Date: January 26, 2011

To: Jeffrey Egeberg, Department of Public Works

From: Timothy Burroughs, Climate Action Coordinator

Subject: Presidio School Team Report on Electric Vehicle Infrastructure in Berkeley

Accompanying this memo is a report prepared by five Presidio School of Management Sustainable MBA students. The student team prepared the report in the Fall 2010 as part of the Presidio School’s service learning requirement. I served as the City of Berkeley liaison to the student team and facilitated several meetings with the student team and Planning and Public Works Department staff as well as representatives from the Public Works Commission.

The report should be viewed as an exploration of potential actions the City could take to foster an electric vehicle (EV) infrastructure, including specific recommendations for action from the student team. City staff looks forward to reviewing the report in detail and we are confident that it will add to our knowledge of EV-related issues and contribute to the City’s ability to serve our community. I hope that the report may also be a useful resource for the Public Commission’s effort to respond to City Council’s request to provide guidelines and recommendations regarding enabling EV charging for residents who do not have access to off-street parking.

Finally, I want to recognize the immense professionalism, creativity, and focus the students brought to their project. And I appreciate their willingness to take the time to present their findings and recommendations to the Public Works Commission.
Electric Vehicle Charging Infrastructure in the City of Berkeley

Project Partner:
City of Berkeley

12/15/2010
Strategic Management

Team dEVA
Justin Bean
Katherine Dunn
Rudi Halbright
Obrie Hostetter
Tim McLaughlin
# Table of Contents

1. **Executive Summary** ........................................................................................................... 2  
2. **1.0 Introduction** ................................................................................................................. 4  
3. **2.0 Internal Analysis** ......................................................................................................... 5  
4. **2.1 City of Berkeley Overview** .......................................................................................... 5  
5. **2.2 Community Engagement** ............................................................................................ 6  
6. **2.3 National Trends in Municipal Sustainability** .............................................................. 7  
7. **2.4 Municipal Sustainability in the California and SF Bay Area** ...................................... 8  
8. **2.5 Climate Action in Berkeley** .......................................................................................... 8  
9. **2.6 Measure R** .................................................................................................................... 10  
10. **2.7 Systems Point of View** ............................................................................................... 11  
11. **3.0 External Analysis** ........................................................................................................ 12  
12. **3.1 Industry Overview** ..................................................................................................... 12  
13. **3.2 Market Overview** ....................................................................................................... 13  
14. **3.3 Hybrid Trends** ............................................................................................................ 13  
15. **3.4 Demand in Berkeley** .................................................................................................. 15  
16. **3.5 Early Adopters** .......................................................................................................... 15  
17. **3.6 Policy and Legislation** ............................................................................................... 16  
18. **3.7 Electric Vehicle Technology** ...................................................................................... 17  
19. **3.7.1 Commercialization** ............................................................................................... 17  
20. **3.7.2 Electric Vehicle Sustainability Impact** .................................................................... 17  
21. **3.7.3 Electric Vehicle Supply Equipment (EVSE)** ......................................................... 18  
22. **3.7.4 Electrical Upgrades and Infrastructure** ................................................................. 19  
23. **4.0 Strategy** ...................................................................................................................... 21  
24. **4.1 Comparisons** ............................................................................................................. 21  
25. **4.2 2x2 Analysis and Strategic Comparison** ..................................................................... 23  
26. **4.2.1 Residential Curbside Charging** .............................................................................. 24  
27. **4.2.2 Key Recommendations** ......................................................................................... 25  
28. **4.3 Timeline & Metrics for Recommendations** ............................................................... 27  
29. **4.4 Extended Recommendations** ................................................................................... 31  
30. **4.4.1 Future Scenarios** ................................................................................................... 32  
31. **4.5 Conclusion** ................................................................................................................ 34  
32. **Appendices** ..................................................................................................................... 36  
33. **Appendix A: Demographic Information** ........................................................................ 36  
34. **Appendix B: Legislation** .................................................................................................. 36  
35. **Appendix C: Strengths, Weaknesses, Opportunities, and Threats** .................................. 38  
36. **Appendix D: Berkeley Strategy Canvas** ......................................................................... 41  
37. **Appendix E: Timeline of Recommendations** .................................................................. 42  
38. **Appendix F: Financial Analysis of Public Charging Network** ....................................... 43  
39. **Appendix G: Description of Matrix Axes and Scenarios** .............................................. 45  
40. **References** ....................................................................................................................... 49
Executive Summary

Auto manufacturers will begin releasing electric vehicles (EVs) to the American consumer in late December of this year. The environmental impact of electric vehicles powered from the U.S. energy grid has the potential to reduce greenhouse gas (GHG) emissions significantly when compared to internal combustion engine (ICE) vehicles. This is directly in line with the City of Berkeley’s goal to develop a transportation plan that will reduce the amount of transportation related GHGs by 30% below 2000 levels by 2020 (City of Berkeley Climate Action Plan, 2009).

Expansion of electric vehicle infrastructure is imperative to the success of EV adoption. While demand remains unknown, over 841,000 PHEVs and EVs are predicted to be sold in the US by 2015 (Pike Research, 2010). If hybrid adoption rates are an indicator of EV adoption, then the City of Berkeley (CoB) can expect to have one of the highest EV adoption rates in the country.

While CoB is interested in investing in EV infrastructure, this does create financial risk. In order to maximize citizen benefit while minimizing the city’s financial risk, Team dEVA recommends the following three high level strategies:

- Move second: closely monitor other municipalities, utilities, and the EV charging market. Avoid mistakes and consider replicating what has worked in other places.
- Develop policies that incentivize the private sector to consider building and supporting EV charging infrastructure.
- Ensure that city-sponsored EV infrastructure is fully integrated into a larger and more diversified transit system.
We recommend that CoB position itself to become a “second mover,” so that it can learn from other cities’ successes and failures. The goal is to get it right the first time, thereby minimizing financial risk and maximizing citizen benefit. The following sections of this plan include an internal analysis of CoB, an external evaluation of current EV industry trends, a scenario plan, and detailed strategic recommendations.
1.0 Introduction:

John and Mary have lived in a house on Rose Street in Berkeley for 10 years. John works in downtown San Francisco, and is glad to be able to walk or ride his bike to BART to commute. Mary is a business owner in Oakland, and drives their Toyota Prius to work on most days. The couple bought their car in 2004, and they are considering giving it to their daughter, Trish, when she goes off to college in the fall. John and Mary are environmentally conscious, and like to be on the cutting-edge; they were one of the first of their friends to buy a hybrid. Now, they are considering either getting another hybrid or buying a fully electric vehicle, such as the Nissan Leaf. John is totally excited about the idea, while Mary has reservations. She writes a list of pros and cons about getting a fully electric vehicle:

![Figure 2: Resident's notebook](image2.png)
Many people have similar fears about getting an EV. CoB wants to meet the needs of early adopters such as John and Mary, as well as prepare the infrastructure of the city to be ready for an influx of EV drivers. However, the city has its own concerns about investing in a technology that might change rapidly over the next few years. The following strategic plan analyzes expected EV trends and offers strategic recommendations for implementing EV charging infrastructure.

2.0 Internal Analysis

2.1 City of Berkeley Overview

The City of Berkeley provides public services for a population of roughly 107,000 residents. It has approximately 1,500 employees and an annual budget of $320,953,621. Berkeley has a reputation for environmentalism and it prides itself on being a hub for “academic achievement, scientific exploration, free speech and the arts” (City of Berkeley website, 2005). It is liberal (78.5% of citizens are Democrats) and home to progressive...
environmental policies such as PACE (Property Assessed Clean Energy) and Berkeley FIRST (Bestplaces, 2010). Both are financing systems for renewable energy or energy efficiency that have influenced state or national policy. The tables below show that the median income and education level of Berkeley citizens is significantly higher than the US average. Appendix A offers more demographic information.

<table>
<thead>
<tr>
<th>2009 Estimates</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Income (Individual)</td>
<td>$60,625</td>
</tr>
<tr>
<td>Median Income (Family)</td>
<td>$95,720</td>
</tr>
</tbody>
</table>

Table 1: Estimated Median Incomes, Berkeley, CA (US Census)

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School Diploma or Higher</td>
<td>93.5%</td>
</tr>
<tr>
<td>Bachelor’s Degree or Higher</td>
<td>67.1%</td>
</tr>
</tbody>
</table>

Table 2: Educational Data, Berkeley, CA (US Census)

2.2 Community Engagement
Given that many citizens are well-educated and involved in their community, the City of Berkeley actively engages with its citizens through several methods, including:

- Hosting town hall meetings
- Involving citizens on commissions to inform the City Council
- Sending a periodic email to citizens from the Mayor
- Posting information on its website
CoB needs to communicate well with its citizens in order to gain support for any EV policy it adopts. The recommendations section highlights how the City of Berkeley can leverage and augment these forms of communication.

2.3 National Trends in Municipal Sustainability

The following section gives Berkeley a point of reference through highlighting national and statewide trends towards sustainability. Cities across the nation are making large strides in becoming more sustainable by implementing policies and plans that result in lower GHG emissions and more “livable” cities (Smarter Cities, n.d.). These initiatives include increased public transportation, green building incentives, focus on “walkability” and “bikeability,” increased parks and green space, and urban gardening.

Many cities have also recognized that a transition from vehicles employing internal combustion engines to EVs will largely impact the amount of GHGs (greenhouse gases) emitted within their boundaries. Portland, San Francisco, and New York are three cities aggressively pursuing the development of EV infrastructure. A more thorough overview of cities working toward EV readiness can be found on the Project Get Ready web site: http://projectgetready.com/category/city. Project Get Ready is a Rocky Mountain Institute initiative to help cities and communities plan EV infrastructure. See the strategy canvas in Appendix D for a visual interpretation of these actions.
With the upcoming re-introduction of EVs from a multitude of manufacturers, cities are taking strides to ready themselves for increased EV usage. At this point, no city has developed EV infrastructure beyond an infancy stage. As a result, best practices do not yet exist. The City of Portland is perhaps leading the way nationally in planning an EV infrastructure. Portland has released a document called “Electric Vehicles: The Portland Way,” (www.chargeportland.com), that summarizes its EV strategy.

2.4 Municipal Sustainability in the California and SF Bay Area

California is leading the nation with its aggressive goals for reducing GHG emissions. In 2006, the state passed the Global Warming Solutions Act (AB 32) which sets binding targets for the state’s GHG emission reductions (Assembly Bill 32: California Global Warming Solutions Act, n.d.). The Bay Area is a regional leader in clean technology development and GHG reduction. This is evidenced by the National Resources Defense Council’s (NRDC) Smarter Cities project, which ranked the nation’s top sustainable cities. Three of the study’s top five “large cities,” San Francisco, Oakland, and San Jose, are Bay Area municipalities (Smarter Cities, n.d.). Berkeley’s smaller population (102,743) precluded it from being ranked.

2.5 Climate Action in Berkeley
The City of Berkeley is indeed a national leader in municipal sustainability initiatives. These initiatives are documented in the city’s Climate Action Plan (CAP), which was officially adopted on June 2nd, 2009 (City of Berkeley Climate Action Plan, 2009). CAP’s purpose is “to guide the development, enhancement, and ultimately the implementation of actions that aggressively cut Berkeley's greenhouse gas emissions” (City of Berkeley Climate Action Plan, 2009). Through CAP, the city intends to reduce its greenhouse gas (GHG) emissions 33% below year 2000 levels by 2020 and achieve an 80% reduction by 2050. The city has already reduced GHG emissions by 8.9% from 2000 to 2005. Approximately 46% of Berkeley’s GHG emissions come from transportation. The following pie chart shows a breakdown of the city’s GHG emissions in 2005.

![Pie Chart: Greenhouse Gas Distribution, 2005](image)

**Figure 4: Greenhouse Gas Distribution, 2005**
As shown in Figure 3 above, in 2005 gasoline-based transportation accounted for 29% of the city’s GHG emissions, which equates to 169,031 metric tons of carbon dioxide equivalent (CO₂e) (City of Berkeley Climate Action Plan, 2009).

Because gasoline consumption is the largest source of GHG emissions in Berkeley (City of Berkeley Climate Action Plan, 2009), a transition to more efficient vehicles like plug-in hybrid electric vehicles (PHEVs) and EVs will help the city reach its GHG targets. CAP lists the following goals regarding vehicular transportation:

- Create incentives for high-efficiency vehicles, including electric vehicles and plug-in hybrids in the community
- Provide leadership in building a market for plug-in hybrids (City of Berkeley Climate Action Plan, 2009)

In addition to the policies listed above, CAP lists actions to implement those policies. These include:

- Reducing parking rates for low-emission vehicles
- Creating free parking and charging stations for PHEVs and EVs
- Incentivizing developers and businesses to install EV charging stations
- Providing information about EVs to the public
- Purchasing PHEVs for the city’s fleet
- Partnering with car share organizations to help them add EVs to their fleets

Currently, CoB provides an electric vehicle charging station in the Center Street garage and two dedicated on-street parking spaces for electric vehicles near City Hall (City of Berkeley Climate Action Plan, 2009).
2.6 Measure R

On November 2, 2010, through majority vote, the CoB passed Measure R to help guide the City in revitalizing its downtown in a “green” way. This revitalization will be based upon LEED green-building standards, public open spaces, and clean forms of transportation (City of Berkeley Climate Action Plan, 2009). The details of these policies, and thus the role of EVs in the new downtown plan, are yet to be determined; however, it could be an indicator of public support for sustainability.

2.7 Systems Point of View

It is important to note that the widespread adoption of EVs cannot replace the role that public transportation, bicycling, and walking must play in reducing the City’s GHG emissions. A convenient EV infrastructure must complement, integrate with, and balance other efficient forms of low or zero-emission transportation. To this end, the city’s CAP calls for increased use of BART, AC Transit, bicycling, and walking as viable, reliable, and convenient forms of transportation. In terms of vehicular transportation, CAP calls for increased use of car sharing programs and taxis, as well as a city-wide conversion toward low and zero-emissions vehicles, such as EVs and PHEVs (City of Berkeley Climate Action Plan, 2009). To find the proper balance of “parts” within the transportation system that will allow for maximum reduction in GHGs while increasing transportation convenience for its populace, CoB must take a systems approach. In other words, it must balance its promotion
of EV usage with that of its other transportation initiatives. This “balance” is visually portrayed in the figure below.

Figure 5: Systems view of CAP transportation distribution

Because each “part” of CAP’s transportation initiatives are interconnected and ultimately affect the others, CoB must consider the effects EV adoption by citizens might have on other modes of transportation.

3.0 External Analysis

3.1 Industry Overview
Due to increasing crude oil costs, energy security, and rising fuel and air quality standards, the demand for alternative fuel vehicles is increasing. According to the U.S. Energy Information Administration (EIA), alternative fuel vehicles could have a nearly 50% market share by 2035 (Hincha-Ownby, 2010). EVs are one of the strongest contenders in this emerging market.

3.2 Market Overview
The two types of electric vehicles on the market are the all-electric EV and the plug-in hybrid gas and electric (PHEV). Over 841,000 PHEVs and EVs are predicted to be sold in the US by 2015, amounting to 26% of the global market (Pike Research, 2010). Numerous auto manufacturers have been ramping up production plans to release EVs and PHEVs this year. Automakers that have already deployed or announced PHEV deployment plans in California and other domestic markets include General Motors, BYD, Fisker Automotive, Think Motors, Ford Motors, Mercedes Benz, Daimler-Chrysler, Mitsubishi, Renault, Nissan, BMW, Toyota, and Tesla Motors (Crosby, 2009).

3.3 Hybrid Trends
Of the 255.9 million registered passenger vehicles in the U.S., 1.6 million are hybrids (US DOE, 2009). In 2009, 290,272 hybrid vehicles were sold (Market Dash Board, 2010). This is a decline of 8 percent compared to 2008; however, the overall auto market fell by 21 percent and hybrid sales have consistently beaten the market. In 2009, the total market share of hybrid gas-
electric vehicles was 2.8 percent (Market Dash Board, 2010). Figure 5, below shows historic hybrid sales from 1999 to 2009 (US DOE, 2009).

![Figure 6: US Hybrid-Electric Vehicle Sales from 1999-2009](chart-area.png)

In 2009, the top sellers for hybrids in the U.S. were the Toyota Prius, the Honda Civic Hybrid, and the Toyota Camry Hybrid. The largest number of hybrid sales has been in California, with 55,553 hybrid vehicles sold in 2009 (Market Dash Board, 2010). The 2000 U.S. census showed there to be roughly 58,000 vehicles registered in Berkeley. In 2007, 2.8% of all vehicle registrations in Berkeley were hybrids, roughly four times greater than the state average (Kahn, 2009).

3.4 Demand in Berkeley
The closest estimates we can use for EV and PHEV demand in Berkeley are hybrid sales, and Berkeley has one the highest hybrid penetration rates in the country. As mentioned above, in 2007 2.8% of all vehicle registrations in Berkeley were hybrids and 58,000 total vehicles were registered in 2000 (Kahn, 2009; Market Dash Board, 2010). While these numbers are slightly out of date, we can make an assumption that there are at least 1,624 hybrids in Berkeley.

Primary research at the Toyota and Nissan dealerships revealed that the Toyota Dealership in Berkeley has a waiting list of 500 PHEVs. The Toyota salesman indicated that the majority of these PHEVs were heading to Berkeley. The closest Nissan Dealership (in Richmond) is no longer taking orders for the Nissan Leaf; all 20,000 that will be rolled out nationwide in December have been pre-ordered.

3.5 Early Adopters

The first Berkeley residents to buy EVs will be considered “early adopters.” As Figure 6 shows below, EVs offer the advantages of clean tailpipe emissions and at-home charging. However, one could argue that at present, EVs have limited range, lack convenient access to charging infrastructure, and have extended recharging times, making them less convenient than PHEVs, Hybrids, and ICE vehicles.
3.6 Policy and Legislation

There are a number of environmental and public policies at the federal and state level that support alternative fuel vehicles. The 2009 American Recovery and Reinvestment Act (ARRA) offered over $14.4 billion in grants, loan guarantee programs, and tax credits for EV and related infrastructure projects. Tax credits for consumers include: $7,500 federal tax credit for the purchase of the vehicle, $5,000 credit from the state of California, and another $2,000 federal credit toward the purchase of a charging unit (Vlasic, 2010). A partial list of legislation that supports alternative fuel vehicles is listed in Appendix B.
3.7 Electric Vehicle Technology
The all-electric driving range varies for both EVs and PHEVs. The anticipated vehicle range for PHEVs is between 14 to 40 miles (before the internal combustion engine kicks in), while the range for generally available EVs only reaches up to 100 miles. As a result, aiding the installations of EV chargers could relax the range anxiety that might deter EV adoption.

3.71 Commercialization
Major factors that influence EV and PHEV commercialization include (Crosby, 2009):

- The initial PHEV cost premium relative to a comparable combustion vehicle
- Electricity rates
- Gasoline fuel cost trends
- Competitor vehicle and cost trends
- Consumer willingness to pay
- Availability of electricity
- Forecasts of California demographics (such as population, employment, and personal income, consumer behavior)
- PHEV and EV manufacturer production capacity

3.72 Electric Vehicle Sustainability Impact
Two highly anticipated EVs, the Nissan Leaf and the Chevy Volt, will be available as early as winter, 2010. With widespread EV adoption, the City of Berkeley could greatly reduce its GHG emissions. How much an EV can reduce GHGs (when compared to a traditional ICE) depends on the mix of
energy used to charge the vehicle. For example, an EV whose energy originates at a coal-fired power plant might reduce GHG emissions only slightly. On the other hand, an EV that is charged from a solar charging station or other clean energy source will have no GHG emissions associated with. From a national standpoint, EVs powered from the U.S. grid reduce GHG emissions by a range of 11%-100% when compared to ICE vehicles (Boschert, 2008). As shown in Figure 8, California already has a cleaner energy mix than the overall US on average. As Californians and Berkeley residents reduce their dependence on fossil fuel energy to rely more on clean, renewable energy, EV usage will have an even larger impact in GHG reductions (California Energy Commission, 2010).

3.73 Electric Vehicle Supply Equipment (EVSE)

EV charging is divided into levels by voltage and amperage. In the case of Level 1 and 2 charging, the actual charger is built into the vehicle itself while the EVSE (Electric Vehicle Supply Equipment) provides an interface to the source of power. EVSE’s are nonetheless frequently referred to as “charging
stations.” The following chart compares the relative performance at each level:

<table>
<thead>
<tr>
<th>Level 1 (on board charger)</th>
<th>Volts</th>
<th>Amperage</th>
<th>Time to fully charge a battery pack</th>
<th>Home or Public Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 volts</td>
<td>12A using 15A circuit, 16A using 20A circuit</td>
<td>8 to 20 hours</td>
<td>Home or Public</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2 (on board charger)</th>
<th>Volts</th>
<th>Amperage</th>
<th>Time to fully charge a battery pack</th>
<th>Home or Public Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>220 to 240 volts</td>
<td>Up to 80A</td>
<td>4-6 hours</td>
<td>Home or Public</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DC (or fast) charger (off board charger, controlled by vehicle)</th>
<th>Volts</th>
<th>Amperage</th>
<th>Time to fully charge a battery pack</th>
<th>Home or Public Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>480 volts</td>
<td>150-400A</td>
<td>Under 30 minutes</td>
<td>Public</td>
</tr>
</tbody>
</table>

Table 3: Relative EVSE Performance

3.74 Electrical Upgrades and Infrastructure

The extent of infrastructure upgrades depends on both the EV demand as well as the age and load capacity of the current transformers and infrastructure.

Residential Charging

Currently, there are no standards in place to guide residential customers for installing at-home charging stations. At this time, the customer has the choice of having the EV electricity charges fall within their existing billing plan, or setting up a separate meter that will allow the cost of electricity to be based on time-of-use (TOU). While California Public Utilities Commission (CPUC) Rules 15 and 16 vary by utility, they dictate that PG&E customers must pay for installation upgrades from the service point in excess of $1918.
If the transformer is a distribution transformer (meaning two or more residents use it) then ratepayers will ultimately pay for the upgrades. If it is a service transformer then only single resident will use it and thus that single resident would be required to pay for the upgrade. Figure 8 illustrates this below.

![Diagram](image)

**Figure 9: Utility Customer Boundary Under Duel Meter (CPUC)**

**Public Charging**

It is expected that the majority of public charging stations will be Level 2.

According to Mike DiNucci, Coulomb's Vice President of Strategic Accounts, “Level 2 charging stations normally cost about $5,000 each and another $1,000 for installation.” However, Coulomb Technologies has received $54 million in state and federal grants to provide a number of its charging stations to municipalities, businesses, and individuals free of charge (Halstead, 2010). Currently, DC Fast chargers range in price from $60,000 to $150,000 (Halstead, 2010). However, Nissan has announced that it will bring to market
a fast charger for $17,000 (Halstead, 2010). Infrastructure upgrades are site specific. At this time the cost of these upgrades is unknown.

4.0 Strategy
The previous sections set the stage for why the City of Berkeley deems it necessary to address EV infrastructure for its citizens. Appendix C presents a detailed SWOT analysis to expand upon external and internal factors affecting CoB. The second half of this report analyzes how to address EV infrastructure for the city. It compares the other cities’ plans; presents a feasibility verses value-added comparison; considers possible future scenarios for electric vehicles; and offers recommendations for the city to move forward.

4.1 Comparisons
As Figure 9 shows, Berkeley has a unique set of attributes compared to three other cities that are building EV infrastructure: Portland, New York, and San Francisco. It is less dense than San Francisco and New York, has a strong progressive perspective, and is bound by stronger state regulations regarding parking permitting and classification for EVs. However, it also enjoys many favorable regulations for EV adoption (see Appendix B). Although Berkeley is supportive of EVs, it is still in the exploration phase for creating policy. Additionally, its public transportation system allows residents to easily commute to neighboring cities, such as San Francisco.
Nevertheless, Berkeley’s public transportation system is not as expansive the other cities’ systems.

The comparison cities have created different goals and objectives for their EV plans as shown in Figure 11 and in the Strategy Canvas in Appendix D. The City of Berkeley should take different ideas from each of these cities to create an EV plan that fits its size, population, strengths and weaknesses.

<table>
<thead>
<tr>
<th></th>
<th>Dense Population</th>
<th>Large Geographic Size</th>
<th>Progressive Perspective (vs. Diverse Outlook)</th>
<th>Public Transportation</th>
<th>Supportive EV Policy</th>
<th>Autonomy from state regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkeley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10: Matrix of Cities’ Attributes

![Figure 10: Matrix of Cities’ Attributes]

<table>
<thead>
<tr>
<th>Portland</th>
<th>Key Focus</th>
<th>All car commuters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Easy access to charging</td>
<td>Permitting</td>
<td></td>
</tr>
<tr>
<td>• Stations</td>
<td>• Leverage municipal EV fleet to set precedent for adoption</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New York</th>
<th>Key Focus</th>
<th>Early adopters only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Commercial parking garages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Not offering incentives, only supporting demand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>San Francisco</th>
<th>Key Focus</th>
<th>Long-term integrated transportation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Public parking in dense areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Alliances with car share programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Utilize existing assets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11: Comparative EV Infrastructure Plans
4.2 2x2 Analysis and Strategic Comparison

The figure above visually depicts the feasibility and value-added of different initiatives the city can take. Initiatives near the upper-right corner of the graph are the most feasible and add the most value. According to this figure, CoB should initially focus on fast track permitting and an online EV Guide. It should also address early adopters’ needs first and therefore not spend money on creating cost incentives for buying electric vehicles. It should consider installing showcase solar charging stations in highly visible areas, and partner with local businesses and car share programs. As shown above and in Appendix D, on-street residential charging should be among the
lowest of priorities for the short-term. The following section explains the rationale for this conclusion, and the recommendation section presents ways to meet residential needs while delaying on-street residential charging.

4.21 Residential Curbside Charging
The City of Berkeley was initially interested in evaluating the feasibility of installing curbside charging stations in residential neighborhoods and for drivers without a garage or dedicated parking space. This analysis shows that the City of Berkeley should refrain from investing resources in residential curbside charging stations in the short term. This is due to several factors:

- Demand estimates vary widely, making the installation of charging infrastructure in residential areas inadvisable at this time. This also makes the determination of appropriate sites extremely difficult in the short run.
- Right-of-way use laws at this time are unclear about EV charging infrastructure; this can present legality and safety issues for CoB and Berkeley residents.
- Early adopters will generally have a dedicated parking space and their charging behavior will provide data for siting and sizing of future installations.
- Solutions to address utility upgrade and grid issues have not been articulated or tested yet, and present substantial regulatory and financial barriers to implementation.
- Future technology preferences and adoption, as well as future prices of alternative fuels are uncertain. This makes the value generated from the substantial investment required to install curbside charging stations in residential areas unpredictable to a reasonable degree of certainty.
While the City of Berkeley should refrain from installing curbside chargers at this time, it can take steps to address the requests of citizens who do not have a dedicated parking spot for their vehicles. These actions include:

- Push the state and local governments to address the policies regarding EV parking and charging
- Monitor solutions and results in other cities
- Provide information to residents without a dedicated parking space about other charging options near their homes or encourage them to work with their building managers to install charging stations on private property
- Explore the legality and/or feasibility of simple do-it-yourself solutions (such as temporary ADA-approved cord covers and ramps, underground DIY conduit, etc.)
- Facilitate relationships between private owners of charging stations and EV owners without dedicated parking spaces.

4.22 Key Recommendations

As demonstrated in Figure 12, a hybrid approach for EV infrastructure in Berkeley will address early adopters’ needs while building the groundwork for increased EV adoption in the future. It will help address the threats and weaknesses shown in the SWOT analysis, especially pertaining to the uncertainty of EV adoption over other alternative fuels and potential budget constraints. Additionally, involving local businesses could shift some of the costs away from the city and increase sales in business districts. Providing clear information to its residents will help the City of Berkeley communicate its plan and build support.
Key Focus
Hybrid approach to meet a variety of early adopters’ needs

Recommendations

Provide a menu of options for specific user profiles
- First focus: early adopters. Adapt the plan from their experiences to be ready to provide the best options for mainstream users.
- Fast permitting for home charging.
- Car share/private lot owner/BART alliances for residents without garages.
- Install chargers for opportunity charging for range-anxious drivers. Monitor kilowatt usage to gather data for future plans (including plans for installing stations offset by solar power).
- Commercial parking lots/garages in downtown areas.
- On-street opportunity charging in shopping districts (Solano, North Shattuck, 4th Street).

Facilitate private infrastructure implementation.
- Provide information about federal and state tax credits and incentives to businesses and apartment owners with parking.
- Encourage conventional fuel stations to install fast charging options.
- Promote business case for installing overnight charging stations to private parking lot owners.
- Encourage developers to gain LEED points by installing EV chargers in new buildings’ garages

Showcase Berkeley’s innovative actions
- Apply for grants to install charging stations that are offset by solar energy in visible areas (City Hall & near Freeway), with educational display.
- Provide targeted and focused information about EV options through City of Berkeley website.
- Engage the UC Berkeley community to add innovation and visibility to EV solutions.

Figure 13: Key Recommendations
4.3 Timeline & Metrics for Recommendations

These recommendations should be carried out in a sequence in order to maximize their effectiveness and mutual synergies. Appendix E offers a visual representation of the timeline and metrics outlined below.

Recommendations that address early EV adopters, educate the public about EVs, and take a “path of least resistance” should be implemented as early as possible to lay the groundwork for initial EV adoption in Berkeley. Later tactics are meant to be contingent upon EV adoption progress, and should be implemented when indicators point to a positive development scenario. Stated times are estimates, and can be varied to match actual progress of EV adoption and charging infrastructure use in Berkeley.

Within 3 months

- Fast-track permitting: this will lay the groundwork to allow homeowners with garages and apartment owners who wish to provide charging with an easy process to have stations installed as soon as possible, facilitating a smooth transition to EVs for early adopters. *Metric: speed of permit approval & number of applications.*

- Create CoB website with options for different EV-user profiles: provide specific information and details about options for homeowners with garages, renters without a dedicated parking space, and commercial parking lot owners who wish to install charging stations, including nearest available charging stations, and permits required (with links to fast/online permitting information and helpful external links). *Metric: high website traffic and online survey feedback.*
Car share/BART/private parking lot alliances: this will provide basic overnight charging coverage for early adopters without garages who are willing to park their EVs a short distance from their homes. They may also be enticed by the promise of a reliably available parking space. *Metric: profitable charging stations (high per-day usage) and EV driver satisfaction with charging availability and proximity (measured by survey and average distance to station).*

Commercial parking lot opportunity charging: encourage commercial parking lot owners (especially near business districts and high density neighborhoods where EVs will likely be parked) to install Level 2 or Level 3 charging for their customers. Provide them with information about the benefits to their business (increased customer traffic, added value to company image, incentives and tax breaks available for installation, potential supplemental revenue). *Metric: charging stations per square mile/block in targeted areas, number and location of permit applications.*

Evaluate EV charging station data for use and behavior patterns that will inform future decisions such as rate plans, time of use, potential location of future stations, and whether to offset energy with photovoltaic options depending on energy use. *Metric: continued attention to EV issues and regular formulation of informed next steps.*

Begin to apply for grants to install initial charging stations in commercial areas (as recommended to implement within 6 months). *Metric: success of securing grants*

Within 6 months

Disseminate information throughout the city about the benefits and options available for EV purchase, ownership, charging, and
infrastructure installation (including tax breaks, paybacks, and incentives for businesses). **Metric:** informative website traffic, ratio of that traffic and other focused inquiries (in response to Berkeley informational programs) to uninformed, unsolicited inquiries; also ratio of expenditures on education to inquiries, similar to return on advertising investment.

- Implement on-street opportunity charging for high-traffic business and shopping districts. This will increase the feasibility of owning an EV in Berkeley, and make it a more attractive option for drivers. Monitor to gather data about future EV installations and carbon offsets necessary. **Metric:** daily use rates for these charging stations, level of expressed demand for more from businesses and/or citizens.

**Within 18 months and on-going**

- Encourage conventional fuel stations to install fast charging stations as EVs become more common in Berkeley. Presenting the business case and options for tax breaks and financial incentives will be essential. **Metric:** number of installed stations and daily use rates, profitability of stations.

- Promote the business case for private parking lots and garages to install charging stations. This may include the added value to location image, paybacks after rebates and tax breaks, or the reliability of securing contracted parking agreements with local drivers. **Metric:** number of installed stations, daily use rates, and satisfaction rates of parking lot owners.

- Implement exciting new projects to encourage interest in and further adoption of EVs, including high-visibility solar charging stations, pilot projects for battery swapping, wireless charging, and other new technologies. This will have the added benefit of reinforcing the image
of Berkeley as a thought and innovation leader. *Metrics: number of innovative projects in Berkeley and favorable perceptions, media coverage of them, etc.*

- Provide incentives for EV purchase after basic infrastructure is installed. Due to the high demand that already exists for EVs, we recommend that CoB focus on building infrastructure to meet the needs of early adopters before encouraging a greater adoption of EVs. Therefore, we recommend that it delay investing in the incentives laid out in its CAP. *Metrics: EV sales in Berkeley and application rates for incentives (to be offered once EVs remain available without preorder for a length of time approaching the industry standard for cars).*

- Work with UC Berkeley and Berkeley City College to create “green job” training for EV auto and EV infrastructure related jobs. This may include both skilled labor such as EV auto repair and/or technical engineering jobs such as improving battery technology. *Metrics: number of certifications awarded, employment rates of graduates from these programs.*

<table>
<thead>
<tr>
<th>Goal</th>
<th>Metric for Progress &amp; Attainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of Information</td>
<td>- Usability of website based on a survey of site users and EV owners, and number of website hits</td>
</tr>
<tr>
<td>Accessibility of charging</td>
<td>- Concentration of charging stations and daily use rates</td>
</tr>
<tr>
<td>Adoption of EVs</td>
<td>- Number and zip codes of registered EVs</td>
</tr>
<tr>
<td></td>
<td>- Berkeley’s EV adoption rate compared to US trends</td>
</tr>
<tr>
<td>Business partnerships</td>
<td>- Rate of residents who charge using installed stations</td>
</tr>
<tr>
<td></td>
<td>- Profitability of charging stations</td>
</tr>
<tr>
<td></td>
<td>- Increase in the number of charging stations</td>
</tr>
<tr>
<td>Overall perception of Berkeley’s EV plan</td>
<td>- Media and local citizen attention, visibility of projects, and reaction</td>
</tr>
<tr>
<td></td>
<td>- Survey responses</td>
</tr>
</tbody>
</table>

Figure 14: Metrics for Recommendations Summarized

4.4 Extended Recommendations
Appendix F highlights how the City of Berkeley’s EV infrastructure could be not only socially and environmentally beneficial, but also financially sustainable by comparing four options: a) installing charging stations using a baseline of California’s energy mix; b) offsetting the GHG emissions by buying offsets such as PG&E’s ClimateSmart; c) investing in buying a photovoltaics (PV) solar system to generate some or all of the required energy; or d) leasing a PV solar system. Based on analyzing the net present value and net social benefit of these investments, as shown in the preliminary recommendations, the City of Berkeley should secure grants for “baseline” charging stations, which are the least expensive option, and then monitor the kilowatt usage to assess whether or not to offset the energy. If usage is high, the City should adopt option d since it has a lower capital outlay and less risk of from changing technology than buying a PV system outright.
4.41 Future Scenarios

The metrics indicate how the City of Berkeley should monitor the impact of its EV plan. However, as Figure 14 indicates, there are some factors that are outside of the city’s control, such as the state and national climate change policies and the future of EV technology. Appendix G offers a deeper description of the axes in Figure 14 and highlights four possible scenarios for the future based on the four quadrants above. The gray circle on the figure above represents how the recommended plan allows the City of Berkeley to move ahead with creating effective solutions for EV infrastructure, while still addressing the other quadrants. It advocates monitoring the environment and acting as a “second mover” after evaluating the successes and mistakes of other cities.
If the City of Berkeley sees the trends going towards the most optimistic northeast quadrant in the Future Scenarios chart above, it should consider bolder plans for the next 5-10 years. As shown below, Berkeley has the potential to integrate its EV infrastructure with renewable energy generation and other forms of transportation.

By increasing investment, the city could also make the infrastructure economically sustainable and create educational opportunities for its residents. By monitoring outside political, cultural, and technical factors, CoB can mitigate risk and adapt this strategic plan to stay relevant.

Berkeley

5-10 Year Extended Recommendations

- Greater penetration:
  Integrate EV charging into new buildings, parking meters, and transportation projects.
- Power or offset EV charging with renewable energy generation.
  - Option 1: Buy or lease photovoltaic systems to compensate for charging stations.
  - Option 2: Buy carbon offsets for energy use.
- Charging Revenue:
  - Use proceeds from charging revenue as additional funding for new EV infrastructure, renewable energy projects, and/or education.
  - Integration: Develop a door-to-door transportation plan that integrates EVs into the public transportation network.
- Parking & Charging:
  Charge higher rates for parking in EV-charging spots as opposed to completely prohibiting parking by ICE vehicles, and make charging accessible to several parking spots from one kiosk.
- Education:
  - Build an EV charging technology showcase, demonstrating wireless charging, renewable-powered charging, and other innovative technologies, emphasizing public education.
  - Work with Berkeley City College to develop a curriculum for EV auto and EV infrastructure training for job creation.

Figure 16: 5-10 Year Extended Recommendations
4.5 Conclusion

The City of Berkeley is one of the most environmentally progressive cities in the country. Due to limited resources and unknown EV demand, the City of Berkeley should position itself to become a “second mover” in its efforts to develop EV infrastructure. However, it should also address early adopters’ charging needs within the city and consider extended goals if EVs become dominant in the future. This plan will mitigate financial risk and allow for CoB to learn from other cities’ successes and failures while still taking innovative steps to add value for its residents. The City of Berkeley has the potential to create value for its citizens and set an example for the rest of the country.
Appendix A: Demographic Information

Source: City of Berkeley Statistical & Economic Profile

- 9,700 businesses, non-profits, institutions
- 70,000 jobs
- Gross business receipts: $3.8 billion
- Taxable sales: $1.45 billion

Appendix B: Legislation

Legislation supporting alternative fueled vehicles (Crosby, 2009):

- Assembly Bill 1493 (Pavley). AB 1493 requires CARB to adopt and enforce regulations that achieve the maximum feasible reduction of GHGs emitted by passenger vehicles and light-duty trucks and any other noncommercial personal vehicles.


- AB 1007 - State Alternative Fuels Plan. In AB 1007, the Governor and the Legislature directed the CEC and CARB to develop a state plan to increase the use of alternative fuels, including biofuels, hydrogen, electricity, and others. AB 1007 included petroleum reduction goals established in AB 2076.

- AB 118 is the guiding legislation for the AQIP (Air Quality Improvement Program) and the ARFVTP (Alternative and Renewable Fuel and Vehicle Technology Program). The AQIP and the ARFVTP are funded through 2015 via increases to the smog abatement, equipment registration, and vessel registration fees.

- Senate Bill 375 (Steinberg). SB 375 “Requires metropolitan planning organizations to align their regional transportation, housing, and land-use plans and prepare a ‘sustainable community strategy’ to reduce VMT and transportation-related emissions.”

- Executive Order S-3-05 / AB32, The global warming solutions act. AB 32 requires CARB to adopt a statewide GHG emissions limit equivalent to statewide GHG emissions Levels in 1990 to be achieved by 2020. AB 32 is a complementary air quality policy to local, state, and federal ambient air quality standards consistent with the State Implementation Plan.
Appendix C: Strengths, Weaknesses, Opportunities, and Threats
This section summarizes the findings about City of Berkeley’s internal strengths and weaknesses as well as external opportunities and threats. These high-level assessments inform the strategic recommendations made to CoB.

**Strengths**

- Berkeley’s electricity is generated with a high percentage of renewable resources with minimal use of coal-fired plants, ensuring that adoption of electric vehicles will contribute to Berkeley’s climate action goals
- CoB already has experience with electric vehicles in its municipal fleet
- Berkeley residents have been early adopters of hybrid electric vehicles in the past, and are expected to be early adopters of battery electric vehicles and plug-in hybrids as well
- Berkeley is positioned to be a leader of change and thus can anticipate support for taking a leadership role
- Climate Action Plan goals are in line with supporting EV infrastructure
- Educated and environmentally friendly population who supported alternative fueled vehicles
- CoB is a small city so even minimal EV vehicle infrastructure can have a large effect
- Berkeley is embedded in a large metropolitan area that allows potential EV owners access to a variety of essential locations and activities
- San Francisco Bay Area will build a network of EV charging stations
- Strong public transportation that can link EV charging infrastructure to commuters
- UC Berkeley is a readily available research hub
Weaknesses

- There are significant barriers to meeting the needs of residential customers who wish to purchase an EV but don’t have garages or other dedicated parking spaces
- Berkeley is late in the game in terms of applying for grants; much of the funding has already been allocated
- CoB has taken risks that haven’t always paid off (e.g. electric vehicle that couldn’t make it up the hills)
- CoB does not have 24 hour permitting and does not currently issue permits through online requests
- Berkeley does not have a well-defined process for securing the required permits to install an electric vehicle charger
- CoB does not have funds available to jump-start EV programs

Opportunities

- Coulomb Technologies has funding available that can pay for EV charging stations through its Chargepoint America Program
- COB can emerge as a leader in implementation of EV infrastructure among cities in the United States
- COB can help meet the requirements of its existing Climate Action Plan (CAP) by promoting EVs
- COB has the opportunity to learn from other cities that are further along in their implementation, including Portland, Sacramento, San Francisco and San Jose
- The Green Corridor network increases feasibility of EV ownership
- Being a second-mover decreases risk by allowing COB to learn from other cities’ successes and mistakes
- Taking advantage of upcoming availability of EVs to meet early demand and help to promote EVs
- Partner with non-profits and think-tanks to set nationwide national EV policy
- Measure R will incentivize implementation of green development and infrastructure
Threats

- The current low price of gasoline may lead to lower adoption rates of EVs in the near term
- Businesses and business districts may not be willing or able to spend money to purchase charging stations, and may be too late to get free stations offered through grant monies
- Other technologies, such as natural gas, bio-fuels, or hydrogen fuel cells may displace interest in EVs
- COB may invest in EV infrastructure that will not be adopted
- COB has limited funds to be used toward EV infrastructure
- COB is somewhat disconnected from Green Corridor and other EV development partnerships
- Costs of resources needed for batteries could become limited
- Early dissatisfaction with EVs could lead to abandonment of interest
Appendix D: Berkeley Strategy Canvas

Figure 17: Berkeley Strategy Canvas
Appendix E: Timeline of Recommendations

Figure 18: Timeline of Recommendations
Appendix F: Financial Analysis of Public Charging Network

If CoB is to install a network of public EV charging stations, it could create a financial model that would allow the charging system to pay for itself. Team dEVa created a ten-year financial analysis tool to better understand the potential revenues needed to cover the capital investments and costs that a public charging network might require (see file Team_dEVa_Fin_Analysis_Tool.xls).

This Excel-based tool employs user-inputted quantitative assumptions to calculate the net present value (NPV), internal rate of return (IRR), and payback periods of four potential scenarios:

1. A “grid energy” scenario in which CoB purchases all required EV charging energy from PG&E. It does not “offset” this additional electricity.
2. An “offset” scenario in which CoB offsets the additional energy consumed by EV charging through PG&E’s ClimateSmart program.
3. A solar purchase scenario in which CoB invests in a photovoltaics (PV) solar system to generate some or all of the additional EV charging energy. This option requires a large capital investment.
4. A solar leasing scenario in which CoB leases a PV solar system. Compared to option 3, this option reduces capital investment significantly.

The inputs in the tool are meant to be adjustable. Any cell in yellow on the “Inputs” tab can be changed. NPV, IRR, and payback period for each scenario will automatically be calculated. The model is based on a list of assumptions, which can be found on the “Assumptions List” tab.

We have also included a sensitivity analysis, which presents a range of potential financial outcomes given “pessimistic,” “normal,” and “high” predictions of charging demand and charging price. Consideration of the sensitivity analysis is essential, since EV charging demand and the cash flows associated with that demand are
Currently impossible to predict with precision. Assessing demand will become easier once EV charging behavior can be observed.

Below is sample output based on (a) an average charging price of $3 per hour and (b) a quantity of ten Level 2 charging stations, as well as many other assumptions.

<table>
<thead>
<tr>
<th>Option</th>
<th>NPV ($)</th>
<th>IRR (%)</th>
<th>Payback Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Grid Energy</td>
<td>489,849</td>
<td>103</td>
<td>1.1</td>
</tr>
<tr>
<td>B. ClimateSmart</td>
<td>485,666</td>
<td>102</td>
<td>1.1</td>
</tr>
<tr>
<td>C. PV Purchase</td>
<td>190,230</td>
<td>5</td>
<td>10.0</td>
</tr>
<tr>
<td>D. PV Lease</td>
<td>593045</td>
<td>79</td>
<td>1.4</td>
</tr>
</tbody>
</table>

*Cost of capital: 3%*
Appendix G: Description of Matrix Axes and Scenarios

Description of axes

EV Technology
Both battery and charging technology will heavily influence EV adoption rates. Although most major automobile manufacturers are investing in EV production, it is difficult to predict the rate of EV adoption in both the short and long term. The combination of limited driving range and lack of pervasive charging infrastructure means widespread EV adoption is not yet possible. Battery and charging technology will continue to improve over time, but the thresholds for pervasive adoption are currently difficult to predict.

Public demand will certainly influence the amount of capital that can be invested in battery and charging R&D. Therefore, after major automobile manufacturers, including Nissan and Chevrolet, release EVs for public consumption in 2011, it will be easier to predict adoption rates and the interest in research for EV technology.

State & National Policy
EV adoption in Berkeley will be heavily influenced by government policy, both at the state and national levels. Through its progressive policies, California is a leader in state environmental protection and GHG management. However, the future of politics in California is unknown. Large, out-of-state corporations routinely try to reverse progressive policy in California through the funding and promotion of ballot propositions. The best example of this is 2010’s Prop 23, which could have frozen California’s landmark Global Warming Solutions Act (AB 32); the fact that this proposition did not pass offers some short-term answers about policy in California, but a similar measure could appear again in the future.

National politics is even less predictable. Even when the House and Senate have had Democratic majorities, passing progressive and substantive climate policy has proven to be difficult. With Republicans gaining power in both the House and Senate through the Fall 2010 elections, climate legislation seems even more unlikely, at least in the short-term. Also, as the country feels anxious about the economy, it might be less likely to support climate legislation since many perceive it to be an expensive frill.
Northeast: Path to 350
Part of an educational film at the Smithsonian’s transportation exhibit

The lights in the theater dim as the film begins. Images flash on the screen as the narrator tells the story:

“Young children laugh when they hear the noise of the prehistoric internal combustion engine coming down the road in movies from the 1900s and early 2000s. Parents tell stories of war in the Middle East to secure oil, and of loud, polluting vehicles that brought the planet’s ecosystems to a tipping point. After years of citizen disapproval, the US pulled out the Middle East and brought our soldiers home. The US government then agreed to the toughest environmental and GHG regulations the world had ever seen. US Corporations believed these standards were impossible to comply with, claiming they would go bankrupt and that world economy would collapse.”

“Instead, human ingenuity prevailed and sustainable technologies emerged, bringing clean technology manufacturing into the US economy. It is these regulations, clean technologies, and the building of electric highways that put American citizens back to work. This is what pulled the US out of the great recession and brought it back to superpower status.”

“One of the technologies that emerged from this transitional time is the modern day electric vehicle and EV supporting infrastructure. The transition from oil to electricity was not easy. Many argued that the US was just trading oil for coal. However, federal policy under the ‘Green New Deal’ required a 100% renewable energy portfolio by 2050. No one expected that this mandate would be reached almost two decades early.”

“EV technology advanced rapidly. In 2010, an EV battery weighted almost 600 pounds and could only power 100 miles for each charge.”

“Due to electrified streets and highways the children will never know what is like to have to stop for charging because gas and charging stations are no longer in existence. Drivers can be billed electronically for charging, vehicles are monitored mechanical soundness and safety, and the electricity is from renewable sources.”

“Through advances in EV technology, the amount of CO2 in the atmosphere is now 300ppm. Clean energy and transportation solutions are now so obvious. Your children are lucky that history took this turn.”
Northwest: Clean Cars in a Dirty World
An excerpt from an Atlantic Monthly article

As 2010 came to an end, the first mass-produced electric vehicles—the Nissan Leaf and Chevy Volt—rolled off the assembly line and made their way to eager early adopters. While many were impressed with the new technologically advanced vehicles, others were frustrated by the dearth of fast charging stations, which limited the ability to use these vehicles in electric mode on longer trips. A network of fast, DC charging stations was planned for the San Francisco Bay Area in 2011, but a continued weak economy and lack of political support delayed implementation. In the meantime, as electric vehicle infrastructure seemed a distant reality, funds were allocated to support increased drilling in Alaska for continued growth in the demand for oil.

In 2014 the US economy continued to falter. President Palin promised Americans a quick economic turnaround as she doubled federal government spending and established a 15% universal tax rate for all Americans. This created a bonanza for wealthy Americans and brought record poverty to the poorest. Meanwhile, Nissan debuted the 2015 Leaf, which boasted a range of 200 miles and a sticker price of $22,000. Sales languished as increased drilling in Alaskan nature preserves and tax cuts brought gas prices to their lowest level in 20 years. BP-Chevron published research claiming that Peak Oil was a myth. Rumors circulated that big oil and American automakers paid-off government officials after Congress limited the EPA’s regulatory powers.

In the later half of the decade, Toyota unveiled its new line of electric vehicles, and in doing so, leapfrogged the competition. The new Prius-E offered a range of over 400 miles using advanced battery technology that achieved an 80% charge in less than five minutes with a full charge in just ten. Toyota also announced that it would complete its phase-out of Internal Combustion Engine vehicles by 2025. US support for electric vehicles continued to lag, even as EVs reached a total of three percent of the US vehicle fleet. At the same time, 30% of car sales in Japan and 20% of vehicle sales in the EU were EVs. Congress cut funding for alternative fuel R&D, and instead decided to fund new technologies for drilling deeper into Alaskan preserves in the deep-sea US waters. Despite additional drilling, gas prices continued to rise, topping $10/gallon in 2016. Struggling US car companies sought government funds in order to avoid bankruptcy. The EV technology existed, but the lack of support from the US government-kept the country’s focus on dirty combustion engines.
**Southwest: Dirty Future**  
*Snippets from the news*

**November, 2011** EVs that have been rushed into the market over the last year are plagued by maintenance issues, breakdowns, and lower ranges than manufacturers claimed. Given the pain of the lingering high unemployment rates and recession, government expenditures are scrutinized, most notably by the Tea Party, who initiate a surprisingly cohesive backlash against what they claim to be “wasteful government elite spending.”

**June, 2012.** Under heavy public pressure, cities with progressive EV policy begin to repeal EV and climate initiatives. Obama’s heavy tax cuts meant to appeal to Republican voters in the upcoming elections further strangle government budgets, leaving little room for education or public safety funds, let alone environmental concerns.

**November, 2012.** Sarah Palin narrowly beats out President Obama to become the 45th President of the United States. She passes massive sweeping tax cuts for individuals earning over $65,000 per year while simultaneously shifting government budgets to military expenditures. She announces a full-scale invasion of Yemen in retaliation for recent attempted acts of terrorism traced back to the country. EVs find shrinking government and consumer support due to political ideology and disappointing performance.

**November, 2016.** The US economy is partially recovering from its long, difficult recession, while the deficit grows from wars in Yemen, Iran, and areas of Pakistan. Environmental sustainability is an after-thought in American society, as workers are grateful to simply be able to find work in the defense industry. Americans applaud President Palin’s handling of the economy and re-elect her to a second term as commander-in-chief. EV infrastructure has been removed in many cities with parts converted to weapon components. American automakers shift production to tanks and Humvees, discontinuing their EV and many smaller vehicle product lines, as a decline in average incomes suppresses demand for personal automobiles.

**January, 2020.** The US feels deep empire fatigue after a series of long, protracted wars in the name of national security and domestic economic development. Political insecurity plagues the nation, which lashes out at foreign countries with ideological differences in an attempt to mobilize domestic support. China and India enjoy a spectacular and peaceful rise to the top. Their infrastructures boast EV charging and systemic urban transportation integration, as well as peaceful, clean city environments. Some EVs can still be seen on US streets, but are more of a retro novelty than a viable mode of transportation. Urban asthma and other respiratory illness rates continue to increase. The rise of the East is dubbed the “return of the East”, and a century and a half of Western power is seen as a short-lived bubble. Western economies now scramble to learn how to build sustainable technologies and urban systems like those in China, but cannot afford to do so due to high oil costs, lack of access to raw materials in countries that have exclusive contracts with China and India, and substantial brain drain from their countries. The City of Berkeley and other progressive cities are once again asked for leadership on the issue, but have no workable solutions because they realize the window of opportunity has been missed. Now the US has to wait its turn for the next wave of technological and thought development and hope that China will let it participate.
Southeast: How about Hydrogen?
An NPR transcript from 4/15/2020

NEDA ULABY: It’s a beautiful spring day here in Berkeley and cyclists are out to celebrate. Tim McLaughlin, Founder of Streets of Berkeley and Streets of San Francisco, leads a bicycle tour down historic Telegraph Greenway.

(Sound bite of bicycle gears and laughter)

TIM MCLAUGHLIN: Telegraph offers an interesting snapshot of the Berkeley and Oakland transportation system throughout the years. In its 160 year-old history, Telegraph’s name has changed from Road to Avenue to Greenway, and the way of transportation has followed suit. It’s seen: horses, a steam line, an electric line, gasoline powered cars and buses, a few electric vehicles, and finally this silent solar-powered monorail next to a bicycle and pedestrian greenway.

NEDA ULABY: It has only been 10 years since those gasoline vehicles sped up Telegraph, but it is hard to imagine hearing honking horns and smelling exhaust on this April afternoon. The past ten years of governmental policies supporting sustainable transportation measures has quickly transformed this street known for protests and commerce into the greenway it is today.

NEDA ULABY: In 2010, cities flocked to add EVs to their municipal fleets, install electric charging stations, and offer incentives for EV purchases. When Obama won a strong majority in the reelection of 2012 and the Tea Party extremists were ousted from Congress, the initiatives to research on alternative fuel vehicles sparked the economy into a period of prosperity.

TIM MCLAUGHLIN: Seeing the federal support for EV research, the city decided lay more and more wires under the roads for on-street residential wireless charging. It forgot to think about all of the other alternative fuel options: biodiesel, hydrogen, and even Ethanol… remember thinking about making fuel from food? No one could even imagine how quickly solar and hydrogen technology would advance.

NEDA ULABY: The group is full and happy, as they remount their bicycles. McLaughlin points to a construction crew near a broken pile of asphalt.

TIM MCLAUGHLIN: They’re taking out the EV lines Berkeley installed about five years ago. When Congress passed the $160 billion Sustainability Stimulus Plan of 2015, we all thought EV manufacturers would work together to create standardization in the cars, a less expensive and lighter battery, and charging solutions that were quick and easy. Despite the support for research, it just didn’t happen for EVs… different technologies emerged as better solutions. I’m not disappointed, though: gasoline powered vehicles are almost non-existent, the air is cleaner, and bicycles have gained popularity.

NEDA ULABY: With that, the Streets of Berkeley bike tour pedals off down the greenway, happy on bicycles in Berkeley, California. From Berkeley, California, this is NPR news.
References


http://energyalmanac.ca.gov/overview/energy_sources.html


http://www.berkeleyclimateaction.org/Content/10058/ClimateActionPlan.html

CPUC. (2010). The utility role in supporting plug-In electric vehicle Charging, Attachment A. CPUC


http://www.mnn.com/transportation/cars/stories/predicting-sales-of-
alternative-fuel-vehicles

from: http://www.ioe.ucla.edu/reportcard/article.asp?parentid=2304


Retrieved October 8, 2010 from: http://www.hybridcars.com/hybrid-
sales-dashboard/december-2009-dashboard.html

National transportation statistic table. (n.d). Retrieved from:
table_01_11.html

Official web site of the City of Berkeley, California. (n.d.). Retrieved

http://www.pikeresearch.com/newsroom/3-2-million-plug-in-electric-
vehicles-to-be-sold-worldwide-by-2015

Smarter Cities. (n.d.). Smarter Cities: A project of the Natural Resources
http://smartercities.nrdc.org/

Study ranks America's most liberal and conservative cities. (2005, August
http://govpro.com/content/gov_imp_31439/index.html

http://www.afdc.energy.gov/afdc/data/vehicles.html


http://www.nytimes.com/2010/10/08/business/08electric.html?_r=1&mc=eta1