

Electric Vehicles and the Oregon Tourism Industry

A White Paper

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Photos by (left to right): Frank Hawk, jbcurio, and Nissan

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Introduction

In his 2011 state of the union speech President Obama declared a national goal of putting 1 million electric vehicles (EVs) on US roads by 2015. In the weeks following this announcement, media outlets vociferously debated whether the nation would reach Obama's goal; some questioned if it was even possible given current production levels of EVs. But whether or not the millionth electric car rolls off the dealer's lot by 2015, the level of attention and resources granted to electric cars in the past year indicate a fair start towards that target. In truth, the arbitrary and yet awesome-sounding goal of 1 million EVs will be only a small step towards a transition from combustion to battery packs. The GE-sponsored blog Txchnologist pointed out that 1 million cars would make up only a third of a percent of the current US fleet of 246 million registered vehicles (Txchnologist, 2011).

A significant number of players must commit to EV-adoption in order for transportation electrification to come to fruition in the coming years. Thus far a growing level of interest inspired by environmental concerns and rising gas prices has thrown weight and momentum behind the transition to EVs. Most major car manufacturers will be releasing a plug-in model within the next two years, and many small startups are launching new concept cars. Although it's too early to predict how overall sales will go, even in a down economy consumers are snatching new EVs up so fast that both the Chevrolet Volt and the Nissan Leaf have a waiting list into 2012 (Karson, 2011). The federal government has taken an active role in advancing EVs through federal tax credits ranging up to \$7,500. In preparation for EV drivers that will soon need charging facilities, governments at all levels, as well as private investors, have been funding the installation of demonstration chargers everywhere from ski resorts (Hoffman, 2011) to grocery stores, like Fred Meyers (Van Berkel, 2011).

But despite the growing list of champions for electric cars among governments, businesses and early adopters, EVs still face a daunting series of barriers to becoming a mainstream transportation option: vehicle manufacturers have not indicated any commitment to meeting the Obama administration's goal for 2015 (School of Public and Environmental Affairs at Indi-

ana University, 2011); the price competitiveness of EVs to conventional cars fluctuates with the price of gasoline; electric cars are perceived to be too expensive for a typical consumer, and surveys have indicated pervasive range anxiety, or fear of being stranded far from the nearest charger (Deloitte Consulting, LLC, 2010).

It should come as no surprise that the corollary fear of range anxiety is that of limitation: consumers worry that driving an electric car will constrain the types and lengths of trips taken. In terms of everyday travel, the typical American needn't worry. Average daily driving behavior in the US is within range of an all-electric vehicle, with urban drivers traveling a modest 22.7 miles per day (Horowitz, 2009). But out-of-town travel in an EV introduces a new set of stresses to a traveler's experience. Drivers will need to know how far they can go on a charge, how to find nearby charging stations on the fly, and who to call for roadside assistance. Because of the high level of uncertainty associated with EVs, many drivers that might otherwise be a prime target audience for electric cars may be hesitant to invest until they are more familiar and comfortable with the technology, and established support networks are already in place.

Perceptions of limitations on travel are thus a bottleneck to large-scale EV adoption. Current perceptions of EV range make travel intimidating. But should consumers perceive that travel will be easy in an EV, they may be more likely to purchase or rent one. Perceptions of tourism and long-distance vehicle travel are part of the mainstreaming of EVs, and the tourist industry has the power to influence this public perception by offering rental and car sharing experiences as well as supportive charging infrastructure.

From a marketing standpoint, becoming EV friendly is also a smart business move. The tourism industry can be a driver of EV adoption, building a brand that eco-conscious travelers can identify, or it will likely have to play catch up to the trend once EVs have reached a saturation point. The tourism and hospitality industry have been given the unenviable and yet critical task of evolving to support a largely unknown, undeveloped market: the electric vehicle traveler. Of course, with this challenge comes opportunity. By tapping an emerging "green traveler" market, the tourist industry stands to benefit from participating in the impending EV rollout. Likewise, adoption of EVs within the tourist industry

would ease the national transition away from the internal combustion engine.

Electric Vehicle Technology Primer

To better understand the relationship between electric vehicles and tourism, it is first critical to understand the current state of EV technology. Because trip range varies wildly by car type, and charging speed is equally variable depending on station technology, an analysis of the opportunities and barriers to EV adoption in the tourist industry requires a working knowledge of existing tools and models of electric vehicles. What follows are some common acronyms and definitions used throughout this paper.

ICEs: Internal combustion engines are occasionally referred to throughout this paper as ICEs. This refers to conventional vehicles which run solely on gasoline or diesel fuel.

EVs or PEVs: Electric vehicles, or EVs, can all be lumped into a broad category that includes any vehicle with a battery that can be charged by plugging into a wall outlet. They are often also called plug-in electric vehicles, or PEVs. Their plug-in charging feature distinguishes these vehicles from existing hybrids such as the Toyota Prius, which recharge a battery using regenerative braking.

PHEVs: Plug-in hybrid electric vehicles (PHEVs) are PEVs with hybrid technology, meaning they can run either on all electric power or on a gas-powered generator. The Chevrolet Volt, released to the public in 2011, and the Toyota Plug-in Hybrid Prius, to be released in 2012, are both PHEVs. These cars run off of a battery for the beginning of the trip, and then switch to a gas-powered generator when the battery runs low. Their electric range and gas efficiency vary wildly, but in general these cars have a similar total range to conventional cars. The Volt runs for 35 miles on battery power, and then averages 37mpg on the gas motor for up to 340 additional miles (Chevrolet, 2011). The plug-in Prius, on the other hand, runs off battery power for 13 miles, but then averages 51mpg from the gas tank (Kuo, 2011). Hybrids such as these will play a critical role in the transition

to transportation electrification, as they have a longer range than current all electric models and the gas engine relieves buyers' range anxiety.

BEVs: Battery-Electric Vehicles (BEVs) are PEVs that operate solely off of battery power. The newly released Nissan Leaf, Mitsubishi iMiEV, and Ford's anticipated 2012 Electric Focus both fall into this category. Both vehicles are advertised as having a 100 mile range on a charge in optimal weather conditions, but this is by no means the limit of possible EV ranges. At the upper end of the price and range spectrum, the Tesla Roadster can travel 240 miles on a single charge. Tesla has plans to release a hatchback, the Model S, with options of between a 130 and 300 mile range on a single charge (Addison, 2010). As battery technology continues to develop and become more widely available, ranges will likely increase and prices decrease for BEVs. In the meantime, federal tax credits make BEVs comparable in price to a new Toyota Hybrid Prius, but with a much lower operating cost.

Charging Technology: EVs can be recharged at three different speeds: Level I, Level II and DC quick charge (see Table 1). Car makers and charge station companies have standardized Level I and II charge plugs to fit any car. However, DC quick charge plugs have not yet been standardized, and as a result American automakers have chosen not to include the requisite extra quick charge port, lest they become obsolete once a standard is chosen. Japanese EVs can be ordered with a quick charge port installed. (Liggett, 2011)

Table 1: Charging Speeds (based on a 24kwh battery)

	Voltage	Time to fully charge
Level I	120VAC	20-22 hrs
Level II	240VAC	5-7 hrs
DC Quick Charge	480VAC	20-30 minutes (to 80%)

EVs and Oregon Tourism: One step ahead

Although many areas have taken on the role of electric vehicle test bed, the Pacific Northwest, and Oregon in

particular, has distinguished itself as a national leader in electric vehicle demonstration projects. With a significant state and federal investment in charging infrastructure and a robust tourism industry, Oregon tourism has significant opportunities both to capture and to drive the electric vehicle traveler market. Oregon travelers, including out-of-state and in-state travelers, identify themselves as environmentally conscious, and share many characteristics with EV early adopter and majority consumers. As new infrastructure is put into place, Oregon has an opportunity to build EVs into its brand. Doing so will both attract new EV drivers and educate tourists about electric transportation.

Oregon has engaged in several pioneering EV initiatives and demonstration projects. With a mild climate hospitable to battery power, a predominant cultural support for sustainability, and a series of densely built cities within 100 miles of each other, Oregon has been identified by the federal government and by automakers as an ideal location to launch EVs and PHEVs (Beard, 2011). Because of the level of investment in charging infrastructure, driving a BEV will likely be initially easier in Oregon than in most other states.

The Oregon Department of Transportation (ODOT) has procured funding for charging stations along several different major highway routes through the state. Federal American Recovery and Reinvestment Act grants have funded the installation of up to eight quick-charge stations along Interstate 5 between Eugene and Ashland to complete an important leg of the nation's first "West Coast Green Highway" from Vancouver, British Columbia to San Diego, California (Oregon Department of Transportation, 2010). Off of the I-5 corridor, ODOT will fund 22 quick charging stations along the Oregon Coast and the Columbia River Gorge with a \$2 million discretionary grant from USDOT's Tiger II Program, with construction slated to start in 2012. All 30 DC quick charge stations in Oregon will also have accompanying AeroVironment Level II EV chargers on site, to be installed by AeroVironment at their own expense. (Ashley Horvat, personal communication, Sept. 27, 2011)

The EV Project, a public-private partnership of the Department of Energy, the State of Oregon, ECOTality and Nissan, intends to install 800 public charging stations and 22 DC quick chargers in and around the

cities of Portland, Eugene, Salem and Corvallis over the next three years (ECOTality, 2010). Governor Ted Kulongoski said in regards to the EV Project that "Oregon [i]s the right state to launch this next generation of vehicles and show the rest of the country that we can make this transition without inconveniencing or pricing regular citizens out of this market" (ECOTality, 2010).

Being first in line to install charging infrastructure has also meant that Oregon has been targeted by automakers for initial releases of EVs. Because of its involvement in the EV Project, Oregon has been one of the first states to see the public release of Nissan's Leaf. The state has also been chosen for a limited first public release of Toyota's plug-in hybrid Prius (Kuo, 2011). Additionally, Toyota has issued eight plug-in hybrid Priuses to cities in northwestern Oregon as part of a nationwide demonstration project (ESQ Communications, 2011). Although most of these cars were placed with individuals to test drive, two were given to Zipcar, a car-sharing company, for locations in Portland.

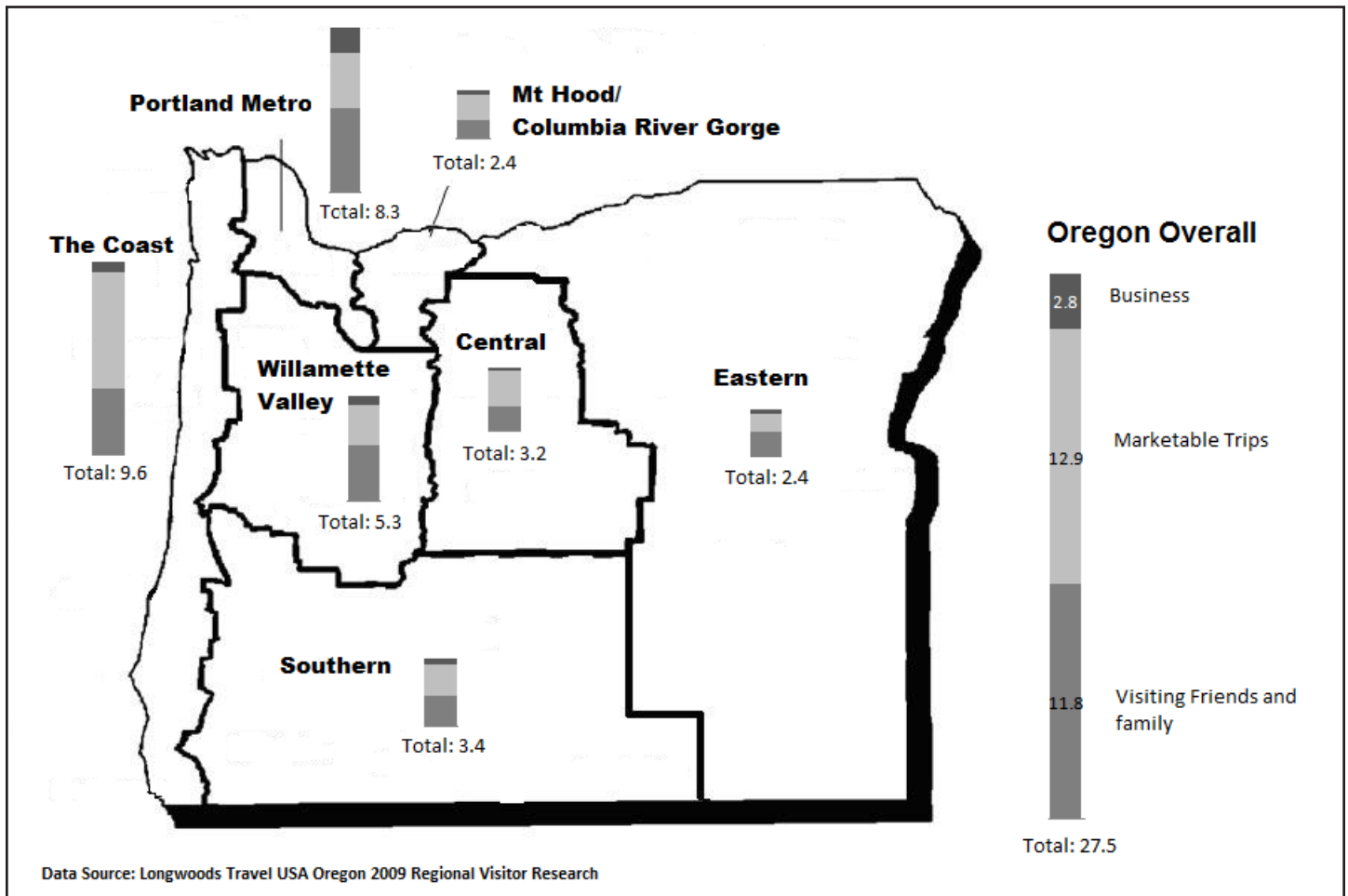
The connection between this growing trend and tourism is not readily made by people outside of the tourism business. But many players within Oregon's travel sector are already anticipating how to accommodate future EV travelers. They are wise to do so: a brief examination of the parallels between Oregon's tourism market and the profile of a typical EV early adopter indicate a likely shared target audience.

Profile of an Oregon tourist

Travel Oregon, Oregon's state tourism office, defines a tourist as someone who travels at least 50 miles from home or stays the night. The office commissions the travel research firm Longwoods Travel, USA to conduct annual survey research on Oregon travelers to better understand the domestic market and its demographics. In 2009 the Longwoods Oregon Visitor Report recorded 22.5 million overnight trips in Oregon. The Longwoods report categorizes trips by three different purposes: business, visiting friends or family, and "marketable" or leisure trips. The proportion of these three categories varies by region (see Figure 1).

As shown in Figure 1, the greatest numbers of overnight trips occur in the Portland Metro, Willamette Valley and Coastal regions. These areas contain a large number of densely located attractions: the Willamette

Figure 1: Regional Overnight Trips by Trip Purpose (in millions)



Valley has developed a strong food tourism industry around a growing network of vineyards; the Oregon Coast draws sightseers for scenic drives along Highway 101, a nationally acclaimed scenic route lined with coastal towns; and the Portland metro area, easily accessible by airport or I-5, acts as both an urban destination and a gateway for other nearby attractions. This density of destinations also makes these regions ideal for EV travel. Most travelers are already choosing destinations that could easily accommodate EVs.

Currently, the majority of Oregon travelers access their destination by private automobile. Although data is not available for business or family trips, 84% of marketable trips are made in private cars or trucks (see Figure 2). These trips generally originate from within the state or from an adjacent state. In 2009, 55% of overnight travelers within Oregon were Oregonians themselves (40% of the overnight travelers were from Portland) and 20% come from Washington state, another EV project test state and the site of the first electric

Scenic Byway on Highway 2 (Longwoods Travel USA, 2010a; Washington State Department of Transportation, 2010). These short trips traveled by private automobile could easily be replaced by private EV travel.

Oregon travelers are thus likely traveling within Oregon or visiting from Washington, traveling in their

Figure 2: Mode Split of Oregon Overnight Travel*

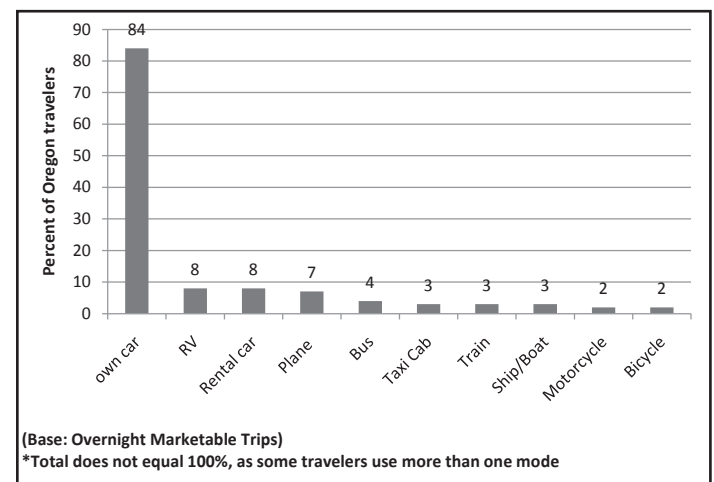
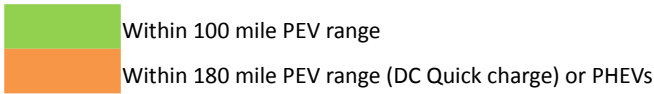


Table 2: Distance Between Travel Destinations in Oregon

	Portland	Salem	Corvallis	Eugene	Medford	Bend	Mt Hood	Cannon Beach	Newport	Astoria	Hood River
Portland		47	80	110	275	162	56	80	136	95	62
Salem	47		35	66	229	146	90	119	46	134	108
Corvallis	80	35		41	208	128	128	132	81	172	145
Eugene	110	66	41		168	128	154	182	111	198	171
Medford	275	229	208	168		173	278	345	274	361	334
Bend	162	146	128	128	173		106	248	162	263	143



Within 100 mile PEV range
 Within 180 mile PEV range (DC Quick charge) or PHEVs

own car. An additional 8% will rent a car during the course of their trip. The participants in the Longwoods study also tended to be well educated (50% have a college degree or higher), and a majority (65%) are of retirement age and have no children under the age of 18 (Longwoods Travel USA, 2010a). This demographic mirrors early adopters of EVs. Table 2 shows the travel distances throughout the state to major destination and classifies these distances by PEV range. The table shows that many locations can be reached with a comprehensive quick charging infrastructure (see Appendix A.)

Oregon travelers have also indicated in surveys that the environment is a priority for them. A nationwide Green Traveler analysis conducted by the US Travel Association found that 85% of survey respondents who were considering a trip to Oregon categorized themselves as environmentally conscious. Even more importantly, of those considering a trip to Oregon, 15% claimed they would be willing to pay more for travel companies that “offer eco-friendly option[sic] to customers” (US Travelers Association, 2010). Other surveys about sustainable tourism have found similar results. National Leisure Travel MONITOR found in a survey of 1,500 travelers that 80% considered themselves to be environmentally conscious, 38% would chose a hotel based on its environmental friendliness, and 30% were willing to pay up to 9% more for green travel services (Sustainable Travel International, 2011).

Profile of an EV early adopter

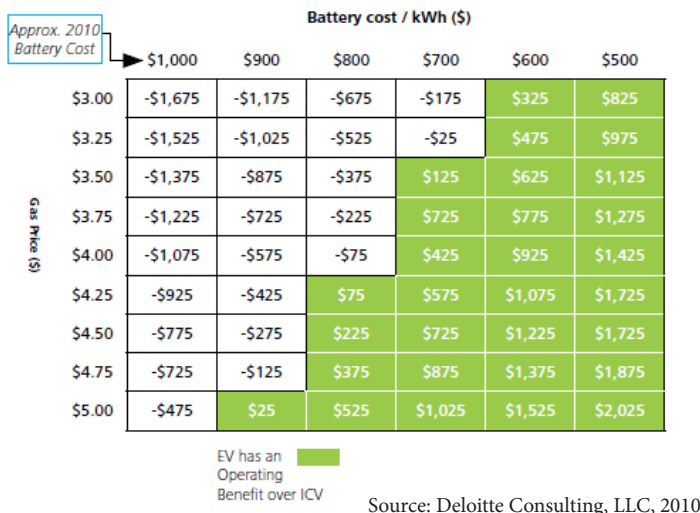
Initial studies of EV early adopters mirror the results of Oregon travel surveys in some critical ways, but diverge in equally fundamental areas. A study of

2,000 current vehicle owners by Deloitte Consulting, LLC identified market segment profiles for non-adopters, early adopters and the early majority. The early majority, a group they estimated at 1.3 million US citizens, constitute the prime target group for EV marketing efforts. Consumers in the survey within this group were environmentally conscious, willing to pay a premium for convenience, and perceived EVs as “clean and green.” Nissan has zeroed in on young baby boomers (averaging 45 years old) with college degrees as the target for the Leaf (Gordon-Bloomfield, 2010).

This target EV group in some ways aligns with the profile of Oregon visitors: both are college educated and environmentally aware. One major discrepancy between these two profiles, however, is household income. According to the Longwoods Travel Survey, over 60% of overnight travelers in Oregon have a household income (HHI) below \$75,000 (Longwoods Travel USA, 2010a). This is a far lower than Nissan’s target HHI of \$130,000 for the Leaf (Gordon-Bloomfield, 2010), or the Deloitte (2010) survey’s early majority, which averaged an HHI of \$114,000. These analyses are all based, however, on surveys conducted when gasoline cost \$3 a gallon. Deloitte’s survey results (2010) indicated that consumers would be more likely to buy an EV if they were price competitive with internal combustion engines. Deloitte constructed a chart of EV competitiveness based on battery prices (which will likely go down in the future) and gas prices (which will likely increase) (see Figure 3). As EVs become more affordable compared to ICEs, the average income of EV users will likely decrease.

In the meantime, however, the Oregon tourism industry holds a unique opportunity to play an impor-

Figure 3: EV Operating Benefit Over ICEs



tant role in EV adoption. By accommodating and encouraging EV owners to visit, Oregon destinations, hotels, event centers and scenic areas can have an edge in an emerging market. Even if Oregon travelers in fact cannot afford to initially purchase EVs or PHEVs, they could gain familiarity with the new technology, and build positive associations with it through rentals, tour buses or Zipcars. Consumers with range anxiety could take an EV test trip before committing to buying one themselves.

Rental and car-share fleets have a mass buying power that individuals do not, and can invest in a few electric vehicles without the same level of risk as a single household. In addition, bulk purchases of EVs by fleet operators may help in the short run to reduce the price of batteries by spurring production levels (Electrification Coalition, 2010).

Both the alignments and the discrepancies between the Oregon tourism industry and the market for EV early adopters indicate opportunities for mutual gains. But many forces must align to take advantage of these prospects.

Important Players

Tourism is an \$8.7 billion industry in Oregon (Oregon Tourism Commission, 2007; John Hope-Johnston, personal communication, August 25, 2011) directly generating 90,400 jobs. As such, the industry includes a large number of players, both local and national, that stand to play an important part in Oregon’s EV rollout. Many have already taken a leadership role.

Tourism Offices

Oregon has tourism offices at the state, regional, and city level assigned the task of encouraging local tourism in order to support the economy and promote local activities, events and destinations. These offices have the power to promote EV travel through branding, marketing campaigns and public private partnerships. As both promoters and educators, they can draw attention to growing EV supportive businesses, as well as provide route and service information to potential EV travelers.

Travel Oregon is Oregon’s state level tourism commission. Its mission, as stated on its website, is “to enhance Oregonians’ quality of life by strengthening economic impacts of the state’s 8.7 billion dollar tourism industry” (Oregon Tourism Commission, 2007). Travel Oregon constructs and promotes the Oregon brand through campaigns that draw visitors to specific seasonal activities or destinations. Tourism Commissions for localities within Oregon include Travel Portland, Travel Salem and Travel Lane County. In smaller communities, chambers of commerce might play a similar role of branding the area and attracting visitors.

Travel Oregon recently launched a sustainable tourism campaign called Travel Oregon Forever, an umbrella campaign guided by a Sustainable Tourism Advisory Council that encompasses several programs including a sustainable business challenge to recognize leaders in environmentally and socially responsible business practices, and a travel philanthropy fund fueled by an optional green surcharge at participating businesses. The Heathman Hotel (see Hospitality Industry below), which provides EV charging free to hotel patrons, is one of the first businesses to achieve Gold Level recognition in Travel Oregon’s Sustainable Business Challenge.

Car Rental Agencies

Both in Oregon and on a national scale, car rental companies have been among the first to preorder EVs and PHEVs. By adding EVs to their rental fleets, these companies can provide travelers with the opportunity to test and become comfortable with EVs and charging stations. Rental agencies will have the added responsibility, however, of educating customers on their car’s range and charging station locations. To overcome range anxiety, BEV rentals should include optional emergency charging service. Both Enterprise Holdings

and Hertz Rent-A-Car have ordered electric cars for their rental fleets, although currently only Enterprise intends to station some of these cars in Oregon.

Enterprise Holdings, manager of the world's largest fleet of passenger vehicles, reserved 500 Nissan Leafs to distribute among EV project test cities in spring of 2011 (Banks, 2010). The EVs will be offered first from Enterprise's W. Burnside St. location in Portland (Richardson, 2010). Enterprise's unique company history catering to the short term car rental niche market (the company originally targeted insurance clients whose cars had crashed or broken down) has led to a company model of multiple locations and competitive short term rates for business and weekend travelers (Enterprise Rent-A-Car, 2005). They also operate a car-sharing operation aimed at university students called We-Car. As a large fleet operator targeting short or local, leisure and business trips, the company is uniquely situated to expose a wide swath of customers to EVs in a supported, low-risk environment.

Car shares

Car sharing was not originally planned as a tourist service, but as Zipcar has grown both in the number of cities it serves and in its customer base, more and more people are using Zipcar as a car rental alternative. In Portland, according to Bill Scott of Zipcar (personal communication, June 3 2011), an increasing number of Zipcar users are not Portland residents. Zipcar (and car sharing in general) offers the convenience of many car locations and hourly rates that can beat longer term car rentals for quick trips from a hotel. Especially in an urban environment such as Portland with a well-established car network, car sharing could be an ideal model for travelers wishing to make short trips from a home base such as a hotel or relative's house.

Although Zipcar has tried making this connection directly to the traveler market by parking cars at hotels, Scott noted, these partnerships have not yet been fruitful, with the exception of a partnership with a hostel serving international travelers such as Germans who are already familiar with the car-sharing model. However, with an average trip length of about 4 miles, Zipcar trips are perfect candidates for EVs. Zipcar is currently participating in a national trial with Toyota to test the Plug-in Hybrid Prius. Zipcar is, however, hesitant to purchase BEVs, as there is no system in place yet to en-

sure that users will recharge the battery in preparation for the next user. (Scott, personal communication, June 3, 2011)

Taxi services

Nationally, 6 percent of US travelers make at least a portion of their travel trip by taxi. In Oregon, the share of trips by taxi is smaller, at 3% (Longwoods, 2010a). Yet taxi services offer many opportunities similar to those associated with rental car and car share operations. Fleet purchases help create demand and drive down the price of EVs. And taxis facilitate even greater public exposure to EVs, as a taxi will carry many passengers in a day. For many people, an electric taxi ride might be their first EV experience. However, electric taxi services have enjoyed limited success thus far in China and Japan, as the vehicles are still priced as much as 80% higher than a standard taxicab, even after government rebates (Yan, 2011).

Taxi services bring with them their own unique operational challenges. Because the cars are constantly running, one charging option is a battery swap model, in which drivers exchange spent batteries for charged ones throughout the day. A charging infrastructure company, Better Place, has taken on this challenge, committing in October 2010 to installing an all-electric battery swap taxi service in San Francisco and San Jose. The start-up has introduced similar taxi models in Denmark, Japan, Australia and Israel (Better Place, 2010). In Portland, taxis typically travel 200 miles per shift and can have waiting times around 40 minutes between clients. The Port of Portland is exploring placing DC fast charging stations at the airport for taxi use.

Utility Companies

The EV rollout will rely in large part on the cooperation and partnership of energy suppliers. Many remote tourist locations will need service upgrades so that charging stations can be installed. Also, as more people start to use charging stations, utilities can support research to better understand where and how EV drivers choose to charge their car battery. Pacific Power, Eugene Water and Electric Board (EWEB) and Portland General Electric (PGE) have partnered with ECotality to supply power to new charging stations in the test cities of Portland, Salem, Eugene, and Corvallis. PGE has also partnered with Portland State University to con-

duct strategic research on early charging station use.

Hospitality Industry

The cheapest and easiest time to charge an EV is while you sleep, making hospitality businesses an ideal first location for charging stations. The hospitality industry also engages a large portion of the tourist market: of all marketable overnight trips made in Oregon in 2009, 63% arranged accommodations in a hotel, motel or resort, and an additional 20% stayed in an RV park or campground (Longwoods, 2010a). Being EV friendly both paves the way for easier EV travel and puts businesses at the cutting edge of the new market. Large hotel and motel chains have the capital to invest in charging stations, but tax rebates or grant funding could make charging station installation a realistic possibility for hostels, bed and breakfasts and campgrounds. RV parks, which already have 240V outlets, are one step ahead of the game; some campgrounds have already started to offer 4 hour charges for a fee, and the National Association of RV Parks plans to post a list of parks offering EV fueling services on their website (Alfier, 2011).

Sustainable Travel International (2011) found in a traveler survey that, although most respondents felt that sustainability is an important consideration in choosing a hotel, and some were even willing to pay nearly 10% more for a hotel that advertised itself as eco-friendly, over half “were unable to name a single hotel brand that they saw as a stalwart in eco-friendliness” (p. 2). This survey implies that hotels have not done enough to brand themselves with an eco-friendly message; EVs could provide hotels with powerful marketing and branding material to reach the sustainable tourism segment.

Many hotels are already beginning to recognize environmental stewardship as an important marketing strategy, and EV-friendliness as a method of achieving sustainability goals. The Heathman Hotel in Portland offers a Level I charger in its parking garage, and is planning to install a Level II (Hasek, 2011). Larger chains such as Double Tree, Hilton and Kimpton have Green Seal certified branches in Portland that already market themselves as sustainable and would build brand loyalty by providing EV services. As hospitality businesses take note of the growing momentum behind EVs, they can position themselves to have an edge on the new EV traveler market either by providing charging facilities

for travelers with their own EVs or by entering into partnerships with car-sharing companies to provide EVs on hotel premises for guest use.

Charging Station Companies

Private design firms have taken on the task of developing charging infrastructure to accommodate a wide range of environments from parking garages to on-street parking to residential car ports. The surge of funding for charging station installation has spawned a fiercely competitive and wide open market for station design companies. Because the industry is so new, the market is full of start-ups and many station designers have developed brand-specific charge cards specific to their charging-station network. Such is the case with Blink stations, designed by Roush Manufacturing out of Michigan, the design ECOTality chose for the EV project (Siemers, 2011). Although proprietary network cards are a way for station companies to get a foothold on the market, such network exclusivity will be incompatible with a casual tourist market. As EV traffic picks up, proprietary charge cards could be a potential barrier to electric vehicle tourism.

Destinations

Many popular destinations and activities in Oregon are ideal opportunities for electric travel. In analyzing the adaptability of a trip from gas to EV travel, distance traveled on primary and secondary trips and time at each destination influence how well EVs might fit into the equation. Here we have analyzed Oregon’s three most visited tourism regions: the Portland Metropolitan area, the Oregon Coast, and the Willamette Valley, and supplied sample EV tours for each region. Tours are planned to accommodate the range of the Nissan Leaf or other PEV, and listed charging stations are based on plans by ECOTality for station siting. Although these charging stations could still be used by a traveler in a PHEV to achieve better gas mileage, all of these trips could be done in one charge in a PHEV such as the Chevrolet Volt.

Portland

Portland makes up a large portion of both the origins and destinations of Oregon’s travel market. Of

the 27.5 million trips made to Oregon in 2009, 30% included time spent in Portland (Longwoods, 2010b). But Portland is not representative of the travel market for the state; the Portland traveler is a unique market segment with different trip purposes and modes of travel than the average Oregon visitor.

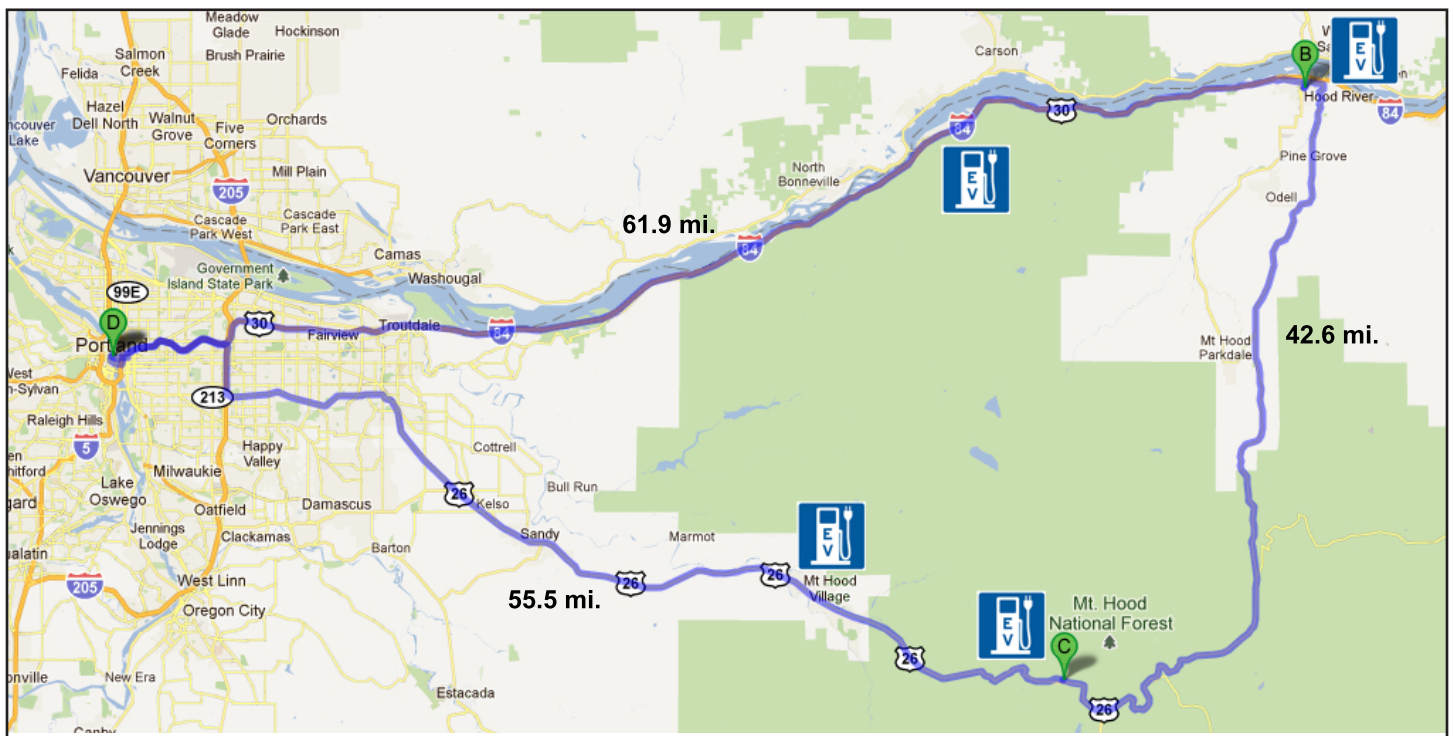
Most visitors to Portland are from Washington and Oregon, a group Travel Portland calls “rubber tire” visitors because they arrive driving their own vehicles (Veronica Rinard, personal communication, June 13 2011). However, compared to the state tourism market as a whole, travelers visiting Portland are 10% less likely (74%) to arrive by private vehicle, and 10% more likely to rent a car (19%) than state travelers overall. The Portland International Airport (PDX) is an important portal to the city. Of the travelers that arrived in PDX in 2008, one in five rented a car. The car rental market among Portland visitors is an ideal target for EVs, as destinations within and around Portland are well within EV range and will be connected by a network of charging station infrastructure.

Visitors to Portland often come to attend a special event (41% of marketable trips), at twice the rate of visitors to the state as a whole (19% of marketable trips). Portland’s convention center, concert venues and sports arenas are all regional draws that attract visitors from

within and outside of the state. Of all overnight trips to Portland, 16% were business related, a 50% increase over Oregon as a whole. Business conventions, sports events and concerts are ideal events for EV drivers, as they involve staying in one place for several hours. An EV driver could travel from as far away as Salem or Vancouver on one charge in a BEV, or from Seattle or Eugene in a PHEV, charge during their event, and then drive home that night or the next day. In order for this opportunity to come to fruition, event centers such as the Rose Garden, the Oregon Convention Center or the Oregon Zoo must take the initiative to provide the service, or seek funding from initial demonstration projects. The Oregon Museum of Science and Industry has done just that, and a set of EV chargers were installed in their parking lot this year.

Portland also acts as a gateway to other scenic areas in the vicinity. Visitors often make secondary trips to areas outside the city, trips for which EVs or PHEVs may be appropriate depending upon the distance from the city. The top three areas visited while visiting Portland are The Oregon Coast, The Columbia River Gorge, and the Willamette Valley (Longwoods, 2010b). While ODOT’s planned charging stations (Appendix A) will enable all of those regions to be accessible from Portland by BEV, the destinations themselves will require

Figure 4: Hood River Getaway



both quick chargers or Level II chargers and ancillary activities commensurate with the time needed to re-charge.

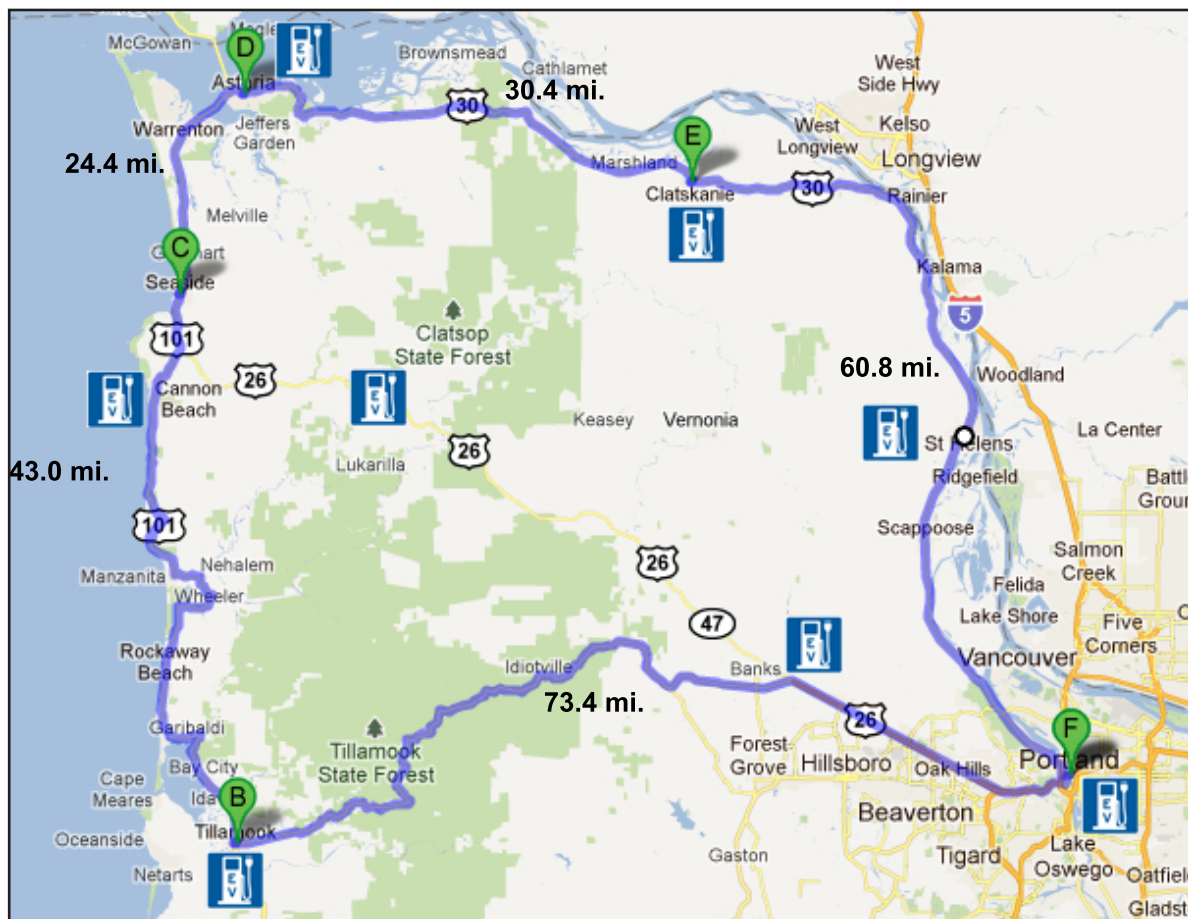
Figure 4 shows a sample route from Portland to Hood River by EV. The EV symbol on the maps represent planned DC quick charging station locations. A visitor might rent an EV in Portland and then drive to Hood River for a summer getaway of wind surfing and hiking (Point B). At slightly under 65 miles, this leg of the trip would be close to the limit of a BEV's range, but well within reason for a PHEV. A traveler could hike or wind surf by day, while charging their car in the evenings with a Level I/II charger at their hotel in Hood River. On the return trip, this tour routes the tourist up to Mt. Hood for stunning views and a trip to Government Camp (Point C), an ECOTality quick charge site (Appendix A). After a short half visit while their car re-charges, the traveler is ready to continue on to Portland for an evening in the city (Point D).

Oregon Coast

The Oregon Coast sees more tourist traffic per year than any other region of the state (See Figure 1, pg. 6). This area also has the largest proportion of marketable leisure trips, at 61%. These are also made primarily by private automobile: visitors to the Oregon Coast utilize personal vehicles 90% of the time, significantly more than for any other region in Oregon. Also, 54% of overnight marketable trips to the Coast originate in Portland, meaning charging infrastructure along the highways leading to and from the city will be especially critical to support EV trips to this region. (Longwoods, 2010c)

Given that most Oregon Coast visitors are driving personal vehicles, as typical EV travelers to the region would also likely be driving their own car, as opposed to driving a rental. In 2009, 58% of Oregon Coast leisure travelers booked a night in a hotel, motel or resort, and 19% stayed in an RV park or campground (Longwoods, 2010c). The campground segment of the tourist industry is particularly interesting, as RV faci-

Figure 5: Oregon Coast Tour



ties already have 240 Volt outlets on site. Campgrounds and small towns are close enough to each other along the coast that an interspersed selection of Level II and DC quick charging stations would guarantee sufficient support for travelers.

In Figure 5, the blue line depicts a trip originating in Portland with a charge at a private residence in preparation for a four day vacation along the Coast. On the first day, the limits of battery technology could take a traveler to Tillamook, a 70 mile drive, on one charge, although the more conservative might wish to charge along the way at the outskirts of Washington County, in Hillsboro or Forest Grove. Much like the Hood River Wine Tour outlined in Figure 4, this trip involves mostly Level I/II charging overnight at hotels or motels, which is possible due to the near proximity of each destination town to each other. One could spend the night at Tillamook (Point B), Seaside (Point C) and Astoria (Point D), charging in the evenings at hotels, before returning home to Portland, or take 4-5 hours to enjoy Seaside while recharging at a Level II charge station on the way from Tillamook to Astoria. The last leg of the journey, from Astoria back to Portland, about 100 miles of driving, is broken up here into two segments with a 20-minute stop for a quick-charge in Clatskanie (Figure 5, Point E).

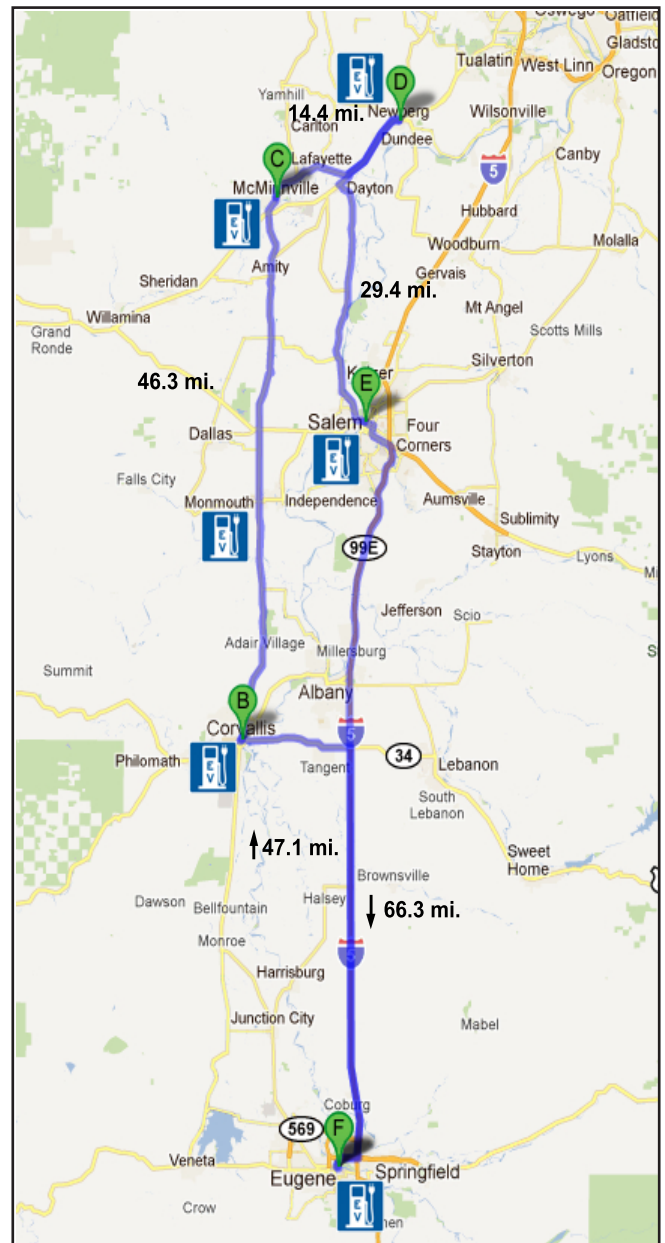
Willamette Valley

Although many tourists visit the Columbia River Gorge from Portland, the Willamette Valley receives more tourist traffic overall than any region in the state besides Portland and the Coast. And unlike trips to either the Coast or to Portland, over half of Portland's overnight trips in 2009 (53%) were to visit friends and relatives. Twenty-nine percent of these visitors stay in an RV Park or campground, while another 25% stay in Motels and 21% stay at the residence of a friend or family member (Longwoods, 2010e). Because the Valley contains three cities participating in the ECOTality EV Project--Salem, Eugene and Corvallis--the area will likely have a wealth of Level II chargers available. However, depending on the distance traveled to get to the Valley, the trip may require a quick-charge along the highway.

Available statistics for the Willamette Valley leisure market are somewhat limited. The Longwoods survey only contains data on trip destinations and travel

modes for marketable overnight trips. While this makes up a significant percentage of trips in Portland and along the Coast, in the Willamette Valley this makes up only 38% of the region's overnight travel sector. No data is currently available for the travel behavior of the 53% previously mentioned who come to visit friends and relatives, as those trips are not considered marketable. Within this limited dataset of marketable overnight trips, however, over a third (37%) of Longwoods survey participants shopped during their trip to the Willamette Valley. Visitors most often noted "historic places" as a special activity (49%), along with "cultural activities/attractions" (29%). (Longwoods, 2010e)

Figure 6: Willamette Valley Wine Tour



It is especially notable that wine tasting and wine tours, considered a growing pillar of the Willamette Valley tourist industry, was the second to least common “Activity of special interest” named by this group, at 12% (Longwoods, 2010e). It is unknown whether the trend among Oregon travelers of favoring historic and cultural activities and destinations over the highly publicized winery circuit would carry over to other overnight trips.

The map in Figure 6 charts a weekend trip within the Willamette Valley starting and ending in Eugene, highlighting a cluster of wineries north of Salem. Although travel bureaus might market a trip of this nature as a wine tour, one could easily modify it to fit other purposes such as fishing or shopping – the wealth of activities in the Valley and the variety of charging stations and speeds will make EV travel in the Willamette Valley flexible and convenient. Beginning in Eugene (Figure 6, Point A), travelers would drive 47.1 miles to Corvallis (Point B), where they would have to stop downtown to use a quick charge station and visit a café or walk along the waterfront park for 20 minutes. Back on the road, it would be another 46.3 miles to McMinnville, where they might stay at a bed and breakfast and spend the following day visiting tasting rooms in McMinnville and Newberg (Points C and D). Although McMinnville will have an ECOtality quick charger, a traveler could also likely use a slower charge overnight to power up for the ride home. If the vehicle used were a BEV, the return trip along I-5 would include one more mid-trip quick charge in Salem (Point E).

Opportunities and Barriers

Transitioning travelers from ICEs to EVs will require ingenuity and resourceful leveraging of existing opportunities. Fortunately, there are several illustrative examples of programs or promotional deals from abroad that have some relevance in Oregon. In Japan, the Kyoto prefecture offers discounted admission to 27 temple sites for visitors who arrive driving an EV or PHEV (Souza, 2010). The Swiss conceived of Alpmobil, a series of Norwegian EVs available to rent at daily rates from train stations and hotels, in the hopes of encouraging quiet, pollution-free alpine travel (Green tourism proj-

ect, 2010). In Hawaii the tourist-focused car sharing company Green Car Hawaii received a \$200,000 grant to introduce EV car sharing at hotels (Denison, 2011).

Opportunities for promotions like these can be found in the Oregon tourism industry as well. What follows are some existing programs that might be used to leverage these opportunities, as well as some much-needed areas of innovation.

Promotions, Discounts, and Branding

Like Kyoto’s discounted temple admissions, many events or destinations in Oregon could encourage EV use by offering special rates for EV drivers, or even something as simple as a free drink at the hotel bar. Discounts could assuage the perception on the part of consumers that EVs are prohibitively expensive. Once charging becomes a commodity that users pay for, offering free charging to customers could have the added benefit of attracting EV users for the free power-up. Promotions like this can help businesses build a brand as an eco-friendly business. Travel Oregon has just launched a program as part of its Travel Oregon Forever initiative to recognize sustainable hospitality businesses. EV friendliness could become one of the criteria for certification.

Yet another opportunity for EV promotion and development might be an EV package vacation. Such a concept would require partnerships across businesses, to offer, for example, an EV rental for a weekend with two nights at an EV-friendly hotel, or an EV rental with reduced rate ski passes to Mt. Hood Meadows and free charging on the mountain. Packages such as this have the added benefit of being educational tools. They would show travelers what is possible in an EV, and advertise charging station locations.

Education

Perhaps the greatest barrier Oregon will experience on the road to EV adoption is the fear, anxiety and lack of information that accompanies any major transition. For this reason, education and information will be critical to making EV travel a comfortable, memorable and happy experience for newer EV drivers. There are several specific types of information that will be critical to supply to EV drivers, either through rental companies or through tourism commissions and chambers of

commerce.

First, drawing a picture of a complete trip from start to finish through products like package vacations or a map of day or overnight trips would make trip planning easier for someone who has never used an EV before, or for EV owners new to travel in Oregon. Maps should include mileage between destinations, and charging station locations and available levels. This information would also ease range anxiety, as drivers could plan according to available charging infrastructure and avoid being stranded on a dead battery. These maps could also be used to promote important cultural and natural assets, such as Oregon's Scenic Byways, two of which have been designated as All-American Roads.

Another critical gap in both services and education that will need to be filled is roadside assistance. Because of range anxiety, rental companies and roadside assistance services like AAA will have to intentionally plan to address this fear head-on by offering roadside assistance services should a traveler run out of juice.

Education will also require use of popular media outlets. Travel Portland promotes trips and destinations using what they call Fam-Tours, short for Familiarization Tours. Travel Portland will invite a magazine or blog to go on a tour of their design in exchange for writing a review of the trip. This provides media exposure to novel travel experiences, and can help other travelers envision themselves on a similar trip.

Constraints

Some barriers are not so easily addressed by policymakers. Certain types of trips lend themselves to EV use more than others, either due to distance between the origin and the destination, or because of the battery depleting effects of weather extremes.

Charging stations can easily be provided to accommodate urban trips, but supporting EV trips to remote undeveloped locations provides a unique challenge. Oregon has been branded as a place for outdoor recreation, and 24% of Oregon visitors list their primary trip purpose as outdoor recreation (Longwoods 2010a). Some of the more visited outdoor destinations in the state have well developed visitor centers and ranger stations where charging infrastructure might be located. But for hikers, anglers, backpackers, kayakers, and others whose drive ends at a trailhead, charging will have to take place at a restaurant or gas station along the way

to the final trip destination.

Longer trips also become more complicated for BEV drivers. If a driver has to stop for 20 to 30 minutes every 100 miles, a three-hour trip by ICE could become four by BEV. These stops are both a nuisance and a potential opportunity. Spending a routine 20 minutes at a gas station could be a painful experience. But appropriate and inviting ancillary activities and business models alongside charging stations could turn the stop into an anticipated part of the journey. Depending on the target demographic for the area, this might mean food stands, short nature walks, interpretive centers, or any number of other half-hour activities.

Next Steps

- OUTREACH to hotels, taxi companies, rental car companies, tour businesses and others to educate professionals about electric vehicles and the opportunities available to them through tax credits or partnerships.
- PROMOTION OF EVS as part of Oregon's brand through tourism offices and commissions. Incorporation of EV-friendliness into existing or new green certification processes for the travel industry.
- FURTHER RESEARCH regarding the economic impact of EV-friendly services on tourist businesses, as well as more data gathering on distances traveled by vehicle type, trip purpose and destination.
- DEVELOP SUPPORT INFORMATION for EV travelers, both in paper form and online, with guides to charging stations, suggested tours, and contact information for roadside assistance.

Conclusion

The Oregon tourism industry has much to gain from electric vehicle adoption. Establishing EV support as part of an individual business' offerings or as a state attraction will capture this new market in its infancy. Doing so will build loyalty within an existing green tourism market, and attract new EV drivers as the cars begin to proliferate. Building a strong support network for EVs will also send a strong message to visitors that driving an EV can be an easy, attractive and green way to travel.

Oregon has many assets and attractions that lend themselves to EV travel, and a supportive government that is committed to providing a robust charging

network. By developing convenient charging stations, by providing competitively priced electric car rental services, by creating and distributing critical educational materials and maps, using positive media coverage, and creating special promotions that feature EV travel to Oregon's cultural and natural attractions, Oregon tourism and EV adoption can fully leverage this opportunity for mutual gains. Whether or not the US reaches Obama's goal of one million EVs by 2015, Oregon can be a national role model for transportation electrification.

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Works Cited

Addison, J. (2010, February 17). Top 10 electric car maker 2011. Clean Fleet Report. Retrieved from <http://www.cleanfleetreport.com/clean-fleet-articles/top-electric-cars-2010/>

Addison, J. (2011, Jan. 6). Enterprise starts renting the Chevy Volt electric car. Clean Fleet Report. Retrieved from <http://www.cleanfleetreport.com/clean-fleet-articles/enterprise-rental-chevrolet-volt/>

Airport Futures. (2009). Portland airport futures: economic development inventory. Portland, OR: City of Portland Bureau of Planning and Sustainability and Port of Portland. Retrieved from <http://www.portlandonline.com/bps/index.cfm?a=247817&c=44799>

Banks, G. (2010, December 7). Hertz and Enterprise to rent evs in 2011. Gizmag. Retrieved from <http://www.gizmag.com/hertz-plans-to-rent-evs-by-the-hour-in-2011/17196/>

Beard, G. (2011, April 1). Electric Vehicles: Are we in the driver's seat? Transportation Seminar Series, Portland State University, Portland, OR.

Better Place. (2010). Better Place to bring electric taxi programs to the San Francisco Bay area. Press Release. Retrieved from <http://www.betterplace.com/global-progress-north-america-california>

Chevrolet. (2011). 2011 Volt: It's more car than electric. Retrieved from <http://www.chevrolet.com/volt/>

CMIGreen/Community Marketing, Inc. San Francisco. (2010). 2nd Annual Green Traveler Study 2010-2011. San Francisco: Roth, T.

Deaton, J. (2010, July 28). Five states for Nissan Leaf release announced. U.S. News. Retrieved from <http://usnews.rankingsandreviews.com/cars-trucks/daily-news/100728-Five-States-for-Nissan-Leaf-Release-Announced/>

Deloitte Consulting LLC. (2010). Gaining traction: a customer view of electric vehicle adoption in the U.S automotive market. Giffi, C. et al.

Denison, C. (2011, March 30). "Electric car sharing comes to Hawaii." Earth Techling. Retrieved from <http://www.earthtechling.com/2011/03/electric-car-sharing-comes-to-hawaii/>

ECOTALITY. (2010, Sept. 21). ECOTALITY reveals ev infrastructure plan for Western Oregon. Press Release. Retrieved from http://www.ecotality.com/pressreleases/09222010_ECOTALITY_reveals_EV_infrastructure_plan_for_Western_Oregon.pdf

Electrification Coalition. (2010). Electrification roadmap: Revolutionizing transportation and achieving energy security.

(2005) Enterprise Rent-A-Car Company. International Directory of Company Histories, Vol.69. St. James Press. Retrieved from <http://www.fundinguniverse.com/company-histories/Enterprise-RentACar-Company-Company-History.html>

ESQ Communications. (2011). Toyota Prius Plug-In Hybrid Demonstration Program. Retrieved from <http://www.toyota.com/toyotaSearch/esq?ESQNAV=1&>

filter=Environmental&categories=Prius%20Plug-In&linkinfo=27--portland-state-university

Gordon-Bloomfield, N. (2010, September 10). Just who is a typical 2011 Nissan Leaf buyer? We find out. All Cars Electric. Retrieved from http://www.allcarselectric.com/news/1049202_just-who-is-a-typical-2011-nissan-leaf-buyer-we-find-out

(2010) Green tourism project introduces Alpmobil to Alpine tourism. ETurboNews. Retrieved from <http://www.eturbonews.com/17039/green-tourism-project-introduces-alpmobil-alpine-tourism>

Gunderson, L. (2011, March 8). Fred Meyer to add charging stations for electric cars. Retrieved from http://blog.oregonlive.com/windowshop/2011/03/fred_meyer_will_offer_charging.html

Hasek, G. (2011, January 13). Sleeping Lady to install electric vehicle charging station. Green Lodging News. Retrieved from <http://www.greenlodgingnews.com/>

Hasek, G. (2011, June 6). San Francisco hotel chooses ParkPod for vehicle charging. Green Lodging News. Retrieved from <http://www.greenlodgingnews.com/>

Hasek, G. (2011, March 24). EV charging stations popping up to meet needs of travelers. Green Lodging News. Retrieved from <http://www.greenlodgingnews.com/>

Hoffman, J. (2011, June 10). Electric-car chargers land at Stevens Pass. ESPN Action Sports. Retrieved from <http://sports.espn.go.com/action/snowboarding/news/story?id=6647940>

Horowitz, D. (2009). Daily VMT (Vehicle Miles of Travel) Per Person 1990 to 2009. Metro. Retrieved from http://library.oregonmetro.gov/files/1990-2009_dvmt-portland-us.pdf

Jenkins, T. (2009). Top local tourist attractions. Portland, OR: Portland Business Journal, Oregon Business Magazine.

Karson, D. (2011, June 13). Can electric cars put a jolt in the job market? National Public Radio. Retrieved from <http://www.npr.org/2011/06/13/137044209/can-electric-cars-put-a-jolt-in-the-job-market>

Kiec, J. (2010). Electric vehicle green hotel shuttles. EcoGreenHotel. Retrieved from <http://www.ecogreenhotel.com/Electric-Vehicle-Green-Hotel-Shuttles.php>

Kuo, I. (2011, January 11). Toyota Prius Plug-in: Can it measure up to Chevrolet, Ford and Nissan's offerings? Green Beat. Retrieved from <http://venturebeat.com/2011/01/11/toyota-prius-plug-in-electric-2012/>

Liggett, B. (2011, February 17). Lack of standard for fast-charging ev stations means some cars can't plug in. Inhabitat. Retrieved from <http://inhabitat.com/lack-of-standard-for-fast-charging-ev-stations-means-some-cars-cant-plug-in/>

Longwoods Travel USA. (2010a). Oregon 2009 visitor report. Portland, OR: Travel Oregon.

Longwoods Travel, USA. (2010b). Oregon 2009 regional visitor research: Greater Portland. Portland, OR: Travel Portland.

Longwoods Travel, USA. (2010c). Oregon 2009 regional visitor research: The Coast. Portland, OR: Travel Portland.

Longwoods Travel, USA. (2010d). Oregon 2009 regional visitor research: Mount Hood - Columbia River Gorge. Portland, OR: Travel Portland.

Longwoods Travel, USA. (2010e). Oregon 2009 regional visitor research: Willamette Valley. Portland, OR: Travel Portland.

Alfieri, M. (2011, August). Getting a Charge Out of RV Parks. MotorHome. p. 17.

Oregon Department of Transportation. (2011, August 16). Oregon Department of Transportation selects AeroVironment to install 22 (twenty-two) fast chargers for electric vehicles (EVs) in Northwest Oregon. Press Release. Salem: Oregon Department on Transportation.

(N.D.). Oregon Tourism. Travel Oregon website. Retrieved from <http://industry.traveloregon.com/upload/otc/departments/2011drivingeconomicgrowth.pdf>

(2007). Oregon Tourism Commission. Travel Oregon website. Retrieved from <http://industry.traveloregon.com/>

Richardson, K. (2011, June). Electrifying Oregon. Oregon Travel Lodging News. Oregon: Oregon Restaurant and Lodging Association.

School of Public and Environmental Affairs at Indiana University. (2011). Plug-in electric vehicles: a practical plan for progress. Bloomington, Indiana: Dr. Graham, J. et al. Retrieved from http://www.indiana.edu/~spea/pubs/TEP_combined.pdf

Siemers, E. (2011, January 18). Oregon bets big on electric cars. Drive Oregon. Retrieved from <http://driveoregon.org/news/oregon-bets-big-on-electric-cars/>

Souza, F. (2010, June 11). Electric cars charge up tourism. Green ITers. Retrieved from <http://www.greeniters.com/forum/topics/ev-hybrid-news-in-japan-ju-ne?groupUrl=theelectricvehicleevgroup>

Sustainable Travel International. (2011). Sustainable tourism, travel and the green movement: Research and statistics 2001-2010. White Salmon, WA.

The City of Portland. (2009). Electric vehicles: The Portland way. Portland, OR: Travel Oregon. (2010). Oregon tourism and hospitality indicators report. Issue

7, Winter 2009, Portland, OR.

Txchnologist. (2011, April 15). Can the U.S. put 1 million evs on the road by 2015? GE. Retrieved from <http://www.txchnologist.com/2011/can-the-u-s-put-1-million-evs-on-the-road-by-2015>

U.S. Travelers Association. (2010). Travel Oregon/Green traveler analysis. Portland, OR: Travel Oregon.

Van Berkel, J. (2011, June 9). First electric-car charging stations go online in Seattle. The Seattle Times. Retrieved from http://seattletimes.nwsourc.com/html/localnews/2015278394_electriccars10m.html

Washington State Department of Transportation (WSDOT). (2010). West Coast Green Highway. Retrieved from <http://westcoastgreenhighway.com/partners.htm>

Oregon Department of Transportation. (2010). Office of innovative partnerships and alternative funding. Retrieved from http://www.oregon.gov/ODOT/HWY/OIPP/inn_charging_stations.shtml

Yan, F. and Durfee, D. (2011, July 3). Electric cars remain tough sell in China. NY Times. Retrieved from http://www.nytimes.com/2011/07/04/business/energy-environment/04green.html?_r=1&pagewanted=2

