Level 1 EVSE Hardware: $500-$1,000	**AC Level 2 EVSE Hardware: $450-$5,000**	**DC Fast Charger Hardware: $6,500-$50,000**

EVSE can be mounted on a wall or pole, or installed as a stand-alone pedestal. In addition to supporting EV tourism, businesses offering EV charging can also help increase visits, keep customers for longer durations, and serve as an employee perk. Determining the number of charging stations to install requires the consideration of three main factors: 1) area travel patterns; 2) area demographics and whether they are correlated with typical EV owner characteristics; and 3) the nature of business (number of visitors/customers and how long they stay). **EVSE installation costs can exceed the cost of the EVSE hardware, so proper design is needed to minimize costs**. Upgrading electrical service is a significant cost, but a load analysis will determine existing capacity. The New York State Alternative Fuel Vehicle Recharging Tax Credit (S.B. 2609 and A.B. 3009) provides an income tax credit for 50% of the cost, up to $5,000, for the purchase and installation of commercial and workplace EV charging stations through December 31, 2017.[46] The distance between the electrical panel and the charging station impacts the length of trenching/repair, conduit, and wire that is necessary. Minimizing this distance is desirable, but placing EVSE in a less desirable location might discourage use. Businesses should also minimize the cord of the EVSE to prevent tripping hazards and ensure that parking lot management practices (pavement cleaning, snow plowing, or deliveries) will not potentially damage the equipment.

A.5.2 Charging Station Applications

The characteristics of each venue visited by EV-tourists will dictate the most suitable type of EVSE. However, one key factor across all venues is that rural destinations requiring the EV to travel further distances should offer AC Level 2 charging. If the destination is close to where the tourist will spend most of the day and potentially stay overnight, then AC Level 1 charging may be sufficient. DC fast charging will primarily be used in heavily traveled corridors to bridge the gap for EVs that cannot get to a destination on one charge. Table A-10 is a breakdown of tourism destinations and stops and the EV infrastructure context.

[46] The New York State Department of Taxation and Finance, Alternative fuels and electric vehicle recharging property credit. www.tax.ny.gov/pit/credits/alt_fuels_elec_vehicles.htm

Table A-10. Tourism Categories and Charging Infrastructure Needs and Barriers

Tourism Category	Sub-Category	Visit Length	Charging Level	Installation	Ideal Number of EVSE	Infrastructure Barriers
Art, culture, history	Galleries/antiques, theatres, museums, historical sites	1-4 hours	Level 2	Galleries and antique shops are typically small facilities, and may have small parking lots or have shared/street parking. If parking lot is private, charge stations will likely need to be placed as close to the panel as possible to eliminate extra costs.	1-2 at a smaller establishment, up to 5 at larger establishments	Most not likely to have major electrical limitations. Older facilities (historic site) may have limited network
Food & drink	Bar/restaurant, winery, distillery, brewery, culinary school, farm	1-3 hours	Level 2	Smaller establishments may have parking lots or shared/street parking. If parking lot is private, charging stations will need to be placed as close to panel as possible. Some facilities may support wall-mounted units. Conduit can be extended in larger parking lots to support future expansion.	2 for most establishments	Rural facilities such as farms may have a more limited electrical network. Wineries and other facilities operating large machinery should have sufficient capacity.
Shopping	Malls, outlets, or markets	2-5 hours	Level 2	Parking lots at shopping facilities are typically fairly large. Charge stations will need to be located near an electrical panel, but conduit can also be build to connect to stations in certain areas of the lot.	Large facilities may be able to support 10-15 stations, smaller facilities 3-5	Not likely to have major electrical limitations.
Outdoors, park, entertainment	Hiking, winter sports, fishing, amusement parks, boating	2-6 hours	Level 2	Some activities may take place in rural locations with no electrical infrastructure. Activities through established companies may feature a parking lot on-site. If there is capacity, there is the potential for wall-mounted units (if there is an office on-site) or pole-mounted units.	1-2 stations at smaller facilities, 5-10 at larger facilities	Rural activities may have a limited or insufficient network for multiple charge stations. More central activities may have a solid but limited electrical network.
	Park/Historical Landmark	2-6 hours	Level 2	Natural or historical sites where tourists spend multiple hours per visit are AC Level 2 EVSE candidates.	1-2 at a smaller site up to 5 at larger sites	Rural sites may have a limited or insufficient network for multiple charge stations. More central sites may have a solid but limited electrical network.

Table A-10 continued

Tourism Category	Sub-Category	Visit Length	Charging Level	Installation	Ideal Number of EVSE	Infrastructure Barriers
Overnight accommodation	Camping	8-12 hours	Level 1	Campgrounds that serve RVs already have electric capacity for EVs. Other campgrounds will have difficulty supporting EV infrastructure.	1-3 stations, depending on capacity	RV campground can serve EVs through existing outlets. Others will have a challenge in accessing any power source.
	Hotel/resort, inn/lodge	8-12 hours	Level 1	Hotels with larger parking lots may require free-standing or pole-mounted units. Wiring required from panel to parking lot. May be easier if already wired for lighting. Can install conduit for potential expansion or if EV popularity increases. Smaller inns (10 rooms or less) may support wall-mounted units.	1-2 stations for smaller locations, otherwise 5+ with pre-wiring for up to 5% of total rooms	Not likely to have major electrical limitations
Transportation	Thruway Rest Stops, Texting Zones	Up to 1 hour	DC Fast Charge + Level 2	Should be installed in a designated cluster, which can be located near gasoline pump or elsewhere in a parking lot. Best practice is to have Level 2 charging available for those waiting for fast-charging.	2+ stations, with pre-wiring to support future installations. Should include both J1772Combo and CHAdeMO plugs	The larger infrastructure required for DC Fast Charging will be most easily installed in rest areas that already include truck stops. Others locations will likely require significant upgrades.
	Car Rental Facility	Up to 1 hour	DC Fast Charge + Level 2	As the EV Tourism packages' primary base location, the charging level required at the car rental facility will depend on the desired vehicle turnaround time. It is likely that EVs will be returned with minimal charge, and will take 6-8 hours to recharge using AC Level 2. Locations with numerous EVs should consider a DC fast charger to increase rental frequency and eliminate the need for multiple lower level chargers.	The number of stations depends on the number of EV rental cars that the rental agency is willing to purchase.	Not likely to have major electrical limitations
	Rail Station	1-12 hours	Level 2	Rail stations are another potential EV Tourism package base location. Vehicles will typically be parked overnight prior to each reservation, but could also be transported from a nearby rental location prior to the tourist customer's arrival. AC Level 1 charging is sufficient for this application if EVs will be parked overnight between rentals. If a quicker turnaround is desired, AC Level 2 or DC Fast Charging would be required.	Depends on number of vehicles in program. For use by EVs not participating in the program, 2-4 stations should be sufficient at less-trafficked stations and 4-8 at busier ones	Not likely to have major electrical limitations

A.6 Fast Charging Locations

A.6.1 Existing EV owners

Although the initial EV Tourism implementation would target noncar owners, a longer-term plan would be to tap into the user base of existing EV owners, who may visit or even have second homes in the Five County study area. This longer-term goal would require DC Fast Charging stations at key locations.

The highest EV ownership counties in New York State are Westchester, Nassau, Suffolk, and New York (Manhattan). Investigating two communities in these counties with the most pronounced ownership, Scarsdale and Huntington, shows that Scarsdale is potentially in EV driving range of Arts & Inns cluster destinations, but not Rock & River, while Huntington would require a recharge or two for either cluster.

Figure A-1. EV Ownership in NY State (April 2014)

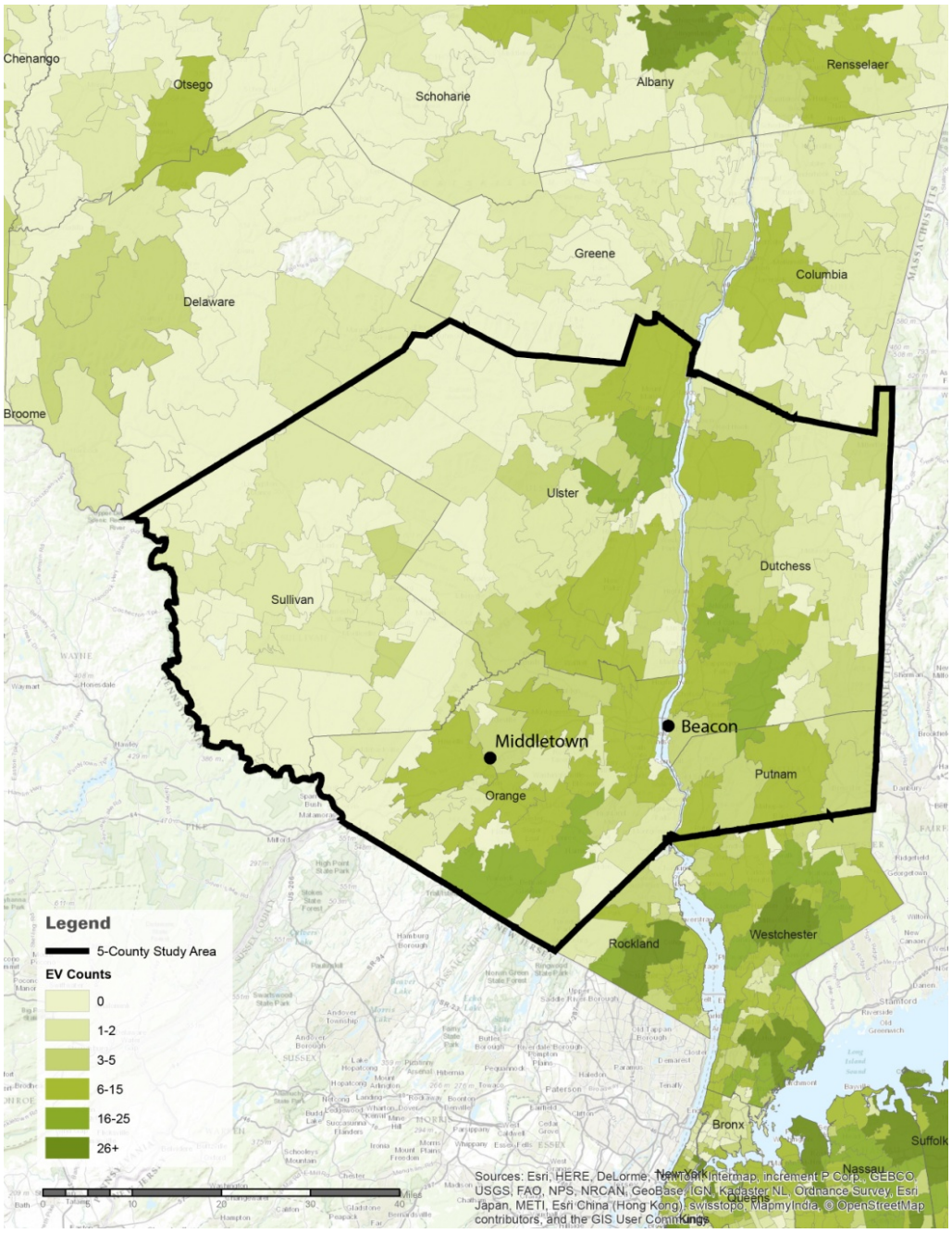
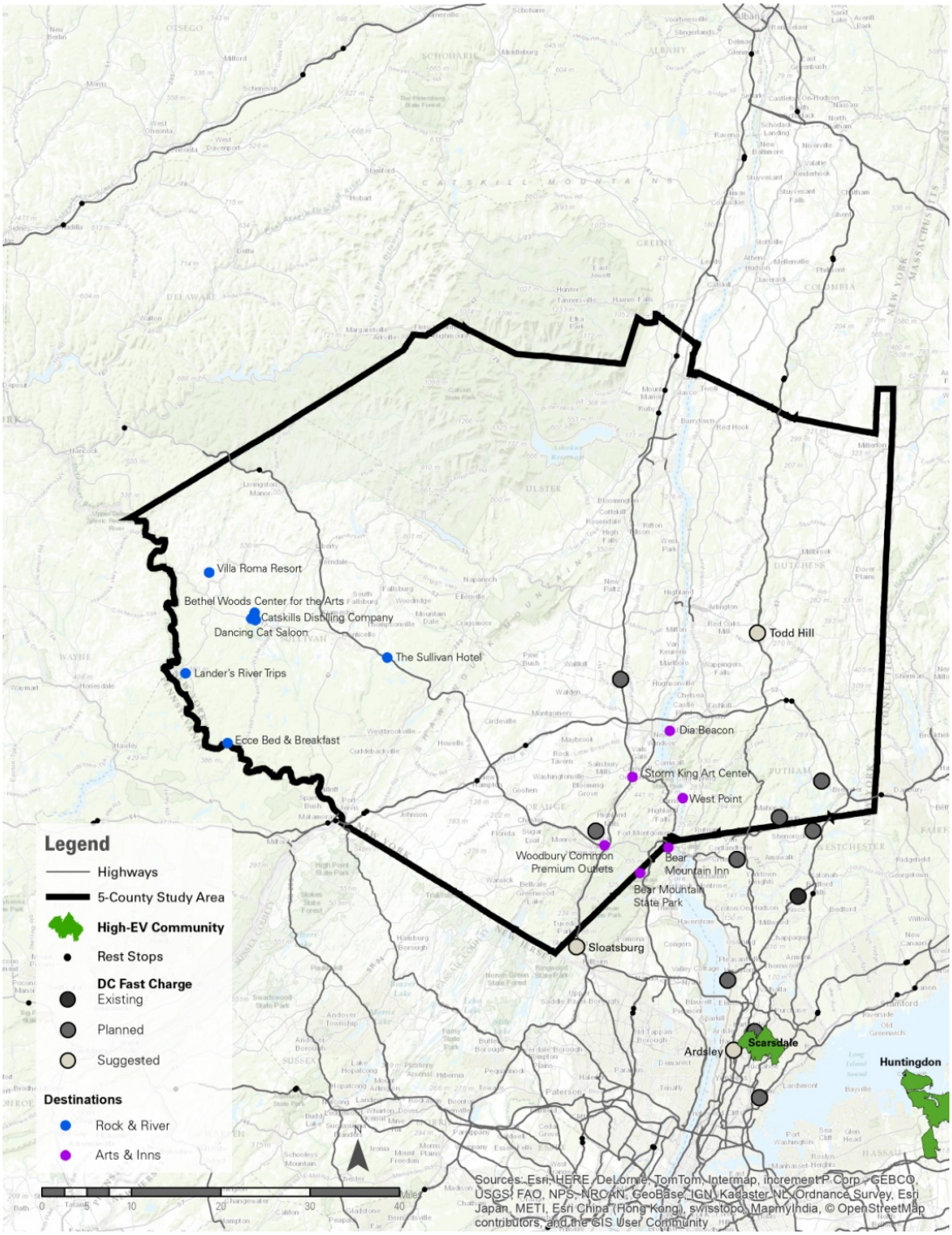


Figure A-2. High-EV Ownership Communities' Proximity to Destinations



A.6.2 Suggested Locations

Fast-charging stations have been slow to arrive in New York State, though several are planned for New York State Thruway travel plazas and in malls in Westchester and Putnam Counties.[47] A partnership between Chargepoint, BMW, and Volkswagen promises to bring fast charging to the Northeast Corridor, though the initial rollout will not likely impact the study area.[48] Given the presumptive station spacing under this program and average ranges for non-Tesla BEVs, 50-mile spacing between Fast Charge stations is a reasonable standard.[49]

Locations as close to highways as possible are preferable for the purposes of this study which prioritizes economic development in locations further north and west. Two existing NYSDOT highway rest areas (travel plazas) along I-87 would serve well as fast-charging locations: Sloatsburg and Ardsley. Sloatsburg would serve any destination West of Hudson, while Ardsley would be of most use for Long Island drivers. For travelers with East of Hudson destinations, the Taconic State Parkway is the highway likely to be used, but does not have rest stops before the Taste NY Market at Todd Hill, which would generally be an excellent location for fast charging, but not particularly suited for this project. The expected station at Staples Plaza in Yorktown Heights is well situated, despite requiring a turn off the highway.

---

47 http://www.lohud.com/story/news/traffic/2015/03/26/thruway-charging-stations-coming/70491338/

48 http://www.chargepoint.com/press-releases/2015/0122

49 BMW Promises CCS Fast-Charging Blitz For 2015, Details In Detroit. http://www.greencarreports.com/news/1095878_bmw-promises-ccs-fast-charging-blitz-for-2015-details-in-detroit

A.7 Evaluation of EVSE Installation Potential Summary

Thirteen tourist destinations in the lower Hudson Valley and Sullivan County were evaluated to determine potential EVSE infrastructure challenges and opportunities, including electrical capacity and upgradability, proximities to power sources, and optimal charging station location. Table A-11 classifies these destinations by venue type and location. (Some destinations are listed more than once if they support multiple activities.)

Table A-11. Tourist Destinations Evaluated for EVSE Installation Potential

	Lower Hudson Valley	Sullivan County
Accommodations	The Roundhouse at Beacon	The Sullivan Hotel Villa Roma Resort
Restaurants	Culinary Institute of America The Roundhouse at Beacon	Catskill Distilling Company
Retail	Beacon Welcome Center Woodbury Commons	
Museums	Dia: Beacon Storm King Art Center	Bethel Woods
Parks/Historical Landmarks	Storm King Art Center	Stone Arch Bridge Historical Park
Tours/Events	Culinary Institute of America Palaia Vineyards The Roundhouse at Beacon	Bethel Woods Catskill Distilling Company Holiday Mountain Ski Area

The two parks, Storm King Art Center and Stone Arch Bridge Historical Park, would be challenged to easily provide the required power for AC Level 2 chargers, which would be needed in those locations where visitors might only stay for a few hours or less. Most other locations had the necessary power to support at least one AC Level 2 chargers, although the electrical infrastructure at some locations was older and may need some upgrades (e.g., Holiday Mountain Ski Area) and some of the smaller locations may not be interested in taking on more energy usage (e.g., Palaia Vineyards and Beacon Welcome Center).

Most locations with adequate power availability had parking spaces that were conveniently located in close proximity to electrical panels or boxes where power could be drawn from. Many of these ideal parking spaces for EVSE installation where near the primary entrances of these destinations and the owners were very interested and supportive in using those for EV parking if charging stations were installed.

For EV tourism, the destinations with the best potential to support EV use are the accommodations. All three of these locations could easily support charging stations and the duration of stay by the drivers is ideal for fully charging the EVs. Everyone on a two-day tour would plan on staying somewhere overnight, so hotels are a great opportunity to charge the EV. When there are other activities at the hotel that may attract tourists or visitors to stop during the day, such as a restaurant or event center, there is more potential for the EVSE to be more heavily utilized and beneficial to EV drivers. The Roundhouse at Beacon is a great example because they have their own restaurant, a brewery is planned to be built onsite in the near future, and they host numerous weddings throughout the year.

EVSE locations beyond the accommodations would be useful to help alleviate "range anxiety," but may not be entirely necessary for completing these routes using EVs. The challenge in installing EVSE at daytime destinations is the limited duration of stay may not provide a full charge and where an EV tourist may want to visit is very dependent on their interests. Although some of the activities/tours available at these destinations may occupy a tourist for several hours, some tourists may be very interested in museums, while others might be more interested in wineries or shopping. Therefore, many more EVSE would need to be installed at multiple locations to make sure a charging station would be on the route selected by the EV tourist. However, the opportunity for these attractions is to leverage the use of charging station by multiple EV drivers, including potential visits by EV owners in the nearby area and employees that might have or be interested in buying an EV. Lower Hudson Valley destinations are likely better candidates to attract these other EV drivers due to favorable demographics and regional driving patterns (residents in Sullivan County typically have longer daily routes to drive because things are more spread out, making EVs less practical). In particular, the Culinary Institute of America and Woodbury Commons Outlet Mall with their large employment base should attract staff that would consider driving EVs. Having both staff and visitors charging EVs at these locations can further justify the EVSE infrastructure investment.

A.8 Analysis BEV and PHEV Models for Use in an EV Tourism Application

Table A-12. Commercially Available Battery Electric Vehicle (BEV) Models in the U.S.

	Vehicle Make and Model	Base MSRP[50]	Federal Tax Credit	Base Purchase Price	Electric Motor Power (kW)	Battery Energy Capacity (kWh)	Onboard Charger Power (kW)	DC Fast Charge Option	MPGe	Electric Driving Range (miles)	Seats
1	BMW i3	$42,300	$7,500	$34,800	125	22.0	7.4	SAE Combo	124	81	4
2	Chevrolet Spark EV[51]	$28,310	$7,500	$20,810	97	21.3	3.3	SAE Combo	119	82	4
3	Fiat 500e[52]	$32,600	$7,500	$25,100	83	24.0	6.6	N/A	122	87	4
4	Ford Focus Electric	$35,995	$7,500	$28,495	107	23.0	6.6	N/A	105	76	5
5	Honda Fit EV[53]	N/A	$7,500	N/A	92	20.0	6.6	N/A	118	82	4
6	Kia Soul EV[54]	$33,700	$7,500	$26,200	50	27.0	6.6	CHAdeMo	92	93	5
7	Mercedes B-Class EV	$42,375	$7,500	$34,875	100	28.0	10.0	N/A	84	85	5
8	Mitsubishi i-MiEV	$23,845	$7,500	$16,345	47	16.0	3.3	CHAdeMo	112	62	4
9	Nissan Leaf	$31,050	$7,500	$23,550	80	24.0	6.6[55]	CHAdeMo	114	84	5
10	Scion iQ EV[56]	N/A	$7,500	N/A	47	12.0	3.0	N/A	121	53	4
11	Smart fortwo EV	$25,750	$7,500	$18,250	55	17.6	3.3	N/A	122	68	2
12	Tesla Model S	$81,070	$7,500	$73,570	300	85.0	10.0	Supercharger	95	265	5
13	Tesla Model X	N/A	$7,500	N/A	300	85.0	10.0	Supercharger	N/A	230	7
14	Toyota RAV4 EV[57]	$50,660	$7,500	$43,160	115	41.8	10.0	N/A	76	100	5
15	Volkswagen e-Golf	$36,265	$7,500	$28,765	85	24.2	7.2	SAE Combo	116	83	5

50 Manufacturer suggested retail price; including destination fee

51 Available only in California and Oregon

52 Available only in California

53 Available only as a lease, discontinued in late 2014

54 Currently only available in California

55 Model with 3.3 kW charger starts at $29,750 before federal tax credit is applied

56 For use by Carshare organizations only, discontinued after 2014

57 Available only in California and Oregon, limited run of 2,500 vehicles will likely end after 2014

A.9 Battery Electric Vehicle (BEV) Evaluation

The key vehicle characteristic that influences the feasibly of using a battery electric vehicle (BEV) in the EV tourism package application (i.e., a rental vehicle with specific EV-friendly destinations) is the driving range. It must be sufficient for travel to a renter's destination (if the opportunity for a full or partial charge exists at this destination), to the next stop, or for the entire round trip. In real-world driving conditions, many BEV drivers have found that the U.S. Environmental Protection Agency (EPA)-reported vehicle driving range is accurate when driving conservatively in moderate temperate conditions (60-75 °F). Experienced BEV drivers may achieve a higher driving range. Newer BEV drivers that are accustomed to driving conventional internal combustion engine vehicles will likely not achieve the specified vehicle range.

Cold and hot ambient temperature conditions will also impact the realized driving range due to added power requirements to heat or cool the interior as well as decreased performance of the EV batteries operating at these temperature extremes. Honda notes that "In extreme cases, some Fit EV drivers have reported driving range reductions of 50% or more in cold weather. In hot weather, drivers have reported range reductions of 10% or more."[58] According to research conducted with the AAA Automotive Research Center in Southern California, the average EV driving range decreased by 57% when driven at 20 °F and by 34% when driven at 95 °F, as compared to the average driving range at 75°F.[59] FleetCarma published graphs that show the impact of ambient temperature on the real-world range of the Nissan Leaf. The data were collected from FleetCarma vehicle data loggers installed on real-world end-user vehicles all across North America.[60] The key takeaway is that ambient temperature has a significant impact on the driving range; however the driver's technique has a large impact over how big the impact is, because the maximum achieved ranges are well above the averages.

---

58 Honda FAQs. http://automobiles.honda.com/fit-ev/faq.aspx

59 Extreme Temperatures Affect Electric Vehicle Driving Range. http://newsroom.aaa.com/2014/03/extreme-temperatures-affect-electric-vehicle-driving-range-aaa-says/

60 FleetCarma. Electric Range for the Nissan Leaf & Chevrolet Volt in Cold Weather. http://www.fleetcarma.com/nissan-leaf-chevrolet-volt-cold-weather-range-loss-electric-vehicle/

To select BEVs with appropriate driving ranges for use in the tourism package application, the following factors were applied to EPA-reported driving ranges to estimate the maximum distance the BEV should travel on the user-selected route:

- 15% reduction in range due to aggressive driving and drivers not accustomed to optimizing BEV range.
- 10% reduction in range as a buffer for unexpected detours, weather conditions, and driver peace of mind.
- Reductions in ranges based on the average temperature per month as shown in Table A-13. (Data were derived from sources listed in the previous paragraph and Poughkeepsie, NY was selected as a representative location in the region for where the routes will take place.)

Table A-13. Temperatures and Estimated Range Reductions for BEVs Operating in the Hudson Valley

Month of the Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Daily High Temperature (°F)	35	40	48	61	71	80	85	83	75	63	52	40
Range Reduction	40%	30%	17%	7%	0%	5%	15%	10%	0%	5%	15%	30%

The daily driving range can be increased by charging the vehicles while parked when the renter is doing the activities at the destination(s). This expectation was critical in planning for this study. Three scenarios were examined to evaluate the impact of charging during the day: 1) no charging during the day, 2) two hours of total charging during the day at one or more stops, and 3) four hours of total charging during the day at two or more stops. It was assumed that the available electric vehicle supply equipment (EVSE, and typically referred to as the EV charger) could provide 6.6 kW of charging. This power output is typical of most modern public-access chargers. Excluding the BEVs that are not yet available for sale in New York State and the luxury BEVs (vehicles over $60,000), the estimate of the maximum daily distance each BEV model should be able travel in each month of the year was plotted for each of the three scenarios (Figure A-4, A-5, and A-6).

Figure A-3. Estimated Maximum Driving Range for BEVs in Hudson Valley EV Tourism Package Application with No Charging During the Day

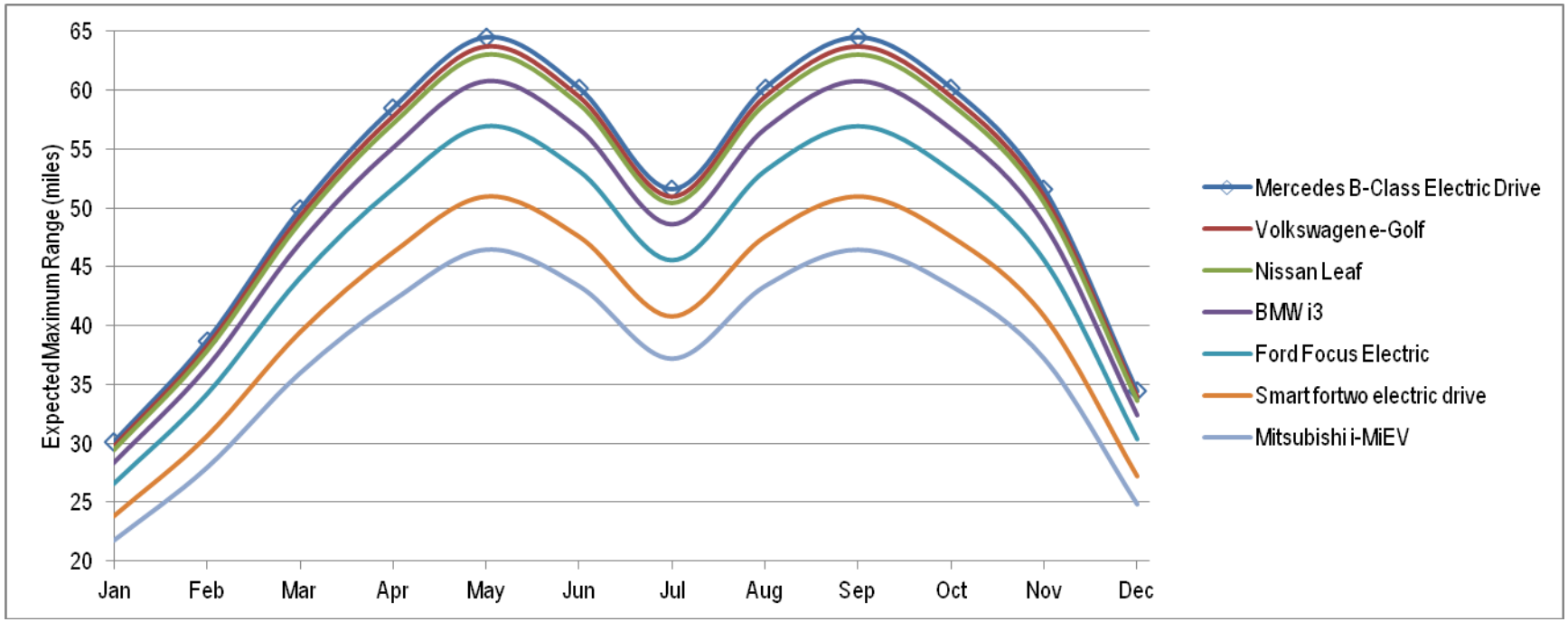


Figure A-4. Estimated Maximum Driving Range for BEVs in the Hudson Valley EV Tourism Package Application with 2 Hours of Total Charging During the Day at One or More Locations

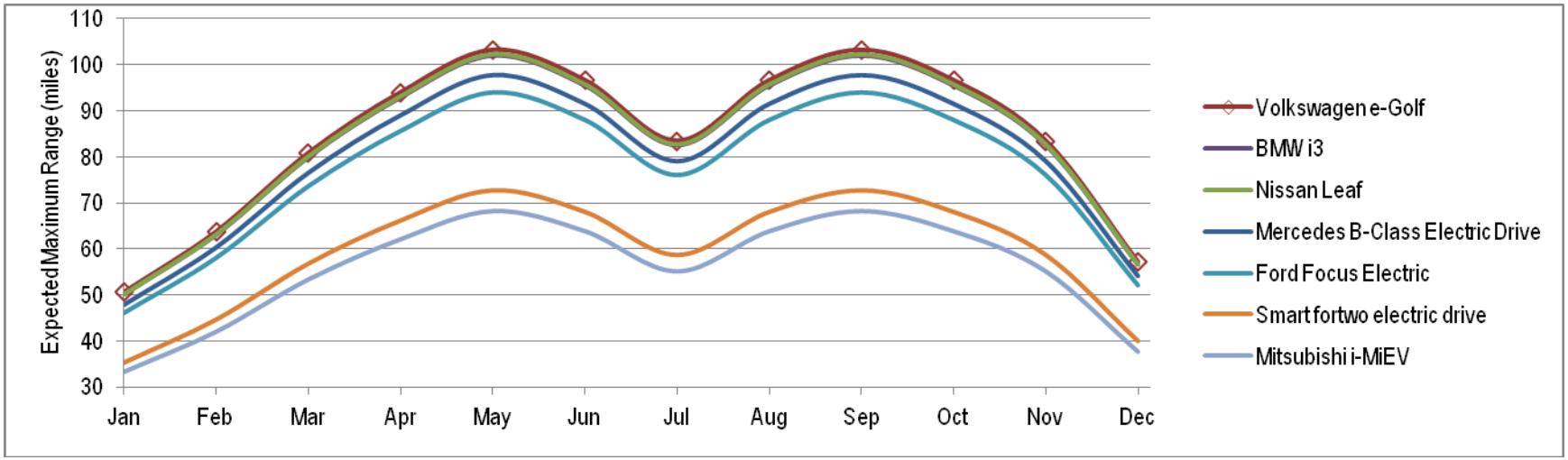
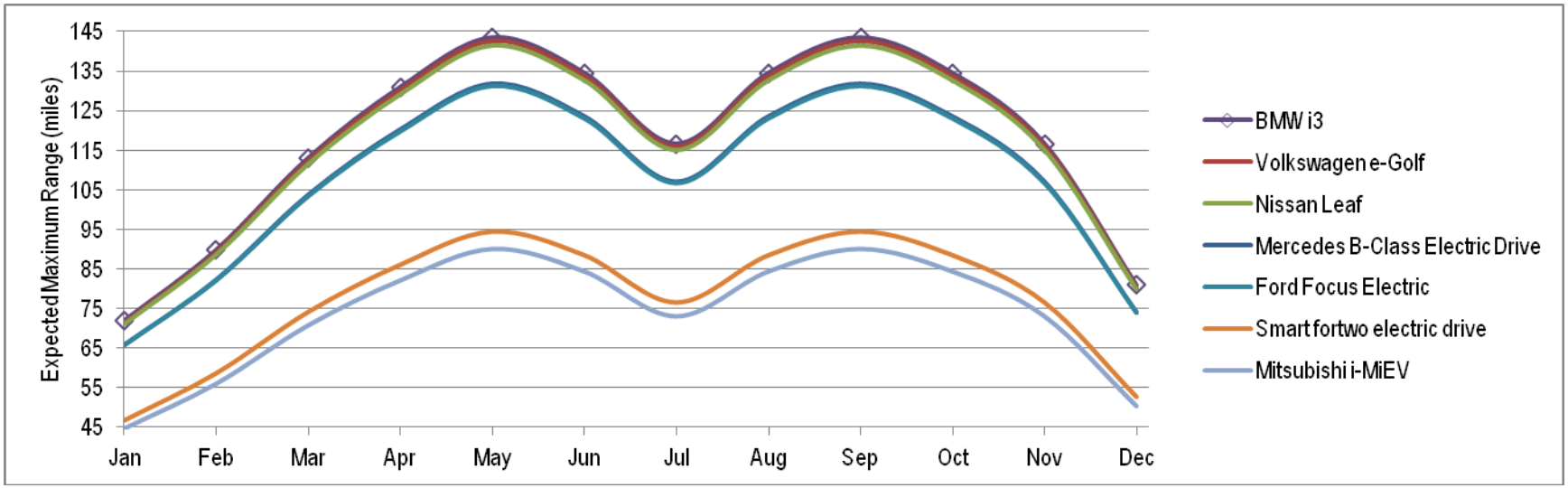


Figure A-5. Estimated Maximum Driving Range for BEVs in the Hudson Valley EV Tourism Package Application with 4 Hours of Total Charging During the Day at Two or More Locations



The impact of lower-powered onboard chargers can clearly be seen in the figures as the gap widens between the two BEVs with only a 3.3-kW onboard charger (the Smart fortwo electric drive and Mitsubishi i-MiEV), compared to the 6.6 kW or larger onboard charger of the rest of the BEVs. The Smart and Mitsubishi BEVs also have smaller battery packs and thus a shorter initial range than the other BEVs, so daily driving range is further restricted. However, these two BEVs were designed to be low-cost, lesser-range vehicles. One other observation to note is that the Mercedes B-Class Electric Drive performs less well as additional charging events are added because it consumes more energy per mile on average than the other BEVs.

The cost per electric range (prior to any reductions due to temperature or driving behavior) can be calculated to compare the vehicles' value and performance (although the resulting value itself is not an indication of economic feasibility). This calculation is based on the purchase price of each BEV along with the electric component specifications and looked at the three different charging scenarios. Results are provided in Table A-14.

Table A-14. Calculated BEV Costs per Electric Range

BEV Manufacturer and Model	No Daytime Charging	2 Hours of Daytime Charging	4 Hours of Daytime Charging	Average for the Three Charging Scenarios	Average Cost Premium
Mitsubishi i-MiEV	$264	$187	$144	$198	0.0%
Nissan Leaf	$280	$181	$134	$198	0.0%
Smart fortwo electric drive	$268	$195	$153	$206	3.7%
Volkswagen e-Golf	$338	$219	$162	$240	20.9%
Ford Focus Electric	$375	$238	$175	$263	32.5%
BMW i3	$430	$269	$195	$298	50.2%
Mercedes B-Class Electric Drive	$406	$279	$211	$299	50.6%

The Mitsubishi i-MiEV and Nissan Leaf have the same average cost per electric range over all three scenarios. The Nissan Leaf has lower costs for the scenarios with charging (because it uses a larger 6.6-kW onboard charger that will provide more miles per charge). Of the three lowest cost BEVs, both the Mitsubishi i-MiEV and Smart Electric Drive provide a shorter overall driving range in all scenarios (see Figures A-4 through A-6), have smaller electric motors, which might not provide as good of an impression to new EV drivers, and are physically smaller (Smart's BEV is a two-seater). The other BEV models have costs per electric range 21-51% greater than the Nissan Leaf and provide minimal additional driving range.

Although other, more expensive BEVs may have more features to justify the cost premium, the Nissan Leaf is the best BEV choice for this EV tourism package application based on available range and cost per electric range. Figure A-7 summarizes the estimated maximum daily driving range for the Nissan Leaf for each of the three daytime charging scenarios. To accommodate trips through the warmer months (March to November) route distances between full charges should be no more than 50 miles with no day charging, 80 miles with two total hours of day charging at one or more locations, and 110 miles with four total hours of day charging at two or more locations. During the cold months, the maximum distance should be no more than 30 miles, 50 miles, and 70 miles for the various day charging scenarios. Table A-15 provides detailed information about additional vehicles.

Figure A-6. Estimated Maximum Driving Range for a Nissan Leaf in the Hudson Valley EV Tourism Package Application for Various Day Charging Scenarios

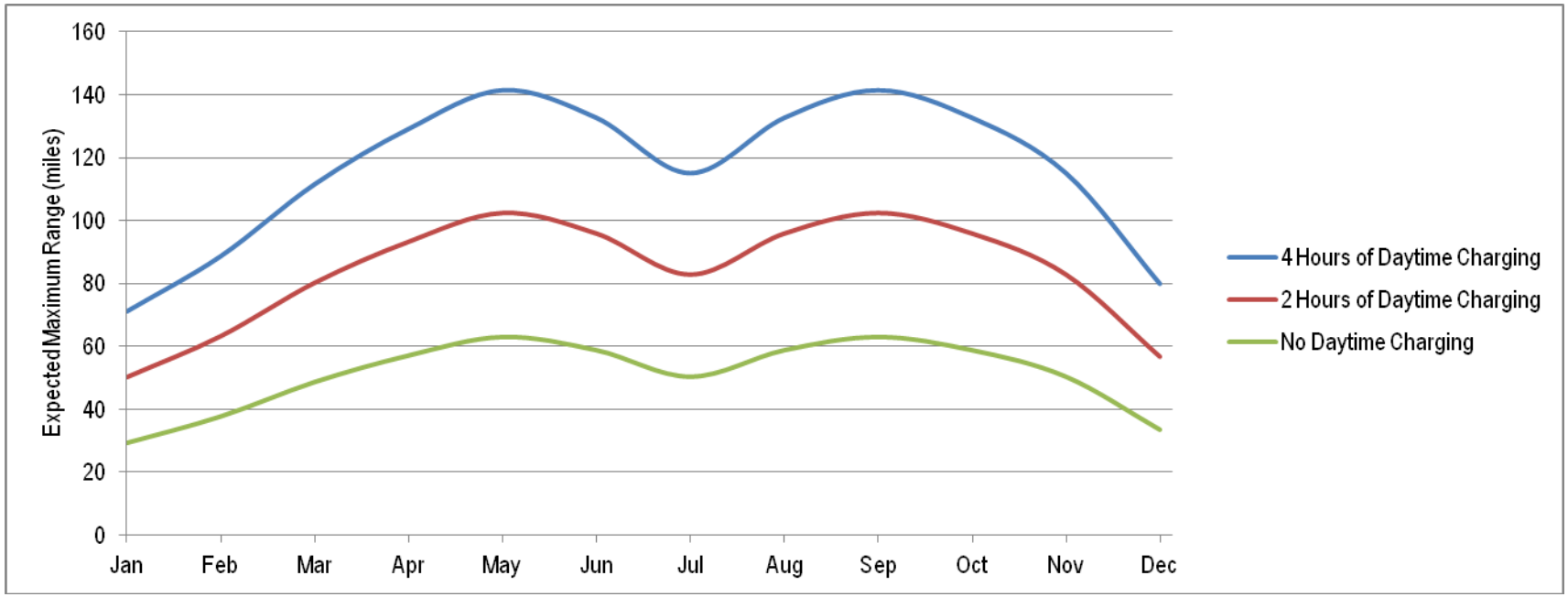


Table A-15. Commercially-Available Plug-in Hybrid Electric Vehicle Models in the U.S.

	Vehicle Make and Model	Base MSRP[61]	Federal Tax Credit	Base Purchase Price	Electric Motor (kW)	Battery Capacity (kWh)	Onboard Charger (kW)	MPGe	Electric Driving Range (miles)	Seats	Total Range (miles)	First Available
1	BMW i3 with Range Extender	$46,150	$7,500	$38,650	125	22.0	7.4[62]	117	81	4	160	May 2014
2	BMW i8	$136,650	$5,000	$131,650	129	7.1	3.3	80	25	2	300	Aug 2014
3	Cadillac ELR	$75,995	$7,500	$68,495	135	16.5	3.3	82	35	4	340	Dec 2012
4	Chevrolet Volt	$35,980	$7,500	$28,480	111	17.1	3.3	98	38	4	340	Dec 2010
5	Ford C-Max Energi	$33,745	$4,007	$29,738	88	7.6	3.3	100	21	5	620	Oct 2012
6	Ford Fusion SE Energi	$35,525	$3,750	$31,775	88	7.6	3.3	100	21	5	620	Feb 2013
7	Honda Accord PHEV	$40,570	$3,626	$36,944	124	6.7	6.6	115	13	5	500	Jan 2013
8	Porsche Panamera S E-Hybrid	$99,975	$4,700	$95,275	71	9.4	3.0	91	20	4	550	Oct 2013
9	Toyota Prius Plug-in Hybrid	$30,710	$2,500	$28,210	38	4.4	3.3	95	11	5	540	Feb 2012

[61] Manufacturer suggested retail price; including destination fee

[62] Includes an option to add an SAE Combo DC Fast Charge port

A.10 Plug-in Hybrid Electric Vehicle (PHEV) Evaluation

The total daily driving range of plug-in hybrid electric vehicles (PHEVs) is less of a concern because the gasoline tank can be easily refilled to extend the travel distance. The intent, however, of the EV tourism package application is to solely utilize electric power for each trip. The same factors that influence the range of the BEVs, aggressive driving and temperature, also influence the electrically powered driving distance of PHEVs. In fact, aggressive driving behavior and cold temperatures may cause the PHEV to start the internal combustion engine prior to depleting all of the stored electrical energy, also known as engine override. This is triggered differently depending on vehicle and the driving circumstances, so engine override was not factored into the analysis. Unlike BEVs, a mileage buffer is not needed for PHEVs because they will always have the internal combustion engine to rely on if necessary, although the EV tourism package would ideally be designed to minimize gas engine use unless special circumstances arose.

Similar to BEVs, the daily electric driving range can be increased by charging the vehicle when it is parked at a destination(s). The same three scenarios examined in the BEV case were examined for the PHEV case:[63] 1) no charging during the day, 2) two hours of total charging during the day at one or more stops, and 3) four hours of total charging during the day at two or more stops. It was assumed that the available EVSE would provide 6.6 kW. Excluding the luxury PHEVs (costing over $60,000), the estimated maximum electrically driven daily range for PHEVs in each month of the year was plotted for each of the three scenarios. The results are shown in Figure A-8, Figure A-9, and Figure A-10. (Note that both Ford models have identical electical systems and the exact same results so one is hidden.)

[63] It should be noted that New York State's own experience with PHEVs and range loss due to cold weather conditions reflect a loss of range of approximately half of that expected from the Fleetcarma article cited in the BEV section (20% vs. 40% range loss). Possible explanations are that the running gasoline engine is able to supply excess heat during the winter months, or the battery casing technology has improved since the article was published in 2013.

Figure A-7. Estimated Electric Driving Range for PHEVs in the Hudson Valley Package Application with No En-Route Charging

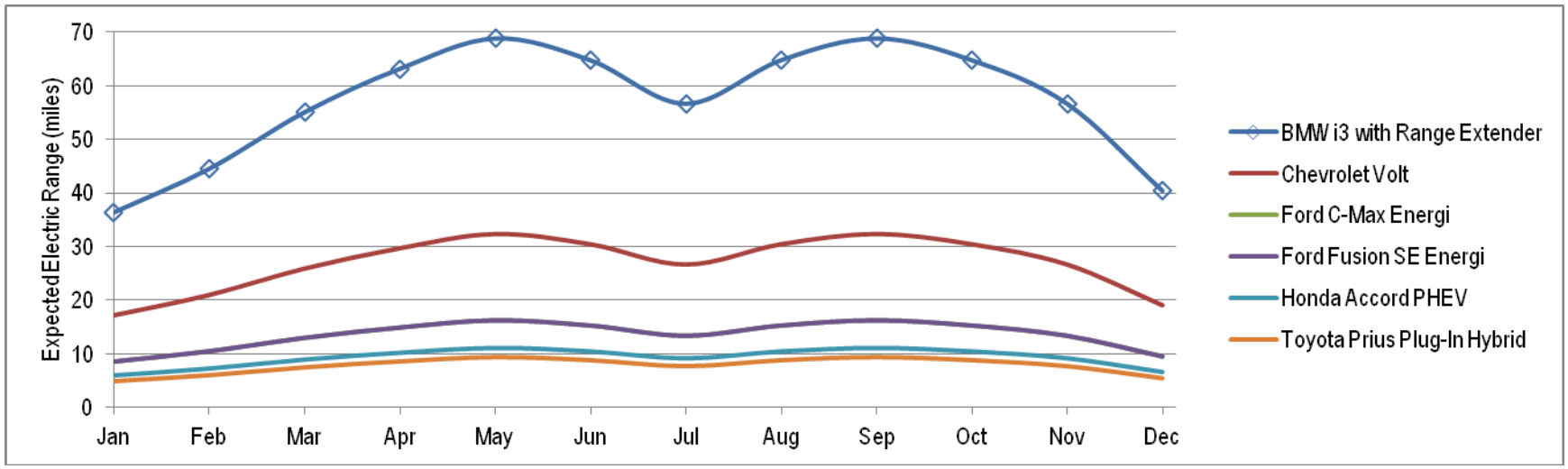


Figure A-8. Estimated Electric Driving Range for PHEVs in the Hudson Valley EV Tourism Package Application with 2 Hours of Total Charging Per Day at One or More Locations

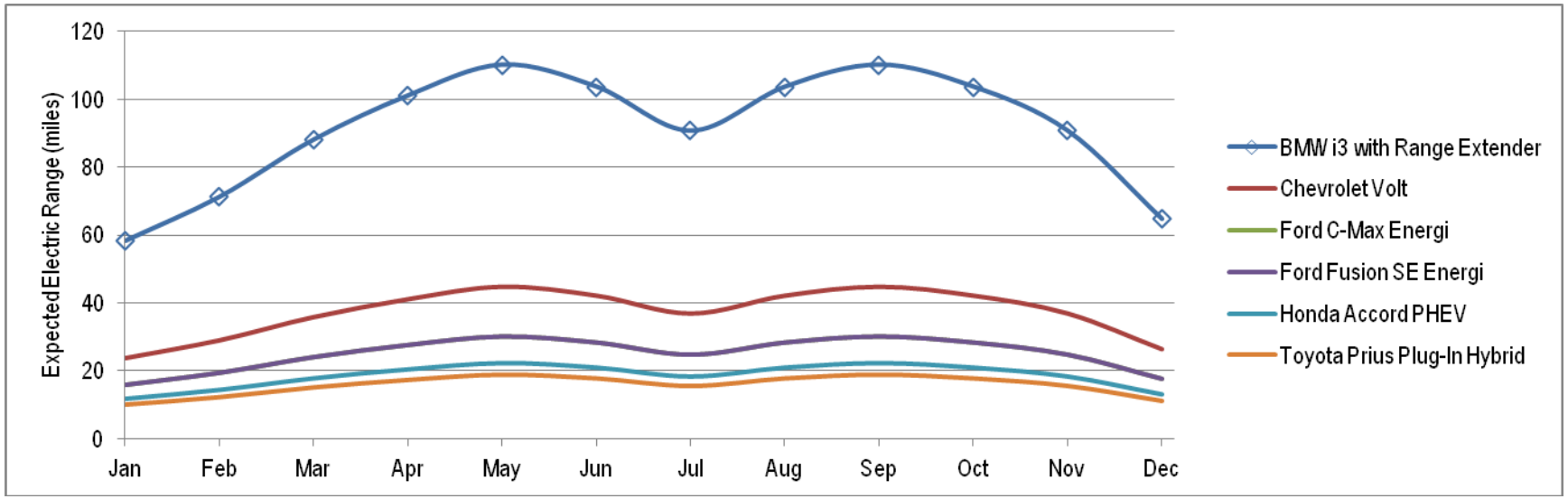
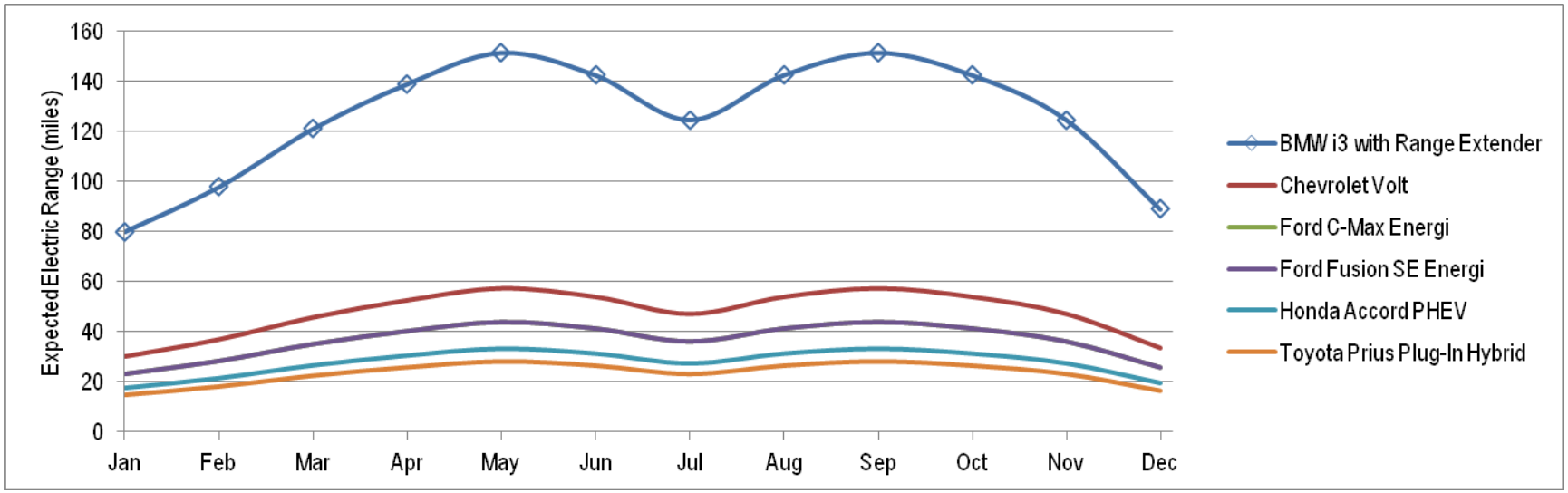


Figure A-9. Estimated Electric Driving Range for PHEVs in the Hudson Valley EV Tourism Package Application with 4 Hours of Total Charging During the Day at Two or More Locations



From these three figures, there is a clear distinction between a BEV that added a range extender generator (i.e., the BMW i3 with Range Extender) and the hybrid-electric vehicles that added a plug-in option and perhaps a slightly larger energy capacity battery pack (e.g., Honda Accord PHEV). The Chevrolet Volt is designed as a compromise between these two approaches. However, the Volt has lower electrical efficiency (calculated by dividing the EPA specified electric mileage by the battery pack size) than many of the other PHEV models, meaning it will get fewer additional miles of range for each hour of charging.[64]

When factoring the purchase price of each PHEV, the cost per electric range (prior to any reductions due to temperature or driving behavior) can be calculated to compare vehicles (although the resulting value itself is not an indication of economic feasibility). This calculation was performed for the previously listed PHEVs for the three difference scenarios, and the results are provided in Table A-16.

Table A-16. Calculated PHEV Costs per Electric Range

PHEV Manufacturer and Model	No Daytime Charging	2 Hours of Daytime Charging	4 Hours of Daytime Charging	Average for the Three Charging Scenarios	Average Cost Premium
BMW i3 with Range Extender	$561	$351	$255	$389	0%
Chevrolet Volt	$882	$636	$498	$672	73%
Ford C-Max Energi	$1,841	$986	$673	$1,167	200%
Ford Fusion SE Energi	$1,967	$1,053	$719	$1,246	220%
Toyota Prius Plug-In Hybrid	$3,017	$1,509	$1,006	$1,844	374%
Honda Accord PHEV	$3,343	$1,672	$1,114	$2,043	425%

[64] A 2016 model of the Volt is due out at the end of the 2015 which should reasonably be expected to match or surpass other PHEV models in electrical efficiency.

The BMW i3 with Range Extender has the lowest cost per electric range over all three charging scenarios and has the longest electric range of any PHEV. To accommodate all-electric trips using the BMW i3 with Range Extender through the warmer months (March to November) route distances between full charges should be no more than 55 miles with no day charging, 90 miles with two total hours of day charging at one or more locations, and 120 miles with four total hours of day charging at two or more locations. Note that this electric range is slightly longer than the BEV recommendation (Nissan Leaf) because the BMW i3 with Range Extender is essentially a BEV at its core, but does not need the range buffer because it does have the range extender if it is needed.

The BMW i3 with Range Extender is the best PHEV choice for the EV tourism application based on available range and cost per electric range; however its average cost per electric range across the three scenarios is 96% more than the BEV choice, the Nissan Leaf. This price premium may be acceptable if the BMW i3 with Range Extender can be more widely utilized by the rental car company in non-EV tourism applications. Most other PHEV models result in a significantly higher price premium per electric range and have no other obvious advantage to the BMW i3 with Range Extender. The one alternative might be the Chevrolet Volt, which has a much lower initial cost than the BMW i3 with Range Extender. The Volt delivers the second highest PHEV all-electric driving range at 30 miles with no day charging, 40 miles with two total hours of day charging at one or more locations, and 50 miles with four total hours of day charging at two or more locations during the warmer months (March to November). If the EV tourism package routes are within, or close to, these shorter distances, or a lower percentage of miles powered electrically is judged acceptable, then the Chevrolet Volt would have a 36% lower cost per electrically-driven mile since the Volt's purchase price is 36% less than the BMW i3 with Range Extender.

A.11 EV Tourism Emissions Savings

Three forms of transportation could be used for part or all of the example tourism routes: a gasoline car (baseline), Metro-North Railroad (public transit for a portion of the route), and an electric vehicle (EV). To quantify the fuel savings and environmental merits of each option, energy efficiency and emission factors shown in Table A-17 were used.

Table A-17. Vehicle Energy and Environmental Factors

Mode	Energy Efficiency	Emissions
Baseline Gasoline Car	21.6[65] miles per gallon	0.9165 pounds per mile
Electric Vehicle	3.3[66] miles per kilowatt-hour	0.16[67] pounds per mile
Rail	51.8[68] passenger-miles per gallon	0.38[69] pounds per passenger-mile

These factors were used to calculate the fuel use and GHG emissions shown in Table A-18 for the case study tourist routes (Route 1 – Lower Hudson Valley, Route 2 – Sullivan County) and three different scenarios:

- Option 1– The **baseline gasoline car** was driven the entire trip (neither an EV nor public transit was utilized).
- Option 2 – **Metro-North Railroad** was used from Brooklyn to a station near the specified tourist destinations and the same route was taken for the return. A **baseline gasoline car** was picked up at the railroad station, used to reach the tourist destinations, and then returned to the station.
- Option 3 – **Metro-North Railroad** was used from Brooklyn to a station near the specified tourist destinations and the same route was taken for the return. An **electric vehicle** was picked up at the railroad station, used to reach the tourist destinations, and then returned to the station.

---

65 United States Environmental Protection Agency. Greenhouse Gas Emissions from a Typical Passenger Vehicle. http://www.epa.gov/otaq/climate/documents/420f14040a.pdf

66 Estimated from various EV data sourced from www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=1&year1=1984&year2=2015&vtype=Electric

67 United States Environmental Protection Agency. Power Profiler (Hudson Valley). Accessed December 31, 2014 from http://oaspub.epa.gov/powpro/ept_pack.charts

68 United States Department of Energy. Average Per-Passenger Fuel Economy of Various Travel Modes. www.afdc.energy.gov/data/10311

69 United States Environmental Protection Agency. Optional Emissions from Commuting, Business Travel, and Product Transport. www.epa.gov/climateleadership/documents/resources/commute_travel_product.pdf

Table A-18. Example Route Transportation Scenarios

			Fuel Use (gallons)			CO_2 Emissions (pounds)		
			Day 1	Day 2	Total	Day 1	Day 2	Total
Route 1	Option 1	Baseline Car Entire Trip	5.9	5.7	11.6	114.8	142.7	257.5
Route 1	Option 2	Public Transit/Baseline Car	4.0	3.8	7.8	77.9	74.9	152.8
Route 1	Option 3	Public Transit/EV	1.4	1.4	2.7	35.8	35.3	71.1
Route 2	Option 1	Baseline Car Entire Trip	5.7	7.3	13.0	111.5	142.7	254.2
Route 2	Option 2	Public Transit/Baseline Car	3.7	5.3	9.0	72.4	103.6	176.0
Route 2	Option 3	Public Transit/EV	1.4	1.4	2.9	36.1	41.7	77.8

The potential energy and environmental benefits of the public transit and EV portions of the trip from this analysis are quantified in Table A-19. The public transit benefits were calculated as the difference between option 2 and option 1. The EV benefits were determined by comparing option 3 to option 2 (both scenarios use public transit to reach a station near the specified tourist destinations). The combined public transit and EV benefits were calculated as the difference between option 3 and option 1.

Table A-19. Potential Savings

	Route 1	Route 2
Public Transit Fuel Savings (gallons)	3.8	4.0
Public Transit Emissions Reduction	41%	31%
EV Fuel Savings (gallons)	5.1	6.1
EV Emissions Reduction	53%	53%
Public Transit + EV Fuel Savings (gallons)	8.9	10.1
Public Transit + EV Emissions Reduction	72%	69%

If these accumulated gas and CO_2 reductions for combined public transit and EV benefits, indicated in Tables 2 and 3, were extended over an entire year, assuming use every weekend between Memorial Day and Veterans Day, inclusive,[70] the aggregate, per-EV savings in fuel and CO_2 would be as shown in the Table A-20. The benefits for a pilot of 15 EVs are shown as well.

[70] Approximately 25 weekends

Table A-20. Potential Aggregated Savings

		Route 1	Route 2
One EV, One Weekend	Fuel Use (gal.)	8.9	10.1
	CO_2 Emissions (lbs.)	186.4	176.4
One EV, 25 Weekends	Fuel Use (gal.)	222.5	252.5
	CO_2 Emissions (lbs.)	4,660	4,410
16 EVs, 25 Weekends	Fuel Use (gal.)	3,560	4,040
	CO_2 Emissions (lbs.)	74,560	70,560

Table A-21 shows the potential environmental benefits of shared use of the EVs with municipalities in an EV Tourism implementation.

Table A-21. Potential Savings for Municipal Fleets per Vehicle

	Fuel Saved (gallons)	CO2 Emissions Saved (pounds)
Per Week (200 mile average)[71]	9.3	150.2
Per Year (50 weeks)	463.8	7,510
For 16 EVs	7,420.8	120,160

A.12 Potential User Survey Results

A.12.1 Survey Results Summary

To better understand the target market for EV tourism, a survey was designed to gather opinions and attitudes from NYC residents that may visit the Hudson Valley and Catskills areas in the future. The goal was to increase the awareness and marketing potential of the EV tourism program, and determine which aspects of EV tourism would be most successful with this demographic. One challenge of promoting EV tourism activity is addressing people's perceptions of EVs. This study found that 85% of respondents are either very likely or somewhat likely to consider zero-emission vehicles a realistic travel mode choice. However, only 19% of the study sample had ever driven an EV. This figure suggests that EV and zero-

[71] From Perspectives on AFVs: State and City Government Fleet Driver Survey, weekly mileage accumulation rates for the Northeast, Figure B-2. http://www.afdc.energy.gov/pdfs/25929.pdf

emission technology may be new to some potential users in our EV tourism target market, and that education about these vehicles may be necessary as part of a marketing campaign. Despite the low frequency of EV usage, 75% of the respondents indicated that they would consider renting an EV in the future.

Several elements of a potential EV tourism were important to this study sample. Although 60% are very likely to rent an EV if the price is the same as a non-EV, this percentage plummets to 10% if the price is somewhat more expensive than a non-EV. If the price is somewhat less expensive than an EV, 80% of respondents reported they would be very likely to rent, suggesting that rental discounts may provide an extra incentive to rent these vehicles. Many respondents confirmed that both discounted car rental rates and easier pick-up/drop-off options when renting would prompt them to definitively choose an EV over a non-EV. In addition, 63% responded that they would be willing to travel between 30-60 minutes on public transportation to rent a car at more than 50% off the rental price. This detail suggests that this demographic may respond favorably to a rental package using Metro-North to pick up an EV at a station relatively close to New York City, but may need further incentives to reach stations such as Beacon, which are nearly 90 minutes away from Grand Central Terminal. Figures A-11 depicts five discounts and deal categories that could incentivize renters to travel to Hudson Valley and the Catskills to rent EVs, with particular emphasis on spa/relaxation discounts and entertainment/nightlife options. Figures A-12 through A-15 provide additional information.

Figure A-10. How likely would you be to rent an EV if the price is somewhat less expensive than a non-EV, knowing that the cost to recharge an EV is significantly less than to re-fuel a non-EV?

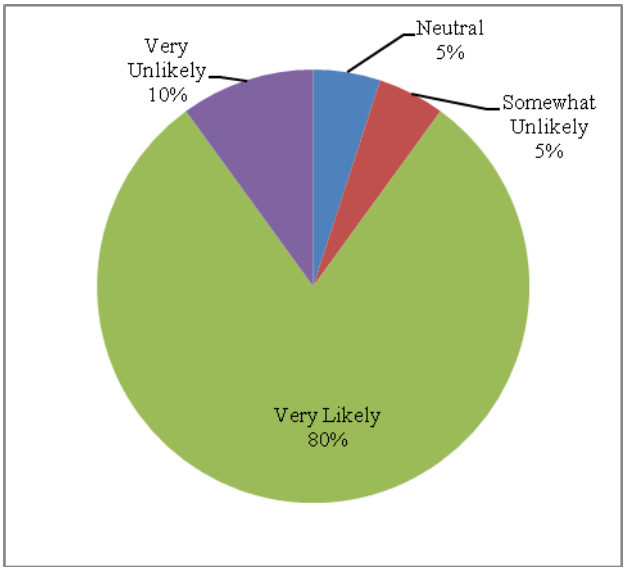


Figure A-11. How likely would you be to rent an EV if the price is somewhat more expensive than a non-EV, knowing that the cost to recharge an EV is significantly less than to re-fuel a non-EV?

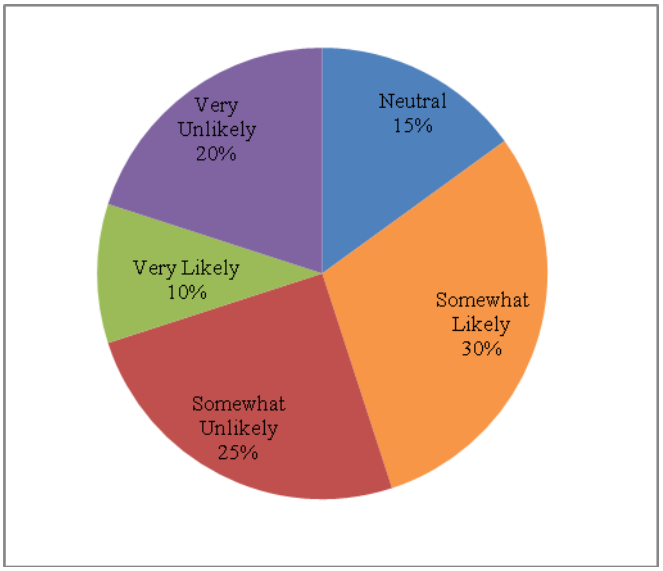


Figure A-12. What discounts or deals would you be most likely to use on vacation?

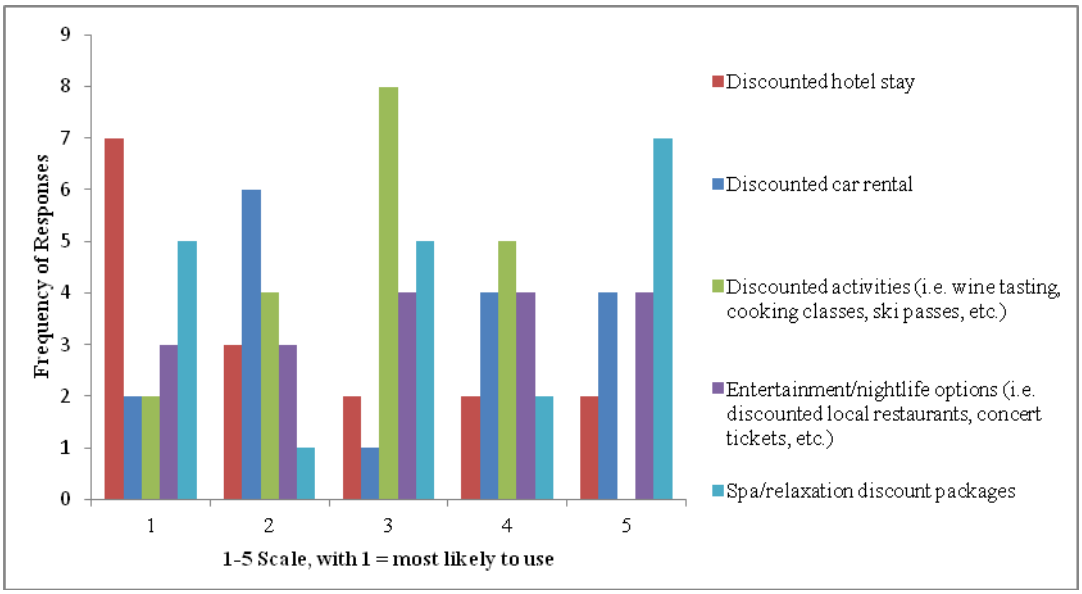
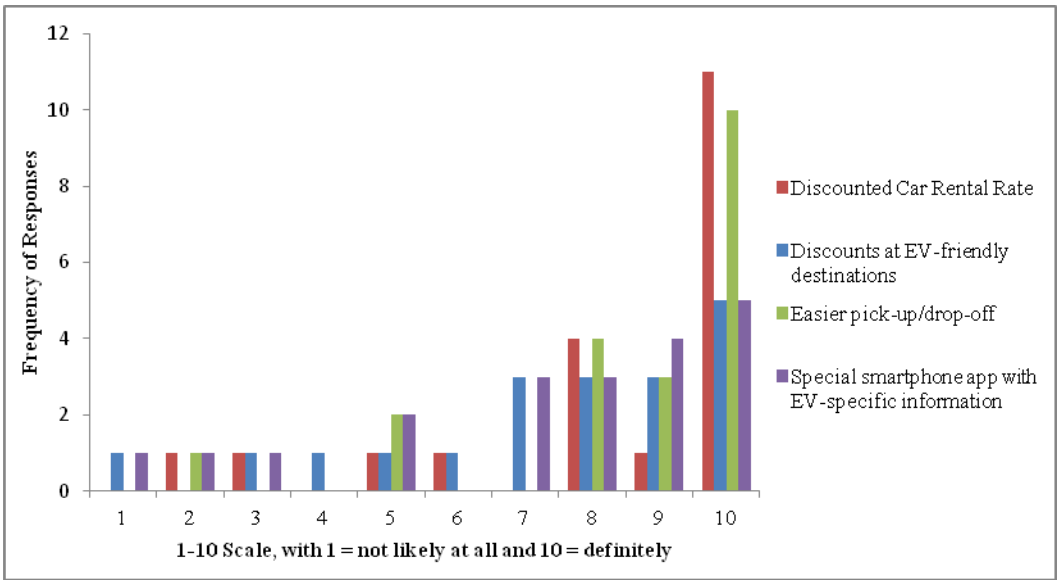
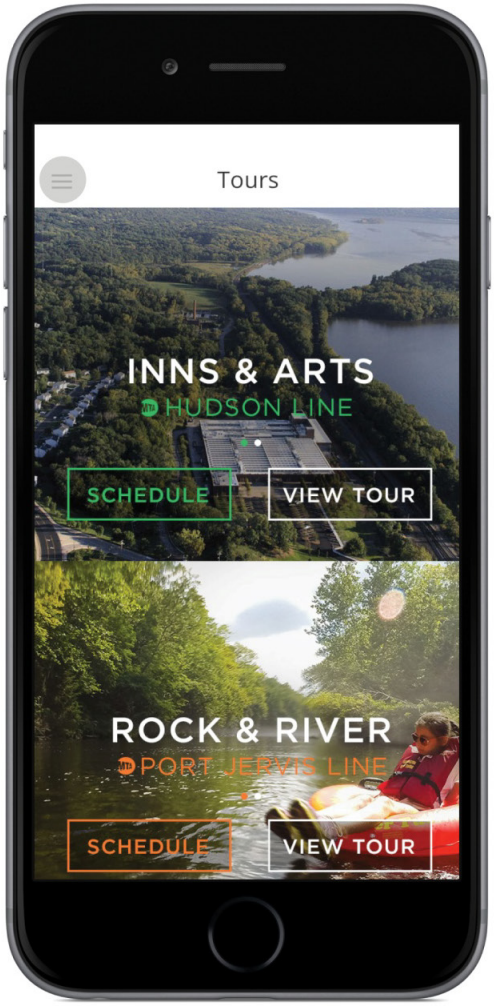
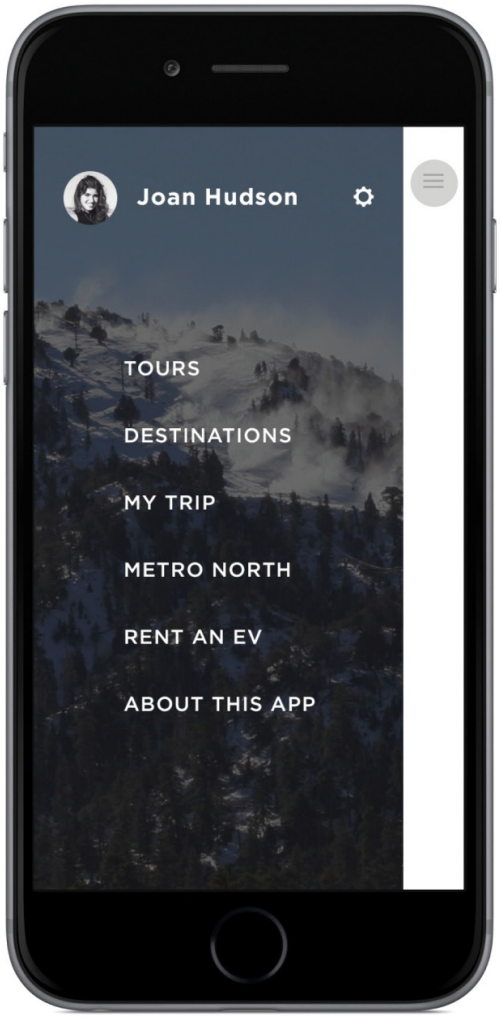


Figure A-13. Which offer(s) would make you more likely to choose an EV over a non-EV?

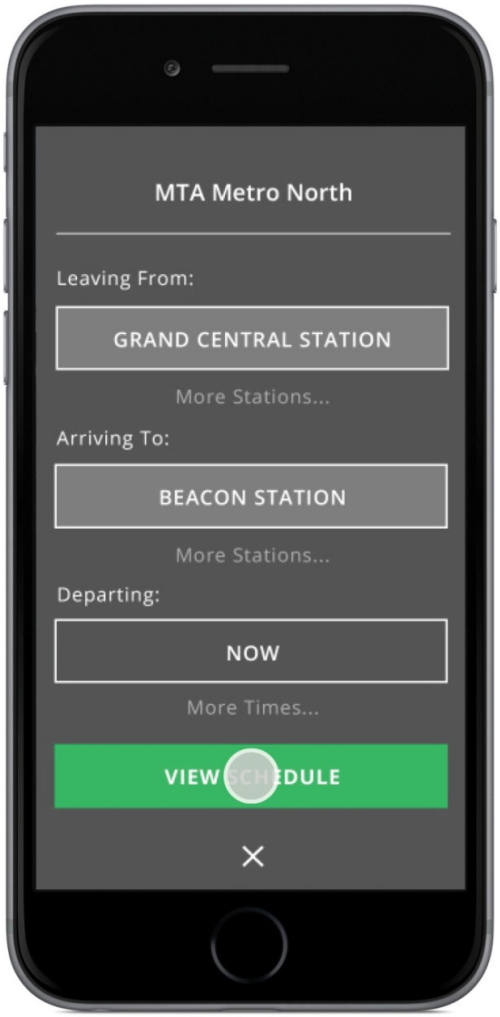


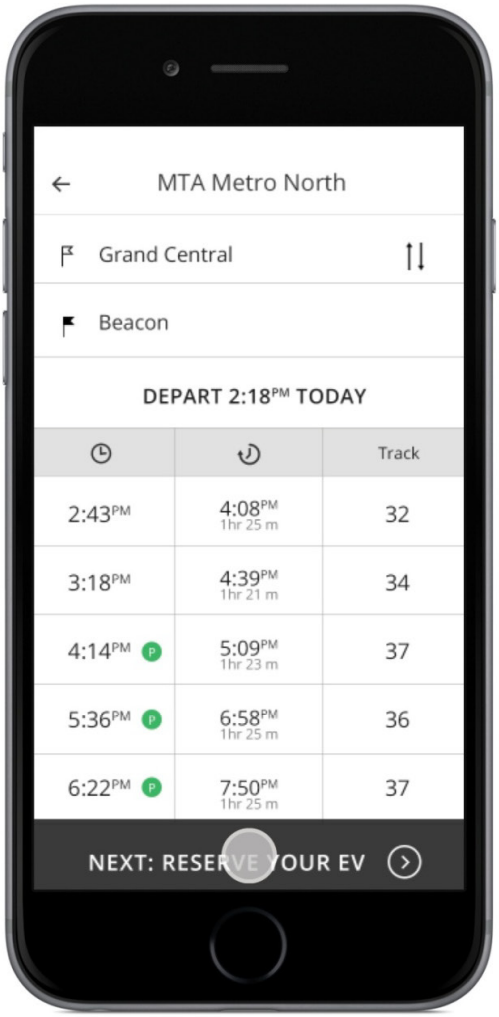
A.13 EV Tourism Smartphone App Mockup and Walkthrough

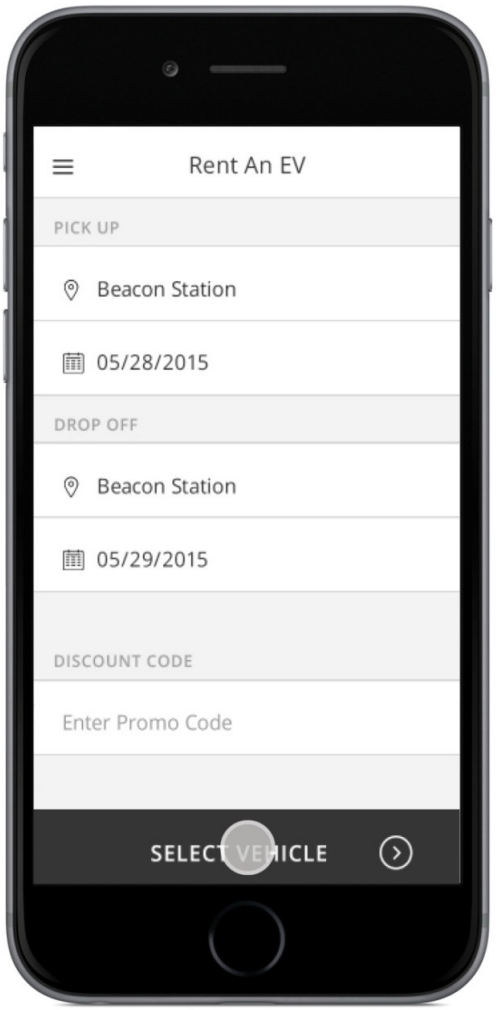


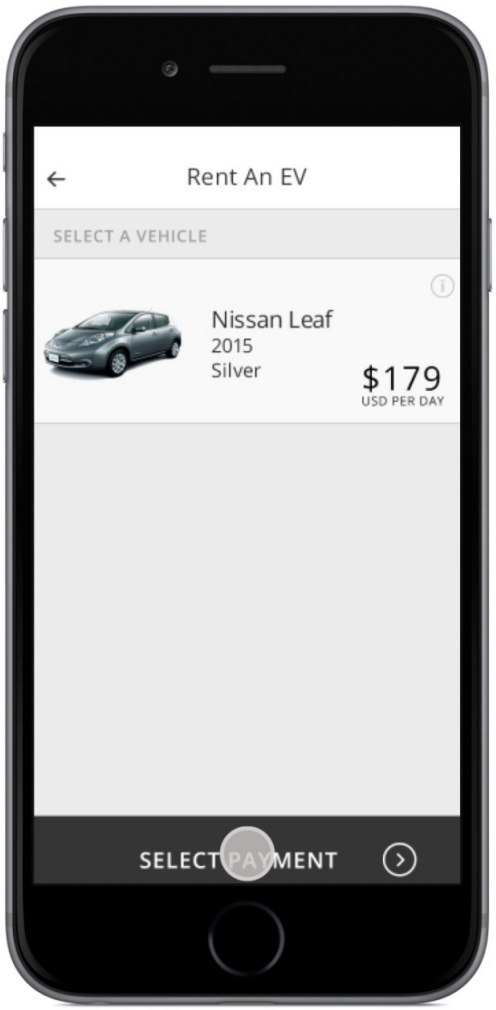

Joan Hudson
TOURS
DESTINATIONS
MY TRIP
METRO NORTH
RENT AN EV
ABOUT THIS APP

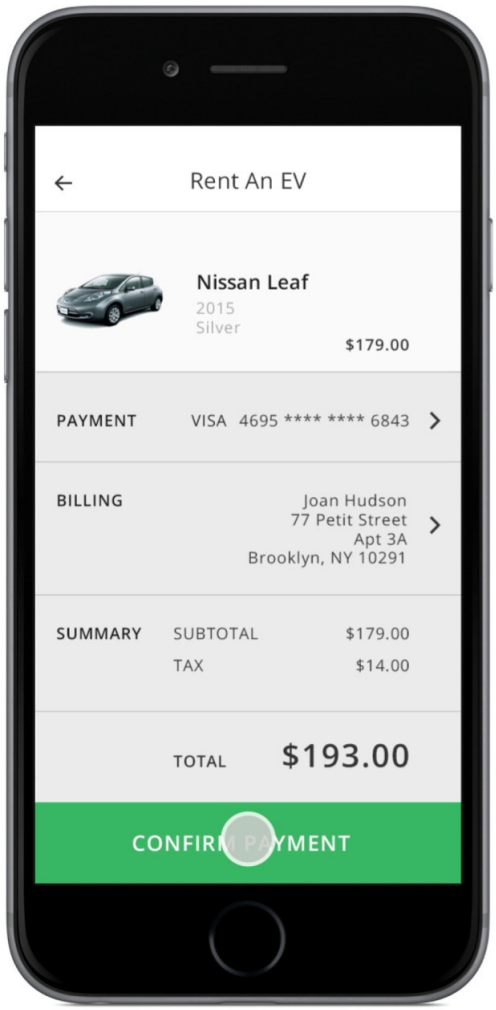

Tours
INNS & ARTS
HUDSON LINE
SCHEDULE
VIEW TOUR
ROCK & RIVER
PORT JERVIS LINE
SCHEDULE
VIEW TOUR

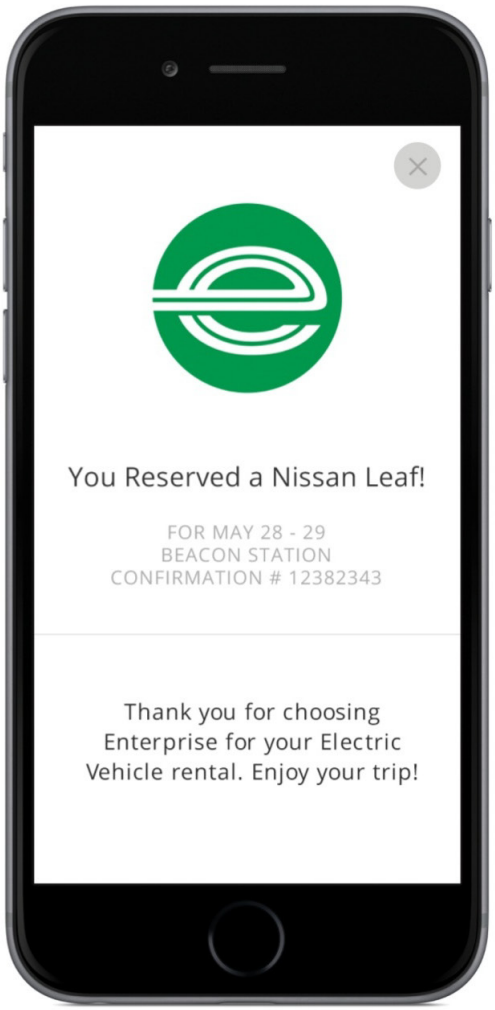

MTA Metro North
Leaving From:
GRAND CENTRAL STATION
More Stations...
Arriving To:
BEACON STATION
More Stations...
Departing:
NOW
More Times...
VIEW SCHEDULE

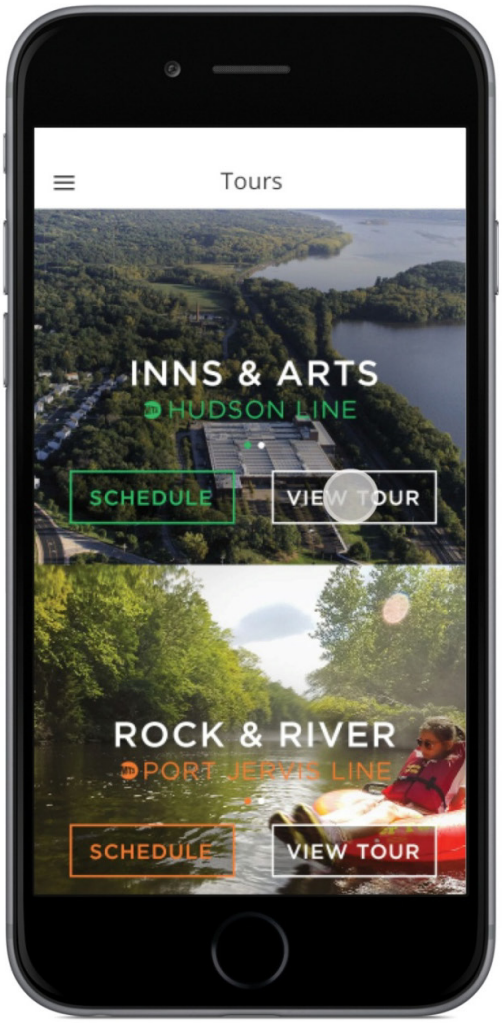

MTA Metro North
Grand Central
Beacon
DEPART 2:18PM TODAY
Track
2:43PM
4:08PM
1hr 25 m
32
3:18PM
4:39PM
1hr 21 m
34
4:14PM
5:09PM
1hr 23 m
37
5:36PM
6:58PM
1hr 25 m
36
6:22PM
7:50PM
1hr 25 m
37
NEXT: RESERVE YOUR EV

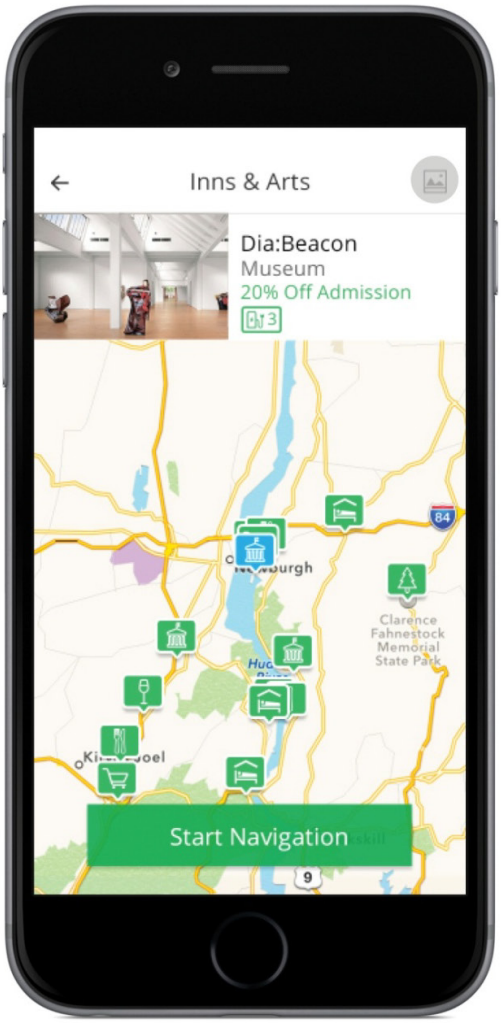

Rent An EV
PICK UP
Beacon Station
05/28/2015
DROP OFF
Beacon Station
05/29/2015
DISCOUNT CODE
Enter Promo Code
SELECT VEHICLE

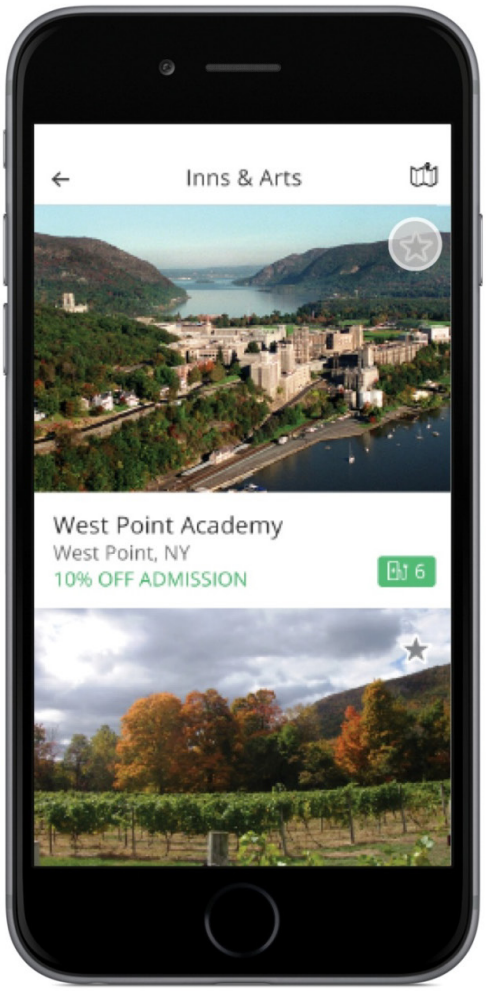

Rent An EV
SELECT A VEHICLE
Nissan Leaf
2015
Silver
$179
USD PER DAY
SELECT PAYMENT

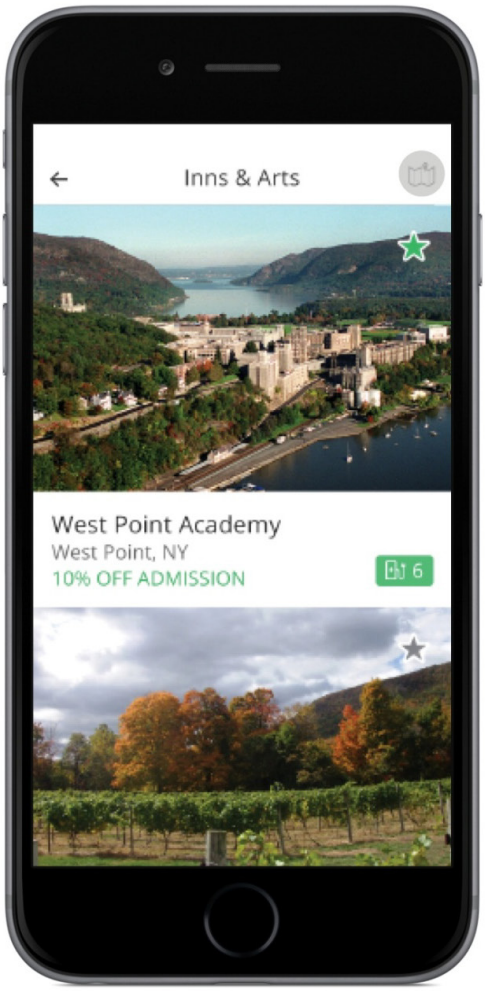

Rent An EV
Nissan Leaf
2015
Silver
$179.00
PAYMENT
VISA 4695 **** **** 6843
BILLING
Joan Hudson
77 Petit Street
Apt 3A
Brooklyn, NY 10291
SUMMARY
SUBTOTAL
$179.00
TAX
$14.00
TOTAL
$193.00
CONFIRM PAYMENT

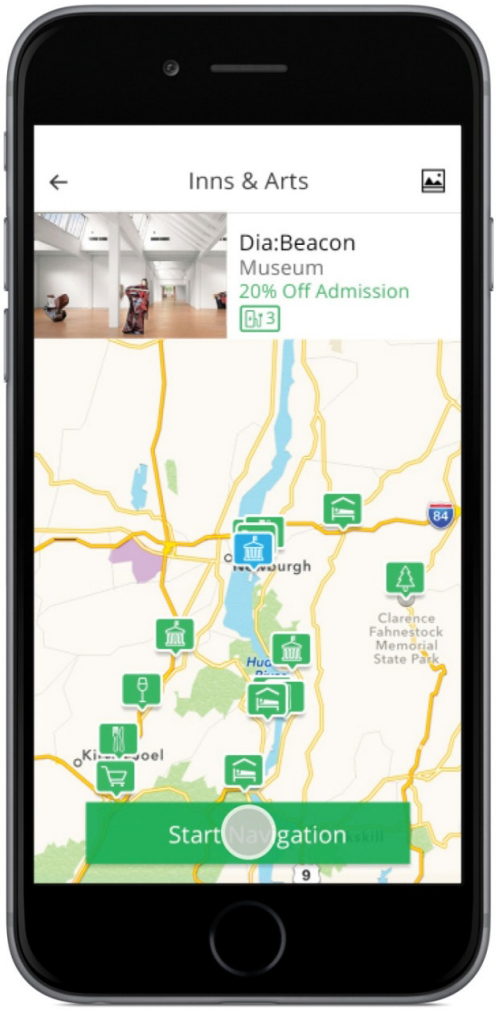

You Reserved a Nissan Leaf!
FOR MAY 28 - 29
BEACON STATION
CONFIRMATION # 12382343
Thank you for choosing Enterprise for your Electric Vehicle rental. Enjoy your trip!

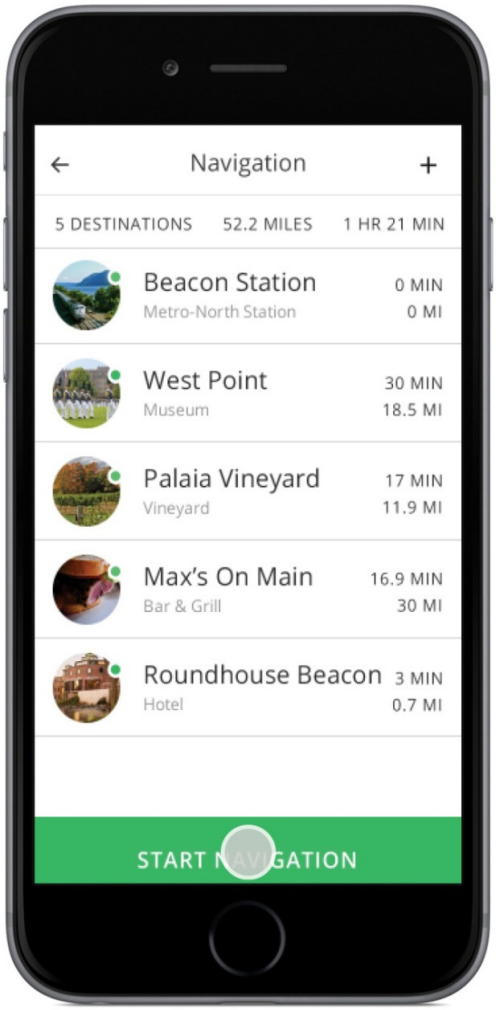

Tours
INNS & ARTS
HUDSON LINE
SCHEDULE
VIEW TOUR
ROCK & RIVER
PORT JERVIS LINE
SCHEDULE
VIEW TOUR

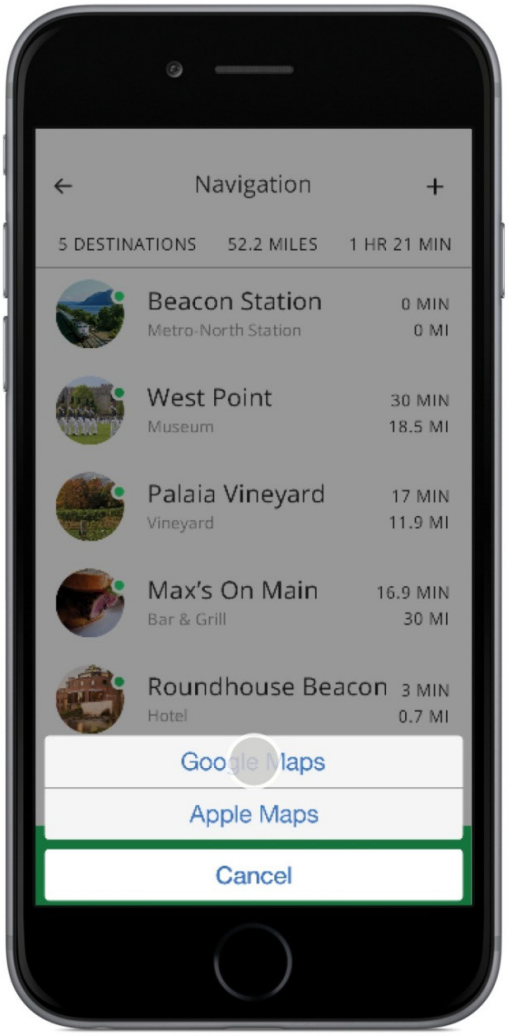

Inns & Arts
Dia:Beacon
Museum
20% Off Admission
Clarence Fahnestock Memorial State Park
Start Navigation

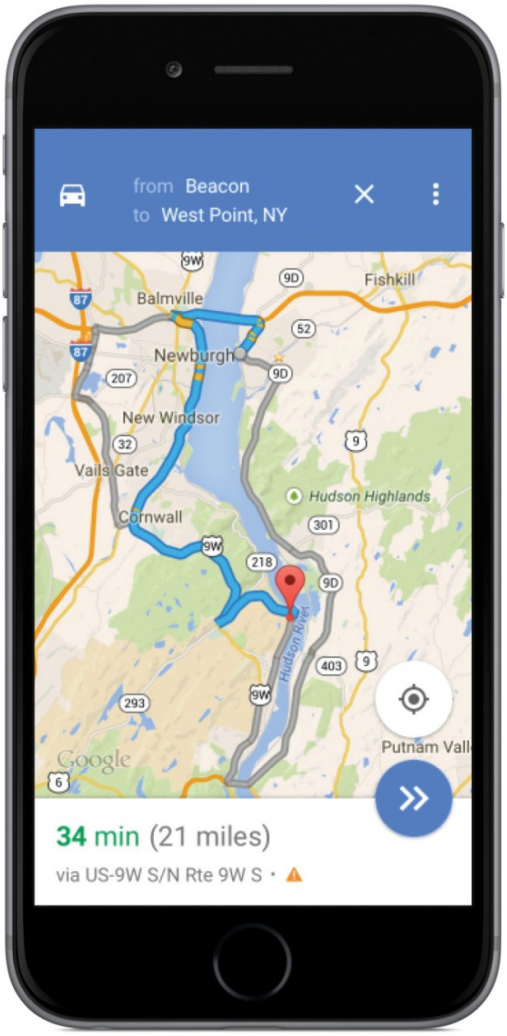

Inns & Arts
West Point Academy
West Point, NY
10% OFF ADMISSION
6


Inns & Arts
West Point Academy
West Point, NY
10% OFF ADMISSION
6


Inns & Arts
Dia:Beacon
Museum
20% Off Admission
3
Clarence Fahnestock Memorial State Park
84
9
Start Navigation


Navigation
5 DESTINATIONS
52.2 MILES
1 HR 21 MIN
Beacon Station
Metro-North Station
0 MIN
0 MI
West Point
Museum
30 MIN
18.5 MI
Palaia Vineyard
Vineyard
17 MIN
11.9 MI
Max's On Main
Bar & Grill
16.9 MIN
30 MI
Roundhouse Beacon
Hotel
3 MIN
0.7 MI


Navigation
5 DESTINATIONS
52.2 MILES
1 HR 21 MIN
Beacon Station
Metro-North Station
0 MIN
0 MI
West Point
Museum
30 MIN
18.5 MI
Palaia Vineyard
Vineyard
17 MIN
11.9 MI
Max's On Main
Bar & Grill
16.9 MIN
30 MI
Roundhouse Beacon
Hotel
3 MIN
0.7 MI
Google Maps
Apple Maps
Cancel


from Beacon
to West Point, NY
Balmville
Fishkill
Newburgh
New Windsor
Vails Gate
Cornwall
Hudson Highlands
Google
34 min (21 miles)
via US-9W S/N Rte 9W S

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

To learn more about NYSERDA's programs and funding opportunities, visit nyserda.ny.gov or follow us on Twitter, Facebook, YouTube, or Instagram.

New York State Energy Research and Development Authority

17 Columbia Circle
Albany, NY 12203-6399

toll free: 866-NYSERDA
local: 518-862-1090
fax: 518-862-1091

info@nyserda.ny.gov
nyserda.ny.gov

State of New York
Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
Richard L. Kauffman, Chair | John B. Rhodes, President and CEO