FINAL REPORT: City of Las Vegas Plug-in Hybrid Electric Vehicle Demonstration Program

Project Summary

The City of Las Vegas was awarded Department of Energy (DOE) project funding in 2009, for the City of Las Vegas Plug-in Hybrid Electric Vehicle Demonstration Program. This project allowed the City of Las Vegas to purchase electric and plug-in hybrid electric vehicles and associated electric vehicle charging infrastructure. The City anticipated the electric vehicles having lower overall operating costs and emissions similar to traditional and hybrid vehicles.

In his 2010 and 2011 State of the Union addresses, President Obama discussed the nation's dependence on oil and reiterated the call for U.S. industry to advance and develop 1 million electric vehicles by 2015. Direct benefits of electric vehicles for consumers include reductions of Scope 1 CO_2 emissions and reduced cost and demand for fuel. However, a critical link to the development of the electric vehicle and plug-in hybrid electric vehicle market is the development of the infrastructure necessary to sustain these vehicles.

The Mayor and City Council of Las Vegas have similarly demonstrated a commitment to sustainable transportation by adopting a body of public policy aimed at reducing the City's carbon footprint, supporting a strong economy and improving the quality of life for current and future generations of Las Vegans. In 2008, the City Council adopted the Sustainable Energy Strategy (R-50-2008) as one implementation measure of those policies. It is a comprehensive strategy that recommends investments in energy conservation and renewable energy based on a triple bottom line approach. The strategy contains several energy conservation goals:

- By 2010, 90 percent of fuel consumed will be cleaner burning, domestically produced alternative fuel.
- By 2011, 10 percent reduction to the City's carbon footprint, 20 percent by 2020, and 30 percent by 2030.

The City of Las Vegas has been nationally and internationally recognized as an innovative and aggressive leader in the research, development and deployment of cutting edge alternative fuel technologies in a fleet operation since 1994. In support of that effort, this funding opportunity allowed the City to test and demonstrate the viability of both electric and plug-in hybrid electric vehicles. Between 2011 – 2013, the deployed vehicles in high mileage sectors of the fleet and charging station infrastructure available to both the City and general public. The City found no performance issues with the vehicles with respect to maintenance or climate and noted favorable performance and use of the deployed charging stations.

Scope of Work

The City of Las Vegas was awarded $142,725 for the City of Las Vegas Plug-in Hybrid Electric Vehicle Demonstration Program and included a 50% matching requirement. The initial scope of work was to convert four to six Toyota Prius Hybrids to plug-in hybrid electric vehicles. A local company headquartered in the greater Las Vegas region was to be contracted with to acquire production line models from a major auto manufacturer and to deploy the units to gather essential data associated with reliability and performance in desert climatic conditions.

Between the original date of the award in 2009 and early 2011, the City of Las Vegas experienced a major delay to the project related to personnel reassignments and separation resulting from major declines in municipal revenue associated with the economic recession which impacted the state of Nevada especially hard. In addition, a major contractor identified to perform the conversions went out of business, coupled with the national deployment of electric and plug-in hybrid electric vehicles during this time period required the City to seek and receive DOE approval for a change in scope of work.

The City purchased five new electric and plug-in hybrid electric vehicles in their fleet and deployed them over the duration of the project. Data, such as performance, maintenance, energy usage, fuel economy, and emissions were gathered to evaluate the reliability and performance during the fleet testing phase of the project. The City purchased and installed electric vehicle charging stations at designated locations across the City.

Electric Vehicles

The City purchased five electric vehicles beginning in June 2011. The City's Purchasing Division attempted to acquire as many vehicles locally as possible; the launch of both the Chevrolet Volt and the Nissan Leaf in select national markets created a waiting list for the vehicles in Nevada, which lengthened the overall deployment time. Both Volts were acquired locally in 2011, while dealers in California, Utah, and Arizona were contacted for availability of other vehicles and models; the City eventually purchased a Leaf from a dealer in Reno, NV and a Mitsubishi mi-EV locally. Later in 2013, given fund availability, the City purchased a newly released Plug-in Prius from a dealer in Carson City, NV.

Vehicle	Acquisition Cost	Department	Primary Use	Annual Performance details
2011 Chevrolet Volt	$44,659	Planning	Departmental use – Inspections	• Lifetime Average of 44 MPG • 3,176 electric miles • 4,049 total miles • 25 gallons
2012 Chevrolet	$45,980	Parking	Parking Enforcement – City Marshals	• Lifetime Average of 43 MPG • 7,409 electric miles • 17,372 total miles • 403 gallons
2011 Nissan Leaf	$39,278	Administrative Services – City Manager	Departmental use	• Estimated average range of 106 miles per charge • 5,083 electric miles
2012 Mitsubishi Mi-EV	$31,101	Parks and Recreation	Departmental use	• Estimated average range of 54 miles per charge • 2,117 electric miles
2013 Toyota Prius Plug-In Hybrid	$33,243	Parking – Economic Development	Departmental Use	• 47 MPG • 1,804 total miles

- Overall Vehicle Performance Throughout the fleet testing phase, City staff and Fleet mechanics noted no major performance issues, nor were any noted by any of the primary drivers when vehicle performance updates were requested. Both Chevrolet Volts were serviced in mid-2012 to address battery recall and airbag concerns. No battery degradation issues or concerns were noted on any vehicles.

  - The Leaf and Mi-EV tended to have extended vehicle ranges on the battery during the winter months, often to ranges exceeding their EPA estimated ratings. However, both tended to have reduced ranges during summer months. Vehicle occupants in all vehicles typically require use of the air-conditioning system, which provides a greater drain on the battery and thus less
  - Staff members noted that the Mitsubishi mi-EV did not perform as well on the freeway; given similar driving patterns and tests, battery consumption was greater in the Mi-EV than in the Leaf. The lighter vehicle weight also made the mi-EV more difficult to control on the freeway, especially in windy conditions.
  - Of all the vehicles, the 2011 Volt drove the most highway miles and averaged 49 MPG during one extended freeway test period (off battery). In a 920 mile round trip between Las Vegas and Reno, NV for a state conference in 2012, the Volt averaged 55 MPG (off battery). Given a full charge at the beginning of the trip, the vehicle may have been able to travel the entire distance between cities on one tank of gas.
- Given all vehicle trip and performance data, the City estimates annual fuel savings as follows, (assumes average City fuel prices for regular unleaded in 2013 at $3.35 / gallon and 19.84 lbs CO_2e of 1 gallon regular unleaded):
  - 2011 Volt – 3,176 electric miles / 44 MPG = 72 gallons
    - $241.81 fuel savings, 1,428 lbs CO_2e avoided
  - 2012 Volt – 7,409 electric miles / 43 MPG = 172 gallons
    - $577.21 fuel savings, 3,413 lbs CO_2e avoided

Charging Stations

While the City required its own charging station infrastructure for its vehicles, widespread electric vehicle adoption has necessitated the rollout of new infrastructure for charging access in the community as well. As a result, the City chose to make its procured charging station infrastructure publically available rather than base them at gated or non-accessible City facilities. In initial planning meetings, the City identified candidate public facilities to ensure that it would create the foundation of a network of charging stations that would permit residents and recharge their vehicles while they take care of business or visit a City facility.

Due to the installation of more than 2 megawatts of solar covered parking at more than 30 City parks, fire stations, community centers, and a City requirement to construct new buildings and facilities to LEED standards, additional conduit was made available between the meter and parking lot at these facilities to allow for the expansion of solar or to add electric vehicle infrastructure at a later date. Community centers were selected as they had the most public traffic and had the greatest chance for use. Charging station locations include:

- Centennial Hills Community Center (2)
- Veterans-Memorial Community Center (2)
- Mirabelli Community Center (2)
- City Hall (8)
- City of Las Vegas Development Services Center (DSC) (3)

In 2010, a Blink Level II electric vehicle charging station was installed at Stupak Community Center as a pilot project. While the station (not funded under this program) serves as a successful demonstration for the ease of constructability at City facilities where solar is installed, this station requires an RFID card and makes it difficult for members of the public to access.

A wide range of charging station technologies were evaluated and initially put out to bid in a joint request for proposals with the City of North Las Vegas. Factors evaluated included at a range of variable prices and features, including Level I/II//III capabilities, station design, RFID-fee card features, ease of use, installation requirements, durability, and performance in an arid desert requirement. While an initial vendor was selected, a high quoted cost of construction and installation and additional features that increased the unit cost, including national network connections, RFID cards, and pay-per-use features, the City rejected the proposal and decided to utilize City staff to make the installations. City Purchasing personnel identified and recommended SPX AC Level 2 charging stations as a lower cost alternative solution. As a part of LEED requirements for a newly constructed City Hall, an additional four PEP AC Level 2 stations were procured. Installation took place in summer 2012.

- Charging station performance: All charging stations are currently operational and in excellent condition. With the exception of the following, City staff has evaluated all stations and report no additional performance issues.
    - Upon initial deployment, some SPX Charging stations were not able to charge Tesla Model S vehicles. The problem was determined to be a software "handshaking" problem on the pilot data line between the charging station and the vehicle that did not allowing them to sync. City staff determined that an upgrade of the internal software of the SPX station was required.
    - One PEP charging station at City Hall became inoperable after a period of days that exceeded 110 degrees. The station was located in direct afternoon sunlight. City staff determined the

station needed to be rebooted. The station was relocated to another space and is no longer in direct sunlight.
    - One PEP charging station at the DSC repeatedly disconnected from the City's network for unknown causes. City staff had to be reconnect and reboot the system.
- Charging station usage
    - Personal vehicles of the general public and other City employees were noted to frequently use the charging stations at City Hall; they are
    - Despite on-street signage, City project management staff failed to see any personal vehicles of the general public utilizing charging stations at City community centers upon periodic site visits during the fleet testing phase. Community center staff at each site reported seeing periodic use (typically from the same vehicle owners) at all community center locations. Most estimated the use was for approximately one-hour or less – the typical visiting duration at these types of facility.
- Charging station energy consumption
    - Energy consumption was not able to be determined for any charging stations. No charging station was submetered and none have the capability of providing usage or consumption data. In addition, facility energy consumption is so great and blended utility rates are so low that it was not possible to isolate individual charging events or to estimate charging station energy consumption at any facility
    - All operators of the City's vehicles were requested to plug-in upon return to City Hall or the DSC where the vehicles are based. Charging duration for all vehicles typically average 3 to 4 hours, but varies depending on use. Department-only use vehicles are used infrequently (1-2 times per week on average) and noted to typically only need to recharge half of the battery; the Volt Prius utilized for Parking Enforcement nearly always need a full recharge from empty.
        - Electric costs per charge (estimated average of half-full charged to full)
            - City Hall blended rate per kWh = $0.08393
            - Average 1 full charge – 34 kWh ~ $2.85

- City staff was initially concerned about charging station vandalism, theft, or potential copper theft. All stations are in excellent condition and have had no incidents.

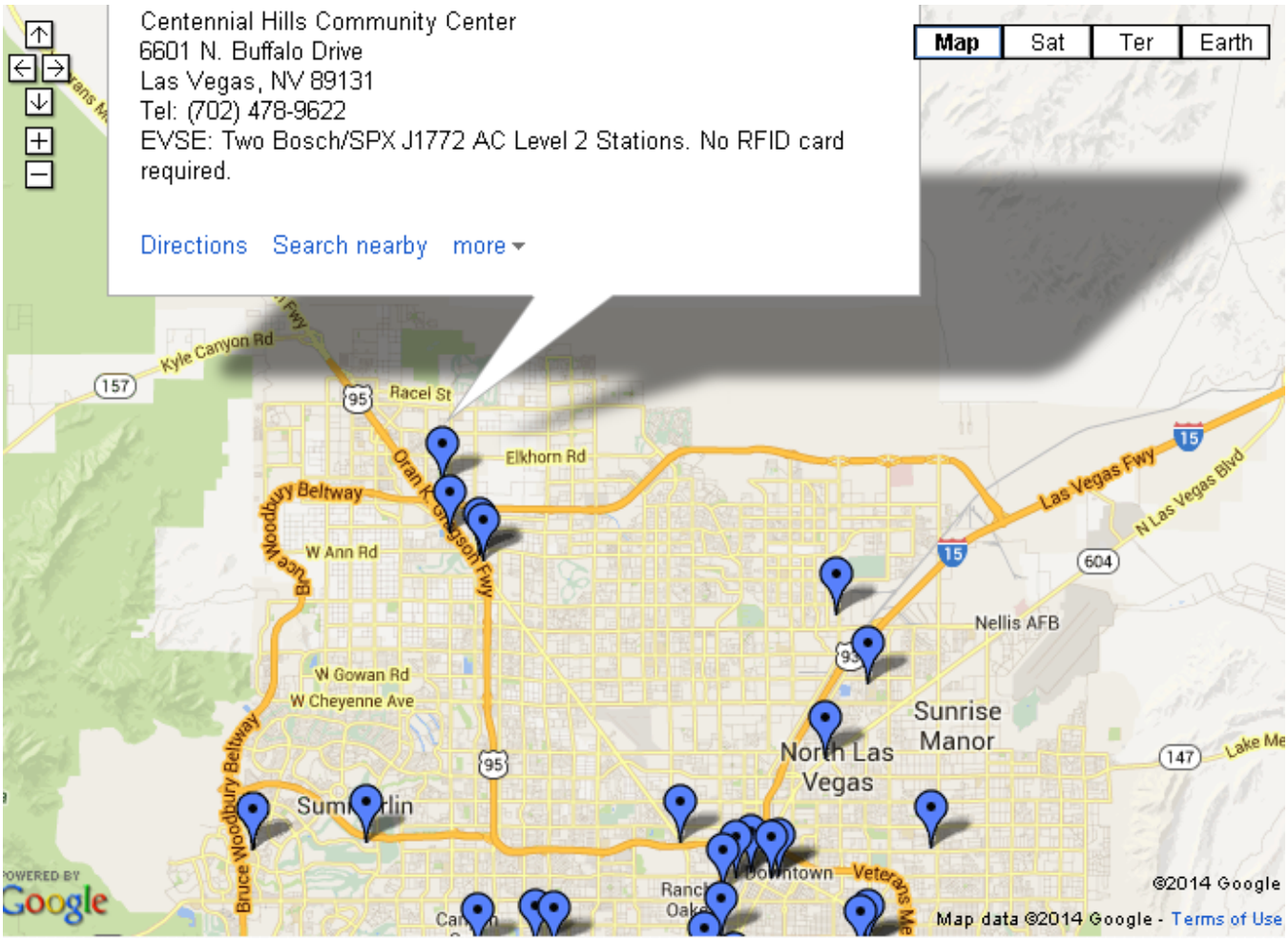
Conclusion

Alongside the tangible benefits of the Plug-in Hybrid Electric Vehicle Demonstration Program has been the spin-off benefits that have helped grow market adoption of electric vehicles and associated infrastructure. The City notes that as a result of being the first public agency in the State of Nevada to purchase electric vehicles, it helped begin a dialogue with other public sector agencies, auto dealers and other private sector entities, non-profits, and state and local governments including Clark County, City of North Las Vegas, City of Henderson, Nevada Department of Transportation and the Regional Transportation Commission of Southern Nevada, to ensure their regional support and success, as well as the adoption of building and zoning codes that ensure infrastructure is permitted. The City also established a parking permit program for alternative fuel vehicles. The City issues permits to qualifying electric or plug-in electric hybrid vehicles allowing them to park for free at parking facilities it operates, including on-street parking meters.

The resort industry in both Southern and Northern Nevada, the University of Nevada and Washoe County, NV took interest in electric and plug-in hybrid electric vehicles and have procured their own vehicles or have installed charging stations at their properties. Many of these entities consulted with City staff to obtain additional background information and resources. Additional adopters also included a member of City Council and staff members that purchased vehicles for personal use. In Downtown Las Vegas, Tony Hsieh, the CEO of national e-retailer Zappos.com announced in 2013 a new venture called Project 100. For a $400 monthly subscription fee, users will be able to borrow one of the project's 100 Tesla Model S electric vehicles.

Among the other additional benefits of the program were that NV Energy, the state's investor owned utility, proactively deployed a time of use electric vehicle retail rate. This rate allows customers to pay a discounted rate if they charge the vehicle during the utility's off-peak hours between 10 p.m. and 6 a.m. for all power used during those periods, including power used to charge vehicles. This action will further help facilitate deployment of vehicles.

The Nevada Electric Vehicle Accelerator, founded in 2011 to support a statewide task force responsible for the development of Nevada's electric vehicle infrastructure, has deployed a website containing electric vehicle resources specific to Nevada. The Accelerator, hosted by NV Energy, the Nevada Department of Transportation, and non-profit REA250. includes a functional public charging station network map (http://nevadaeva.org/evse-locator-map/), codes and standards, public education, and a fleet vehicle network that supports people throughout the state.



The City of Las Vegas is aware that the electric vehicle market is ever changing, which presents certain risks and benefits with respect to fuel and costs of fleet replacement and maintenance. As a result, public agencies have questioned whether waiting, favoring a phased change out approach over a longer period and therefore obtaining new generation of vehicles will be an appropriate long-term course of action. City staff concludes that spending the needed time to thoroughly test vehicles and install infrastructure is the correct approach; this allowed City staff to determine both the costs and benefits of procuring electric vehicles and installing the infrastructure necessary to establish itself and take hold. As the City moves forward with future purchases of vehicles, the City will continue to analyze and evaluate new vehicles to ensure that the city meets the energy conservation goals outlined in the Sustainable Energy Strategy. The City will also monitor and track energy and fuel consumption and consider additional public infrastructure at its facilities as demand warrants.