NEW YORK STATE ASSOCIATION OF METROPOLITAN PLANNING ORGANIZATIONS

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Electric Vehicles and Green House Gas Reduction

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Electric Vehicles:

Electric vehicles are propelled by an electric motor (or motors) powered by rechargeable battery packs, instead of a gasoline engine. Unlike hybrid vehicles, the electric vehicle is powered exclusively by electricity, rather than being partially powered by gasoline.

Electric cars are able to produce an approximate driving range of 100 miles before needing to be to be recharged and produce no tailpipe emissions. They also have substantially lower energy costs, while gasoline costs about 12 cents or more per mile driven, electric vehicles may have an energy cost as low as 2 cents per mile driven.

Relationship to Greenhouse Gases:

Electric cars are now on the road in very limited quantities. By taking gasoline out of the equation all together, many people assume the electric cars must be zero emission vehicles. While their tailpipe emissions are close to zero, we should remember that their source of power, electricity, is generated by power plants.

It is evident that the amount of greenhouse gas missions saved by electric cars will vary widely from state to state, depending on their grid sources. Many states in the Midwest and Southeast rely heavily on coal and therefore in those areas, electric cars will still produce fewer emissions than regular gasoline vehicles, but the difference won't be as great[1]. California's grid is relatively carbon-free, with more than 45% of the state's electricity coming from the burning of natural gas, which produces less carbon than coal[2]. New York State's electricity generation is estimated to be made up of 31% nuclear, 31% natural gas, 21% conventional hydroelectric, 10% coal, 2% petroleum, with the remaining amount produced from wind and biomass[3]. This is a relatively clean electrical power source.

Moreover, leading analysts have commented that the benefits of electric cars will increase as the use of renewable power grows. Even if the grid is not as clean as we would like now, it is expected to get cleaner over time – allowing for less emissions. Experts also conclude that it is much easier to "de-carbonize" the grid than it is to cut the greenhouse gas emissions from millions of fuel-burning cars. Electric vehicles are a necessary part of an overall strategy to reduce GHG emissions. Patricia Monahan, Director of the Clean Vehicles Program at the Union of Concerned Scientists, predicts that by 2030, the nation must be on a path to electrification if we want deep greenhouse gas reductions[4].

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[1] http://articles.sfgate.com/2010-07-19/business/21988864_1_electric-cars-electric-vehicle-greenhouse-gas-emissions

[2] http://articles.sfgate.com/2010-07-19/business/21988864_1_electric-cars-electric-vehicle-greenhouse-gas-emissions

[3] http://www.instituteforenergyresearch.org/state-regs/pdf/New%20York.pdf

[4] http://articles.sfgate.com/2010-07-19/business/21988864_1_electric-cars-electric-vehicle-greenhouse-gas-emissions

Current Status in the United States

President Obama's Goals

Beginning in July, 2010, the Obama administration has provided approximately $5 billion to encourage the development and sale of plug in hybrid and rechargeable electric cars through providing grants and low cost loans to various car companies and battery manufacturers.

Part of the $5 billion comes from the American Recovery and Reinvestment Act (ARRA), which includes $2.4 billion dedicated to the development of 30 different manufacturing plants and to supporting demonstration projects. These funds are matched at least dollar for dollar by the manufacturers resulting in approximately $5 billion for electrical vehicle development. Additionally, the United States has invested another $2.6 billion in the Advanced Technology Manufacturing (ATVM) Loan Program.

The following are some noteworthy accomplishments in United States development of electric car technology and efficiency: construction of nine battery manufacturing plants funded by ARRA are underway, construction of 11 battery component manufacturing facilities are also underway (the Celgard f plant in North Carolina, as one example, is being expanded to produce 1 million electric drive batteries per year), and 10 electric drive component projects are being supported by federal funds. Together the new facilities will have the ability to provide batteries and components for 500,000 electric vehicles annually. This is about 40 percent of the worldwide share of advanced vehicle batteries[5].

The Department of Energy, (DOE) in tracking this new electric car industry has predicted the expected battery costs per kilowatt hour will drop from $1,000 in 2009 to $300 in 2015 and then to $100 by 2030. DOE is actively assisting in this movement. For example, DOE has partnered with LG Chem, a South Korean chemical and battery maker company, to build a $203 million battery plant in Holland, Michigan. Funding for the plant is split evenly, with a DOE grant providing $101.4 million and LG Chem providing $101.5 million.

In addition to these advances, the White House predicts that there will be 20,000 charging stations in residential, commercial, and public locations by December 2013. The expansion in charging infrastructure will allow for a smoother and larger adoption of electric vehicles[6].

[5] http://www.zdnet.com/blog/green/white-house-big-cost-reductions-in-electric-vehicle-batteries-coming/13057
[6] http://www.zdnet.com/blog/green/white-house-big-cost-reductions-in-electric-vehicle-batteries-coming/13057

The EV Project

After being awarded an initial $99.8 million grant from the Department of Energy in August of 2009, ECOtality North America started the "EV Project. The project has a goal of deploying nearly 15,000 charging stations in 16 cities by the end of 2012. The selected cities are Phoenix (AZ), Tucson (AZ), San Diego (CA), Los Angeles (CA), Portland (OR), Eugene (OR), Salem (OR), Corvallis (OR), Seattle (WA), Nashville (TN), Knoxville (TN) and Chattanooga (TN), Washington D.C., Dallas (TX), Fort Worth (TX), and Houston (TX). The company has also received an additional stimulus grant of $15 Million from the DOE, and a private match of $15 Million; making the grand total of money invested in the program of $230 million[7].

The ultimate goal of the project is to deploy an initial 8,300 electric vehicles, and also to learn about how these cars and charging stations may be more widely used, and to understand adaptation to varied climate conditions and geographies. The EV project will be deploying 5,700 Nissan Leaf electric vehicles and 2,600 Chevy Volt plug in hybrid cars.

The EV Project will also attempt to create a model for growth and expanded usage of electric vehicle infrastructure throughout the US that will not require long term government support in the future[8].

The charging stations deployed will be both Level 2 and Level 3 chargers. The Level 2 charging stations result in a 220 Volt charge that allows recharging in four to six hours, typically used for overnight charging at home or at businesses. The Level 3 charging stations (also called DC Fast Charging), will allow for a 330 Volt charge; taking minutes as opposed to hours to charge. They will be deployed in high density areas in each of the launch markets: and in major transportation corridors, to allow EV users to commute between major cities[9]. Most of the stations will have Level 2 chargers, which can be accessed by the public.

Charge Point America

The Charge Point America Program is "made possible by a $15M stimulus grant through the Transportation Electrification Initiative administered by the Department of Energy"[10].

This grant is just part of a $37 million project administered by Coulomb Technologies. It will supply 4,600 charging stations in nine participating regions by October 2011.

[7] http://sunpluggers.com/news/ev-charging-station-project-to-expand-to-los-angeles-washington-dc-0651
[8] http://sunpluggers.com/news/ev-charging-station-project-to-expand-to-los-angeles-washington-dc-0651
[9] http://www.theevproject.com/education.php
[10] http://chargepointamerica.com/pr/pr-20100714.php

The regions are Austin, Detroit, Los Angeles, **New York**, Orlando, Sacramento, San Jose/San Francisco Bay Area, Washington DC, and Bellevue/Redmond (WA).

In addition to public charging stations, Charge Point will also install charging stations for individuals and businesses. The top automakers in the field: Chevrolet, Ford, and Smart USA (leader of "smart cars") have also joined in the partnership. In order to more accurately asses the demands and needs of certain regions and the actual production of the charging stations, Coulomb will collect and analyze data from the charging stations. Currently, the project is installing Level 1 and Level 2 charging station infrastructure in wall, pole, and bollard options[11].

West Coast Green Highway

The goal of the West Coast Green Highway is to place public-access electric vehicle fast charging stations every 40 to 60 miles for the entire length of Interstate 5. Designated by USDOT as the "Corridor of the Future", the 1,350 miles of interstate, travels from the Canadian border, through Washington, Oregon, and California, to the Mexican border. Through funding by public-private partnerships, business assistance, branding, and fueling and charging sites, the West Coast Green Highway hopes to be the nation's greenest, smartest, and cleanest highway.

The West Coast Green Highway is currently installing Level 2 chargers at Washington's Gateway safety rest areas for public education and outreach. Level 3 fast charge stations will be developed through public private partnerships with private firms.

The Electric Highway project, as it is often called, is headed by two state agencies, the Washington State Department of Commerce and the Washington State Department of Transportation. Funding is provided by the Dept. of Commerce with American Recovery and Reinvestment money being administered through the State Energy Program[12]. The private public partnerships, primarily in terms of who will provide the charging stations, have yet to be determined, although talks with Better Place, a leading charging station and battery switch company, have been rumored to be in the works for much of the project[13].

Better Place's battery switch operations consist of a five minute process of replacing the depleted battery with a new one in order to continue the longer journey without having to stop and charge. The driver remains in the vehicle and the actual process of switching the battery takes just under 80 seconds[14].

[11] http://www.coulombtech.com/products-charging-stations.php
[12] http://www.westcoastgreenhighway.com/electrichighways.htm
[13] http://seattletimes.nwsource.com/html/localnews/2008827158_greenfreeway08m.html
[14] http://www.greencarcongress.com/2009/05/better-place-demo-20090513.html

International Examples

Israel

Israel is a leader in environmental technological advances.

Better Place, a private company, gained recent attention for their deal with the Israeli government to provide a pilot program that may result in a complete conversion of the countries infrastructure to support electric vehicles. The venture backed firm based out of Palo Alto, California has signed up 17 municipalities, including Jerusalem to participate in the pilot and it also has convinced over 90 companies to lease a fraction of their fleets from the firm. They are partnering with Nissan for the electric vehicles.

Additionally, Better Place has teamed up with Dor Alon Energy to set up battery switch points at some of its 170 gas stations. Better Place's battery switch operations consist of a five minute process of replacing the depleted battery with a new one in order to continue the longer journey without having to stop and charge. The driver remains in the vehicle and the actual process of switching the battery takes just under 80 seconds[15]. If all goes well , 1,000 electric cars will be added in Israel each month in 2011, serviced by between 70 to 100 battery service stations and thousands of charge spots.

The cost of the battery station will be approximately half a million dollars, but the mystery of how much the electric cars will cost remains (Better Place insists it will be less than its gas-counterpart). The costs of the expensive lithium-ion batteries and the infrastructure (which include charging spots at home, businesses, and public spaces, as well as the battery switch station) will be provided by Better Place[16].

Better Place's plans to charge subscribers on a per-mile basis offering rate plans similar to cell phone minutes.[17].

Tokyo, Japan

Better Place, the California based company behind Israel's pilot program, has teamed up with Nihon Kotsu, Tokyo's biggest taxi operator, and the Japanese government to administer a pilot electric taxi program.

The pilot began in April 2010 and after initial success, the original three month program entered its second phase, which will aim to further evaluate battery performance, driver behavior, and other metrics. The taxi pilot program is also aimed at testing the feasibility of all- electric cabs using switchable battery technology as a way to reduce emissions and fuel

[15] http://www.greencarcongress.com/2009/05/better-place-demo-20090513.html
[16] http://solveclimate.com/blog/20100209/better-place-takes-big-leap-forward-israel-electric-car-pilot
[17] http://solveclimate.com/blog/20100209/better-place-takes-big-leap-forward-israel-electric-car-pilot

consumption, as opposed to the more well known appeal of charging stations. Tracking the three pilot vehicles across approximately 40,000km, the drivers have completed battery swaps over 2,000 times, with an average swap said to take 59.1 seconds from start to finish[18].

Better Place estimates that Tokyo's 60,000 taxis are just two percent of vehicles on the road but are responsible for 20 percent of vehicle emissions.

Better Place hopes that electric taxis will encourage consumers to consider purchasing electric cars for their personal needs as well.

The current test vehicles are converted Nissan Dualis SUVs, called Qashqai in some markets. Nissan is not involved in the scheme directly: an outside company has re-engineered the cars with batteries provided by U.S.-based A123 Systems[19].

Although Japan is home to some of the world's top automakers, including Nissan and Mitsubishi, the vehicles produced by those makers are different than the ones being used in the Better Place Tokyo cab project; those automakers are producing electric cars that have batteries that cannot be switched but rather require time for recharging in stations instead[20].

According to Yoshihiko Takahashi, one of the eight taxi drivers using the electric cabs, the switchable batteries have proved simple and fast, not changing the amount of passengers being carried each day (about 22 or 23 on average).

The electric taxi's range is about 100km (62 miles) on a full charge, resulting in between four to five battery swaps every shift[21].

New York Applicability

Mayor Bloomberg is a proponent of the installation of charging **stations in support of PlaNYC's long term sustainability goals.**

Congressman Jose Serrano also has strongly supported Coulomb Technologies' charging stations in New York, stating that his district is the "epicenter of the childhood asthma in New York"[22].

[18] http://www.goauto.com.au/mellor/mellor.nsf/story2/27710BFDB55A1B67CA257790000AB296
[19] http://www.reuters.com/article/idUSTRE6891YH20100910
[20] http://www.businessweek.com/ap/financialnews/D9FAMMS80.htm
[21] http://www.reuters.com/article/idUSTRE6891YH20100910
[22] http://chargepointamerica.com/pr/pr-20100714.php

As part of the $37 million Charge Point American program, Coulomb Technologies opened the first New York City station in July 2010. Located at the Edison Properties parking facility on Ninth Avenue between 35th and 36th Streets, the electric vehicle charging station is the first of approximately one hundred charging stations to be installed in New York by Coulomb.

Cost

Electric Cars

Tesla's current model, the Roadster, is priced at approximately $109,000. It has a 240 mile electric range.
In addition to their popular Roadster, Tesla is also developing the roomier Model S five-door hatchback that will start at $57,400. The Model S is expected to be in production in late 2011 produced at a rate of 20,000 cars a year. The lithium-ion battery packs will be available in three sizes, with a base model starting at a range of 160 miles and the larger packs providing a range of 230 or 300 miles[23].

The recently released 2011 Nissan Leaf is priced to start at $32,780 [24]. The Nissan Leaf can recharge 80% of its battery within 30 minutes at a quick charge station or recharge fully through a lower voltage charger (200V) within eight hours[25]. Although many gas powered cars are able to reach approximately 400-500 miles on a full tank of gas, and the Nissan Leaf (and other electric vehicles) can only drive 100-120 miles without recharging their batteries. Analysts say this difference won't affect most people; 90 percent of Americans drive less than 50 miles per day, and an average driver only travels 29 miles per day[26].

Electricity Costs

According to California cars Initiative, electricity costs are on average 75 cents to drive 25 miles, whereas the same distance would cost about $3 using gas in regular gasoline driven cars. The benefits of reducing greenhouse gas emissions to the environment are combined with the savings efficiency demonstrated in the elimination of gasoline as well as the ability of the batteries in most of the electric cars to maintain most of their capacity over time (unlike rechargeable batteries in today's cell phones or laptops)[27]. In fact, most of the handful of

[23] http://www.autoweek.com/article/20090327/CARNEWS/903279971
[24] http://www.egmcartech.com/2010/04/29/nissan-leaf-expected-to-be-in-short-supply-within-the-first-3-months-of-sales/

[25] http://www.citylimits.org/news/articles/4121/electric-car-infrastructure-coming-to-nyc
[26] http://www.citylimits.org/news/articles/4121/electric-car-infrastructure-coming-to-nyc
[27] http://www.citylimits.org/news/articles/4121/electric-car-infrastructure-coming-to-nyc

Toyota RAV 4 EVs that were placed on the market in 1999 are still functioning and operating at about 85 percent capacity today[28].

Charging Stations

The cost of providing charging infrastructure is an important element in the success of electric vehicles. Charging stations vary drastically in price, with many ranging from $1,000-$6,000 for simple charging stations to as high as $50,000 for Level 3 fast chargers[29][30].

Observations/Conclusions:

Recent improvements in the energy storage capacity of batteries make electric vehicles an emerging technology. More improvements are anticipated resulting in near term cost reduction.

Electric vehicles are now commercially viable now, at a higher price point than conventional gasoline vehicles. The Nissan Leaf can go 100 miles before needing a charge. The Tesla Roadster can go 240 miles before needing a charge.

The federal government's tax credit of $7,500 is a significant incentive for purchase of electric vehicles as it narrows the gap between the higher purchase price between the electric vehicles and conventional vehicles.

The savings per mile of energy costs are significant. Depending on the location the savings in energy charges for use of electricity rather than gasoline may be as high as 70 %.

It is still not certain if private sector plans to provide battery swapping stations on a subscription basis may be commercially viable. However, if demonstrations prove viable there could be a sudden surge in the availability of battery swap stations.

It is anticipated that government may play a significant role in providing charging stations in public places. West Coast governments are working on establishing a green highway on Route 5 from Canada to Mexico.

Widespread adoption of electric vehicles would result in a significant reduction in Green House Gases in New York State from the transportation sector as recognized in the New York State Climate Action Plan. This is because the electric power sources in the state are relatively green. New York State's participation in the Regional Emission Reduction Initiative will result in further GHG emission reductions from power production in the future.

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[28] http://www.citylimits.org/news/articles/4121/electric-car-infrastructure-coming-to-nyc

[29] http://featured.matternetwork.com/2008/10/grid-recharges-plug-hybrids.cfm

[30] http://blogs.edmunds.com/greencaradvisor/2010/03/coulomb-claims-to-install-first-ev-charging-stations-

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