BUSINESS OPPORTUNITIES AND THE SOCIO-ECONOMIC BENEFITS OF AN
ALL-ELECTRIC VEHICLE ARCATA

By

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Abstract

BUSINESS OPPORTUNITIES AND THE SOCIO-ECONOMIC BENEFITS OF AN ALL-ELECTRIC VEHICLE ARCATA

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This project will examine the policies, business opportunities and economic impacts that will be necessary for Arcata to become 100% electric vehicle (EV) city. The focus of this work is to get the maximum adoption of EVs in all of Humboldt County by learning from cities that are currently engaging in promoting EVs. This paper will focus on the following cities: Barcelona, Portland, Amsterdam, Stockholm and EV Town. Early EV adoption is an opportunity to embrace new technology in an environmentally sound way. This movement goes beyond the norm to imagining a new future to keep the earth thriving for future generations. Establishing local infrastructure is also a marketing strategy to open up new forms of tourism to the area. This will bring in a fleet of EV owners to visit the community as an environmental leader. The goal of achieving a 100% EV city would benefit Arcata in that there will be no longer a dependence on foreign oil.
Acknowledgements

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Introduction

The world is on a trajectory toward catastrophic climate change due to rising greenhouse gas emissions from fossil fuel use. Currently most of the United States’ economy is powered by fossil fuels. Transportation is responsible for 30% of greenhouse gas emissions from the US. It’s hard to view the world today as an oasis where current acknowledgement by President Obama in response to climate change is that the country and the world needs to find solutions so future generations may survive. Many state and local governments are already planning for the impacts of the climate crisis and its effects on our local ecosystems. Wealthy fossil fuel companies, on the other hand, are lobbying strongly against climate policy. If fossil fuel reserves are used, the earth will be ravaged by catastrophic climate change. Therefore coming up with clean energy policies, technologies and businesses so the world can dramatically reduce greenhouse gas emissions is absolutely critical for our finite planet ("Global Climate Change: Energy Innovations", 2015).

Numerous climate summits have been held, gathering political leaders around the world to prioritize actions in hopes of avoiding climate tipping points. Continuing with business as usual will threaten humanity’s survival. It is terrible to take this finite planet and use it for profits. It’s necessary to begin a drastic reduction of greenhouse gas emissions today.

Modern economic markets lead to overuse of the Earth’s renewable and non-renewable resources because negative externalities are not priced. People are consuming
resources at a faster rate than the earth can renew them. These negative externalities are not reflected in market prices resulting in increasing pollution that is frequently exported to the developing world (Greenpeace International, 2009). Worldwide, communities are beginning to feel the effects of pollution that is damaging the earth’s waterways, forests, ice caps, and air quality. Hence, as a matter of planetary survival, each nation must correctly account for the effects of negative externalities in the current economic system.

This paper seeks to understand the policies, incentives and business models necessary to make all vehicles operating in the city of Arcata fully electric. This work shall examine current incentives at the federal and state level, city-level EV-friendly policies from around the world in order to assess the best practices that can be adopted in Arcata, California. Based on this research, a broad mix of policies, business models, charging infrastructure and community awareness are necessary for the rapid uptake of EVs among the population. It is in Arcata’s interest to go 100% EV because it can be a global leader and also benefit from improved air quality, reduced noise, increased job creation, etc. The primary goal is to outline Arcata to the world as a pioneering small town for further acknowledgement and potential for good practice outside of the area.
History of EVs

Electric vehicles can be traced back to over 100 years ago. Beginning in 1832 when Robert Anderson, from Scotland, built the first ever prototype setting the stones for future entrepreneurs. Then came Thomas Davenport, from the United States, who invented the first operational direct current electrical motor in a vehicle. He used it to operate a small model car that operated on a circular electrified track. By the 1930s EVs were overtaken by cars powered by internal combustion engine (ICE) technology. The domination of ICE technology has continued ever since. Within the last 5 years the world has begun to see mass-market introductions of EVs due to increased oil prices, decreasing battery costs, improved vehicle life and performance and government incentives, including non-monetary incentives like carpool lane access, etc. In fact in 2011, there was a new global peak of 50,000 EVs sold and by 2012 the EV stock exceeded 180,000 (Global EV Outlook, p.8). Other reasons include activist consumers who want to reduce their carbon footprint and reduce local air pollutions.

The *Global EV Outlook*, with data from the 15 member governments of the Electric Vehicle Initiative (EVI), shows that the United States invested over 8.7 billion USD funds in research and development since 2008, lowering total battery costs from 1,000 USD/kWh in 2008 to 485 USD/kWh in 2012. The increased market has facilitated an influx of environmental goals set by various government officials and a technical shift in demand for EVs due to rising oil prices. These new innovations include wireless charging, car sharing and workplace charging stations. Governments are assisting EV
growth via investment strategies and consumer incentives as well (Global EV Outlook, p.8).

Current EV Manufacturers

Below are summaries of two most popular EV manufactures and are well known within the EV industry. Tesla is a high end manufacturer known for their lithium ion powered batteries along with their high performance, top of the line vehicles. Nissan is also manufactures EVs but is a more economically viable option for most consumers. The background on both car manufactures give insight into the world of sustainable driving.

Tesla

Tesla is one of the leading contributors to accelerating EV manufacturing by making all their patents freely available for other competitors to use. Encouraging the development of RD&D spurred to ensure vehicle technology is at its highest performance at lowest cost. Their open market viewpoint is truly industry leading by asking their consumers and industry partners to take the next step in a sustainable future. Tesla’s newest supercharge station is free to Model S owners and provides a full charge in as little as 20 minutes, designed for a 300 mile range. These stations are strategically placed along well-traveled highways in North America, Europe and Asia ("Supercharger | Tesla Motors")

The Model S is also designed for battery swapping, which is faster, than filling a conventional vehicles gas tank. This swap happens in just 90 seconds and is priced based
at slightly less cost than the price to fill the tank of gasoline for a premium sedan (Tesla, "Battery Swap").

**Nissan**

Looking at more economical approach to vehicles that are purchased amongst the middle class, Nissan is also in the running with a push for more EVs on the road. They will be building 1,000 EV charging stations beginning January 2015 stretching into April 2016. On the other hand, BMW and Volkswagen announced a few days earlier that they will be joining forces to build 100 EV charging stations along the East and West Coast (NY Times, 2015). Tesla and their proactive efforts laid out the increased trend for EV adoption for an all-electric future. Although Nissan did not state where the EV charging stations will be located, the NY Times speculated that they will be built in urban areas. The high-speed charges can fully charge a battery in 20 to 30 minutes. The stations will include dual charges, both compatible with the two main operating battery types. Nissan is also having their stations run by third-party networks like NRG eVgo, unlike BMW and VW (NY Times, 2015). The trend in the US is an avid increase in charging stations along with Humboldt County (Schatz Energy Research Center, 2013, p. 1). Another key source is to research where the energy is being derived from for the charging stations. An analysis on local impacts and clean energy sources will be further discussed later.
EV Sales and Incentives

Human activity is responsible for global warming calling for the Climate Action plan in 2009 created by President Obama. Its overall objective is the reduction of the total United States carbon emissions targeted at 17% below 2005 levels. This plan will stimulate job growth, energy research and tough fuel economy standards ("The President's Climate Action Plan", p. 4). Another initiative, brought on by the Obama Administration, is the EV Everywhere Grand Challenge, which focuses on the U.S. becoming the first nation to produce affordable plug-in electric vehicles for the average American family by the year 2022. Investments to reach these goals are; job growth and creation in the U.S. by improving its competitive position, reduction in dependency on foreign oil, monetary savings by the reduction in overall fuel costs for businesses and families, and the protection of overall health and safety by mitigating the impact of energy production and climate change (Energy.gov, 2015).

Policies supporting EV adoption in cities globally

According to The International Council on Clean Transportation, a written work by Mock and Yang, globally the sales of electric vehicles have grown from about 45,000 vehicles sold in 2011 to more than 200,000 in 2013. Figure 1 below shows that although fiscal incentives do matter, “a clear direct relationship remains elusive between national fiscal incentives and electric vehicles’ early market growth across each of the major
vehicle markets….This indicates both the limitation of fiscal policy and also the limited understanding of all the underlying factors and other policies that could help drive and sustain the electric vehicle marketplace (Mock, 2014).” Despite relatively high fiscal incentives, the current total market share of EVs for the United Kingdom seemed to be lower in comparison to other markets. This shows the illusive factors with a direct relationship between national fiscal incentives and EVs. Other underlining factors need to be analyzed and taken into account that could help drive and sustain the EV marketplace (Mock, 2014, p.3).

Figure 1. "A Global Comparison of Fiscal Incentive Policy For Electric Vehicles” Mock, P., & Yang, Z. (2014).
Figure 2 also illustrates as a large number of countries seek to address future energy requirements, as the goal set by the International Energy Agency’s (IEA) “2DS” scenario in which it would limit average global temperature increase to 2°C by the year 2050. This seeks to decarbonize the transport sector in achieving long-term solutions in reduction of greenhouse gases and other pollutants (International Energy Agency, 2013). This research outlines opportunities for increased market share of EVs for governments and private industries to accelerate this adoption for sustainable investment. EV growth in countries around the world will be analyzed with advantages and disadvantages, the impact and effective cost of EV ownership versus its gasoline powered counterpart.

Figure 2. "Role of Transport in CO2 Reduction", EV Global Outlook, p. 7.
In order to promote EV readiness and promotion, the City of Arcata will need to explore different incentives and opportunities. For proper market penetration strong government support on both the supply and demand side have shown an increase in EV adoption by consumers. Increased financial incentives readily available to consumers on the national and local levels have made it possible for the purchasing of EVs. The benefits of early adoption by local economies can give them a “leg-up” in the global market playing field. Car manufactures and consumers alike will have a growing confidence in the market if infrastructure deployment is seen in the area, a key incentive for an EV-friendly economy (Global EV Outlook, p. 19). Table 1 outlines the current national policy initiatives throughout many key countries working to strengthen EV adoption. It analysis policy support and market dynamics throughout different markets and countries giving insight to global deployment efforts. EV Global Outlook states, “In most cases, strong government support on both demand and supply sides have contributed to rising market penetration. Well-designed financial incentives for consumers at the national and local levels are lowering upfront costs for EVs and EVSE, quickening sales and infrastructure deployment in a number of global markets. Such incentives are not only a benefit to early adopters, but give car manufacturers and other consumers’ confidence in market development (EV Global Outlook, p. 19).”
<table>
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<tr>
<th>Country</th>
<th>Financial Infrastructure RD&amp;D</th>
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<tr>
<td>China</td>
<td>Purchase subsidies for vehicles of up to RMB 60,000.</td>
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<td></td>
<td>- RMB 6.95 billion for demonstration projects.</td>
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<td>Denmark</td>
<td>Exemption from registration and road taxes.</td>
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<td>DKK 70 million for development of charging infrastructure.</td>
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<td></td>
<td>Focus on integrating EVs into the smart grid.</td>
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<tr>
<td>Finland</td>
<td>EUR 5 million reserved for vehicles participating in national EV development programme, ending in 2013.</td>
</tr>
<tr>
<td></td>
<td>EUR 5 million reserved for infrastructure as part of the national EV development programme, ending in 2013.</td>
</tr>
<tr>
<td>France</td>
<td>EUR 450 million in rebates given to consumers buying efficient vehicles, with 90% of that amount from fees on inefficient vehicles. Remaining 10% (EUR 45M) is a direct subsidy.</td>
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<td></td>
<td>EUR 50 million to cover 50% of EVSE cost (equipment and installation).</td>
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<td></td>
<td>EUR 140 million budget with focus on vehicle RD&amp;D.</td>
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<td>Germany</td>
<td>Exemption from road taxes.</td>
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<td></td>
<td>Four regions nominated as showcase regions for BEVs and PHEVs.</td>
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<tr>
<td></td>
<td>Financial support granted for R&amp;D for electric drivetrains, creation and optimisation of value chain, information and communications technology (ICT), and battery research.</td>
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<tr>
<td>India</td>
<td>INR 100,000 or 20% of cost of vehicle, whichever is less. Reduced excise duties on BEV/PHEV's.</td>
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<td>The National Mission for Electric Mobility will facilitate installation of charging infrastructure.</td>
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<td></td>
<td>Building R&amp;D capability through joint efforts across government, industry, and academia. Focus on battery cells and management systems.</td>
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<tr>
<td>Italy</td>
<td>EUR 1.5 million for consumer incentives, ending in 2014.</td>
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<td>Four regions nominated as showcase regions for BEVs and PHEVs.</td>
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<tr>
<td></td>
<td>Financial support granted for R&amp;D for electric drivetrains, creation and optimisation of value chain, information and communications technology (ICT), and battery research.</td>
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<tr>
<td>Japan</td>
<td>Support to pay for 1/2 of the price gap between EV and corresponding ICE vehicles, up to YEN 1 million per vehicle.</td>
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<tr>
<td></td>
<td>Support to pay for 1/2 of the price of EVSE (up to YEN 1.5 million per charger).</td>
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<td>Major focus on infrastructure RD&amp;D.</td>
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<td>Netherlands</td>
<td>Tax reduction on vehicles amounting to 10-12% net of the investment.</td>
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<td>400 charging points supported through incentives.</td>
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<td></td>
<td>Focus on battery RD&amp;D (30% of 2012 spending).</td>
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<tr>
<td>Spain</td>
<td>Incentives up to 25% of vehicle purchase price before taxes, up to EUR 6,000. Additional incentives of up to EUR 2,000 per EV/PHEV also possible.</td>
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<td>Public incentives for a pilot demonstration project. Incentives for charging infrastructure in collaboration between the national government and regional administrations.</td>
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<td>Five major RD&amp;D programmes are operational with incentives for specific projects.</td>
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<td>Sweden</td>
<td>EUR 4,500 for vehicles with emissions of less than 50 grams of CO₂/km. EUR 20 million for 2012-2014 super car rebate.</td>
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<td>No general support for charging points besides RD&amp;D funding (EUR 1 million in 2012).</td>
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<td>EUR 2.5 million for battery RD&amp;D.</td>
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Arcata can also learn from pilot cities such as Amsterdam, Barcelona, Hamburg and San Francisco, just to name a few, to learn about the transformation of local markets so as not to bear all of the costs of the beginning phases of introducing incentives to change the local economy. *EVI and partner organizations* published the *EV City Casebook*, emphasizing the EV deployment efforts globally. This case book outlines 16 cities and regions across a total of 9 countries holding 30% of worldwide EV stock and show the highlights of early leaders in EV deployment along with challenges (Global EV Outlook, p. 22).

The City of Amsterdam is expecting that nearly all of the total kilometers driven will be powered by electricity driven by windmills, solar panels, and biomass plants all by the year 2040. Figure 3 below, illustrates the Netherlands electricity mix, featuring natural gas at 62%, coal 23%, renewable energy at 8%, nuclear at 4%, and other at 4% as well. EV targets for the Netherlands are: 20,000 vehicles on the streets by 2015, 200,000 EV’s by the year 2020 and 1 million EV’s by the year 2050. The tourist experience will be more enjoyable by canals filled with electric boats, not adding to the noise pollution seen today. Figure 5 is a description of the transportation mix for the Netherlands, with 44% passenger vehicle, 30% public transport, 22% biking and 4% walking. The city itself
even expects to smell and sound better while cargo is expected to be transported via road and water using electric power. Amsterdam is also expected to have 10,000 EVs on the road by 2015. Although prices for the EVs are higher than traditional vehicles but with increased electric cars being produced, prices are expected to fall (EV City Casebook, p. 9).

Figure 3 "Amsterdam Snap Shot" EV City Casebook, p. 8.

Figure 4 "Amsterdam Transportation Mix" (EV City Casebook, p. 8).
Figure 5, illustrates the transportation mix for Barcelona, Spain. A key incentive laid out by the Barcelona City Council is the public-private platform LIVE (Logistics for the Implementation of Electric Vehicles). LIVE was created with the following objectives: the creation of Living Labs, which demonstrates and promotes electric mobility projects; promotion of research and development; supporting local organizations at the national level and European projects and technology and knowledge programs at the university and professional level; creating the events that promote EVs and the creation of charging stations throughout the city (EV City Casebook, p. 13).

Barcelona, Spain is another gem laying the foundations down for an EV City. Barcelona being the second largest city in Spain has a high population density with most of the transportation system relying primarily on bus, metro, train and tram. A huge part of non-motorized transport equates to 41.7 percent all in thanks to “Bicing”, a public bike system with 35,000 daily users (EV City Casebook, p. 13).

Portland, Oregon is another city with an EV readiness plan underway. Figure 6, illustrated below, shows the transportation mix for Portland, Oregon, while Figure 7 gives insight to their total CO2 emission mix. The electrification strategy is about electrifying transportation with the first Metropolitan Area Express (Max) light rail trail since 1986. They seek to have a 30% percent reduction in total green gas emissions.
related to transportation by 2030, which totals to 39% of the total emissions currently. In addition to the reduction in emissions EVs will play a key role within this plan. The conditions for EVs are completely in the city’s favor with the average commute being 18.5 miles. The electricity prices are also cheap for consumers along with clean electricity systems in place.

Another key factor is the huge environmentally concerned public who support the goals of the Climate Action Plan. The current infrastructure for EVs is funded by the U.S. Department of Energy and has deployed 2,000 stations in the city and surrounding areas. Charging is therefore free to those participants who agree to anonymous data collection. Financial incentives also play a key role with the federal tax credit of up to $7,500 for PEV purchase. At the state level there is up to a $750 tax credit for residential charging station installation along with a business installation tax credit up to 35 percent (EV City Casebook, p. 55). “Businesses are eligible for up to 35 percent of the incremental cost between and ICE vehicle and an EV in Oregon Business Energy Tax
Credits (BETC) (EV City Casebook, p. 55).” Oregon also plans on designating $4 million for Oregon businesses interested in replacing diesel trucks with electric trucks (EV City Casebook, p. 55). Not only do you see incentives at the federal and state level but the universities are jumping on the EV movement as well. Portland State University has constructed “Electric Avenue” in the south end of downtown Portland city. “This project aims to showcase the interplay among electric vehicles, charging infrastructure, integrated transit, public greenway space, and urban design. All parking spaces on Electric Avenue are reserved for vehicles in the process of charging, with a single DC Quick Charge for up to one hour and Level II charging stations that serve seven parking spaces (EV City Casebook, p.56).”

Stockholm, Sweden is another innovator of EV infrastructure by seeking to be completely fossil free by the year 2050. Figure 8 shows the countries total electricity mix and nation EV Target of 6,000 EVs by the year 2015. The foundation for this goal is laid
out by; a large population of environmentally conscious people; having 90% of Stockholm’s electricity generated from hydro and nuclear sources; a high capacity electricity production system; low electricity costs driving a reduction in EV costs; and 65% of local households have access to engine block heaters and hence already have plugs in their vehicles. The European Commission even named the city the European Green Capital. The city council adopted the EV/PHEV strategy in May of 2011, with the goal of being fossil free in the inner-city by 2030, to then expand to the remaining regions by 2050. To reach these goals Sweden has encouraged the development of device regulations and standards, such as clearer indoor charging stations available for its citizens (EV City Casebook, p. 69).”

National incentives for EVs range from exemption from vehicle tax for the first five years, after initial purchase; reduction on tax rate for company vehicles that are EVs; and a Super Clean Car Premium, where purchasers of EVs receive 40,000 SEK in state funding. Stockholm is continuously encouraging EV adoption as they work toward a cleaner sustainable vehicle alternative.
Business models that support EV adoption

EV charging stations consist of non-residential locations where vehicles can conveniently plug-in their vehicles to an electrical source to re-charge their batteries. Public charging stations are built in public accessible places such as parking lots and off highways. Commercial charging stations are found in typical business establishments such as commercial buildings and public commercial parking lots. These charging stations are necessary for growing support of EV infrastructure for the growing fleet of EVs seen throughout California (Zhu, p. 5).

The national infrastructure in the Netherlands for rolling out EVs was surprisingly brought on by the private sector. This business opportunity was seized by Car2Go, a company that was launched out of Amsterdam with 300 smart-for-two EVs. The business model follows the public awareness and growing need for sustainable driving. Each vehicle can be picked-up and dropped off at any public parking spot inside the business area with no specific return time nor location. The vehicles can be charged by the minute at €.29/minute or €12.90/hour. Large fleets of electrical taxis are also active in the city. This is a huge savings in greenhouse gases because the average diesel taxi emits 35 times more nitrogen dioxide than the average city petrol vehicle, reducing pollution and improving the air quality for all to enjoy. Real time charging stations are also available and free for the public. There are approximately 1,000 charging stations scattered throughout the city and citizens have access to each location and availability through a real time open API system. (EV City Casebook, p. 12).
EV Town is another great innovator and promoter of an all-electric vehicle community. The efforts were brought by a collaboration of local business officials, government representatives, and other interested stakeholders who all believed in the benefits that EVs could offer the community of Bloomington-Normal, Illinois. The town aims at connecting interested members with potential EV ownership by helping them evaluate the costs in addition with viewing and test-driving the vehicles. The EV Town is not just a concept but also an organization that frames the community’s interest in sustainable practices. Normal, Illinois uses the EV community as a competitive advantage by having low cost EVs to help entice outside businesses and people to move to their town. This helps generate tax revenues for the community to further their commitment to sustainable practices. Local incentives also included qualifying EV and plug-in electric hybrids eligible for 1% local share of state sales tax, available to local residents and business owners (evtown.org).

**Lessons for Arcata from above experiences**

All of these noted city efforts are helping to raise the bar on EV infrastructure and is raising awareness and business opportunities for those to follow. Each City has its own play on reducing greenhouse gas emissions and has already seen the positive effects of combined efforts at the national level, state level, private and public sectors. Eliminating emissions needs to start somewhere and with greenhouse gas emissions being partially due to the transportation sector starting with EVs is only the beginning. There are numerous cities and companies working hand-in-hand to shape a sustainable market
growth, employing new innovative techniques and consumer awareness. In this section, the lessons from the experiences of cities globally in promoting EVs will be adapted to Arcata.

The policy efforts in Europe mirror some elements of the City of Arcata’s *Community Greenhouse Reduction Plan*, prepared in 2006. This plan is trying to raise community awareness about climate change and the efforts each individual can do on their own. Part of the plan is to also improve the bicycle infrastructure in creating more bike lanes, bridges and intersections to be more bicycle-friendly. An increase in bicycle parking will also be more plentiful ("Community Greenhouse Reduction Plan", p. 4). The City of Arcata can adopt some of Barcelona’s efforts in greenhouse gas emissions reduction such as projects and technology and knowledge programs at the university and professional level and creating the events that promote EVs and the creation of charging stations throughout the city in pursuit of providing opportunities for its citizens via entrepreneurial, technical and economic development.

**Economic impacts of 100% EV adoption in Arcata**

Thanks to the Schatz Energy Research Center, located at Humboldt State University, lead researchers partnered with PG&E along with the Redwood Coast Energy Authority (RCEA) to design a strategic plan for Humboldt County named *RePower Humboldt*. This plan is based on the parameters in delivering sustainable energy to consumers at a minimal cost. “Humboldt County has untapped renewable energy
resources including wind, wave, hydropower and biomass. Combined, these resources could provide about three times more electricity each year than we currently consume. If electricity is used for heating (with heat pumps) and transportation (with electric vehicles), there is enough renewable energy in Humboldt County to meet all of our present energy needs (Schatz Energy Research Center, 2013, p. 1).”

They are projecting helping with implementation of hundreds of new jobs and tens of millions of dollars, estimated to be generated from switching to local renewable energy by the year 2030. This will decrease greenhouse has emissions in the area by 33% to 45%. The switch will also help the economy by not relying so heavily on imports. RePower Humboldt is developing local infrastructure for the encouragement of EVs by providing 11 stations in the local area (Schatz Energy Research Center, 2013, p. 8).

**EV vs. Contemporary Vehicles**

EVs and plug-in hybrid vehicles (PHEVs) can offer a substantial cost advantage over comparable gasoline-fueled vehicles. The overall benefits to electric vehicle owners are simple: lower fuel costs and fewer maintenance obligations. EV Town gave great insight on a cost benefit analysis, as follows: “Vehicles using electricity as a supplemental or sole fuel source will require fewer dollars to operate. This is because the cost per mile will be less expensive with electricity compared to gasoline. The example below illustrates the saving presented by a Mitsubishi "i" (16kW battery) compared to a conventional gasoline-fueled vehicle that gets 30 miles per gallon. For the purposes of
this example, it is assumed that the cost per kWh of electricity is $0.12 while gasoline is $3.49 per gallon (no increases in electric or gas costs were assumed in future years) (evtown.org).”

Table 1 "Mitsubishi "i" versus Conventional Gas Vehicle", taken from www.evtown.org/about-ev-town/operating-costs.html, 2015

<table>
<thead>
<tr>
<th></th>
<th>Mitsubishi &quot;i&quot;</th>
<th>Conventional Gas Vehicle</th>
<th>Total Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost for 25 miles</td>
<td>$0.90</td>
<td>$2.91</td>
<td>$2.01</td>
</tr>
<tr>
<td>1 year cost (15,000 miles)</td>
<td>$540</td>
<td>$1,746</td>
<td>$1,206</td>
</tr>
<tr>
<td>8 year cost (15,000 miles)</td>
<td>$4,320</td>
<td>$13,968</td>
<td>$9,648</td>
</tr>
</tbody>
</table>

Note: Electricity costs may be reduced further through the use of free public or private charging stations or through use of solar or wind-powered charging stations.

EVs are also unique in that they do not require scheduled maintenance. This is because the regenerating braking system lasts a lot longer than conventional brakes. They also require overall less maintenance costs due to that there are no actual fluids that need changing besides the brake fluid, this means no regularly scheduled oil changes. There are also fewer moving parts in the engine then a typical gasoline engine (evtown.org).”

The amount of times a battery can be charged and discharged are limited in EVs, causing a limit to battery life. This factor is dependent on dealer warranties and the manufacturer’s battery recycling policy. EV Town sourced the following from the U.S. Department of Energy Alternative Fuels and Advanced Vehicles Data Center, “Nissan and General Motors have both announced 8-year/100,000 mile warranties for the batteries in the LEAF and the Volt. Similar warranties are expected with vehicles produced by other major manufacturers. Although manufacturers have not published
pricing for replacement batteries, if the battery does need to be replaced outside the warranty, it is expected to be a significant expense (evtown.org).”

Figure 9 "Estimated Costs of EV Batteries through 2020" EV Global Outlook, p. 17.

But the good news is that battery costs are also decreasing, more than halving within the past four years, as illustrated in the figure above. EV Global Outlook also stated, “battery costs based on development efforts have gone from USD $1,000 per kilowatt hour (kWh) in 2008 to USD $485/kWh of usable energy at the end of 2012. These cost gains may take 3-4 years to be realized by industry, but the numbers give an indication as to what is possible in the near term…Battery costs are not just coming down
in absolute terms, but in the near term battery costs may be less than half the cost of an EV (EV Global Outlook, p. 17).”

Conclusion

Sustainable initiatives should be important to the City of Arcata. Humboldt County prides itself on its Green Image from its University to the local Farmers Market. Locally owned and operated holds a large leverage point for the “locavores”. This identity is known and an accepted image, so why not promote and seize an EV economy? As custodians of the future, keeping tailpipe emissions out of the community is highly important for air quality and health implications, as that is where the population density is. Businesses will also be attracted to an area that thrives and is sustainable.

Economic & Business Advantages

From a business perspective EVs are very cheap to operate with a typical cost of 0.02¢ - 0.03¢ to drive per mile. Combined with federal incentives the price per vehicle can be cheaper then most cars to purchase. Aside from all of the environmental advantages it also frames a strong business argument for the adoption of EV infrastructure. The town of Normal, Illinois even teamed with Mitsubishi to bring in 1,000 EVs and 51 charging stations to their town, with also the help of government grants (evtown.org). This is just one method Arcata can increase the EV adoption rate in the area in par with government incentives and a larger infrastructure. After analyzing all of the above literature, it is
apparent that opportunity for economic development arises from the push for EVs within a given economy. Citizens are also continuously in support for a cleaner energy economy. This is seen through Arcata’s support for no GMO’s, increase in bike lanes within the city limits and local farmers markets.

**Local Impacts**

Early EV adoption is an opportunity to embrace new technology in an environmentally sound way. This movement goes beyond the norm to imagining a new future to keep the earth thriving for future generations. Establishing local infrastructure is also a marketing strategy to open up new forms of tourism to the area. This will bring in a fleet of EV owners to visit the community as an environmental leader. The goal of achieving a 100% EV city would benefit Arcata in that there will be no longer a dependence on foreign oil. The import of gasoline to the county will perhaps be an added cost of business. Deriving electricity from renewable sustainable resources would be the economic driver for a cleaner county. This adoption would be the leading indicator of growth for the local economy. Students would ride local transport powered by clean energy and businesses would be the home of EV charging stations. Other local benefits include improved air quality and jobs, etc. But the primary goal would be to show itself to the world as a pioneering small town. Figure 10 is an EV Adoption Map, which shows the necessary steps and movement between: policy & infrastructure, community awareness, business opportunity and economic impact all needed to work cohesively for EV adoption. By reviewing what prior cities have done successfully Arcata can generate
an economic plan to generate successful adoption amongst consumers. The benefits also extend outside of Arcata’s borders, stretching to neighboring towns and districts. This would be the economic model for others to follow and to come and learn about Arcata’s efforts. The following models show the inner connectedness of EV adoption.

![EV Adoption Map](image)

Figure 10 "EV Adoption Map" by Jessica Ayala, 2015.
Figure 11 "Major Goals & Key Country Incentives for Adoption by Arcata", created by Jessica Ayala, 2015.

The models above outline which policies and business incentives Arcata can benefit to learn from around the world, it also summarizes key points from the readings about Barcelona, Portland, Amsterdam, Stockholm, and EV Town. Arcata would be well positioned with incentives ranging from higher amounts of EV parking within city limits, like Amsterdam does; or collaboration with businesses like how EV Town took
advantage of their partnership with Mitsubishi. All of these examples show progress in today’s society in a greater push for EVs. An example of this is Tesla generating a garbage truck or a medium-duty delivery truck that runs on electricity (Kelly-Detwiler, 2015). This new technology will help urban areas reduce their total carbon emissions per capita. It’s innovation like Tesla, Toyota and other sustainability champions that help promote and drive EV adoption. They have seen the business opportunity in investing in technology that helps promote the long-term profits by reading the writing on the wall. Arcata can implement a strategy based on the above core strategies outlined by cities that have already shown promise. These core promises, can be the cities stewardship objects; where the city council can design long-term solutions to decrease greenhouse gas emissions, educate the public, incentivize regulation through tax breaks, increase the usage of LEED certified buildings, while the list goes on and on. Local citizens can even partner with Humboldt State University to analyze the cities in this project to introduce a strategic plan for the city of Arcata. Policy makes can learn from the early leaders to promote feedback based on early market introduction. The market seems to progress its development outlining the solutions that will bring Arcata closer to a vision of sustainable transportation.
References


