Accommodating Electric Vehicles in South Australia
Acknowledgments:

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EXECUTIVE SUMMARY

Considering heightened global awareness of climate change, many countries have responded by identifying passenger vehicles as one of the key sources of greenhouse gas (GHG) emissions and are proposing low carbon fuel policy initiatives that promote use of alternatives fuels to petroleum. This report will review the current status of commercialized electric vehicles (EVs) as substitute to traditional forms of passenger transport and discuss the opportunities and challenges associated with introducing policy to accommodate them in South Australia.

PART I: THE EMERGENCE OF ELECTRIC VEHICLES AS A LOW-CARBON TECHNOLOGY

Policy Drivers

Increasing awareness of electric vehicles can be attributed to many environmental and economic factors. The following is a summary of the most commonly referenced drivers contributing to the emergence of policies around the world that address carbon emissions and electric vehicles.

- Heightened awareness of climate change and its effects
- Urban air pollution and health concerns
- Emergence of GHG reduction policies
- Need for reduction of petrol consumption due price volatility and geopolitical factors
- Threat of peak oil
- New technologies are being developed to promote energy efficiency

Background on Electric Vehicles

In the last three years alone, electric vehicle popularity has exploded around the world. Elevated global concern for climate change combined with economic catalysts (such as the global financial crisis, failing automobile giants and volatile liquid fuel prices) created a demand for more fuel efficient vehicle technologies.

Moreover, electric-drive power train technology matured to a level where experts have deemed it mass marketable. As an integral component for electric drive technology, batteries have improved in terms of energy storage capacity, weight, and cost (Kalhammer et al). As a result of changes on both the supply and demand side, electric vehicles are now considered a technically and economically feasible option for passenger transport.

Consequently, dozens of new vehicle brands and models have been announced, with a majority slated to hit the market in the 2010-2012 time frame. In fact, almost every major automaker has announced some form new electric vehicle platform, and a score of new companies have materialized in this budding market.
Benefits of EVs | Challenges / Barriers to Entry
---|---
Zero emission driving | Upfront Cost
Synergies with Renewable Energy | Charging and Public Infrastructure
Lower Cost of Ownership than Petrol Vehicles | Public Perception and Awareness

**PART II: A REVIEW OF POLICIES TO PROMOTE ELECTRIC VEHICLE ADOPTION IN GLOBAL MARKETS**

A majority of nations, both developed and developing, have adopted policies to address the impact of passenger transport on their constituencies and many of these policies include clauses to incentivize the uptake of electric vehicles.

Among other things this report reviews respective policy drivers and initiatives underway in the three global markets covered -- UK, US and Canada – to provide a benchmark of policy approaches and support a more in depth proposal for South Australia.

A simple comparative analysis of policy positioning in each country studied indicates that countries have targeted policies based on their individual country environmental impacts. Some policies are driven by a need for policy to meet their commitments for GHG emission reduction; others by improving air quality and reducing petroleum consumption. Generally speaking, all three countries show consciousness of scientific, social and economic drivers and have responded by unveiling policy measures aimed at stimulating a new green economy.

**Summary of Initiatives Underway in Global Markets:**

**United States**

1. Federal Grants to Bolster Electric Car and Component Manufacturing totaling $2.4 billion
2. A Target for 1 million EVs on US Roads by 2015
3. Substantial Federal Tax Rebates for Consumers
4. Increased Passenger Vehicle Regulatory Policy Measures
5. Funding for a Network of Smart Grids

**United Kingdom**

1. Mapping EV technologies and planning for their implementation
2. Launch of a £1 million grant fund for development of electric vehicle infrastructure
Ontario, Canada

In July of 2009, the Premier of Ontario, Dalton McGuinty unveiled a policy aimed to stir the green vehicle market. Elements of that policy roll-out include:

- Consumer rebates
- Green Vehicle License Plates
- Electric Vehicles in Public Service Fleet
- Public Charging Infrastructure
- Commitment of $16.7 million to battery manufacturing

PART III: ACCOMMODATING ELECTRIC VEHICLES IN SOUTH AUSTRALIA

South Australia has yet to unveil a comprehensive plan targeting passenger transport emissions, though various government departments are exploring electric vehicles, among other low carbon technologies, to facilitate carbon reduction goals.

This report will evaluate the unique attributes of South Australia under the pretext of supporting electric vehicles as an element of a comprehensive low carbon policy for GHG reduction from passenger transport.

South Australia is Uniquely Positioned

South Australia is uniquely positioned to be a leader in the deployment of electric vehicles in Australia, if it chooses to leverage its strengths imminently. Unlike other Australian States and Territories, South Australia is characterized by the following attributes, which make it an ideal testing bed for early deployment of EVs.

Summary of Strengths

1. **Aggressive Renewable Energy Target and Deployment Strategy**
   Commitment to attain the highest level of renewable energy of any other State or Territory (33% by 2020).

2. **Low Emissions Intensity of Electricity Grid**
   Fueling a vehicle with electricity in South Australia is less GHG-intensive than fueling with petroleum, even without use of GreenPower.

3. **Grid Capacity for First Influx of EV Adopters**
   Current electricity grid in South Australia able to accommodate low volumes of early adopters.

4. **Metropolitan Population with Mostly Urban Driving**
   73 percent of South Australian residents live in the Adelaide metro region and 95 percent of Adelaide drivers travel 80km or less per day.
(5) Local Political Will Toward Sustainability Policy
   The South Australian government wants to be a leader in sustainable policies.

While electric vehicle deployment is feasible in South Australia, there are a variety of obstacles that may delay or complicate it. Additionally, failure to optimize key elements of an electric vehicle roll-out may adversely impact the inherent benefits of deploying the low carbon technology.

Threats to Deployment

Though South Australia is well prepared to support the imminent deployment of electric vehicles, the following items may create obstacles for electric vehicle uptake.

Challenges for EVs in South Australia

1. Vehicle Availability
   Only a handful of models will be available in Australia in the near term, and potential placement volumes for each model are still unclear.

2. Uptake Levels in Australian Markets Unknown
   Vehicle manufacturers in fact, are also unsure of vehicle uptake, as demonstrated by their initial plans to “trial” new electric vehicle models before selling them to consumers and further by their fuzzy production estimates for EVs in the near term.

3. Little Public Exposure to EVs in Australia
   South Australian citizens’ willingness to engage an individual level relating to decreasing GHG emissions from passenger transport is uncertain.

4. Lack of Coordination
   A wholesome policy targeting low carbon transport is not currently part of the State’s vision for reducing GHG emissions.

Spectrum of Policy Options
There is a sizeable spectrum of EV policy levers on both the supply (or industry) side and the demand (or consumer) side, to support the mass adopting of electric vehicle technologies.

Policy Recommendation 1: Appoint a Central Authority for Coordination
Uncoordinated approaches to advancing electric vehicles and sustainable passenger transport can stall efforts on behalf of the State to show leadership on this initiative. A central authority to coordinate a “coalition of the willing” including government, industry, community organizations
and utilities, would support an impactful policy imitative relating to electric vehicles in South Australia.

**Policy Recommendation 2: Educate and Raise Awareness**
Creating an educational campaign that covers sustainable transport and renewable energy and the synergies of using them together, would not only reinforce the State’s commitment to climate change mitigation, it would cultivate a body of knowledge in its constituency.

Additional benefits to investing in an educational campaign include:
- Increasing citizen engagement on sustainability;
- Fueling demand for clean technology and infrastructure; and
- Marketing the State’s existing progressive renewable policies (e.g. feed-in tariff).

**Policy Recommendation 3: Let the Market Rule, but Give it a Push**
In order to be a leader in sustainable passenger transport policy, South Australia must incentivize its adoption. There is a broad range of consumer incentives levers that can be used to encourage adoption of any low carbon technology; the key is to pick the best one, considering associated costs, benefits and time frames.

Options for consumer incentive include:
- A rebate or tax credit;
- Relief from vehicle registration;
- Early adopter privileges such as green licenses plates or dedicated parking (as outlined by Stephen Schneider).

**Policy Recommendation 4: Have a long term strategy and Continue to Plan Ahead**
With or without the coordinating efforts of a central authority on sustainable transport, policymakers must stay apprised of advances in the clean technology and sustainable transport policy space. Continuous learning and networking will help government officials stay abreast of future developments and advancements.

**Maximizing the Potential**

**Smart grids**
Smart grids aggregate the benefits of communication and advanced infrastructure technology such as smart meters and renewable energy storage to enable more a more cohesive system-wide management of energy distribution. Smart grids are the vision for the next generation electricity grid and have inherent synergies with electric vehicles.

**Ancillary Services / Vehicle-to-Grid**
Vehicle-to-grid (V2G) enables interactivity between the grid and electric vehicles by creating a connection between the batteries in electric vehicles and the utility grid. V2G maximizes the potential of electric-drive vehicles to store energy when they are not being driven, especially during peak times where use of ancillary services is required.
GreenPower and the “Sustainable” Paradigm
GreenPower is a program managed by the Australian Government that enables electricity consumers to offset their energy use with a per kWh investment in renewable energy. One hundred percent Green Power is the cleanest form available and enables zero-emission driving.

Local Automotive Manufacturing and Subcomponents
As one of the country’s hubs for vehicle manufacturing, South Australia has proximity to recent developments in the automotive industry locally, potential for influence of auto industry product development and may be able ultimately to support a green vehicle manufacturing industry in South Australia.

Conclusion

Electric vehicle technology will be deployed imminently in South Australia, with or without government support. Government should plan ahead for the arrival of EVs but also harness the State’s strengths and incorporate EVs into low carbon vehicle strategic plan for GHG reduction from transport.

Without definitive leadership in accommodating electric vehicles, South Australia puts at risk its reputation for leadership on sustainability policy and misses an opportunity for economic stimulus.
PART I: THE EMERGENCE OF ELECTRIC VEHICLES AS A LOW-CARBON TECHNOLOGY

INTRODUCTION

Today’s global society considers electric cars to be among the leading technologies for the future of passenger vehicles. Petrol-powered vehicles commonly used for passenger transport are carbon-intensive, highly polluting, and reliant upon a commodity whose supply and accessibility is increasingly threatened by geopolitical and resource constraints. Given these factors, many people now perceive traditional passenger vehicles as less desirable than in the past.

As the automotive industry explores options to replace internal combustion engines and/or petroleum for vehicle propulsion, policymakers are starting to encourage development and adoption of alternatives. In fact, policies to address vehicle emissions, their greenhouse gas (GHG) intensity and dependence on petroleum for automotive transport are surfacing at various levels of regulation all over the world. Occasionally as part of these policies, or frequently as a stand-alone policy, governments incorporate support of electric vehicles (EVs). Inclusion of electric vehicle specific policy in large-scale carbon reduction environmental policy initiatives illustrates awareness of an imminent electric vehicle deployment globally, and in the case of some countries, apparent support of their adoption.

This report will review carbon reduction policy drivers that target the transport sector in select global markets and policies introduced in those markets to encourage electric vehicle deployment. In California, for example, a low carbon fuel policy, a zero emissions vehicle regulation, and other progressive policy initiatives championed by State government such as the “Million Solar Roofs” program have encouraged research and development locally in renewable energy and clean technology industries. In the case of California, the links between sustainability policy, progressive thinking, technological innovation and economic development are clear.

The markets examined in this report include the United Kingdom, the United States, and Canada, each of whom often serve as a benchmark for Australian policy making. The report will review existing electric vehicle policies in these markets, their drivers, and provide some discussion. Finally, the research of global approaches to electric vehicle policy sets the stage for Part III of the report, analysis of South Australia and specific recommendations for deploying electric vehicles.

Though many other alternative technologies are encouraged worldwide, electric passenger cars (also referred to as “electric vehicles”) will be the sole emphasis of this study.
OVERVIEW OF POLICY DRIVERS

Increasing awareness of electric vehicles can be attributed to many environmental and economic factors. The following is a summary of the most commonly referenced drivers contributing to the emergence of policies around the world that address carbon emissions and electric vehicles. The United Kingdom, the United States, Canada and the Australia each have policy interest due to the many or all of the below factors.

**Heightened awareness of climate change and its effects**
In the last few years policymakers around the world have begun to regard the threat of climate change as more serious than before. Empirical research of climate change indicates detrimental ecological, health, and social implications for consumption of petroleum at current rates. Given the scientific evidence and public concern for long term effects of climate change, global societies are paying closer attention to the problem as a whole and options for addressing it.

**Urban air pollution and health concerns**
For many societies, and especially in urban communities where there are many cars on the road, air quality is a major concern. In fact, the World Health Organization reports that poor air quality leads to greater incidence of cardiovascular and respiratory disease and that each year more than 2 million premature deaths worldwide are the result of poor air quality (WHO). According to many human health analysts, progression of climate change will increase air quality concern as well as contribute to the rise of other negative environmental events, such as natural disasters (e.g. floods, heat waves, hurricanes, etc).

While poor air quality results from various forms of pollution, in many countries, urban transport serves as a large source of unhealthy emissions. In fact, the *Environmental Health Perspectives Journal* published a report in 2005 noting a global growth in “car culture”. Figure 1 illustrates an increasing trend in projected vehicle ownership in every major region of the world (Heavy Traffic Ahead). A greater number of internal combustion vehicles on the road will only increase the number of harmful emissions in the atmosphere.
Emergence of GHG reduction policies
At a global level, individual nations look to remedy the effects of climate change and, even more striking is the way policymakers convene unlike ever before to identify a unified global approach. For example, the Kyoto Protocol, one of the better known climate change treaties enacted as part of the United Nations Framework Convention on Climate Change (UNFCCC) in 1997, links many countries to binding targets for reducing greenhouse gas (GHG) emissions by the year 2012. As of 30 June 2009, 186 countries and 1 regional economic integration organization (the EEC) have ratified the agreement. The United States is not one of them. Kyoto signatories are currently negotiating an international response to climate change, given the current agreement expires in 2012 (UNFCCC). This treaty, along with other emerging global policy initiatives, advances society toward sustainable living that endeavors to change the way the world operates.

Need for reduction of petrol consumption due to price volatility and geopolitical factors
International oil trade has been a political issue for decades, particularly due to the volatility of governments in many oil exporting countries. Former United States’ Central Intelligence Agency (CIA) director R. James Woolsey listed top reasons for encouraging energy independence in a US Senate Committee Testimony on Oil and Foreign Policy. His insights apply beyond US domestic policy and relate to other countries’ interaction with oil products and suppliers that
produce and trade them. Woolsey commented that existing transportation infrastructure is committed to oil products and that the majority of oil products come from regions of the world that are prone to political instability. Furthermore, these unstable regions have a strong hold on supply and pricing strategies for oil products, creating monopolistic tendencies (Energy Bulletin).

Threat of peak oil
In addition to the vulnerability of oil acquisition, general supply is a concern. According to Robert Hirsch, a United States geologist commissioned by the United States Department of Energy (DOE) to research the phenomenon of peak oil, world oil demand is expected to increase by 50% in the year 2025. Hirsch argues that there has been a disparity between world oil reserves and annual consumption, as demonstrated in Figure 2 below (Hirsch, 15).

Figure 2.
Net Difference Between Annual World Oil Reserves Additions an Annual Consumption

Hirsch’s report is not unique. Many other geologists who have reported on the issue of peak oil agree that there is a point in time where petroleum production will decline – irrespective of improvements in petroleum discovery and extraction technologies. In addition to an academic point of view, representatives of the Organization for Petroleum Exporting Countries (OPEC) put forward that oil supply will be inadequate to satisfy world demand in 10-15 years which underscores the need for policy alternatives to mitigate current levels of petroleum consumption globally (Hirsch 3).

Many countries fear diminishing supplies and increasing demand for oil. Cost of oil is expected to increase substantially in the coming years while global dependence on oil shows little sign of decrease. In response, some facilitate their energy independency by increasing their domestic oil
reserves or by developing plans to drill for oil in untapped on- and off-shore rich areas. Others implement policies that encourage use of alternative fuel options.

New technologies are being developed to promote energy efficiency
In addition to a policy-based approach to combating the effects of climate change, the market response is noticeable. Dubbed “clean technology” by most, companies around the world are unveiling new technologies to encourage efficient use of energy, with products ranging from light-globes, residential solar systems and other household electrical appliances, to cars.

Figure 3. New Global Investments in Clean Energy in 2008 in USD

According to Clean Edge, a research firm tracking clean technology development, the global clean energy industry doubled in size from 2007 to 2008. Investment in the sector in 2008 was $155.4 billion USD as reflected in Figure 3 above. Experts expect growth to continue through 2009, especially in the United States given President Obama’s allocation of more than $70 billion of federal stimulus and tax credits (Clean Edge).
BACKGROUND ON ELECTRIC VEHICLES

ELECTRIC VEHICLE TECHNOLOGY AND THE MARKET
In the last three years alone, electric vehicle popularity has exploded around the world. Elevated global concern for climate change combined with economic catalysts (such as the Global Financial Crisis, failing automobile giants and volatile liquid fuel prices) created a demand for more fuel efficient vehicle technologies.

Moreover, electric-drive power train technology matured to a level where experts have deemed it mass marketable. An integral component for electric drive technology, batteries have improved in terms of energy storage capacity, weight, and cost (Kalhammer et al). As a result of changes on both the supply and demand side, electric vehicles are now considered a technically and economically feasible option for passenger transport.

Consequently, dozens of new vehicle brands and models have been announced, with a majority slated to hit the market in the 2010-2012 time frame. In fact, almost every major automaker has announced some form of a new electric vehicle platform, and a score of new companies have materialized in this budding market. Most of the key players have planned for a gradual ramping introduction of this promising new technology and in doing so, are creating an expectation for steady adoption over time. Appendix B reveals a list of electric passenger vehicles either on the market today or with a planned release in the next three years.

BENEFITS OF EVS
Electric vehicles are intriguing to consumers and policymakers alike because they possess characteristics that make them not only an interesting product, but also a potential remedy for policy drivers such as climate change, geopolitical and peak oil issues and clean technology-focused economic development.

There are many benefits of electric vehicle use and three of the central benefits are highlighted briefly below.

**Zero emission driving.** Electric vehicles are powered using electricity stored in batteries. They do not require use of any petroleum to operate thereby alleviating geopolitical concerns around obtaining cheap oil from politically volatile countries. From an emissions standpoint, electric vehicles are typically net lower emitters of pollution than internal combustion vehicles, but the relative cleanliness of an electric vehicle depends solely on the type of fuel used to generate electricity (Simpson, Environmental Attributes). The cleaner the electricity grid (facilitated by a mix of energy sources such as natural gas and renewable energy), the more environmentally friendly EV driving becomes. This value proposition is further supported by use of 100 percent renewable energy, which when used to charge an EV, results in zero emission driving.

**Synergies with Renewable Energy.** Electric vehicles offer a variety of potential synergies with renewable energy that strengthen their benefits for immediate
deployment. Firstly, electric vehicles can interact with the electric grid, in some cases providing ancillary storage capacity. Additionally, electric vehicles can support increasing penetration of renewable energy such as wind power by matching recharging loads with intermittent generation. Thirdly, electric vehicles can maximize these first two benefits by way of a smart grid - the next generation electricity grid that allows for advanced metering, interconnectivity and increased communication between energy suppliers and users. Finally, as previously noted, EVs are most sustainable when charged with clean energy.

**Lower Cost of Ownership than Petrol Vehicles.** Given electric vehicles are a relatively new technology, they typically are characterized as having high upfront costs. However, recent studies have verified what EV advocates have understood to be true – EVs have lower fueling and maintenance costs than petrol-powered cars thus making their overall lifetime costs lower (AECOM). A study conducted by AECOM for the New South Wales government in late 2009 reviewed the cost of EV use considering infrastructure needs and the cost of externalities such as GHG emissions and further affirmed the financial viability EVs in Australian application.

**CHALLENGES / BARRIERS TO ENTRY**

Although challenges to electric vehicle integration in the market have decreased recently, there remain obstacles that preclude electric vehicles from displacing traditional internal combustion vehicles completely.

**Upfront Cost.** Firstly, though electric vehicle development costs decrease as car companies get closer to production at economies of scale, the upfront cost of electric vehicles is still quite high. For example, the Chevy Volt plug-in electric sedan is expected to have a MSRP (manufacturer’s suggested retail price) of around $40,000 USD (Ehrt). Compared to the starting price of the most fuel efficient vehicle currently on the US market, the Toyota Prius, there is a $18,000 USD difference in sticker price (Toyota). However, recall the cost of owning and operating an electric vehicle is projected to be comparatively less expensive than a petroleum-fuelled car (Simpson, Environmental Attributes).

**Charging and Public Infrastructure.** Electricity is ubiquitous and readily accessible at most homes, offices and retail locations but various physical and mechanic limitations to electricity accessibility especially outdoors raises question as to how electric vehicles will be able to charge. In response to these concerns, many governments incorporate infrastructure improvement funding into their electric vehicle policies. Also, researchers study how charging of electric vehicles will impact the electricity grid at different levels of energy usage. There is concern for charging electric vehicles during peak times where the current grid capacity in most regions is already stressed to its limits. Use of smart grid technology and the potential for intelligent vehicle-to-grid networks can address
this uneasiness, though none of these supplementary technologies are fully developed or deployed (Book).

Public Perception and Awareness. Electric vehicles have jumped in popularity, especially given announcement of many new models becoming available around the world, however very few people have ever experienced (much less driven) an electric car. This situation creates misperceptions about the vehicle technology and may contribute to low vehicle adoption rates if not properly addressed via government demonstration projects and informative commercial marketing campaigns.

ADDITIONAL CONSIDERATIONS: OTHER LOW CARBON VEHICLE TECHNOLOGIES
While electric vehicles emerge as the favoured advanced vehicle technology, they are not the only one. Other forms of advanced transportation are continuously investigated by vehicle manufacturers and policymakers alike, but with less fervour than for electric drive technologies currently.

The interest around electric vehicles results from their popularity among automotive manufacturers as the preferred clean technology. Their selection is based on scientific evidence that reflects their superiority in tank-to-wheel efficiency, meaning that from the source of the propulsion energy to the vehicle use of that energy, battery electric vehicles are a net winner when compared to all competing technologies. Figure 4 illustrates one of many examples where battery electric vehicle efficiency has been compared to other technologies.

Furthermore, compared to other alternative fuels (e.g. hydrogen), the additional infrastructure requirements for EVs are considered to be much lower due to the ubiquity of existing networks for electricity transmission and distribution.
### Figure 4. Comparison of Tank-to-Wheel Efficiency of Various Vehicle Powertrain Technologies.

<table>
<thead>
<tr>
<th>No.</th>
<th>Fuel</th>
<th>Powertrain</th>
<th>Fuel specific energy (MJ/kg)</th>
<th>Engine / Fuel Cell / Battery specific power (W/kg)</th>
<th>Engine / Fuel Cell / Battery efficiency (%)</th>
<th>Curb Masse (kg)</th>
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<th>TTW Energy Consumption (MJ/km)</th>
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<td>F</td>
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<td>S</td>
<td>E85</td>
<td>HEV</td>
<td>24.8</td>
<td>642</td>
<td>32.4</td>
<td>1815</td>
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<td>T</td>
<td>E10</td>
<td>HEV</td>
<td>35.3</td>
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<td>1800</td>
<td>14.7</td>
<td>2.47</td>
</tr>
<tr>
<td>U</td>
<td>Diesel</td>
<td>HEV</td>
<td>37.3</td>
<td>510</td>
<td>34.8</td>
<td>1996</td>
<td>16.7</td>
<td>2.71</td>
</tr>
<tr>
<td>V</td>
<td>BioD</td>
<td>HEV</td>
<td>31.9</td>
<td>510</td>
<td>34.8</td>
<td>1972</td>
<td>16.7</td>
<td>2.71</td>
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<tr>
<td>W</td>
<td>ULP</td>
<td>FCEV</td>
<td>37.3</td>
<td>258</td>
<td>37.0</td>
<td>2234</td>
<td>14.7</td>
<td>2.75</td>
</tr>
<tr>
<td>X</td>
<td>MoOH</td>
<td>FCEV</td>
<td>19.5</td>
<td>250</td>
<td>41.5</td>
<td>2293</td>
<td>16.2</td>
<td>2.55</td>
</tr>
<tr>
<td>Y</td>
<td>GH2</td>
<td>FCEV</td>
<td>12.7</td>
<td>375</td>
<td>56.5</td>
<td>1889</td>
<td>22.4</td>
<td>1.66</td>
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<tr>
<td>Z</td>
<td>LH2</td>
<td>FCEV</td>
<td>9.5</td>
<td>375</td>
<td>56.5</td>
<td>1926</td>
<td>22.4</td>
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<td>Aa</td>
<td>ULP</td>
<td>FCEV</td>
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<td>38.2</td>
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<td>Bb</td>
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<td>Dd</td>
<td>LH2</td>
<td>FCEV</td>
<td>9.5</td>
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<td>1914</td>
<td>24.0</td>
<td>1.58</td>
</tr>
<tr>
<td>Ee</td>
<td>Li-Ion</td>
<td>BEV</td>
<td>0.5</td>
<td>420</td>
<td>95.0</td>
<td>2854</td>
<td>39.2</td>
<td>1.14</td>
</tr>
<tr>
<td>Ff</td>
<td>NiMh</td>
<td>BEV</td>
<td>0.26</td>
<td>393</td>
<td>92.0</td>
<td>2746</td>
<td>37.5</td>
<td>1.22</td>
</tr>
<tr>
<td>Gg</td>
<td>VRLA</td>
<td>BEV</td>
<td>0.13</td>
<td>300</td>
<td>60.0</td>
<td>2917</td>
<td>36.4</td>
<td>1.27</td>
</tr>
</tbody>
</table>

**Notes:**
2. From TIAK (2002)
3. For fuel blends, values are calculated in proportion to the constituent fuels.
4. Based on 140 Wh/kg and 420 Wh/kg lithium-ion (Li-Ion) batteries (SAFT, 2003)
5. Based on 76 Wh/kg and 220 Wh/kg nickel-metal-hydride (NiMH) batteries (Ovonic, 2003)
6. Based on 35 Wh/kg and 300 Wh/kg valve-regulated lead-acid (VRLA) batteries (JVB, 2000)

PART II: A REVIEW OF POLICIES TO PROMOTE ELECTRIC VEHICLE ADOPTION IN GLOBAL MARKETS

PURPOSE OF STUDY

This section of the report is a literature review of respective policy drivers and initiatives underway in the three global markets -- UK, US and Canada – to provide a benchmark of policy approaches and support a more in depth proposal for South Australia. The report will also briefly note EV policies in smaller global markets, to emphasize broader interest in deployment of the technology.

Overview

A majority of nations, both developed and developing, have adopted policies to address the impact of passenger transport on their constituencies and many of these policies include clauses to incentivize the uptake of electric vehicles.

Given the recent release of policies in the United States, the UK and Canada, it is difficult to assess the success or relative impacts on each respective country. Many policy announcements are only just becoming incorporated into legislation and business proposals. However, a simple comparative analysis of policy positioning of each country studied indicates that countries have targeted policies based on their individual country environmental impacts. For example, US policies focus on improving air quality due to high levels of smog in major metropolitan areas and reducing petroleum consumption to discourage reliance of foreign imports of liquid fuels; whereas UK and Canadian policy appears to underscore the need for policy to meet their commitments for GHG emission reduction. Air quality and health concerns are important to the UK and Canada, but their focus with relation to electric vehicle policy announcement, shows greater concern for meeting international carbon reduction targets and for showing leadership with regard to emerging policy concern around transport emissions.

Additional study of electric vehicle policy initiatives compared to plans for product placement in those markets would provide further analysis of the effectiveness of the policies introduced by each country. This comparative study requires further research and is out of scope for this paper.

ELECTRIC VEHICLE POLICIES

Policymakers undertake various approaches to encourage use of electric vehicles in specific global markets. Each country approaches electric vehicle policy in a manner that best suits their aforementioned policy drivers. Another consideration is a country’s desired outcome with respect to economic development in this area.

Many EV policies stimulate either supply or demand side of the market, or a combination of the two. The chart below depicts the most common types of EV policies announced today, covering both supply and demand sides of the market.
### Table 1. Common Global Electric Vehicle Policies

<table>
<thead>
<tr>
<th>Supply-side (i.e. industry)</th>
<th>Demand Side (i.e. consumers)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle Research, Development &amp; Deployment</strong></td>
<td><strong>Monetary Relief for Upfront Cost</strong></td>
</tr>
<tr>
<td>Subsidies to companies who design, develop and manufacture electric vehicles and components</td>
<td>Consumer rebates/tax credits</td>
</tr>
<tr>
<td>Government enthusiasm for the technology illustrated by goals/targets (e.g. 1 million EVs by 2015)</td>
<td>Waiver of vehicle registration or operating fees</td>
</tr>
<tr>
<td><strong>Utility Mobilization</strong></td>
<td><strong>EV Charging</strong></td>
</tr>
<tr>
<td>Subsidies for improvements to utility infrastructure (e.g. smart grids, smart meters)</td>
<td>Reduced utility rates for EV charging at home</td>
</tr>
<tr>
<td>Support for renewable energy generation (per zero emission vehicle value proposition)</td>
<td>Government-subsidized municipal charging stations</td>
</tr>
<tr>
<td><strong>Increasing EV Technology Market-share</strong></td>
<td><strong>Early Adopter Bonus</strong></td>
</tr>
<tr>
<td>Low/Zero emission vehicle regulations to encourage up-take of green vehicles</td>
<td>Creation of dedicated EV parking spaces</td>
</tr>
<tr>
<td>Funding for training programs for new technologies as part of “green economy”</td>
<td>Access to high occupancy vehicle (HOV) lanes on congested thoroughfares</td>
</tr>
<tr>
<td>Leading by example: Incorporating EVs into government fleets</td>
<td>Waiver of highway tolls and congestion charges</td>
</tr>
<tr>
<td></td>
<td>Special green vehicle license plates</td>
</tr>
</tbody>
</table>
UNITED STATES

As the world’s largest economy and third largest global population, the United States is often relied upon for leadership on policy matters that affect the world. With the exception of some progressive State and municipal efforts, for nearly a decade the United States has been perceived publicly as showing minimal undertaking of climate change policy, especially given its refusal to ratify the Kyoto Protocol. Despite its past reputation, US Climate Change policy recently has been revitalized as a result of the election of President Barack Obama, who campaigned on a pro-environmentalist policy platform. Coupled with this change in leadership, climate change societal awareness has also increased in the United States since the emergence of a new “green economy” and also thanks to plentiful discussions in the news media. In the US, climate change is now being evaluated as a potential threat to national security.

Since his election, President Obama has put forth many proposals for addressing climate change on a national level. Most noteworthy is Obama’s support for regulation of greenhouse gases, a topic debated during the oversight of the prior administration until the Supreme Court ruled GHGs should be regulated as they are deemed dangerous to public health and welfare because of their contribution to air pollution (EPA). These recent changes in American political ideology and mounting support for additional pro-environmental laws spur policies for reducing petroleum consumption in the US. Thus, policies around mitigating pollutant emissions are nearer to implementation than ever before.

The United States continues to participate in summits regarding global climate change policy, indicating that as a nation, it is engaged in climate debate. Unlike Canada and the United Kingdom, the United States’ interest in the uptake of alternative transport options is as much about reducing emissions as it is securing energy independence. Americans drive more than any society and for that reason, import large amounts of oil to facilitate driving. Driving is required for transport in most American cities and any change in this behavior might disrupt economic growth for the United States. Additionally, given the recent downturn of the major car companies in Detroit, the United States’ market share of vehicles has waned and government investment in the development of new technologies appears to be the only opportunity for the US to regain market share in the auto sector.

Key EV Policy Drivers

Driving Habits. Americans drive more than any other nation. Figure 5 reflects the frequency of American use of private transport, especially in highly suburbanized areas, which is drastically higher than its frequency in other parts of the world.
The United States also has more passenger vehicles on the road than any other country. In 1990, the Bureau of Transportation Statistics (BTS) reported 193.1 million total highway vehicle registrations nationwide. That figure increased to 225.8 million in the year 2000 and shot up to 250.8 million in 2006, in the most current BTS report. Considering only standard passenger vehicles sales, more than 16 million vehicles were sold or leased in the United States in 2007, a 16% increase in sales from 1990 (US Census).

On average Americans consume 8,989,000 barrels of petrol per day and of that, roughly 60% of American consumption of petroleum is used for transportation (EIA). For nearly a century, the United States has created an economy based on a limitless consumption of an abundant and inexpensive national resource – petroleum. However, the United States is turning a new leaf in terms of how it perceives petroleum use for transportation. In March 2008, the United States Department of Transportation reported the most drastic decline in vehicle miles travelled since the oil shock in 1979. Americans drove 4.3 percent less in 2008 than they did in 2007. This figure represents the sharpest decline of driving in American history, and though its cause is most likely due to poor economic conditions, it may possibly represent a permanent behavioral change in driving patterns (Stratfor).

_Greenhouse Gas Emissions and Air Quality._ Given American driving habits, it is not surprising to learn that greenhouse gas emissions from transport carry a high percentage of the total amount of pollutants in the atmosphere in the United States. Specifically, the transportation sector accounted for 1,924.6 Tg CO2 in 2007, representing 33 percent of CO2 emissions from petroleum consumption. Of that figure, passenger vehicles represented 61 percent of domestic
CO\textsubscript{2} emissions. Between 1990 and 2007, emissions from passenger transport rose 29 percent (EPA).

Poor air quality also poses a huge problem for the health of Americans. Statistics assembled by the American Lung Association (ALA) indicate that poor air quality adversely affects the respiratory health of Americans. For example, the ALA notes more than one third of the US population is exposed to unhealthy levels of smog and of those 70,000 die each year. Annual global fatalities from air pollution reach up to 570,000 (ALA).

Air pollution is also costly. The ALA reported up to $55 billion USD spent annually on human health costs related to outdoor air pollution (ALA).

**Electric Vehicle Policy Initiatives**

The United States has been the foreground for electric vehicle developments recently. This prominence is no coincidence as the United States has been very vocal in its support for electric vehicle deployment since late 2008, and as a result, there is a litany of policy initiatives nationally to support electric cars.

Highlights of these policies include:

**(1) Federal Grants to Bolster Electric Car and Component Manufacturing totaling $2.4 billion.**

As part of the stimulus package funding, this grant supports domestic production of advanced vehicle technologies as represented by 48 different electrification projects (Wald). Some project areas include:

- Grants for US-based manufacturers to produce batteries and their components and to expand battery recycling capacity
- Awards for US-based manufacturers to produce electric drive components for vehicles
- Purchase of thousands of vehicles for test demonstrations in dozens of locations
- Support for electric vehicle charging infrastructure
- Workforce training to support the transition to advanced electric transportation systems (Green Car Congress)

**(2) A Target for 1 million EVs on US Roads by 2015.**

The manufacturing announcement follows on the heels of President Barack Obama’s campaign promise of placing 1 million electric vehicles on U.S roads by 2015.

**(3) Substantial Federal Tax Rebates for Consumers.**

Also in support of this policy initiative, the US government announced a federal tax rebate of up to $7500 for electric vehicles purchased after 1 January 2009. This
sizeable consumer incentive from the federal government is expected to encourage quick uptake of the new, highly-subsided technology (Green Car Congress).

(4) Increased Passenger Vehicle Regulatory Policy Measures.
In addition to the legal regulation of GHGs, US federal policy includes a policy measure for regulating the fuel economy (or miles per gallon of petrol consumed while driving) of traditional internal combustion engine cars. In 2007, President Bush signed into law energy legislation that forced the Corporate Average Fuel Economy (CAFE) standard for passenger vehicles up to a minimum fuel economy of 35 miles/gallon by 2020 (NHTSA). Requiring carmakers to make more efficient cars supports the uptake of green vehicles as car companies appropriately market their “green” products to an emerging demographic of sustainable consumers.

Also, rigorous State regulatory policy in large vehicle markets has resulted in a shift in the increased options for consumers seeking cleaner cars. In particular, the State of California has advocated low carbon vehicle technologies since the 1990s. Its Zero Emission Vehicle (ZEV) regulation is the law that is best known for mandating research and development of alternative fuel vehicles in the auto industry. Since the early 1990s, the ZEV regulation has required any car manufacturer who wishes to be able to sell vehicles in the State to ensure that some portion of its market share in the State consists of at least one type of zero emission vehicle technology (Calef and Goble). California’s ZEV regulation is still in place and continues to drive the auto industry’s direction for new technology development.

(5) Funding for a Network of Smart Grids.
In October of 2009, President Obama announced $3.4 billion dollars investment in smart grid related projects. These programs are part of the stimulus package and require equal matching from industry. The administration divided funding into the following main categories:

- $2.0 billion for Advanced Metering infrastructure
- $67.3 million for Customer Systems
- $509 million for Electric Distribution Systems
- $298.4 million for Electric Transmission Systems
- $51.6 million for Equipment Manufacturing
- $5.2 billion for Integrated of Cross-Cutting Projects
  (Green Car Congress, Smart Grids)

States and Cities
The federal policies in place to support EV adoption are plentiful in the US, but States and cities are also announcing policies of their own to support EVs. In fact, there are too many on which to elaborate in this review. Figure 6, a map of the United States produced by the Department of Energy, highlights which US States have policies in place to encourage electricity use as an alternative fuel. California, Washington State and New York have the greatest number of polices.
with each supporting at least 11 separate policies. While this figure encompasses more than electric vehicle-exclusive policies, it illustrates general State level support for policies “related to federal laws and incentives related to alternative fuels and vehicles, air quality, vehicle efficiency, and other transportation-related topics” (DOE). Table 2 summarizes a few key initiatives underway at State and municipal levels in the US.

**Figure 6. Number of Policies Supporting Electricity as Fuel**

## Table 2. Summary of Select EV Policies Initiatives in States and Cities in the US

<table>
<thead>
<tr>
<th>State</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland</td>
<td>Hybrid and EV Tax Credit (Tran. Code 13-815)</td>
</tr>
<tr>
<td></td>
<td>• Up to $2000 tax credit for EVs</td>
</tr>
<tr>
<td></td>
<td>• Adoption of California Low Emission Vehicle Regulation</td>
</tr>
<tr>
<td>Washington</td>
<td>Washington’s Leadership on Climate Change (Exec. Order 09-05)</td>
</tr>
<tr>
<td></td>
<td>• Adoption of comprehensive GHG policy encouraging EV uptake including developed of charging infrastructure</td>
</tr>
<tr>
<td></td>
<td><strong>Alternative Fuel Vehicle and Hybrid Tax Exemption (Revised Code of WA 82.08.020 and 82.08.809)</strong></td>
</tr>
<tr>
<td></td>
<td>• Certified EVs exempted from State sales tax until 1 January 2011</td>
</tr>
<tr>
<td></td>
<td><strong>Electric and Plug-In Hybrid Electric Vehicle Demonstration Grants (Revised Code of WA 43.325.110)</strong></td>
</tr>
<tr>
<td></td>
<td>• Government agencies, school districts and utilities eligible for grant funding to cover the cost of purchase or conversion of existing vehicles to EVs for use in an applicant's fleet or operation</td>
</tr>
<tr>
<td>California</td>
<td><strong>Alternative and Renewable Fuels and Vehicle Technology Program's Investment Plan (CEC-600-2009-008-CT)</strong></td>
</tr>
<tr>
<td></td>
<td>• CA’s first transportation investment plan aimed at stimulating green transportation projects and encouraging innovation to help meet the State’s climate change policies</td>
</tr>
<tr>
<td></td>
<td>• Allocates $176 million (USD) over the next two years, including $46 million (USD) for electric vehicles</td>
</tr>
<tr>
<td>Michigan</td>
<td>Increase to Electric Car Subsidies per Michigan Economic Growth Authority (MEGA Board (HB 4515, and SB 31))</td>
</tr>
<tr>
<td></td>
<td>• Adds an additional $220 million USD in refundable tax credits to original $335 million USD, allocated for companies involved in the development and application of advanced-battery research, engineering, and manufacturing;</td>
</tr>
<tr>
<td>City</td>
<td>Policy</td>
</tr>
<tr>
<td>Newark (Delaware)</td>
<td>• First electric utility in US to approve use of the electricity grid to store and provide power, legally enabling vehicle-to-grid (V2G) systems (January 2009)</td>
</tr>
<tr>
<td>Bay City (Michigan)</td>
<td>• Installation of multiple public EV charging stations and parking spots, available to the public free of charge (August 2009)</td>
</tr>
<tr>
<td>San Jose (California)</td>
<td>• First US city to contract Coulomb Technologies (Charge Point) to provide municipal pay-by-use charging infrastructure</td>
</tr>
</tbody>
</table>

Source: U.S Department of Energy and Green Car Congress. Note: Additional State policies can be found at http://www.afdc.energy.gov/afdc/progs/all_State_summary.php/afdc/0
**UNITED KINGDOM**

Generally speaking, there is a broad array of policy activity in the United Kingdom directed at climate change mitigation. The UK passed landmark climate change legislation in November of 2008 which legally binds the government to a framework aimed at aggressively minimizing impacts of climate change. Under this law, the UK aspires to act as a world leader on climate policy. Key provisions include reducing greenhouse gas emissions by at least 80 percent of 1990 levels by 2050; the creation of an independent Committee on Climate Change to advise the government of potentially cost effective policy measures and plans to explore domestic and international carbon trading schemes (Department of Energy and Climate Change, UK).

Additionally, in July of 2004, the government initiated discussion about the direction of its sustainable transport strategy by issuing a white paper called *The Future of Transport: A Network for 2030*. This paper provided a starting point for future policy papers, including the *Low Carbon Transportation Innovation Strategy* which will be discussed later, and signaled an awareness of the relative importance of transport to the economy, but also underscoring the importance of balancing transportation with environmental protection in the future (DEFRA).

**Key Policy Drivers**

*Driving Habits*
Driving in the United Kingdom may be on the decline if based on recent vehicle registration figures. In 2008, UK drivers registered 2.67 million vehicles, a 16% decline since 2004 and registration figures have been decreasing since that year (UK Department of Transport).

*Greenhouse Gas Emissions and Air Quality*
According to a greenhouse gas inventory conducted in 2008, greenhouse emissions in the UK come primarily from the energy sector at 33 percent of total emissions. Transport follows with 24 percent of the nation’s greenhouse gas emissions. (Choudrie et al). Considering transport emissions, nearly 60 percent of all vehicle emissions come from passenger transport, as reflected in Figure 7 (Low Carbon Transport). Despite declining passenger transportation purchases in the UK over the last few years, transportation from passenger vehicles is still a major contributor to the country’s air pollution problems.
In spite of recent improvements to air quality levels in the UK as a result of policies instituted to reduce coal-generated emissions, air pollution remains a concern. Recognizing the inherent health and environmental problems that tend to coincide with high levels of air pollution, policy makers have developed an Air Quality Strategy (AQS). The Air Quality Strategy, first published in 1997 and then revised a decade later, has mapped out a strategy for tackling air quality issues. Objectives of the air quality strategy include (but are not limited to):

- Continued measurement of pollutant emissions
- Encouraging the adopting of low emission vehicles
- Incentivizing early adoption of more stringent vehicle emission standards (UK National Air Quality)

Annual reporting of air quality status in the UK has created a valuable baseline for benchmarking over time and as a result, is instrumental in helping the UK achieve its carbon reduction policy goals.
Electric Vehicle Policy Initiatives

Similar to the United States, the United Kingdom (UK) has been a world hub of economic activity related to the nascent green economy that has been cultivating in response to increasing global awareness of climate change. Particularly in relation to the automotive industry, major auto manufacturers including Daimler, Mitsubishi and Ford have all announced plans to launch demonstration programs in the UK in advance of a large scale roll out of electric cars. Given this interest, the UK government has paid proportional attention to electric cars on the policy front, viewing them as a clear means to achieving the country’s greenhouse gas reduction goals in upcoming years.

Highlights of these policies include:

1) **Mapping EV technologies and planning for their implementation.**

The UK’s *Low Carbon Transportation Innovation Strategy*, first published in 2007 was a precursor to a litany of transport-related low carbon policies that have emerged in the first half of 2009. Figure 8 presents a technology roadmap developed by the Department of Transport that highlights a comprehensive review of advanced vehicle technologies and how they transition over a 50-year period into the automotive industry of the future. The three main breakthroughs represented illustrate periods of an anticipated turning point with respect to innovation in each technological categories; this development will enable advancement in commercialization of these technologies. Note in Figure 8 that electric vehicles are expected to become a mass market vehicle technology in the UK in approximately 2017.
To support realization of this technology road map and more importantly, carbon emission reduction goals for mid-century, the UK has announced a series of complementary policies. A joint announcement made by Secretary of State for Transport Geoff Hoon, and Secretary of State for Business, Enterprise and Regulatory Reform Peter Mandelson in April of 2009, indicated extensive government support for the following policy initiatives related to electric vehicle deployment:

- A £250 million scheme to incentivize consumer adoption of commercial electric vehicles, £20 million of which is allocated for the creation of an electric vehicle charging infrastructure;
- Plug-in electric vehicle and pure electric vehicle exemption from vehicle excise duties;
- A competition to demonstrate 200 ultra low carbon vehicles around the country;
- Integrating low carbon fuelled vans into the public fleets of various cities (Department for Transport).

(2) **Launch of a £1 million grant fund for development of electric vehicle infrastructure.** Recognizing the importance of creating a network of charging access points to support the initiatives above, the UK government launched a £1 million grant fund in July of 2009 to support the development of electric vehicle infrastructure (New Energy Focus). As other elements of the UK’s low carbon strategic plan are released piecemeal, they will begin to
form a complete picture for how the UK will manage all aspects of its plan for reducing greenhouse gas emissions.

**CANADA**

The Canadian government considers climate change and its impacts a threat to the country, and though its policies to combat it are not among the most aggressive, they are increasingly purposeful. The Canadian Ministry of the Environment is the primary agency for tackling issues related to climate change, though climate change is among 10 other core environmental policy interest areas, for which the department has a $500 million dollar budget to spread between them. According to Environment Canada, a website dedicated to communicating about these issues, the department is committed to fighting climate change through the development of policies and programs, scientific research, and collaboration with other governments and businesses (Environment Canada, Climate Change). Additionally, some individual Canadian provinces have developed policies for tackling climate change. This report will focus on one province, Ontario, given its prominence in addressing the impacts of climate change through sustainable transportation policy.

**Key Policy Drivers**

**Driving Habits.**
Canadians drive often and many of them own cars. As of 2008, Canada has more than 28 million vehicles registered on the road. Given a population estimate of 33,487,208 by the CIA, more than 84 percent of Canadians operate a vehicle (CIA World Fact Book). Passenger vehicle sales have increased by 27 percent in 2008 compared to new vehicle sales in 2004, indicating an increasing trend of vehicle ownership (Statistics Canada).

**Greenhouse Gas Emissions and Air Quality**
As is the case for most parts of the world, emissions in the transportation sector in Canada have been on the rise. In fact, emissions from transportation have risen from the 1990 to 2007 time frame by 37.5 percent, or equivalent to 54.5 Mt CO₂. Of particular interest is a 117 percent increase in emissions from light-duty trucks (better known as sports utility vehicle), which accounts for 24.3 Mt CO₂ alone.
In addition to experiencing an increase in greenhouse gas emissions from transport, emissions as a whole have elevated to unhealthy levels in Canada. In fact, Canada’s Ground Level Ozone Indicators, one of the two key components of smog (the other is fine particulate matter), is showing a trend of increase as illustrated in Figure 9 (EC Air Quality). The ramifications of this trend include the increased presence of smog especially in municipalities and industrial areas, and of greater concern, potential respiratory health problems.
As one of the first signatories of the Kyoto Protocol in 1998, Figure 10 illustrates that Canada is not even close to meeting its goal for decreasing GHG emissions 6 percent below the 1990 baseline. Though the Canadian government has pledged to meet its Kyoto obligation during the commitment period of 2008-2012, cynics question how the government will achieve this without more stringent policies targeted at reducing GHG emissions (CBS News).

**Electric Vehicle Policy Initiatives**

Electric vehicles, as a policy initiative, have gone virtually unnoticed by the Canadian federal government. There is no mention of electric vehicle technology development (or alternative fuel or vehicle development) in a list of Green Initiatives on the Environment Canada Climate Change web portal, or in various publications related to how Canada is strategizing to tackle sustainability as a broad topic. In general, Canadian recognition of alternatives to petroleum-based vehicles for passenger transport exists, but is lacking. However, the Canadian government has targeted vehicle emissions from traditional petrol-powered passenger vehicles recently, announcing a plan to develop more stringent regulation of these emissions by 2011. In hoping to create a harmonious policy with United States’ plans for policies regulating vehicle emissions, the Canadian plan, dubbed the ecoENERGY initiative has allocated $3.9 billion dollars of investments to help Canadians improve their access to cleaner and more efficient technologies.
Allocation of these monies is consistent with the government’s goal of decreasing transport-based emissions to 20 percent of 2006 levels by 2020 (Environment Canada).

Highlights of electric vehicle policies include:

(1) Case Study: Ontario
Ontario, the largest Canadian province by population, seems to have emerged as a leader on electric vehicle policy in Canada. In fact, no other Canadian province has a policy regarding electric vehicles at the time this paper was investigated. (NB: The City of Vancouver in British Columbia is the first North American city to insist new development be enabled for electric vehicle infrastructure) (Lorinc). In July of 2009, the Premier of Ontario, Dalton McGuinty unveiled a policy aimed to stir the green vehicle market. Targeting electric cars as the favored technology, this policy aims to make “1 car in every 20” an electric-drive vehicle by 2020.

- **Consumer rebates.** Purchasers of plug-in hybrid and electric vehicles will receive a rebate ranging from $4,000-$10,000 (CAN) for vehicles purchased after July 1, 2010.

- **Green Vehicle License Plates.** Starting in 2010 and for five years after, early adopters of electric vehicles will be rewarded with a special “green vehicle license plate” and with it, will be able to drive in special high occupancy vehicle (HOV) or “carpool” lanes.

- **Electric Vehicles in Public Service Fleet.** Given a desire to lead by example, the Ontario government will ensure 20 percent of its public service operation fleet is electric by 2020.

- **Public Charging Infrastructure.** The Ontario government will collaborate with local businesses and utilities to enhance the existing electrical infrastructure so that it can easily integrate with electric vehicles. Public parking lots will be equipped with electric vehicle parking spots and recharge points (A Plan for Ontario).

- **Commitment of $16.7 million to battery manufacturing.** To further promote the adoption of electric drive vehicle technologies, the McGuinty administration has committed to a $16.7 million CAN investment in local battery manufacturing for Canadian company Electrovaya, citing job creation as one the benefits (Ontario, Office of the Premier).

Additionally, the Ontario government has been a leader in promoting other aspects of sustainability policy. Exemplary is the Green Energy Act which received legislative approval in 2009. This law encourages continued investment in all forms of renewable energy and recognizes inherent benefits of such investments include improvements to carbon emission reduction policies as well as potential economic benefits.
**Similarities and Differences**

The United States’ policy approach to electric vehicle is rigorous and comprehensive. The nation has addressed both aspects of policy initiative – incentivizing and regulatory – and in doing so is expected to see a significant uptake of electric vehicle technology in the near term. Additionally, the United States (more so than other markets) aims to cultivate a “green economy” wherein development and production of new clean technologies is conducted on domestic soil.

Investment in multiple aspects of electric vehicle deployment puts the United States in a leadership position on electric vehicle policy. While it is still too early to analyze the costs versus benefits of electric vehicle technology investment, many experts conclude that the uptake of electric vehicles in the United States will happen sooner and more rapidly than in other markets.

Like the United States, the UK is proactive in its approach to reducing emissions from passenger vehicles and encouraging uptake of alternative transport. The UK approach to policy intervention has greater emphasis on the regulatory and planning side, whereas the United States and Canada chose to incentivize industry development and consumer adoption. The UK plan is worthy of praise for his breadth of reach, but lacks the economic development perspective provided by incentivizing industry, as in the United States.

Generally speaking, all three countries show consciousness of scientific, social and economic drivers and have responded by unveiling policy measures aimed at stimulating a new green economy.
OTHER NOTEWORTHY GLOBAL POLICIES

The above reviewed national policies targeting electric vehicle deployment exemplify big-scale global policy initiatives; many other countries have also done a lot to encourage electric vehicle adoption. Below is a brief summary of other recent policy announcements in this space. Please note this list is not comprehensive.

Table 3. Brief Summary of Other Global Policies

<table>
<thead>
<tr>
<th>Country</th>
<th>Electric Vehicle Policy Initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Earmarked €400 million ($549 million USD) to encourage the development of electric cars and the creation of charging infrastructure by 2011. EDF, the French energy provider of which 85 percent is government owned, runs the world’s largest fleet of EVs (Williams).</td>
</tr>
<tr>
<td>Germany</td>
<td>Invested €500 million ($705 million USD) to promote uptake of electric vehicles, development of battery technology, creation of an efficient energy infrastructure, and training of a new specialized workforce to support a national goal of putting 1 million vehicles on German roads by 2020 (Cremer).</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Published goal of 5% plug-in vehicle adoption by 2020 as part of national strategic plan (Linton). Recently introduced policy to alleviate road user charges for electric vehicle owners until 2013 (Traffic Technology Today).</td>
</tr>
<tr>
<td>China</td>
<td>Committed 10 billion yuan ($1.46 billion USD) to aid automotive industry innovation. Federal government is planning on offering consumer subsidies, starting first with up to 60,000 yuan, ($8,800 USD) offered for purchase of EVS for government fleets and taxis (Bradsher).</td>
</tr>
<tr>
<td>Israel</td>
<td>First nation to support comprehensive electric car and infrastructure plan as proposed by Project Better Place. Private and government investors contributed nearly $200 million to support R&amp;D and to enable first program roll-out (Project Better Place).</td>
</tr>
<tr>
<td>Denmark</td>
<td>As part of larger energy plan, exempted electric cars from tax until 2012 (current tax on an internal combustion engine is 180%) and has attracted electric automotive manufacturers such as Better Place, BYD and Renault-Nissan to unveil their early EV products in Denmark (Ministry of Foreign Affairs of Denmark).</td>
</tr>
</tbody>
</table>
PART III: ACCOMMODATING ELECTRIC VEHICLES IN SOUTH AUSTRALIA

INTRODUCTION

Given heightened global awareness of climate change, many countries respond by identifying passenger vehicles as one of the key sources of greenhouse gas (GHG) emissions. Australia’s GHG emissions totaled 576 Mt CO2-equivalent in 2006 and in September of 2009, Australia surpassed the US as the country with the greatest CO2 per capita in the world (Maplecroft).

Concerning transport in Australia, roughly 79 Mt of CO2-equivalent emissions per year (NGA 2009) come from transport and of that figure, 53 percent of GHG emissions from transport are attributable to passenger vehicles such as cars and motorbikes. In South Australia, 16.7 percent of GHG emissions come from transport (DCC, 2007).

![Figure 11. Australian Emissions per Sector](image)

Source: Garnaut, 2008.

Many countries around the globe have introduced low carbon fuel policy initiatives in the last few months that promote use of alternatives fuels to petroleum. Some markets also accommodate new technologies in their policy framework to support a low carbon society.

Given recent improvements to battery technology and cost for vehicle application, electric vehicles are a leading alternative technology for passenger transport in various global markets. Additionally, nearly all of the most recognizable automobile manufacturers have endorsed electric vehicle technology as favored for mass-market adoption and upwards of 500,000
production-ready electric vehicles are expected to be on roads around the world by 2013 (Simpson, EV Conference 2009). Dozens of countries around the world are promoting the deployment of this technology as one means for reducing national carbon emissions and encouraging sustainable alternatives to driving petrol-powered cars. Australia, however, has yet to unveil a comprehensive national plan targeting passenger transport emissions, though various levels of government explore electric vehicles, among other low carbon technologies, to facilitate carbon reduction goals.

This aspect of the report will evaluate the unique attributes of South Australia under the pretext of supporting electric vehicles to reduce greenhouse gases from passenger transport. Analysis will include the feasibility of electric vehicle deployment and associated policy recommendations in the immediate short term. Alternative low carbon fuels and technologies, including plug-in hybrid electric vehicles (PHEVs) and electric motorbikes will not be covered in this report.
SOUTH AUSTRALIA IS UNIQUELY POSITIONED

A State with a progressive plan for the future, South Australia has many achievements related to improving local environmental conditions for its people. One product of having a vision for the future is amassing support for an ideal – a commitment from the persons and entities that can help make that vision a reality.

The South Australia government, in many cases, has demonstrated an understanding for the need for action as far as the environment is concerned. While various other governing bodies are willing to take the risks associated with negotiating with the environment, South Australia is prepared to take steps toward effective change.

South Australia is uniquely positioned to be a leader in the deployment of electric vehicles in Australia, if it chooses to leverage its strengths imminently. Unlike other Australian States and Territories, South Australia is characterized by the following attributes, which make it an ideal testing bed for early deployment of EVs.

- Aggressive renewable energy target and deployment strategy, particularly involving wind power
- Electricity grid with relatively low emissions intensity compared to other Australian States and Territories
- Sufficient grid capacity for first influx of EVs, given projected production volumes
- Largely metropolitan population with mostly urban driving
- Political will at various levels of government for sustainable policy development

While electric vehicle deployment is feasible in South Australia, there are a variety of obstacles that may complicate it. Additionally, failure to optimize key elements of an electric vehicle roll-out may adversely impact the inherent benefits of deploying the low carbon technology.

At the time this report was written, no other State in Australia had a competitive advantage over South Australia in terms of advantageous attributes for the deployment of electric vehicles. However South Australia’s progress in the electric vehicle policy space is behind its counterparts, such as Victoria which has recently announced a $5 million electric vehicle demonstration program, promising electric vehicles on its roads in 2010. The package of recommendations in the final portion of this report outlines a carefully tailored plan that, if enacted in the upcoming months, could propel South Australia, ahead of its peers, into the spotlight as the most progressive Australian State on clean vehicle policy.

“\nWe will achieve a better future for South Australia by keeping our communities strong, maintaining an international outlook, and promoting knowledge, inquiry and innovation.”

Excerpt from South Australia’s Strategic Plan, 2007
It is incumbent upon decision-makers to consider both the optimal and sub-optimal characteristics of the State’s current position with relation to preparedness for electric vehicle deployment and act according to its broader vision for the technology as part of its sustainable transport landscape. Swift action is required for South Australia to retain its position afoot of other Australian States and Territories on climate change mitigation strategy.

SUMMARY OF STRENGTHS

Renewable Energy Target and Deployment Strategy
Merely three of Australia’s States and Territories have targets for renewable energy generation. Of those States (New South Wales, Victoria, and South Australia), South Australia’s target is the most aggressive. In June of 2009, South Australia increased the existing renewable energy target from 20 percent to 33 percent of electricity to be generated by renewable energy by 2020.

Additionally, South Australia is on an impressive trajectory for deploying wind power. With the largest wind generation capacity of any Australian State or Territory, South Australia expects to reach a capacity of nearly 2000 MW by 2015, making it one of the world’s largest wind farms (Changarathil).

Further affirming its commitment to renewable energy, the South Australian government, under Premier Mike Rann who is also the Minister for Sustainability and Climate Change, created RenewablesSA, a sub-committee of the State’s Economic Development Board.

RenewablesSA is comprised of 10 board members, all community and industry leaders in the renewable energy sector, whose primary objective is to cultivate South Australia as a “clean energy State” by attracting investment in the local renewable energy sector and by facilitating government coordination of related initiatives (RenewablesSA).

Recall, renewable energy and electric vehicles have inherent benefits when used together due to one key commonality – their use of an interconnected electricity grid. Utilization of renewable energy decreases the emissions intensity of the grid generally, making electric vehicle charging cleaner than without renewable energy. Additionally, electric vehicles have the potential to interact with the electricity grid, offering relief by providing additional ancillary services during peak usage times. As demonstrated in Denmark, which has the world’s largest wind power generation ability, electric vehicles facilitate additional capacity for wind power penetration due to their ability to store intermittent load generation. This paves the way for large-scale demand/response energy distribution which will increase the total consumption of renewable energy (Energinet). Researchers at the National Renewable Energy Laboratory in the United States have further demonstrated the enabling wind generation via electric-drive vehicles (Short and Denholm).

South Australia’s national leadership on wind energy gives it a unique opportunity to demonstrating the synergy between renewable energy systems and electric vehicle storage possibilities. Moreover, South Australia’s impressive commitment to attaining the highest level
of renewable energy of any other State or Territory in the Commonwealth gives it potential to be the ideal State for early electric vehicle deployment.

**Emissions Intensity of Electricity**

The grid-based carbon emissions are an extremely important factor in the policy discussion around electric vehicle adoption in Australia. Australia is widely characterized by a relatively “dirty” grid given its use of coal as a primary energy source for electricity generation. South Australia however, has a relatively cleaner grid than most of the other States and Territories in Australia and as mentioned before, it has the most ambitious target for renewable energy generation in the country.

Figure 12 illustrates South Australia’s emissions factor for the consumption of electricity (scope 2) juxtaposed with capital city population. Types of emissions factors and their descriptions are explained in Appendix C. South Australia has a favorable grid emissions intensity considering other State attributes that support electric vehicle deployment. Though the Northern Territory and Tasmania have lower grid emissions intensity than South Australia, they lack other key characteristics that will encourage EV deployment such as an aggressive renewable energy target or a dense urban population.

![Figure 12. State Comparison of Emissions Intensity and Capital City Urban Population in Australia (2009)](image)

Sources:
Australian National Greenhouse Gas Accounts (NGA), “Quarterly Update of Australia’s National Gas Inventory” (June 2009)
Policymakers are often concerned about the relative cleanliness of using the existing Australian electricity grid to fuel a vehicle compared to burning a liquid fuel such as petrol. Figure 13 illustrates the advantages of using EVs over petrol. As of June 2009, the emissions intensity of Australian grids by State/Territory indicates that regardless of the analytical assessment, fueling a vehicle with electricity is less GHG-intensive than fueling with petroleum (NGA, 2009). Note also that with the use of GreenPower, electric vehicles are the cleanest vehicle option of all reviewed and have nearly zero emissions.

**Figure 13. Relative Emissions, Petrol vs. Electric Vehicles**

Note that Figure 13 does not depict the comparative impact of hybrid vehicles, whose emissions generation is substantially lower than pure petrol vehicles. Hybrid vehicles are relatively cleaner than petrol vehicles, but electric vehicles are cleanest vehicle option available when fuelled with 100 percent GreenPower.

The cleaner the electricity grid, the more compelling the argument for adoption of electric vehicles make in the near term. Because South Australia’s grid is relatively clean and its capital city has a large urbanized population in Australia, it is uniquely suited for the least emissions intensive electric vehicle deployment in Australia.
Grid Capacity for Early Adopters
The current electricity grid in South Australia is subject to peak demand during daytime hours, especially in summer months, when air conditioners are widely used. Demand on the grid is a serious concern for both energy service providers and policymakers alike.

Courtesy of Albrecht, et al in their study of infrastructure needs for electric vehicle uptake in Australia, the figure below reflects power demand in South Australia for each day in 2007 starting at 12:00pm each day. The red vertical lines represent the energy necessary to power 25 million electric vehicle kilometers in South Australia. The red vertical lines also illustrate the off-peak periods of time or when the grid has the most available capacity, typically between the hours of 10pm and 6am.

Figure 14. South Australia Power Demand and EV Capacity (2007)

Historically, there rarely have been enough electric vehicles driven in a central location (accessing the same energy supply) to pose a threat to electricity supply; however, as more electric vehicles come to market, the risk of additional demand on the grid poses problems for daily traditional energy needs increases. It is likely, however, that before the impacts of electric vehicles on the grid are felt, continuing demonstration of vehicle charging in clusters will produce data around electric vehicle owner behavior and the grid’s response for study.

Tesla Motors, the only US electric vehicle manufacturer that is currently producing electric cars and delivering them to consumers, has charging data from its first 627 customers. Figure 15 below depicts Tesla customer charging habits against peak demand on the Californian grid.
While South Australian and Californian grid usage habits are not completely analogous, the connection between South Australian grid off-peak times and the likelihood of when most electric vehicle will charge (at home, overnight), as demonstrated by the example in California, is unlikely to vary greatly, especially for early adopters.

**Metropolitan Population**

South Australia is the fifth most populous State in Australia with a population of 1.62 million as of October 2009. Its largest and most metropolitan city is Adelaide, which is also the State capital. Roughly 73 percent of South Australian residents live in the Adelaide metro region (ABS 2008).

According to analysis of Adelaide travel habits by the AutoCRC, a large majority of residents tend to drive less than 100km per day. In fact, 95 percent of Adelaide residents drive less than 80km per day. The AutoCRC report also reviewed travel habits in Sydney and concluded that Sydney drivers travel more passenger vehicle kilometers per day than Adelaide drivers. As demonstrated in Figure 16 below, roughly 85 percent of Sydney residents drive 90 kilometers per day or less. A comparative study of Australian capital city driving patterns does not exist, most likely due to the unavailability of complete data sets by State on this topic.
Given that the majority of electric vehicles coming to market in the next three years are estimated to have a driving range of 100 kilometers or greater (median range of 160 km), experts anticipate early electric vehicle adoption to happen first amongst city drivers (Book et al).

**Figure 16. Daily Kilometers’ Driven in Sydney and Adelaide (Auto CRC)**

<table>
<thead>
<tr>
<th>Percentile</th>
<th>City</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>50th percentile</td>
<td>Adelaide</td>
<td>26 km</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>36 km</td>
</tr>
<tr>
<td>85th percentile</td>
<td>Adelaide</td>
<td>55 km</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>91 km</td>
</tr>
<tr>
<td>90th percentile</td>
<td>Adelaide</td>
<td>64 km</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>113 km</td>
</tr>
<tr>
<td>95th percentile</td>
<td>Adelaide</td>
<td>79 km</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>157 km</td>
</tr>
<tr>
<td>99th percentile</td>
<td>Adelaide</td>
<td>117 km</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>270 km</td>
</tr>
</tbody>
</table>


**Figure 17. Average EV Range for Upcoming Models**

Finally, factoring a number of early adopter characteristics supposed by researchers including those at the University of Michigan (including age, income level, and number of vehicles owned per household) Figure 18 illustrates the ideal region in South Australia for initial electric vehicle deployment (Curtin). The image below was generated using heat maps in GIS.

**Figure 18. Proposed Area of Early Electric Vehicle Adopters by Adelaide Statistical Division (2009)**


Considering its high urban population relative to other States and that its drivers travel fewer kilometers per day than Sydney drivers, Adelaide presents a compelling case as the best city for electric vehicle deployment in next few years.
Local Political Will
South Australian government is generally receptive to the promotion of sustainable policies. On top of the aforementioned aggressive renewable policy strategy, the State has also has a number of policy initiatives that underscore its progressive thinking on climate change mitigation policy. Some examples of these policies in South Australia include:

- **Solar Feed-In Scheme**
  The South Australian government passed a measure in 2008 that set a feed-in tariff at $0.44 per kWh of energy generated for individuals who produce solar power that is fed directly into the South Australian grid. South Australia is the first Australian State to legislate a premium feed-in tariff and it is set to last for 20 years (SCCD).

- **Plastic Bag Ban**
  In May of 2009, the South Australian Plastic Bag Ban came into effect. The policy, aimed at curbing pollution from the non-biodegradable and easily accessed “grocery-style” bags, forbids retailers from providing lightweight plastic bags to customers. Instead, retailers must offer for sale alternative bags and notify their customers with written signs of the Statewide policy. Violators are subject to a maximum $5000 spot fine (Zero Waste SA).

- **Premier’s Climate Change Council**
  In 2007, South Australian Premier Mike Rann established the Climate Change Council. The Council is comprised of 10 business and community leaders who advise the Premier on matters relating to climate change including, improving energy efficiency and cultivating upon the State’s renewable energy industry (SCCD).

- **AutoCRC “Preparing for Electric Vehicles” Research**
  The South Australian Department of Trade and Economic Development, in conjunction with local researchers from the University of South Australia, applied for and received funding from the Cooperative Research Centre for Advanced Automotive Technology (AutoCRC) to research and report on the list of topics below. This research project is the most extensive government-commissioned report on electric vehicles in Australia to date. The AutoCRC’s findings were published in 2009 and are widely referenced in this document (AutoCRC).
    - Technologies for Sustainable Vehicles
    - Uptake and Use of Electric Vehicles in Australia
    - Emissions analysis of electric vehicle use
    - Emission requirements for electric vehicles in Australia

- **Global Green Challenge (World Solar Challenge)**
  For more than two decades, South Australia has served as the proud host of the cross-country solar-electric vehicle race, the only one of its kind in the world. This event
has elevated the visibility of electric vehicles around the world and South Australia’s clear role in the event can be capitalized in future (Global Green Challenge).

The City of Adelaide, often in conjunction with the State Government as part of the Capital City Committee, has championed a variety of noteworthy sustainable initiatives related to transport. Two of Adelaide City’s climate change policy achievements relate to electric vehicle policy are:

- **Tindo, Solar-Electric Bus**
  Tindo, named after the Kaurna Aboriginal term for the sun, was commissioned in 2007 by the Adelaide City Council. It is Australia’s only solar-electric and thus zero-emissions public bus. The bus travels daily around the city proving transport services (ACC).

- **ACC approval of EV charging**
  The Adelaide Council passed a motion in September 2009 to provide electric vehicle charging infrastructure to regular parking customers in the city’s U-PARK car parks. This announcement of the first of its type in South Australia (Wills).
ADDITIONAL BACKGROUND: EXISTING EV-RELATED POLICIES ON NATIONAL LEVEL

There is little policy activity supporting the adoption of electric vehicles at both the federal and individual State levels. The following Commonwealth Government policies address the deployment of electric vehicles in some form.

- **Green Car Innovation Fund**
  This $1.3 billion dollar fund was announced in April of 2009 and was intended to incentivize research and development of domestic low carbon technologies over a period of 10 years. Unfortunately, the GCIF only provides financial matching for projects at a ratio of 3:1, discouraging development of potentially feasible low carbon technologies, which can be extremely expensive in their developmental states especially for parties that have low capital reserves or limited private investment. The Fund also fails to note that innovation of vehicle technologies is far advanced in other global markets, deteriorating Australia’s competitive advantage in this area. Lastly, this fund does not set aside monies for consumer incentives or marketing campaigns, which would encourage adoption of these technologies when developed and deployed (Minister for Innovation et al).

- **Smart Cities, Smart Grid**
  Recognition that smart grids are the wave of the future electricity grid, the Commonwealth Government unveiled a $100 million grant for application of the country’s first small scale demonstration smart grid network to set the stage for future development (Department of the Environment et al).

- **Infrastructure Australia and Funding for Public Transit Enhancements**
  In early 2009, the Australian government announced the creation of *Infrastructure Australia*, a government agency tasked with planning for and executing on the country’s infrastructure needs, and a grant $20 billion set aside for more than a dozen public transit and infrastructure enhancement plans across the country (Infrastructure Australia).

- **Carbon Pollution Reduction Scheme (CPRS)**
  The CPRS is a national emissions trading scheme that would put a cap on the total amount of carbon emissions allowed in the country and would also serve as the Commonwealth Government’s primary mechanism for reducing GHG emissions. Its effects on electricity pricing and GHG reductions from transport are yet unknown. At the time this report was published, the CPRS was being debated in Parliament and had not yet been legislated (DCCC).

- **COAG Vehicle Efficiency Report**
  The Council of Australian Governments (COAG) is a consortium of the leaders of Australian governments that convenes on a number of issues relevant to the country at various levels of government. COAG met in July of 2009 and
discussed vehicle fuel efficiency as part of its *National Partnership Agreement on Energy Efficiency*, though to date, no Australian government has taken action to regulate vehicle tailpipe emissions (COAG).

Some Australian States and Territories have also engaged in electric vehicle related projects. The following list is sample of projects ongoing in Australia, as known to the author. This list is not comprehensive, but highlights high visibility projects and those that are most relevant to this discussion.

**Canberra/ Better Place Partnership**  
Project Better Place, an electric vehicle and associated infrastructure service provider and the first to announce plans to bring EVs to Australia, signed an accord with Australian capital city Canberra in July 2009 for its first deployment in the country (Better Place Australia).

**Victoria MOU with Nissan-Renault Alliance for EV demonstration**  
On the heels of Nissan’s release of its production EV the LEAF, the Victorian government released details of its Memorandum of Understanding with the automobile manufacturer. As part of a $38 million State transport plan, the Victoria government will direct some funds to EV vehicle demonstration projects (Invest Victoria). This plan is the most competitive EV-related policy initiative in Australia at the time this report was published.

**University of Western Australia and Murdoch EV Charging**  
University of Western Australia and Murdoch University together have been awarded a grant totaling $229,000 from the Australian Research Council's Linkage grant scheme to install EV charging stations in Perth for demonstration and to collect data on charging behavior and interactivity with the electricity grid (University of Western Australia).

**UTS Plug-in Hybrid and Vehicle-to-Grid Demonstration**  
The University of Technology Sydney (UTS) has converted a Toyota Prius into a plug-in electric vehicle to demonstrate the vehicle technology and test use of vehicle-to-grid (V2G) capabilities with the electricity grid. This project is the first V2G demonstration program in Australia (UTS).
WHAT MIGHT HOLD US BACK
Though South Australia is well structured to support the imminent deployment of electric vehicles, the following items may create obstacles for electric vehicle uptake:

- Vehicle availability (particularly given the relatively smaller size of the South Australian vehicle market compared to VIC or NSW)
- Understanding trends for EV uptake in Australian markets
- Limited public exposure to electric vehicle or other clean vehicle technologies
- Uncoordinated engagement in the area of sustainable transport as a GHG mitigation strategy

CHALLENGES FOR EVS IN SOUTH AUSTRALIA

Vehicle Availability
Most of the global automakers have researched a multitude of low carbon technologies but after extensive analysis have endorsed EVs as the most commercially viable technology. In fact, at the time of publishing, most major automakers have announced plans to mass produce an electric drive vehicle in the next five years. Despite the budding number of clean car options around the world, only a handful of models will be available in Australia in the near term, and potential placement volumes for each model is still quite unclear.

Appendix B provides a comprehensive list of electric and plug-in electric vehicles coming to market in the near term, compiled by electric-drive advocacy group, Plug-in America. From this list, only Mitsubishi and Nissan have confirmed plans to bring vehicles to Australia in the next two years, though BMW, Tesla Motors, Daimler, General Motors (Holden) and Toyota have all suggested loose plans to unveil vehicles in Australia in the future (Simpson, EV Conference).

South Australia and Victoria both have a relationship with the automotive industry in Australia, but as noted earlier, Victoria has already laid plans for electric vehicle deployment, giving it an advantage over South Australia in this regard.

What is undeniable is that currently, there appears to be greater demand for electric vehicles than available supply. Waitlists for electric vehicles, similar to those created for earlier models of the Toyota Prius, indicate an inequity in supply and demand. For example, within two months of its March 2009 release, the Tesla Motors’ second model electric car, the Model-S, had more than 1000 cars reserved for sale (Tesla Motors).

As of early 2010, electric vehicle conversions are the only electric cars available for sale in Australia.

Uptake Levels Unknown
Although most global vehicle manufacturers have made announcements about producing electric drive vehicles in the near term, few have cited initial production volumes with certainty. Vehicle
manufactures are also unsure of vehicle uptake as demonstrated by their initial plans to “trial” new electric vehicle models before selling them to consumers and further by their unclear production estimates for EVs.

Expert analyses of EV uptake scenarios vary. Figure 19 below depicts three different uptake scenarios, one from academic, a second from a vehicle manufacturer and a third from a consultancy. EV uptake is consistently estimated at roughly 600,000 units by 2013 but production volumes beyond that date vary.

![Figure 19. Global Industry Production of EVs and PHEVs](source: Simpson, EV Conference, 2009)

Additionally, the AutoCRC conducted sensitivity analysis around electric vehicle uptake in Sydney and Adelaide based on existing travel patterns data. Their analysis indicates that even with 5 percent EV penetration in South Australia, more than 25,000 petrol-powered journeys would be reduced. Note that this figures offset trips made by cars that typically travel fewer than 100km per day. Figure 20 illustrates the full analytical output.
Little Public Exposure to EVs
Electric vehicles are prevalent in worldwide media and in many cases, are the focal point of carbon reduction strategies, but in Australia, electric vehicles are still widely unknown and misunderstood. In fact, there has never been a production electric vehicle available on the Australian car market.

Australians have a general perception of climate change and what policies exist to mitigate its impacts. According to a national public opinion poll conducted by the Lowy Institute, 76 percent of Australians think that climate change is a serious problem. Of the group sampled, more than 50 percent agree that finding a solution to climate change is more urgent than before, and that in the last 12 months there has been no change in terms of resolving this problem. Figure 21 highlights the Lowy Institute Survey Results.
Figure 21. Australian Perspective on the Urgency of Climate Change

As illustrated by the Lowy survey, Australians believe climate change to be a serious concern needing policy attention. The survey does not depict Australian astuteness for taking action at an individual level. For example, if the market offered vehicles with low (or no) tailpipe emissions, would Australians choose a more efficient vehicle to support decreasing GHG emissions from their own motoring?

Lack of coordination

A number of government agencies are engaged in electric vehicles and low carbon transport policy development, but in South Australia, no one entity is coordinating the policy area. Lack of coordination on a single policy issue involving many stakeholders will limit the State’s ability to take a leadership position on electric vehicle deployment.

It appears that the core of the South Australia’s lack of coordination on electric vehicle deployment stems from its GHG mitigation strategy – South Australia is intently focused on deployment of renewable energy and not on reduction of transport emissions.

The South Australia’s Strategic Plan, last published in 2007, exemplifies the limited policy framework in South Australia on carbon emissions reductions. The plan lists “Attaining Sustainability” as one of its six cornerstones. Each of the broader six categories has a series of subcategories highlighting key initiatives for the State under the umbrella topic; under the
sustainability category are objectives for “greenhouse gas emission reduction” and “renewable energy”.

Review of or action on policies related to passenger transport or its associated greenhouse gas emissions remain without mention. Public transport is represented in the South Australia Strategic Plan and is in fact the only mention of transportation in the sustainability portion of the strategic plan, where it is cited as a means for “reducing reliance on private vehicles”. Unfortunately, a wholesome policy targeting low carbon transport is not part of the State’s vision for reducing GHG emissions to date. (SA Strategic Plan, 2007).

Given the large number of diverse stakeholders involved in electric vehicle deployment, and the direct implication for climate change, infrastructure, energy and transport policy planning, government is the best candidate for coordinating an approach to supporting vehicle deployment and associated policy initiatives.
POLICY DISCUSSION

SPECTRUM OF POLICY OPTIONS

There is a sizeable spectrum of EV policy levers on both the supply (or industry) side and the demand (or consumer) side, to support the mass adoption of electric vehicle technologies.

Should the South Australia government decide to support the imminent deployment of electric vehicles locally, there is a range of policy options at varying costs and levels of effectiveness to consider. Some options can be stand-alone, while others must be implemented as a part of a package. Whichever policy package policymakers select, it should match the individual characteristics of its target population (e.g. do not impose a relief on congestion taxes in a market where congestion is not a major issue).

Figure 22. Range of Potential EV Policy Initiatives
RECOMMENDATIONS

In order to gain a stronghold in the electric vehicle space across Australia, the South Australian government must act swiftly and competitively. The following four recommendations, if unveiled as a total policy package, would make South Australia a visible leader for electric vehicle deployment in Australia and impress upon the public again its commitment to leadership on sustainability policy.

Policy Recommendation 1: Appoint a Central Authority for Coordination

Suggested Approach
The only way South Australia can gain a stronghold in the electric vehicle policy arena in Australia is to appoint a central coordinating government agency to drive policy initiatives. This department may reside in a number of existing State government agencies, but not any one in particular. The department should have visibility into existing policy developments related to clean vehicles and understand the complexities associated with deploying a new technology and raising awareness of it. The department should work closely with energy service providers and automotive manufacturers from around the world, not just those accessible in Australia.

Figure 23. List of Electric Vehicle Stakeholder Groups in South Australia
Furthermore, the South Australian government should commission a separate board of representatives from a variety of stakeholder groups to support planning and execution of EV deployment in South Australia.
Policy Recommendation 2: Educate and Raise Awareness

Suggested Approach
South Australia should be prepared to commit resources, both monetary and human capital, to supporting an education campaign on sustainable transport and renewable energy. This program should have no fewer than 10 electric vehicles for demonstration purposes.

The *South Australian Sustainable Transport Plan* should be comprehensive in its description of renewable energy and sustainable transport developments, partially highlighting the State’s existing policies in renewable energy, but also underscoring emerging passenger transport technologies. As electric-drive technology is available now, it should be the focal point for the educational materials, both digital and paper-based.

Requirements for the demonstration program would include purchase of a minimum of 10 road-ready electric vehicles and an example renewable energy charging mode (e.g. solar panel charging station). The recommendation of a 10-vehicle program is based on two considerations – firstly, a review of active global demonstration programs, nearly all of which have at least 25 vehicles in demonstration, and also factoring potentially low vehicle availability in Australia in the short term. An ideal demonstration program would have at least 25 vehicles in operation, but given the limitations noted, 10 vehicles would suffice for awareness building in a city like Adelaide.

The demonstration vehicles would not only provide opportunity for South Australians to attain familiarity with the technology and the concept by experiencing it firsthand, the vehicles could also be used to collect data on driving behavior and interaction with the local electricity grid.

An alternative approach to a vehicle demonstration program would be to commit to purchasing an allotment of electric vehicles to replace dirtier cars in the government’s fleet. Influx if EVs into the government fleet demonstrates government leadership on this topic, but its main demerits for imminent short term deployment are that it 1) diminishes the value of visibility and teaching potential that a demonstration vehicle provides and 2) it is potentially unfeasible in large volumes in the near term due to global vehicle availability of EVs for fleet application. Electric vehicle deployment in government fleets would be best suited for Phase II of the State’s comprehensive EV strategy.

Summary of Pros and Cons
An educational campaign that covers sustainable transport and renewable energy and the synergies of using them together would not only reinforce the State’s commitment to climate change migration, it would cultivate a body of knowledge in its constituency. It can build upon its strengths as the renewable energy capital of Australia and as the host of the world’s only solar-electric Global Green Challenge.

Despite the State’s commitment to climate change mitigation especially in the area of renewable energy development evidence indicates South Australians do not take advantage of the sustainable lifestyle opportunities around them as well as their counterparts. Per Figure 24, South
Australians have the lowest interest in paying a few cents more per kWh of energy used to buy GreenPower than any other State in the country. This statistic stresses the need for increased awareness of the opportunities the State has created for its constituents to lower their individual carbon footprints and by doing so, support a shift in favor of GHG reduction goals.

Additional benefits to investing in an educational campaign include:

- Increasing citizen engagement on sustainable alternatives for energy consumption
- Fueling demand for clean technology and infrastructure (which would stimulate the market for sustainable products)
- Marketing the conceptually progressive renewable policies already enacted that the average citizen might not be aware of (e.g. feed-in tariff)

With regard to electric vehicles, it is incumbent upon government officials to strike a balance between the amount of publicity it commits to for the technology and the ability of the existing infrastructure to support an increase in usage demand in the short term. An extremely high uptake of electric vehicles would upset the existing electricity grid; however uptake at a level below 10 percent of Australia’s existing fleet could be managed with minimal impact (Albrecht et al). Additionally the State should be mindful of the risks associated with endorsing one technology exclusively rather than endorsing an ideology (e.g. support “zero-emission driving” rather than just “electric cars”).
Policy Recommendation 3: Let the Market Rule, but Give it a Push

Suggested Approach
In order to be a leader in sustainable passenger transport policy, South Australia must incentivize its adoption. There is a broad range of consumer incentives levers that can be used to encourage adoption of any low carbon technology, the key is to pick the best one, considering associated costs and benefits.

The best approach for South Australia in the immediate short term would be to choose moderate incentivizing approach to low carbon passenger vehicle uptake – considering both the imminent availability of clean cars and the cost to the State. Key elements of a consumer-based incentive initiative would include all of the following three programs, though more could be added.

1) Consumer rebate or tax credit for new vehicle purchase

South Australian consumers need financial relief from the high upfront cost of any new-to-market low carbon technology, as well as a symbolic gesture from the government to applaud their personal decision to lower their transport emissions. A consumer rebate will encourage automotive manufactures to deploy the technology locally, rather than in other, more attractive markets. These consumer rebates can vary in award amount, depending on the relative greenhouse gas reduction expected from use of each technology.

2) Relief from vehicle registration for all low carbon vehicle technologies

This plan would include relief from vehicle registration fees for any low carbon vehicle purchase. Low carbon vehicles, for the sake of this policy, should include hybrid vehicles and electric cars, as well as any other low carbon vehicle technologies currently available on the global market. High efficiency petrol or diesel powered vehicles could be included, but a carefully designed mechanism for quantifying emissions reductions would be required.

3) Early adopter benefits

The State should reconsider the proposal put forward by 2006 Thinker in Residence Stephen Schneider, which encourages the aforementioned plan for relief of vehicle registration under a feebate scheme, as well as the installation of green number plates for clean cars. Other options for early adopter benefits include dedicated electric vehicle car parks and discounted electric vehicle charging tariffs. Any one or combination of multiple benefits would encourage use of cleaner cars in South Australia.

It is important to note that each of the above three incentive proposals should be regressive. For example, the State may decide to phase out the relief from vehicle registration in the five years following its inception as low carbon vehicle adoption increases.
Also, the State is discouraged from implementing only one of the three incentive policy packages, as each incentivizing policy is less effective as a stand-alone policy. Without substantial financial relief from the high upfront cost of new technologies such as electric vehicles, and without endorsement by the State of individual action in favor of lowering passenger transport emissions, the adoption of electric vehicles as well as other low carbon vehicle technologies will be slower in Australia than in other parts of the world.

**Summary of Pros and Cons**

Though the global market for electric vehicles is expected to exceed 500,000 in the next five years, the share of vehicles anticipated to deploy in Australia during this timeframe is small. The Green Car Innovation Plan covers domestic R&D efforts in this space, but does not encourage consumer adoption. Furthermore, the eyes of the world are focused on GHG reduction policy as negotiation extension of the Kyoto Protocol continue, and to some extent, there is global focus on Australia for action, as it is the world’s greatest CO₂ emitter per capita. Considering all these factors, Australia as a nation needs to make a bold statement about its plans to encourage adoption of clean cars to address GHG emissions from transport.

Supply for clean vehicles, especially for electric vehicles, has yet to exceed demand. In fact, a good amount of EV manufacturers hold pre-production waiting lists for their products. As was the case in the United States’ early release of a limited-release tax credit for hybrids in the in 2006, expert analysts expect that uptake of the electric vehicle use as well as emergence of a greater variety of products will follow the announcement of government incentives for purchase. Figure 25 below from the US Department of Energy’s Vehicle Technologies Program depicts the increase in purchase of hybrids and the variety of hybrid products on the market in the U.S after the installation of a $3150 hybrid tax credit (DOE Vehicle Technologies).

![Figure 25. Hybrid Sales in the US Over Time](image-url)
Policy Recommendation 4: Have a Long Term Strategy and Continue to Plan Ahead

Suggested Approach
South Australia must prepare its citizens for the deployment of electric vehicles in the immediate short term; however a number of policy initiatives will surface in the longer term. Below is a list of issues areas related to electric vehicle deployment that should remain at the face of longer term planning.

(1) Smart grids
Smart grids aggregate the benefits of communication and advanced infrastructure technology such as smart meters and renewable energy storage to enable a more cohesive system-wide management of energy distribution. Smart grids are the effective vision for a next generation electricity grid.

![Smart Grid Diagram](vtsenvirogroup.files.wordpress.com, 2009)

Smart grids are often considered a necessary precursor to electric vehicle adoption in South Australia. Given concern for the additional demand on the grid electric vehicle charging will create, a system to managed electricity supply and demand is necessary. Local South Australian utilities are concerned about the additional demand on the grid that might come with electric vehicle uptake, but do not believe that the extra demand will be significant enough to merit serious concern in the short term. Recall, most electric vehicle users are expected to charge at night, when demand on the grid is lowest in South Australia.
Smart grids are a fairly new concept and considered by many difficult to define practically. Utilities in South Australia are exploring smart grids, as well as other means for managing peak load on the grid, but as with any proposal for new technology, are concerned about the significant capital investment required to support a new infrastructure design.

The AutoCRC reports that the existing electricity grid in South Australia can manage electric vehicle penetration into the existing national vehicle fleet at uptake levels below 10 percent (Albrecht et al, *Infrastructure*). Given low vehicle production volumes in the near term, it is unlikely for South Australia to reach 10 percent penetration of EVs on the road before additional progress on smart grids and energy transmission monitoring is made.

While the two technological concepts support development of the other, they should be considered separate initiatives, but coordinated together.

(2) Ancillary Services / Vehicle-to-Grid

Vehicle-to-grid (V2G) enables interactivity between the grid and electric vehicles by creating a connection between the batteries in electric vehicles and the utility grid. V2G maximizes the potential of electric-drive vehicles to store energy when they are not being driven, especially during peak times where use of ancillary services is required.

The basic conventions behind V2G assume the following:

- Electric-drive vehicles can store energy
- Their energy (stored by batteries) is rarely dissipated in a single trip
- The average vehicle is only used for transportation 4% of the time, thus is can have multiple purposes
- Vehicles, when connected to the utility grid, can feed unused energy back to the grid

V2G maximizes the potential of electric-drive vehicles to store energy when they are not being driven and subsequently, feed that stored energy back to the grid in the form of electricity (Kempton).

University of Technology Sydney (UTS) unveiled SWITCH, the first V2G enabled plug-in hybrid in Australia as part of a demonstration program with the Department of Environment and Climate Change in New South Whales in April of 2009 (UTS). This project is one of many of its kind globally, though the first in Australia. Ergon and Energetique have discussed a similar trial in Queensland (Smart Grid Australia).

While V2G provides a synergy between electric vehicles and the electricity grids that make supporting EVs more appealing, it is still in early stages of development. The success of this concept is predicated upon additional testing of the technology, a means
for controlled communication between supply and demand (e.g. smart grid), and a meaningful number of electric vehicles operating on Australian roads.

(3) **GreenPower and The “Sustainable” Paradigm**

GreenPower is a program managed by the Australian government that enables electricity consumers to offset their energy use with a per kWh investment in renewable energy. GreenPower customers can choose among various levels of renewable energy (10%, 25%, 50%, 100%, etc) and pay more accordingly (GreenPower).

While the electricity grid in South Australia is cleaner than most other Australian States and Territories, using average energy is not as clean as using GreenPower. One hundred percent GreenPower is the cleanest form of power available in Australia and using GreenPower to charge your electric vehicle can make driving your EV nearly completely emission-free.

The problem, however, is that only small number of Australians are prepared to pay more for clean energy and of those that are, only a smaller percentage use GreenPower. The number of households using GreenPower has increased over time, as illustrated by Figure 27 and as of March 2009, 14 of 39 energy service provider programs offer GreenPower to residential customers in South Australia (GreenPower Status Report Q1 2009).

**Figure 27. Number of Australian Households Using GreenPower**

![GreenPower Chart]


(4) **Local Automotive Manufacturing**

South Australia is one of the few Australian States or Territories to have local vehicle manufacturing and as a result, both community and government ties with the industry. Given its proximity to the automotive industry, the South Australian government should leverage that link to the automotive community to influence its direction and to get a sense for its product planning.
Additionally, South Australia is uniquely positioned to be one of the only States (Victoria is the other) to potentially house “green jobs” in the automotive industry. South Australia can do a lot to prepare for this potential shift in employment opportunity such as arming its labor force with the skills required to service new products or incentivizing the development of clean vehicle technologies such as electric vehicles and their components locally.

THE COST OF INACTION

Whether or not the South Australian government takes action to support electric vehicle deployment, the technology is coming. Initial estimates figure more than 500,000 electric cars will be on roads around the world by 2013 and from more than 20 different automakers; broader analysis suggest even more substantial uptake (BCG). South Australian policymakers must decide how to accommodate this technology.

Two possible approaches include 1) safeguarding the low carbon vehicle technology from infrastructure, regulatory and design policies that might delay or disrupt its natural deployment, or 2) harnessing South Australia’s strengths for electric vehicle deployment and incorporating EVs into low carbon vehicle strategic plan for GHG reduction from transport. Inaction could result in negative policy implications for both approaches, including (but not limited to):

- Status quo or increase in vehicle emissions from passenger transport
- Limiting the local supply of electric vehicles by not encouraging its uptake locally
- Exacerbating demand on the electricity grid
- Insufficient public charging infrastructure for electric vehicles
- Disjoint policy initiatives due to poor coordination in State agencies and other interested parties
- Tarnishing the leadership position of South Australia on sustainability and renewable energy policy
- Low uptake of electric vehicles in South Australia compared to other Australian States and Territories

And most seriously:

- Relinquishing all electric vehicle economic opportunity to the Victoria and other East Coast vehicle markets (centering around Melbourne and Sydney).

Given the analyses provided in this paper, the South Australian government is well served by integrating electric vehicle technology into its policy initiatives related to GHG reduction going forward, and best served by leveraging its strengths to take a competitive leadership position for electric vehicle deployment in Australia.
CONCLUSION
After a review of climate change mitigation action plans worldwide, it appears that a majority of nations are turning to electric vehicles as the leading technology to pave the way for reduced carbon emissions from passenger transport.

Table 4. Summary of Policy Recommendations for South Australia

While electric vehicles may not yet be ready to completely displace petroleum-fuelled vehicles, their mass-market readiness has been validated both by an influx in industry investment and unveiling of production plans, as well as the announcement of electric vehicles as the centerpiece of many global plans for carbon reduction from transport.
APPENDICES

APPENDIX A: REFERENCES


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http://www.lungusa.org/atf/cf/7A8D42C2-FCCA-4604-8ADE-7F5D5E762256/key_air.pdf
Last accessed 16 September 2009.


South Australia Strategic Plan, 2007.


### APPENDIX B: PLUG-IN VEHICLE TRACKER (COURTESY OF PLUG-IN AMERICA)
Last updated 23 November 2009.

<table>
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<th>Make, Model &amp; Type</th>
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<tr>
<td><strong>Audi A1 Sportback PHEV</strong></td>
<td>5 door, 4 passenger, AER 31-62 mi (normal vs efficiency mode), 0-60 mph 8 sec, top speed 120 mph, 20kW electric motor, 1.4L engine. Efficiency mode has slower acceleration and all-electric speed to 62 mph.</td>
<td><strong>Target Intro:</strong> 2011</td>
<td>![Image](source: Audi)</td>
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<tr>
<td><strong>Audi e-tron EV</strong></td>
<td>2 door sports car based on the R8, 2 passenger, range 248 km (154 mi), 0-62mph 4.8 sec, top speed 200 km/h (124mph), 42.4 kWh Li-ion battery pack, 4 hub motors with a combined output of 230kW, Audi announced in Nov 2009, plans to build road capable prototype in 2010 followed later by full production.</td>
<td><strong>Target Intro:</strong> No specific date announced. <strong>Progress:</strong> Concept car unveiled at 2009 Frankfurt Motor Show</td>
<td>![Image](source: Audi &amp; Edmunds)</td>
</tr>
<tr>
<td><strong>BAIC BE701 EV</strong></td>
<td>4-door sedan, range 200km(120mi), 0–100km/h in 15 sec, top speed of 160km/h (100mph), fully self-developed EV by Beijing Automotive Industry Holding Corporation (BAIC) under subsidiary Beijing New Energy Automotive. BAIC also announced investment plans of $334M for a clean</td>
<td><strong>Target Intro:</strong> no date announced <strong>Progress:</strong> Prototype shown in Shanghai Nov 2009</td>
<td>![Image](source: China Car Times &amp; Edmunds)</td>
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| **BMW MINI E EV** | Conversion of MINI 2-door hardtop to 2-seat EV with drivetrain & battery from AC Propulsion, range 150 mi, top speed 95 mph, 35 kWh Li-ion battery back uses 5000+ laptop style batteries, 150kW electric motor, 220Nm torque, 3.4.5 hr recharge on fast charge (240V 48A/32A), 26.5 hr on 120V 12A, wt 3230 lbs | **Target Intro:** no plan announced for mass production  
**Progress:** Trial fleet of 500 cars in US on 1-year leases to general public, first car delivered on lease May 22, 2009 | **source:** BMW |
| **BMW Vision PHEV** | Vision EfficientDynamics, all-new design 2-door 4 seater, 31 mi AER, total range 400 mi, 0-60 mph 4.8 sec, top speed 155 mph, recharge 2.5 hr on 240V, 2 electric motors (1 each axle), 356 hp, 560 lb-ft peak, 1.5L 3-cylinder turbo diesel engine, 3000+ lbs, Cd 0.22 | **Target Intro:** no plan announced for mass production  
**Progress:** concept car shown at Frankfurt Auto Show | **source:** BMW |
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<td>BYD Auto e6 EV</td>
<td>4 door crossover, 5 passenger, range 400 km (249 mi), 0-60 mph 8 sec, top speed 100 mph, BYD Li-ion Fe battery, 10 min recharge to 50% SOC, 4 power combinations using front &amp; rear motors on some models: 75kW, 75+40kW, 160kW, 160+40kW</td>
<td><strong>Target</strong>&lt;br&gt;Intro: China 2009, Europe 2010, US 2011&lt;br&gt;Progress: demo units now</td>
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<tr>
<td>BYD Auto F3DM PHEV</td>
<td>AER 60 mi, total range 250 mi, 1L engine, base price 149,800 yuan ($22,000), Warren Buffet invested $230M for 10% of BYD’s parent, car company is also a battery maker, 130k workers, formerly government run Qingchuan company, located in Shenzen, China</td>
<td><strong>Available Now in</strong>&lt;br&gt;Target&lt;br&gt;Intro: China 2009, Europe 2011, &amp; US 2010&lt;br&gt;Progress: Sold 31 first 7 months of 2009, now selling to govt fleets</td>
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<tr>
<td>Chery Automobile Co. S18 EV</td>
<td>Alternatively referred to as M1 and S18 by Chery, 4-door, 5-seater (this is a compact), range 150km (93 mi), top speed 120 km per hour, 336V 40kWh ferric phosphate lithium battery pack, recharge 4-6 hr or 30 min to 80% with special charger, per Chery VP of new energy vehicle operations, will introduce in June 2010 and expects</td>
<td><strong>Target</strong>&lt;br&gt;Intro: China June 2010&lt;br&gt;Progress: prototye &quot;off production line&quot; in early 2009</td>
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*Accommodating Electric Vehicles in South Australia* | Page 75
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<th>Make, Model &amp; Type</th>
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| Chrysler Dodge Circuit EV   | Restyled from Lotus Europa as EV, 0-60 mph 5 sec, range 150-200 mi, top speed > 120 mph, rear-wheel drive, 200kW motor, dual voltage onboard charger, (120V /15A, 240V/30A) | **Target Intro:** No date set  
**Progress:** prototype, recently closed ENVI group  
*source: Chrysler* |           |
| Chrysler Town & Country PHEV| 7 passenger minivan, AER 40 mile, 0-60 mph about 8 sec, top speed 100 mph, dual voltage onboard charger (120V /15A, 240V/30A), 200kW electric motor, front-wheel drive | **Target Intro:** No date set  
**Progress:** prototype, recently closed ENVI group  
*source: Chrysler* |           |
| Chrysler Jeep Patriot PHEV  | 5-passenger SUV, 2 & 4-wheel drive electric drive, AER 40 mi, total range 400 mi, 0-60 mph 8 sec, top speed > 100 mph, 150 kW (200 hp), gas engine produces 45 kW (60 hp) continuous power for driving, dual voltage onboard charger, (120V /15A, 240V/30A) | **Target Intro:** No date set  
**Progress:** prototype, recently closed ENVI group  
*source: Chrysler* |           |

To sell about 30,000 S18s within three or four years, will cost as much as 130,000 yuan ($19,000)
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| **Chrysler**  
Jeep Wrangler Unlimited PHEV | 5-passenger, two-wheel electric drive, AER 40 mi, total range 400 mi, 0-60 mph 9 sec, top speed > 90 mph, 200 kW (268 hp) electric motor, solid axles front & rear, onboard charger, 120V/15A & 240V/30A | **Target Intro:** No date set  
**Progress:** prototype, recently closed ENVI group | source: Chrysler |
| **Chrysler**  
200C PHEV | 4 door, 4 seater, rear drive, based on shortened version of 300C, AER 40 mi, total range 400 mi, 0-60 7 sec, top speed 125 mph, 150 kW (200 hp), gas engine produces 55 kW (74 hp) continuous power for driving, dual voltage onboard charger, (120V /15A, 240V/30A) | **Target Intro:** No date set  
**Progress:** concept, recently closed ENVI group | source: Chrysler |
| **Citroën**  
C-ZERO EV | Rebadged Mitsubishi i-MiEV. 4-door hatchback, range 130 km "standard combined cycle", top speed 130 kph, 0-100 km/h 15 sec, 60-90 km/h 6 sec, 330V 16 kWh Li-ion battery, recharge with 220V standard plug 6 hr, offboard 400V, 125A 50kW charger 30 min to 80% SOC, 47 kW motor, max torque 180 Nm from 2,000 rpm, weight 1,100 kg, PSA to sell in EU via Citroen & Peugeot | **Target Intro:** EU Q4 2010  
**Progress:** Leasing as Mitsubishi i-MiEV in Japan now, fleet testing in US | source: |
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<tr>
<td><strong>Citroën REVOLTE PHEV</strong></td>
<td>Compact 3-seater city car, said to be inspired by the famous 2CV, Li-ion battery, electric motor, and small gas engine. Photovoltaic cells cover the hood to support climate controls, combines luxury and fun styles, designed to resemble a lounge, measures 3.68 m long, 1.73 m wide and 1.35 m tall.</td>
<td><strong>Target Intro:</strong> no plans announced <strong>Progress:</strong> concept unveiled at 2009 Frankfurt Motor Show</td>
<td>source: Citroën</td>
</tr>
<tr>
<td><strong>Coda Automotive CODA Sedan EV</strong></td>
<td>Formerly the Miles Electric Vehicles XS500, 4-door, 5 seater, mid-size sedan, range 90-120 mi, top speed 85 mph, 333V Li-ion battery, onboard charger 120V/240V, recharge &lt; 6 hr at 240V. Coda is a new company formed to develop &amp; market a re-engineered sedan from the Hafei Saibao, to be built in China by Hafei, Coda in JV with Lishen Battery, price $45,000.</td>
<td><strong>Target Intro:</strong> California test fleet mid-2010, public delivery fall 2010 <strong>Progress:</strong> demonstrator</td>
<td>source: Coda Automotive</td>
</tr>
<tr>
<td><strong>Commuter Cars Tango T600 EV</strong></td>
<td>Unique 2 passenger car, inline seating, range 40-200 mi depending on battery choice, 0-60 in 4 sec, retail price $108,000 for kit with some assembly required by customer, located in Spokane, WA.</td>
<td><strong>Available Now in</strong></td>
<td>source: Commuter Cars</td>
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| **Daimler**  
Smart ED (Electric Drive)  
EV | Conversion of Smart Fortwo to all-electric. Smart began life as Swatch car in 1998, and was first converted into EV form in 2006, range 72 mi, (sodium/nickel chloride battery) & 90+ mi (Li-ion battery), 0-37 mph 5.7 sec, top speed 70 mph, 30 kW / 41 hp, now upgrading w Li-ion batteries from Tesla Motors. Smart EV product manager Pitt Moos says Daimler will "start to produce 5-digit-volumes as of 2012" | **Target Intro:** 2012  
**Progress:** testing 100 cars in London, will test up to 1000 in Italy & Germany late 2009, USA 2nd half 2010. Nov 2009 announced start of 1000 unit build in Hambach, France  
**source:** Daimler & Autoblog Green |
| **Daimler**  
Mercedes Benz  
Blue Zero  
PHEV | Concept car called "BlueZero E-Cell", described with EV & PHEV versions, EV range 120 mi, 35 kWh battery pack, PHEV total range 360 mi, PHEV adds a 67-hp 3-cylinder engine from the Smart ForTwo mounted in the rear and uses a 18kWh battery pack | **Target Intro:** no model specified, announced low volume production of an EV in 2010  
**Progress:** unveile d at 2009 Detroit Auto Show  
**source:** Daimler & Autoblog Green |
| **Daimler**  
Mercedes Benz  
S500 Vision  
PHEV | Luxury sedan based on the popular S-class, AER 19 mi (30km), 10kWh Li-ion battery, 44kW (60HP) electric motor with a 3.5L V6 petrol engine, and 73 mph (3.2L/100km) | **Target Intro:** Not yet announced, expected with next generation S-class  
**Progress:** prototype unveiled at 2009 Frankfurt Motor Show  
**source:** Daimler |
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<tr>
<td><strong>Daimler</strong></td>
<td>Sports car with 4 hub motors with a combined output of 392kW and 880Nm of torque. Daimler claims the vehicle will accelerate from 0-62mph in four seconds. A liquid-cooled 48kWh batter pack will run down the center of the underbody. No official range estimates have been announced yet.</td>
<td><strong>Target Intro:</strong> Not Officially Announced (possibly 2015) <strong>Progress:</strong> unveiled at 2009 Frankfurt Motor Show</td>
<td><em>source: Daimler &amp; Autoblog Green</em></td>
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<tr>
<td><strong>Detroit Electric</strong></td>
<td>ZAP &amp; China Youngman Automotive Group resurrected name but failed to raise planned equity and sold to Albert Lam (current majority owner, Detroit CEO &amp; ZAP Board member) &amp; investors for $750,000 and North American distribution rights. Licensing Persona and Gen 2 &amp; contract manufacturing from Proton. Persona based e63: 4-speed, range 112 mi, 0-62 mph &lt; 8 sec, top speed 112 mph, 25kWh Li-ion battery, curb wt 2743 lbs, $23,000-$33,000</td>
<td><strong>Target Intro:</strong> 2010 <strong>Progress:</strong> demo cars driven at Proton's Malaysia test facility for Press</td>
<td><em>source: Detroit Electric, Proton, Edmunds &amp; Autoblog Green</em></td>
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| **Fisker Karma PHEV** | 50 mi AER, 0-60 mph < 6 sec, 150 mph top speed, luxury 4-door, base price $87,900, electric drivetrain by Quantum Technologies, battery deals with EnerDel & Advanced Lithium Power, GM supplying 260-hp, 2.0L turbocharged Ecotec engine, sales forecasts 7,500 in 2010 & 15,000 in 2011. Manufacturing by Valment Automotive of Finland. Karma Sunset hardtop convertible due 2011, company located in Irvine, CA | **Target Intro:** May-Jun 2010  
**Progress:** prototypes in test now, 1,400 pre orders & 26 dealerships signed up. Public track demo scheduled at Laguna Seca on Aug 15 2009 | *source: Fisker, Washington Times & Autocar* |
| **Ford Escape PHEV** | Based on 5-seater Escape SUV, AER 40 mi, top speed 102 mph, Li-ion 10kWh battery pack, 6-8 hr recharge time on standard 120V/15A outlet, 120 mpg over first 30-40 mi range in mixed city/hwy driving, 3,900 lbs | **Target Intro:** US 2012  
**Progress:** Fleet testing now | *source: Ford & The Birmingham News* |
| **Ford Focus EV** | Based on next generation Focus, converted by Magna International, range 100 mi, Ford converting SUV factory to build Focus models, including Electric Focus. In Jan 09, Ford announced "Ford will start out by producing 10,000 cars" | **Target Intro:** US 2011  
**Progress:** prototype | *source: Ford* |
### General Motors

**Chevrolet Volt PHEV**

- **Make, Model & Type**: General Motors Chevrolet Volt PHEV
- **Features**: 4-door hatchback, 4-seater, front wheel drive, AER 40 mi, total range 400 mi, top speed 100 mph, 16 kWh Li-ion battery from LG Chem, 150 hp electric motor, 1.4L gasoline engine generates electricity only (no direct connection to wheels), first year production 7-10k units, cost near $40,000
- **Status**: Target Intro: US Nov 2010
- **Progress**: First pre-production car on the road June 2009
- **Source**: GM & GM-Volt

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**Opel Ampera PHEV**

- **Make, Model & Type**: General Motors Opel Ampera PHEV
- **Features**: Shared platform with Chevy Volt, AER 60 km, total range 500 km, 0-100 km/h about 9 sec, top speed 160 km/h, 16 kWh battery pack, recharge on 230V household outlet, 1.4L gasoline engine, same E-Flex propulsion as Volt
- **Status**: Target Intro: Europe 2011
- **Progress**: Concept debuted at Geneva Motor Show 2009
- **Source**: GM & Opel

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**Cadillac Converj PHEV**

- **Make, Model & Type**: General Motors Cadillac Converj PHEV
- **Features**: Concept luxury car, AER 40 mi, 16 kWh Li-ion battery, using Voltec drivetrain, recharge time 8 hr on 120V, 3 hr on 240V
- **Status**: Target Intro: no announcement
- **Progress**: Concept revealed at 2009 Detroit Auto Show
- **Source**: GM
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<tr>
<td>Herpa Miniaturmodelle GmbH</td>
<td>Two door modernization of the Trabant with EV range of 155mi (250km). Per Herpa website, Ronald Gerschewski, CEO of project partner company IndiKar said “The best-case scenario would see the first “Trabant nT” with electric motor ready for sale in 2012.”</td>
<td>Target Intro: 2012 Progress: Concept unveiled at 2009 Frankfurt Motor Show</td>
<td>source: Herpa</td>
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<td>Heuliez WILL EV</td>
<td>French coach builder in collaboration with Michelin &amp; Orange, Opel Agila body, 4 Michelin in-hub wheel motors, has 2 trunks (front/rear), Three battery options for range of 150km/93 mi, 300km/186 mi, or 400km/249 mi, price target 20k-25k euro</td>
<td>Target Intro: 2010 Progress: concept, Heuliez currently under court insolvency protection</td>
<td>source: Michelin &amp; Autocar</td>
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<td>Honda EV-N EV</td>
<td>2-door, 4-seater micro car inspired by the Honda N360 first launched in 1967. Features include roof mounted solar panels for battery charging, removable seat fabric and door panel coverings, a spot inside card door for the Honda's U3-X unicycle prototype. Per Honda press, &quot;The EV-N is purely a design study and there are no plans for production.&quot;</td>
<td>Target Intro: no plans announced Progress: concept shown at 2009 Tokyo Motor Show</td>
<td>source: Honda</td>
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| **Hyundai Blue-Will PHEV** | 4-door hatchback, new body design, AER 38 mi, LG Chem Li-ion battery, 100kW electric motor, 1.6L gas engine, combined electric motor and gas engine power are 152 hp, continuously variable transmission (CVT), est. 50-55 mpg in hybrid mode after AER driving | **Target** Intro: 2012  
**Progress:** concept unveiled at Seoul Source: *Hyundai, Autovotive News & Autoweek* | ![Image](image1.png) |
| **Hyundai i10 Electric EV** | EV version of Hyundai's i10 5-door hatchback 5-seater city car, range 160km (100 mi), top speed > 130km (80 mph), 0-60 mph 15 sec, 16 kWh LG Chem Li-ion polymer battery, recharge 240V, less than 5 hr or 415V recharge to 85% SOC in 15 min, 49 kW (66 hp) electric motor, 155 ft-lb torque | **Target** Intro: Korea second half of 2010, globally 2012  
**Progress:** concept unveiled at 2009 Frankfurt Auto Show  
Source: *Hyundai & Autocar* | ![Image](image2.png) |
| **Lightning Car Company GT EV** | Hand built exotic car, range target 188 mi/300 km, 0-60 mph < 4 sec, top speed 130mph, 30 Altair Nano batteries, can recharge in 10 minutes, four in-hub 120kW wheel motors, body made from carbon fiber and Kevlar composites, led by former head of Rolls-Royce / Bentley, price £ 120,000 | **Target** Intro: Spring 2010  
**Progress:** concept car launched at 2008 British Motor Show  
Source: *Lightning & Autocar* | ![Image](image3.png) |
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| **Loremo**<br>Loremo EV<br>EV | LOwREsistanceMObility, no doors, instead front swings open for passengers to step in, 2+2 seating, range 95 mi, top speed 106 mph, 20kW rear mounted electric motor, 2 speed manual gearbox, rear-wheel drive, target less than 30,000 euro | **Target Intro:** EU in 2011, no US target yet | **Progress:** concept car  
source: Loremo |
| **Lumeneo**<br>SMERA<br>EV | Ultra narrow tilting 4-wheel vehicle with two inline seats, 90 mi range, top speed 80 mph, 0-60 mph 8 sec, 10kWh Li-ion battery pack, two 15kW DC electric motors power rear wheels, torque total 1000 Nm, electric motors tilt vehicle to a max of 25 deg, doors open from back, weight 992 lbs, length 2.5m, width 0.82m, price $24,500 euros | **Target Intro:** France 2009, EU 2010 | **Progress:** Selling in Paris  
source: Luneneo & Autoblog Green |
| **Mindset AG**<br>Mindset<br>PHEV | Ultra-lightweight hybrid vehicle with roof-mounted solar panels, gullwing doors, designed by former VW head of design Murat Günak, AER 100-200km based on driving style (ECE avg 180km), total range 800km, 20kWh battery pack, recharge 1-4 hr (depending on charger used), 70kW electric motor, 1-cylinder 17kW gas engine, front-wheel drive, price 50,000 euros | **Target Intro:** 2010  
source: Mindset, Auto Bild & Register Hardware | **Progress:** prototype built by Heuliez is driving |
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<td><strong>Mitsubishi iMiEV</strong>&lt;br&gt;<strong>EV</strong></td>
<td>4-door hatchback body of current gas model, range 100 mi, top speed 81 mph, 330V 16 kWh Li-ion battery from Yuasa &amp; Mitsubishi JV, offboard 200V 50 kW charger 30 minutes 80% SOC, onboard charger 120V/240V 15A for 7-14 hr recharge, 47 kW motor, weight 1,100 kg, LED headlamps, MSRP JPY 4,500K pre-tax (approx $47.5K), target 1,400 cars in Japan in fiscal 2009 and 5000 cars for US &amp; EU (sales via Peugeot Citroen PSA) in 2010</td>
<td><strong>Target Intro:</strong> Japan fleet lease began Jul 2009, private sales in Japan Apr 2010, US &amp; EU 2010</td>
<td><strong>Target Intro:</strong> no plan announced for PX-MiEV&lt;br&gt;<strong>Progress:</strong> Concept car displayed at 2009 Tokyo Motor Show&lt;br&gt;<strong>source:</strong> Mitsubishi</td>
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<td><strong>NICE Micro-Vett e500 (Fiat) EV</strong></td>
<td>Joint effort between Fiat and NICE, 4 seater, range 75 mi, top speed 60 mph, Li-ion polymer batteries</td>
<td><strong>Target Intro:</strong> UK then Europe</td>
<td><em>source: Autoblog Green &amp; The Green CarWebsite</em></td>
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<td><strong>Nissan LEAF EV</strong></td>
<td>5-seater, 4-door hatchback, prototype based on Versa/Tida platform, low drag coefficient, range 100 mi, top speed &gt; 90 mph, 80kW electric motor, proprietary Nissan/NEC Li-ion battery, recharge &lt; 8 hr on 100V, fast charge to 80% SOC in 30 min, $28k-$30k price. Planning for mass production for US &amp; Japan in 2010, with initial sales in States with local State or city agreements in place to deploy charging infrastructure.</td>
<td><strong>Target Intro:</strong> US &amp; Asia in fleets &amp; limited areas 2010, globally 2012</td>
<td><em>source: Nissan</em></td>
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<td><strong>Peugeot iOn EV</strong></td>
<td>Small 4-door, 4-seater city car based on the Mitsubishi iMiEV, range 80mi, Li-ion battery, recharge on standard 240V home electrical in 6 hr, using external fast charger capable of 30 min to 80% SOC</td>
<td><strong>Target Intro:</strong> end of 2010</td>
<td><em>source: Peugeot</em></td>
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| **Pininfarina-Bolloré BLUECAR aka B0 EV** | Pininfarina & Bolloré joint venture, 4-door hatchback, 5-seater, range 155 mi, top speed 81 mph, uses Li-ion batteries & ultracapacitors, recharge 8 hr, quick charge option available. To be built by Bolloré in France & Canada. Sales planned in Europe in 2010, production up to 2,000 cars in 2011 and up to 10,000 per year by 2013. Lease option planned at 333 euro per month | | **Target Intro:** 2010  
**Progress:** concept  
**source:** Pininfarina & USA Today |
| **Renault Fluence ZE EV** | Family sedan, range 100 mi, standard recharge 4-8 hr, quick charge 20 min, “Quickdrop” battery exchange option, using a new body to be introduced in gasoline version in 2009, Renault expects initial production at 20-40,000 units, price not set, but Shai Agassi of Better Place quotes that it will be 3000-5000 euros less than the gasoline version. | | **Target Intro:** Israel & Denmark first half 2011  
**Progress:** Concept unveiled at 2009 Frankfurt Motor Show  
**source:** Renault, Autoblog Green & Reuters |
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| **Renault Kangoo ZE EV** | Compact commercial van, range 100 mi, top speed 130 kph (81 mph), standard recharge 4-8 hr, quick charge 20 min, “Quickdrop” battery exchange option, 70kW electric motor, 226Nm of torque, curb weight 1520 kg, multizone climate control includes heated steering wheel, other unique concept features include polyurethane gel bumpers | **Target Intro:** Europe Mar 29, 2012  
**Progress:** concept car unveiled at 2009 Frankfurt Motor Show  
**source:** Renault & Top Speed | |
| **Renault Zoe ZE EV** | Compact coupe, range 100 mi, standard recharge 4-8 hr, quick charge 20 min, “Quickdrop” battery exchange option, 70kW electric motor | **Target Intro:** Europe first half of 2011  
**Progress:** concept car unveiled at 2009 Frankfurt Motor Show  
**source:** Renault | |
| **REVA NXG EV** | Named for "NeXt Generation", two-seater with a targa roof, designed by Dilip Chhabria, top speed of 130 kmph (81mph), range of 200 km (124 mi), reserves a % of battery capacity for emergency range extension, purchase and lease options, 23,000 euros excluding battery cost in European market, prices of both models in Indian to be announced in | **Target Intro:** Europe & India 2011  
**Progress:** car unveiled in 2009 Frankfurt Auto Show  
**source:** REVA | |
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<td><strong>REVA NXR EV</strong></td>
<td>Named for &quot;NeXt Reva&quot;, four-seat, three-door hatchback family car suitable for urban driving. NXR Intercity top speed 104 km/h (65mph), range 160 km (99 mi), Li-ion battery. NXR City top speed 80 km/h, range 80 km, lead acid battery. Recharge Li-ion model 8 hr on standard charging, 90 min on quick charger, reserves a % of battery capacity for emergency range extension, purchase and lease options, 14,995 euros excluding battery in European market</td>
<td><strong>Target</strong> Intro: Europe &amp; India 2010 <strong>Progress:</strong> car unveiled in 2009 Frankfurt Auto Show</td>
<td>source: REVA</td>
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<td><strong>SAIC Roewe 750 EV</strong></td>
<td>4-door sedan, top speed 150 km/h, range 200 km, Li-ion battery, recharge 6-8 hr from Shanghai Automotive Industry Corporation</td>
<td><strong>Target</strong> Intro: 2012 <strong>Progress:</strong> concept car at Shanghai Auto Show 2009</td>
<td>source: SAIC &amp; Autoblog China (English translation)</td>
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<td><strong>SEAT León TwinDrive PHEV</strong></td>
<td>Debuted at the 2009 Geneva Auto Show, working with parent company Volkswagen, AER 50 km (31 mi), electric mode top speed 100 km/hr (62mph), Li-ion battery pack stored in the trunk, 35kW electric motor</td>
<td><strong>Target Intro:</strong> no formal announcement, SEAT says likely 2014</td>
<td><strong>Progress:</strong> concept car source: SEAT &amp; EV World</td>
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<td><strong>Subaru R1e EV</strong></td>
<td>2-seater, range 50 mi, top speed 65 mph, Li-ion batteries capable of 15 min quick charging to 80% SOC, displayed at the 2008 New York Auto Show, it has been in various test programs in Japan since 2006</td>
<td><strong>Target Intro:</strong> No production plans announced, denoted &quot;concept&quot; by Subaru</td>
<td><strong>Progress:</strong> test cars in Japan, NYC, scattered locations source: Subaru</td>
</tr>
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<td><strong>Subaru Stella EV EV</strong></td>
<td>Conversion of mini-car Stella, 4-door, range 50 mi, top speed of 62 mph, 9.2 kWh lithium-ion battery, recharge 5 hr 240V or 120V, quick-charge to 80% SOC 15 min, 47 kW motor, 125 lb-ft torque, continuously variable transmission, 2,227 lbs, $45,500-$47,600 before Japanese govt incentives, drivetrain evolved from the R1e</td>
<td><strong>Target Intro:</strong> For sale in Japan 2009 as 170 fleet cars</td>
<td><strong>Progress:</strong> deliveries begin Aug 2009 source: Subaru &amp; Edmunds</td>
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<td><strong>Suzuki Swift PHEV</strong></td>
<td>Popular Swift 4-door hatchback 4-seater model, AER 20km, 2.66kWh 260V Li-ion battery pack, 50kW electric motor, 40kW 660cc engine, front wheel drive, CVT transmission</td>
<td><strong>Target Intro:</strong> no plan announced</td>
<td><img src="image1.png" alt="Suzuki Swift PHEV" /></td>
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<td><strong>Tata Motors Indica EV EV</strong></td>
<td>4-seater, range 200 km, 0-60 kmph &lt; 10 sec, polymer Li-ion batteries, joint venture between TMETC (Tata) and Miljobil Greland (Tata owns 50.3% of the Norwegian EV tech company) &amp; possible input from Electrovaya, to be built by Miljobil</td>
<td><strong>Target Intro:</strong> Europe 2009</td>
<td><img src="image2.png" alt="Tata Motors Indica EV EV" /></td>
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<td><strong>Tesla Motors Roadster EV</strong></td>
<td>High performance 2-seater sports car, range 220 mi, 0-60 mph 3.9 sec, top speed 125 mph, liquid cooled 56 kWh Li-ion battery module using 6831 laptop cells, recharge about 3.5 hr using high power charger, can also recharge at 120V &amp; 240V lower current, 375V AC induction air-cooled electric motor, 248 peak hp, 276 ft/lbs of torque, restyled from Lotus Elise, body built by Lotus in the UK, drivetrain integration</td>
<td><strong>Available Now in</strong> USA 2008, Canada &amp; Europe Q4 2009</td>
<td><img src="image3.png" alt="Tesla Motors Roadster EV" /></td>
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*source: Suzuki, Tata & Miljo & Autoblog Green, Tesla*
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| **Tesla Motors**   | New ground-up 4-door, 7-seat design, aka White Star, range 150 mi, 230 mi & 300 mi (based on battery option), 0-60 in 5.5 sec (sport version < 5 sec), top speed 130 mph, recharge @ home in 4 hr, fast charge ability in 45 min, coefficient of drag 0.25, base price of 150 mi model $57,400 & weighs 4,000 lbs. To begin in 2011 with 2,000 cars followed by 12,000 cars in 2012 and full capacity of 20,000 cars a year by 2013 | **Target**
Intro: USA & EU 2011 from new unbuilt factory
Progress: taking pre-orders, demo car, approved for $365M D.O.E. loan | source: Tesla Motors |
| **Th!nk City EV**  | City car, 2+2 seating, range 180km (both based on MES DEA Zebra battery), top speed 100km/hr, other battery options to include Li-ion from A123 & EnerDel, ABS brakes, airbags, body is ABS recycled plastic, steel & extruded aluminum frames, granted first pan-European homologation for an EV, seeking to build factory in US for 2010 volume of 2500 cars, emerged from bankruptcy and raised $47M to resume production. | **Target**
Intro: USA 2010, now shipping in Norway, selling now in Europe to Th!nk rated "EV friendly cities" | source: Th!nk & Venture Beat |
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| **Th!nk O EV**    | aka Ox, 5-seat, 4-door hatchback, range 125-155 mi, 0-60 mph about 8.5 seconds, Li-ion batteries, recharge to 80% SOC < 1 hr, solar panels in roof power the onboard electronics | **Target Intro:** originally set for EU 2010-2011  
**Progress:** concept at 2008 Geneva Motor Show | source: Th!nk & Business Week |
| **Toyota FT-EV EV** | Known inside Toyota as the "BEV" (Battery Electric Vehicle), 2-seater, based on iQ body, will have it's own body style, will get its own body style to create a stand-alone model, top speed 70 mph, range 150km (93 miles), Li-ion batteries from a Toyota-Panasonic joint venture, recharge 7 hr, uses in-wheel electric motors | **Target Intro:** 2010 - no firm date announced  
**Progress:** concept car unveiled at the 2009 NAIAS Auto Show in Detroit | source: Toyota & Autocar |
| **Toyota FT-EVII EV** | named "Future Toyota Electric Vehicle II", 2-door micro car, range 90km (56mi), top speed 100km/h (62mph), sliding doors, combination handlebar type control mechanism replaces steering wheel and floor pedals, see-through tail lights and front sections covered with dye-sensitized solar panels. | **Target Intro:** no plan announced  
**Progress:** concept car shown at 2009 Tokyo Motor Show | source: Toyota |
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| **Toyota Prius Plug-in PHEV** | Based on 2010 model (3rd generation Prius), AER 20-30km (12.4-18.6 mi), using Li-ion batteries, charge on standard home outlet. Toyota hopes to sell at a price comparable to Mitsubishi’s i-MiEV (around US$47,500) and start mass producing in 2012, with first-year output 20,000 to 30,000 cars. | **Target Intro:** end 2009 thru 2010 to release 500 test fleet cars in Japan, EU & USA, Mass production 2012  
**Progress:** currently testing in several public areas | *source: Reuters, Autoblog Green & Nikkan Jidosha Shimbun* |
| **Volkswagen Twin Drive PHEV** | Golf type 6 using VW twinDRIVE no transmission, 1-liter turbocharged gasoline engine, runs on electric only to 30 mph, then switches to gas engine, single gear ratio similar to top gear in a conventional car, electric motor give extra power when needed, 12 kWh battery, “e-mode” for electric only low speed driving. reverse is handled by the electric motor. | **Target Intro:** test fleet of 20 cars 2010, no production goal announced. VW CEO said on Jul 3, 2009 VW will offer their first all-electric car in 2013.  
**Progress:** road-testing a Golf mule with 30 mi AER | *source: Volkswagen, Motortrend, Wired & AFP* |
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<td><strong>Volkswagen</strong>&lt;br&gt; E-Up! EV</td>
<td>2-door mini car, seats 3 adults + 1 child, range 130km, 0-60 mph in 11 sec, 60 kW electric motor, 210 Nm of torque (80-hp and 155 ft-lbs of torque), curb weight 1,085 kg (2,392 lbs), solar panels cover roof</td>
<td><strong>Target Intro:</strong> No plan announced&lt;br&gt;<strong>Progress:</strong> Concept debuted at 2009 Frankfurt Auto Show&lt;br&gt;source: VW &amp; Christian Science Monitor</td>
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<td><strong>Volvo</strong>&lt;br&gt;V70 PHEV</td>
<td>Unspecified future model, shown as a Volvo V70 PHEV concept car, AER 50 km (31 mi), Li-ion battery, recharge about 5 hr from 240V wall socket, diesel engine, &quot;range will be class-leading&quot; and CO2 emissions will be lower than 50 g/km under the NEDC driving cycle, Developed under Volvo's DRIVe program in partnership with Vattenfall (Sweden based northern European power utility)</td>
<td><strong>Target Intro:</strong> 2012&lt;br&gt;<strong>Progress:</strong> Announced with V70 concept car June 1, 2009, Volvo to test 3 cars this summer with Vattenfall&lt;br&gt;source: Volvo</td>
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APPENDIX C. TYPES OF EMISSIONS FACTORS AND THEIR DESCRIPTIONS (NGA)

Excerpt of Types of Emissions Factors from the National Greenhouse Accounts, June 2009 Report.

1.2 Types of emission factors
The world of emission factors can become confusing—the following is provided to clarify the purpose of the types of emissions factors in this workbook.

Firstly, it is important to note that an emission factor is activity-specific. The activity determines the emission factor used. The scope that emissions are reported under is determined by whether the activity is within the organisation’s boundary (direct—scope 1) or outside it (indirect—scope 2 and scope 3).

- Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO₂-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate scope 1 emissions.

- Indirect emission factors are used to calculate scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO₂-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

- Various emission factors can be used to calculate scope 3 emissions. For ease of use, this workbook reports specific ‘scope 3’ emission factors for organisations that:
  
  (a) burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or

  (b) consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the I&D network.

The definition, methodologies and application of scope 3 factors are currently subject to international discussions. Available scope 3 emission factors are listed in Appendix 4. Scope 3 factors and methods are also provided for companies wishing to estimate their scope 3 emissions from disposal of waste generated (e.g. if the waste is transported outside the organisation and disposed of).