State Regulation and Compliance

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ORIGINAL

July 29, 2016

Arizona Corporation Commission
DOCKETED
JUL 29 2016
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Docket Control
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

RE: Arizona Public Service Company ev-READY Study Annual Report
Docket No. E-01345A-10-0123

Attached please find the updated APS ev-READY Study Annual Report. Minor updates were made to figures contained within pages 19-21. If you have any questions regarding this information, please contact me at (602)250-3341.

Sincerely,

Kerri A. Carnes

KC/ks
Attachments

cc: Barbara Keene, Compliance and Enforcement

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2016 JUL 29 P 3:30

ARIZONA PUBLIC SERVICE COMPANY

ev-READY Study

Electric Vehicle Readiness Demonstration Study

Docket No. E-01345A-10-0123

ANNUAL REPORT

Updated July 29, 2016

aps

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Executive Summary

On August 8, 2011, Arizona Public Service Company (APS or the Company) filed its Electric Vehicle Readiness Demonstration Study (the ev-READY Study or the Study) with the Arizona Corporation Commission (Commission). As discussed in the Company's application, the ev-READY Study is designed to assist the Company and its customers in preparing for an increasing penetration of electric vehicles and plug-in hybrid electric vehicles (collectively referred to as EVs in this report) in the APS service territory in the next three years. APS developed the Study to provide tools for early adopters of EVs that will allow for the effective management and integration of an EV into both the customer's lifestyle and the APS distribution grid.

In Decision No. 72582 (September 15, 2011), the Commission declined to approve the ev-READY Study as proposed by the Company, citing the uncertainty surrounding market penetration and customer adoption of EVs and the availability of federally-funded EV incentive programs such as the Department of Energy's *The EV Project*.[1] APS was instead directed to closely monitor EV market penetration in collaboration with industry stakeholders and report annually on the status of EV adoption within the APS service territory. This report is the fifth ev-READY Study Annual Report.

In the Company's 2011 ev-READY Study application, Navigant estimated that approximately 1,982 EVs (one third battery electric vehicles – BEVs, and two thirds plug-in hybrid electric vehicles – PHEVs) would be charging in the Company's service territory by the end of 2015. However, EPRI's Polk[2] sales data based on vehicle registrations showed that there were approximately 2,680 EVs (half BEVs, half PHEVs) registered in APS service territory at the end of 2015. In addition to EPRI's Polk sales data, APS customers self-identify as EV owners through the qualification process for the ET-EV rate. At the end of 2015, 1,036 customers residing in the Company's service territory self-identified as EV owners.

2015 was a banner year for electric vehicle sales; however, the deployment of EV charging infrastructure lagged in comparison to industry expectations in Arizona among other states. In response to this, several utilities across the country have developed plans to invest in EV infrastructure.

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[1] *The EV Project* tested deployment and utilization of charging equipment in several major cities, including Phoenix. The Project was launched in October of 2009 with the intermediate goal of installing 14,000 EV charging stations (both residential and public) in 18 major U.S. cities. The lessons learned from the initial deployment of EVs and supporting charging station infrastructure are then expected to enable the Project's ultimate goal of streamlined deployment of the next 5 million EVs.

[2] Polk, a part of IHS Automotive, is an automotive data company that provides sales information for the automotive industry. EPRI has purchased Polk county vehicle sales data and provides the information as a service to their members (of which APS is one).

- Kansas City Power and Light and Georgia power are in their second year of EV charging infrastructure deployment.
- Kentucky Utilities and Louisville Gas and Electric have received approval to install 20 charging stations around the state.
- Avista has requested approval to deploy 265 charging stations in the state of Washington.
- The California Public Utility Commission (CPUC) approved Phase 1 of Southern California Edison's (SCE) Charge Ready program[3] which authorizes SCE to deploy, own and operate the electric infrastructure (excluding the individual charger) to support up to 1,500 charging stations at 150 sites.
- The CPUC approved San Diego Gas and Electric's (SDG&E) Vehicle-Grid Integration (VGI) pilot[4] which authorized SDG&E to deploy, own and operate 3,500 electric vehicle chargers and supporting infrastructure at approximately 350 sites.
- Pacific Gas and Electric (PG&E) filed for approval of the Electric Vehicle Infrastructure and Education Program. As of filing this report, PG&E is still awaiting a decision from the CPUC on the program.

Utility deployments are primarily focused on areas where people spend several hours parked. This additional infrastructure will help reduce range anxiety (the concern that an EV owner will be stranded without access to a charger) and enable more consumers, such as apartment dwellers or individuals with longer than average commutes, to purchase EVs.

Despite the uncertainty surrounding EV market penetration in 2011, the Commission recognized the importance of addressing expected impacts of residential EV charging behavior on the Company's distribution grid by approving the ev-READY Study Experimental Rate Schedule ET-EV. Rate ET-EV is a "whole house"[5] time-of-use (TOU) rate which incorporates a "super off-peak" time period designed to encourage off-peak EV charging, and provides APS with valuable data related to delivery system performance and customer charging behavior. The rate became available to customers in November of 2012.

An analysis on the impacts of Rate ET-EV can be found in Section II of this report. This analysis looks at the difference between Rate ET-EV and the E-12 Standard Rate.

APS is currently redesigning our residential rates with a time-of-use focus with a shorter on-peak period, low off peak kWh charges, and demand charges that only apply to on peak hours. This new combination of features will provide the opportunity and potential bill savings to incent customers to

[3] CPUC Decision 16-01-023
[4] CPUC Decision 16-01-045
[5] A "whole house" rate measures all energy consumption at a residence, including energy necessary to charge an EV, through a single meter. All household usage is therefore subject to pricing signals contained in the rate.

charge electric vehicles during off-peak hours. Therefore, a special EV time-of-use rate will not be needed.

I. Development of the Electric Vehicle Market

The ev-READY study was designed to assist the Company and its customers in preparing for the expected increase in market penetration of EVs in the near term. In the Company's ev-READY Study application, APS noted that uncertainty existed as to the percentage of vehicle sales that would be comprised of EVs over the next decade. However, the Company also noted that the DOE-funded *The EV Project*, which was supporting the development of the EV market by installing EV charging stations in eighteen major cities across the United States, has included the Phoenix and Tucson areas within the project. APS expected that, as a result of *The EV Project*, a higher percentage of APS customers would be among the early adopters of EVs. Despite a slower than expected market penetration rate, expected early adoption of EVs in the APS service territory increases the importance of developing and implementing a plan to seamlessly integrate EVs into the Company's distribution grid over the long term.

The EV Project targeted the deployment of approximately 900 EVs in the Phoenix and Tucson areas by the end of 2012, of which 350 to 500 were expected to be located in the Company's service territory. As of December 2015, EPRI's Polk sales data reported 2,680 EVs registered in APS's service territory.

Despite the recent drop in gasoline prices and lagging charging infrastructure development, the EV market has shown consistent, albeit low, year over year growth nationwide. Uncertainty regarding EV market penetration and customer adoption of EVs is significantly reduced compared to five years ago when EVs were first offered en masse to consumers.

Although EVs have made progress in the last five years, EVs are still in the early adoption stage for consumers. Consumer concerns regarding range anxiety, high up front cost and access to charging infrastructure continue to hinder wide-scale adoption. Future developments are promising though. Battery costs continue to rapidly decline, making EVs more competitive with traditional gasoline powered vehicles. The total cost of ownership for an EV is now often cheaper than comparable conventional vehicles, and owners who have driven EVs for a few months often have their range anxiety subside as they become more comfortable with their vehicles. In addition, new relatively affordable EVs with over 200 miles of EPA rated range are expected to begin selling in the Arizona market as early as the fourth quarter of 2016.

Battery research continues in an attempt to address limited vehicle range and cost. Lithium-ion batteries used in modern electric vehicles have seen consistent declines in price and improved performance since EVs were mass

introduced in 2010. Battery price reductions are in large part the result of increased volume due to large global sales of EVs. In 2015, the cumulative number of EVs sold worldwide passed 1 million vehicles. With the promise to empower further battery price reductions, Tesla began construction of a large battery factory in 2014 outside of Reno, Nevada. The factory is expected to be capable of manufacturing 35 GWh of storage annually - enough to supply approximately 500,000 electric vehicles per year by 2020, with initial production expected to begin in 2017. Tesla recently announced that they have already begun limited battery production at the factory.

Federal tax credits of up to $7,500 are still available toward the purchase of an EV, dependent upon the battery capacity and gross total weight of the vehicle.[6] The federal tax credit is set to expire for each manufacturer when that manufacturer has sold over 200,000 EVs in the U.S. This continuing support, along with other advances in technology, keeps industry analysts' expectations of increased deployment of EVs high.

APS is working with EV infrastructure contractors to monitor the EV market, both in Arizona as a whole and specifically in the Company's service territory.[7] The Company participates in the EVAZ Stakeholder Group, a group of EV infrastructure manufacturers, auto dealerships, government organizations, utilities, and other industry observers based in Arizona. Meetings of the group are held regularly and participants share information on EV-related programs, successes and challenges. The group is also developing policies that are intended to advance the adoption of EVs within the state.

Company personnel also regularly attend EV industry conferences to network with other utilities, infrastructure developers, and auto manufacturers to maintain a high level of awareness of industry trends and to build a network of information specialists. In 2013, the Company completed the deployment of a pilot program working with Ecotality, the program manager and installation partner for *The EV Project*, which integrated electric vehicle charging infrastructure with photovoltaic systems. In 2014, the Company began electrifying its vehicle fleet by implementing policies and procedures to procure EVs wherever possible. The Company currently has 12 Chevrolet Volts, one Ford Fusion Energi, two plug-in hybrid VIA pickup trucks, two plug-in hybrid Odyne bucket trucks, and 74 electric powered take-off (ePTO) equipped trucks. The VIA and Odyne trucks are part of a Department of Energy and EPRI research program; the ePTO trucks utilize an additional battery to power the vehicles' on-board electronics when stopped, rather than idling the engine.

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[6] Internal Revenue Code (IRC) 30 (Plug-in Electric Vehicles) and IRC 30D (Qualified Plug-in Electric Drive Motor Vehicles).

[7] "IT IS FURTHER ORDERED that Arizona Public Service Company shall work cooperatively with the federally-funded EV infrastructure contractors for the first year of the proposed Study." *Decision No 72582, page 15 lines 5-6.*

The Company, along with over 70 other Investor Owned Utilities, has committed to devote at least 5% of its annual fleet acquisition budget to EV technologies.[8] Over time, The Company plans to have its entire fleet of approximately 2,100 vehicles replaced with all-electric or plug-in hybrid electric models as the technology becomes available and the current vehicles reach retirement.[9] To support these vehicles, APS currently has 19 fleet EV charging stations and two employee EV charging stations with near-term plans for expansion.

A. Availability of Electric Vehicles

The first widely available EVs were deployed in the United States in the later part of 2010 and into 2011. Adoption of these vehicles by consumers during this period was lower than expected amid delays in vehicle availability, the largest of which was the impact of the Tohoku earthquake and tsunami in Japan in March of 2011 on the ability of Japanese car manufacturers to ship product to the United States. Other delays in EV availability included technical difficulties such as software glitches and vehicle component breakdowns, including battery failures.

In 2012, the EV market saw an uptick in the market as Nissan, GM, and Tesla all increased production and sales volume. Overall there were 52,800 plug-in vehicles sold in the U.S. in 2012, more than 5 times the cumulative total at the start of the year.

EV market penetration increased again in 2013 with 96,702 plug-in vehicles sold in the U.S., an increase of 83% over the previous year.

In 2014 the EV market experienced another year of strong sales with approximately 117,000 plug-in vehicles sold in the US, an increase of 22% since 2013.

The EV market had a year of relatively stagnant sales in 2015 with approximately 114,000 plug-in vehicles sold in the US, a modest 2.6% decrease compared to 2014. This is likely in large part attributed to the lack of new vehicle releases, although low gasoline prices may have had an effect.

Figure 1 illustrates the cumulative plug-in vehicle sales in the United States.

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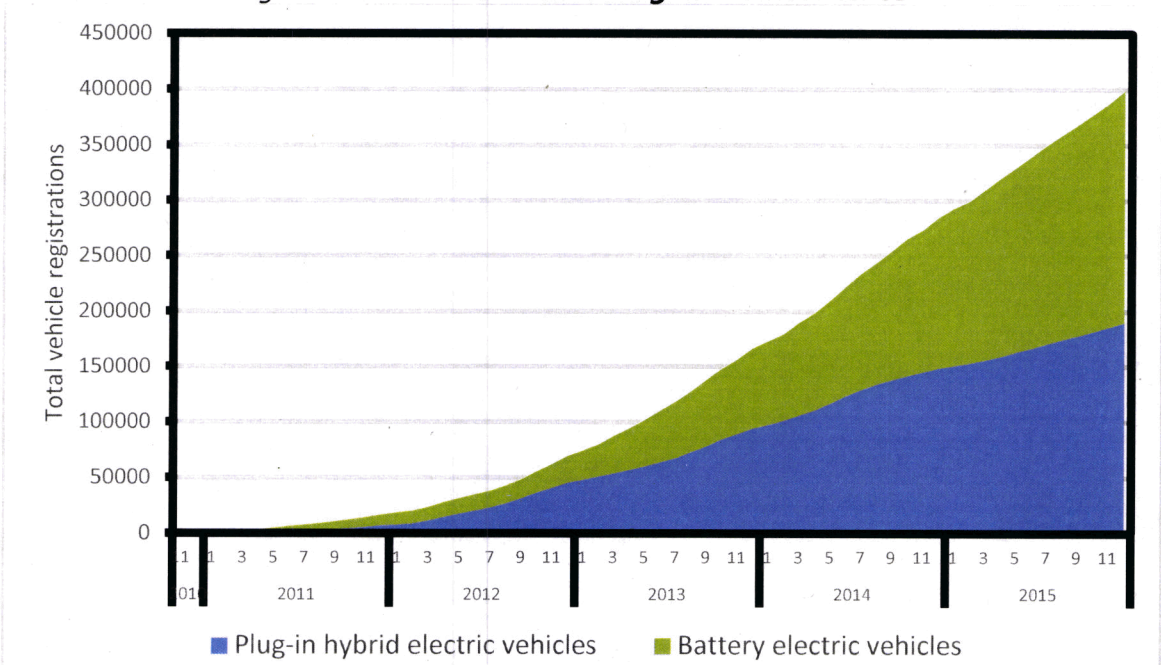
[8] http://www.eei.org/resourcesandmedia/newsroom/Pages/Press%20Releases/EEI%20Announces%20Industry%20Commitment%20to%20Fleet%20Electrification%20at%20White%20House%20Roundtable.aspx

[9] http://www.bizjournals.com/phoenix/blog/energy-inc/2016/04/aps-going-all-electric-with-2-100-vehicle-fleet.html

Figure 1. ***Cumulative U.S. Plug-In Vehicle Sales***[10]



Today there are about 17 new EV models available in the Arizona Market and a total of 25 EV models in select markets. In addition, nearly every major automaker has announced plans to release EV models in the near future (see Table 1).

Most notable of these future EVs are the Chevrolet Bolt and Tesla Model 3. Both vehicles promise more than 200 mile of range for around $35,000. Chevrolet's Bolt is expected to begin selling in Arizona late 2016. Tesla's Model 3 is expected in Arizona in early 2018. Both of these vehicles will be the most inexpensive EVs to offer over 200 miles of electric range ever. On March 31st, 2016 Tesla began accepting $1,000 refundable preorders for its Model 3. In the first 24 hours Tesla received over 180,000 preorders.[11] In the first full week the number of preorders reached 325,000.

Table 1. ***Vehicle Availability at a Glance***[12]

Model Name	Plug-in Type	Body Style	Range (miles)[13]	Availability[14]
Available Now				
Audi A3 Sportback e-tron	Plug-in hybrid	Hatchback	16/380	Nationwide
BMW i3	Battery electric vehicle	Hatchback	81	Nationwide

[10] Source: EPRI Polk Sales Data
[11] http://www.wsj.com/articles/teslas-musk-model-3-orders-surpassed-115-000-within-24-hours-1459483890
[12] Source: EPRI "A Consumer's Guide to Plug-in Electric Vehicles January 2016"
[13] Range for battery electric vehicles is all-electric range. Range for plug-in hybrids is all-electric/combined (electric + gas) range. On vehicles available now, source is www.fueleconomy.gov. On future cars, information source is manufacturer or industry media. Subject to change.
[14] Cars that are currently available are listed alphabetically by manufacturer. Future cars are listed chronologically by their expected market arrival date, then alphabetically by manufacturer.

Model Name	Plug-in Type	Body Style	Range (miles)[13]	Availability[14]
BMW i3 REx	Plug-in hybrid	Hatchback	72/150	Nationwide
BMW i8	Plug-in hybrid	Sport coupe	15/330	Nationwide
BMW X5 xDrive40e	Plug-in hybrid	SUV	14/540	Nationwide
Cadillac ELR	Plug-in hybrid	Luxury sedan	40/340	Nationwide
Chevrolet Volt	Plug-in hybrid	Compact	53/420	Nationwide
Ford C-MAX Energi	Plug-in hybrid	Hatchback	20/550	Nationwide
Ford Focus Electric	Battery electric vehicle	Hatchback	76	Nationwide
Ford Fusion Energi	Plug-in hybrid	Sedan	20/550	Nationwide
Mitsubishi i-MiEV	Battery electric vehicle	Subcompact	62	Nationwide
Nissan LEAF	Battery electric vehicle	Hatchback	107	Nationwide
Porsche Cayenne S E-Hybrid	Plug-in hybrid	Crossover	14/480	Nationwide
Porsche Panamera S E-Hybrid	Plug-in hybrid	Luxury sedan	16/560	Nationwide
Tesla Model S	Battery electric vehicle	Luxury sedan	234-270	Nationwide
Tesla Model X	Battery electric vehicle	Crossover	250-257	Nationwide
Volvo XC90 T8 Twin Engine	Plug-in hybrid	SUV	14/350	Nationwide
Chevrolet Spark	Battery electric vehicle	Compact hatchback	82	Select Markets
Fiat 500e	Battery electric vehicle	Subcompact	87	Select Markets
Hyundai Sonata	Plug-in hybrid	Sedan	27/600	Select Markets
Kia Soul EV	Battery electric vehicle	Compact SUV	93	Select Markets
Mercedes-Benz B250e	Battery electric vehicle	Hatchback	87	Select Markets
Mercedes-Benz S550e	Plug-in hybrid	Luxury sedan	14/450	Select Markets
smart fortwo electric drive	Battery electric vehicle	Subcompact	68	Select Markets
Volkswagen e-Golf	Battery electric vehicle	Hatchback	83	Select Markets
Coming Soon				
Mercedes-Benz GLE550e	Plug-in hybrid	SUV	TBA	Early 2016
BMW 330e	Plug-in hybrid	Luxury sedan	22/370	Spring 2016
BMW 740e xDrive	Plug-in hybrid	Luxury sedan	23/TBA	Summer 2016
Audi Q7 e-tron	Plug-in hybrid	SUV	25/TBA	Late 2016
Cadillac CT6	Plug-in hybrid	Luxury sedan	30/TBA	Late 2016
Chevrolet Bolt	Battery electric vehicle	Hatchback	200	Late 2016
Chrysler Pacifica Hybrid	Plug-in hybrid	Minivan	30/TBA	Late 2016
Ford Focus Electric (Gen. 1+)	Battery electric vehicle	Hatchback	100	Late 2016
Kia Optima	Plug-in hybrid	Midsize sedan	TBA	Late 2016
Mitsubishi Outlander	Plug-in hybrid	Crossover	TBA	Late 2016
Toyota Prius Prime (Gen. 2)	Plug-in hybrid	Hatchback	22	Late 2016
Volvo V60	Plug-in hybrid	Wagon	TBA	Late 2016
Volvo S90 T8 Twin Engine	Plug-in hybrid	Luxury sedan	TBA	Late 2016
Coming Later and Concept Cars[15]				
BMW X3 edrive	Plug-in hybrid	Crossover	20/TBA	2017
BMW i3 (Gen. 1+)	Battery electric vehicle	Hatchback	120	2017
Hyundai Ioniq	Battery electric vehicle and Plug-in hybrid	Sedan	110 and 32/TBA	2017
Kia Soul EV (Gen. 1+)	Battery electric vehicle	Compact SUV	TBA	2017
Tesla Model 3	Battery electric vehicle	Sedan	215	2017
VW e-Golf (Gen. 1+)	Battery electric vehicle	Hatchback	108	2017
VW Cross Coupe	Plug-in hybrid	SUV	20/TBA	2017
VW Tiguan	Plug-in Hybrid	Crossover	TBA	2017
Audi e-tron Quattro	Battery electric vehicle	SUV	300	2018
BMW i5	Plug-in hybrid	Luxury sedan	TBA	2018
Nissan LEAF (Gen. 2)	Battery electric vehicle	Hatchback	200–300	2018–2020
Porsche Pajun	Battery electric vehicle	Luxury sedan	220	2018
Subaru Crosstrek XV	Plug-in hybrid	Crossover	TBA	2018
Jaguar F-Pace	Battery electric vehicle	Crossover	300	2019
VW Budd-e	Battery electric vehicle	Van	233	2019
Porsche Mission E	Battery electric vehicle	Sports car	TBA	TBA
VW Phaeton	Battery electric vehicle	Luxury sedan	TBA	TBA

[15] Information source on availability of future cars is manufacturer or industry media. Subject to change.

1. Market Participants

In 2015, the top three EV models in terms of sales nationwide shifted to the Tesla Model S, Nissan Leaf, and the Ford Energi. In previous years the Chevrolet Volt was among the top three. Additionally, customers were able to purchase several other EVs, each with differing attributes and price points.

The Tesla Model S is an all-electric vehicle using lithium-ion batteries, with ranges of 240 and 294 miles depending on the size of the battery. The cost of the Model S starts at $71,500 for the 240 mile range version. Tesla sold approximately 25,000 Model S vehicles in 2015, a 78% increase compared to 2014.

The Nissan LEAF (Leading Environmentally-friendly Affordable Family car) is an all-electric vehicle with an EPA range of 84 to 107 miles depending on battery size. Deliveries to United States consumers began in December of 2010. In 2015, Nissan sold approximately 18,000 cars in the United States, a 40% decrease over 2014. The new 2016 model starts at $29,010 for the 84 mile range version. The 107 mile range LEAF was just introduced for 2016 and starts at $34,200.

The Ford Fusion Energi is a plug-in hybrid electric vehicle with an EPA estimated electric range of 21 miles. Once the electric range is depleted, the Fusion Energi switches to gasoline. The Ford Fusion Energi sold about 17,000 in 2015.

The Chevrolet Volt is a plug-in hybrid electric vehicle with 38 miles of electric range. The next generation Volt, which is set to begin selling in Arizona by mid-2016, will have a 53 mile electric range. The Volt became widely available in the United States by June of 2010. In 2015 Chevy sold approximately 15,500 Volts, about 20% less than in 2014. The decrease is likely in large part due to anticipation of the 2016 model. The 2016 Volt starts at $33,220 with the aforementioned 53 mile electric range.

Figure 2. ***Tesla Model S***

Figure 3. ***Nissan LEAF***

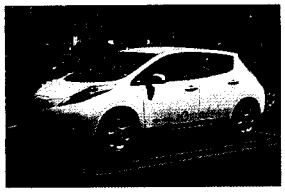


Figure 4. ***Ford Fusion Energi***

Figure 5. ***Chevrolet Volt***

By the end of 2015, several other EV models were available for purchase as listed in Table 1. As illustrated in the table, at least seven EV models are only available in select markets which contain more charging infrastructure and government incentives. In many cases, consumers have reported difficulty in finding EV models at Arizona dealerships due to automakers

apparent prioritization of EV stock deliveries to the select markets that offer more incentives and infrastructure support. EV models and production numbers planned for the coming years have grown significantly, especially with the 200 mile range Bolt and Model 3, creating higher expectations of EV market penetration in the upcoming years.

2. Electric Vehicles in the APS Service Territory

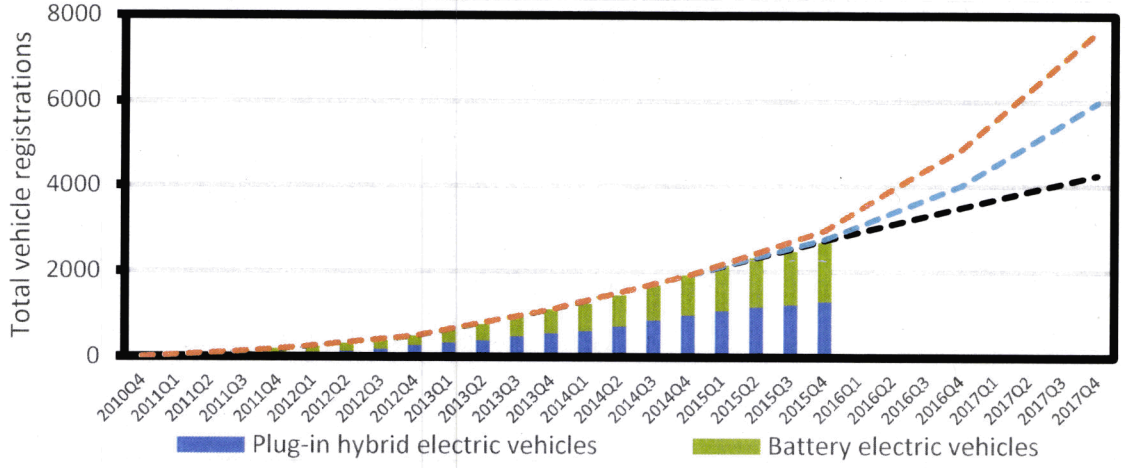
As of December 31st, 2015, APS identified 1,036 EVs by service address that are regularly being charged throughout the Company's service territory. APS customers self-identify as EV purchasers. The Company learns of the individual EV purchaser through customer phone calls to learn about services or other rate options available to EV owners.

For the third year, EPRI provided Polk sales data to their Electric Transportation Program sponsors. Polk sales data is motor vehicle registration data that shows vehicle model registrations in each county. The county registrations are used to estimate how many vehicles in Arizona are in the Company's service territory. This information strongly suggests that there is in fact over 2,600 EVs in APS' service territory. This represents a difference of approximately 1,600 vehicles for which the Company has no data on charging equipment or service address.

Figure 6 shows the cumulative number of new electric vehicles registered per quarter in APS service territory. In addition, the graph shows forecasted EV vehicle adoption in APS service territory (low, medium, and high forecasts).

Figure 7 illustrates the market share per EV model in APS service territory. The accompanying table, Table 2, illustrates the total number of each model in APS service territory through December 2015.

Figure 6. ***Electric Vehicles in APS's Service Territory Through December 2015***[16]



[16] Source: EPRI Polk Sales Data

Figure 7. ***Electric Vehicle Shares by Month APS's Service Territory Through December 2015***[17]

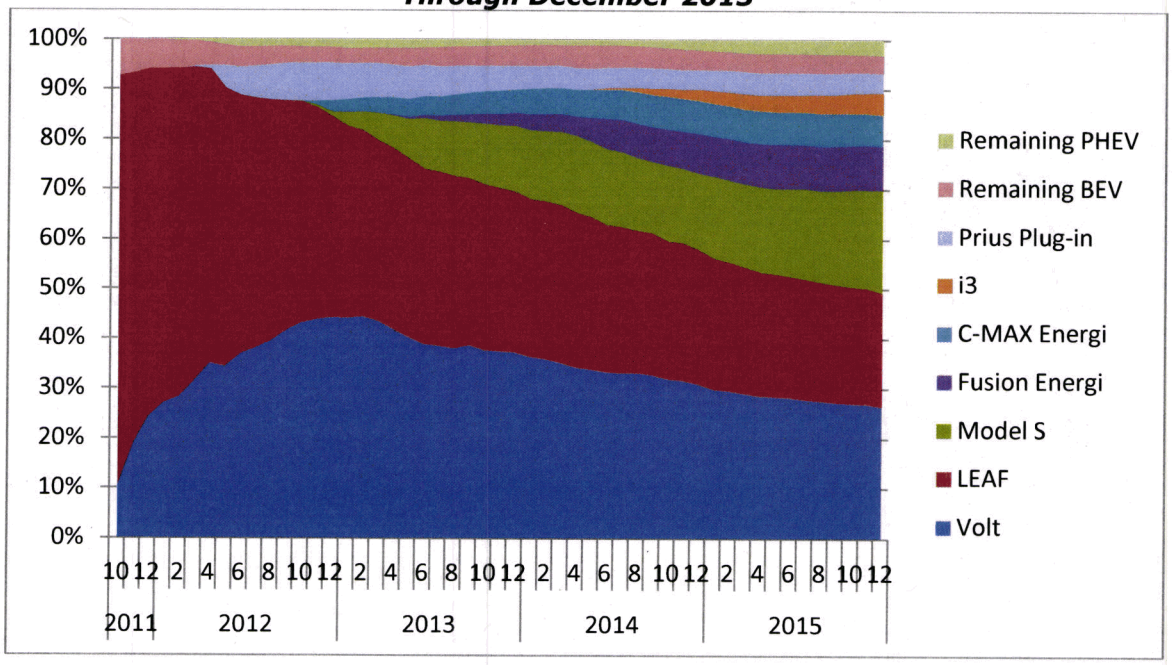


Table 2. ***Electric Vehicles in APS Service Territory Through December 2015***[18]

Model	Number of Vehicles
Volt	714
LEAF	614
Model S	554
Fusion Energi	236
C-MAX Energi	170
i3	115
Prius Plug-in	107
Remaining BEV	97
Remaining PHEV	81
Total	**2,688**

As discussed in the Company's ev-READY Study, APS utilizes information on EV purchases to determine the ability of existing transformers to absorb the additional electric load of EVs being charged within a specific neighborhood. As part of the ev-READY Study, the Company has developed processes and

[17] Source: EPRI Polk Sales Data
[18] Source: EPRI Polk Sales Data

procedures to ensure safe and reliable integration of EVs into the local distribution grid, including the mapping of known EVs.

APS conducted educational outreach efforts in 2014 to re-educate automobile dealers and EV owners on the importance of utility notification and the ET-EV rate with the goal of timelier reporting of EVs in the Company's service territory. However, due to the large discrepancy between the number of self-identifying APS EV customers (Figure 5), and the number of APS owners according to Polk data (Figure 6), APS may need to implement a more robust outreach program for reporting EVs. The addition of 1,600 EVs to our database may indicate significantly more clustering then currently known. Figures 8 and 9 show known transformers where customers have self-identified as charging their EVs.

Figure 8. ***Known Transformers Serving EVs in the APS Service Territory***

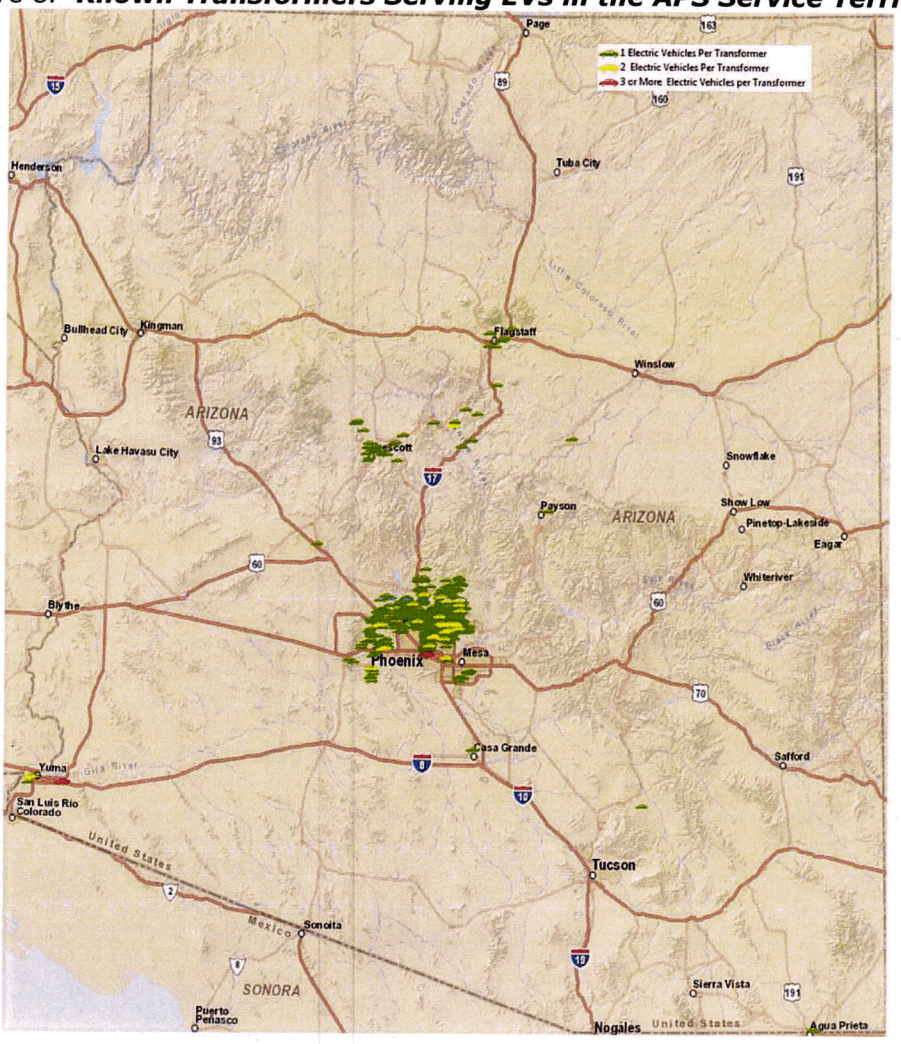
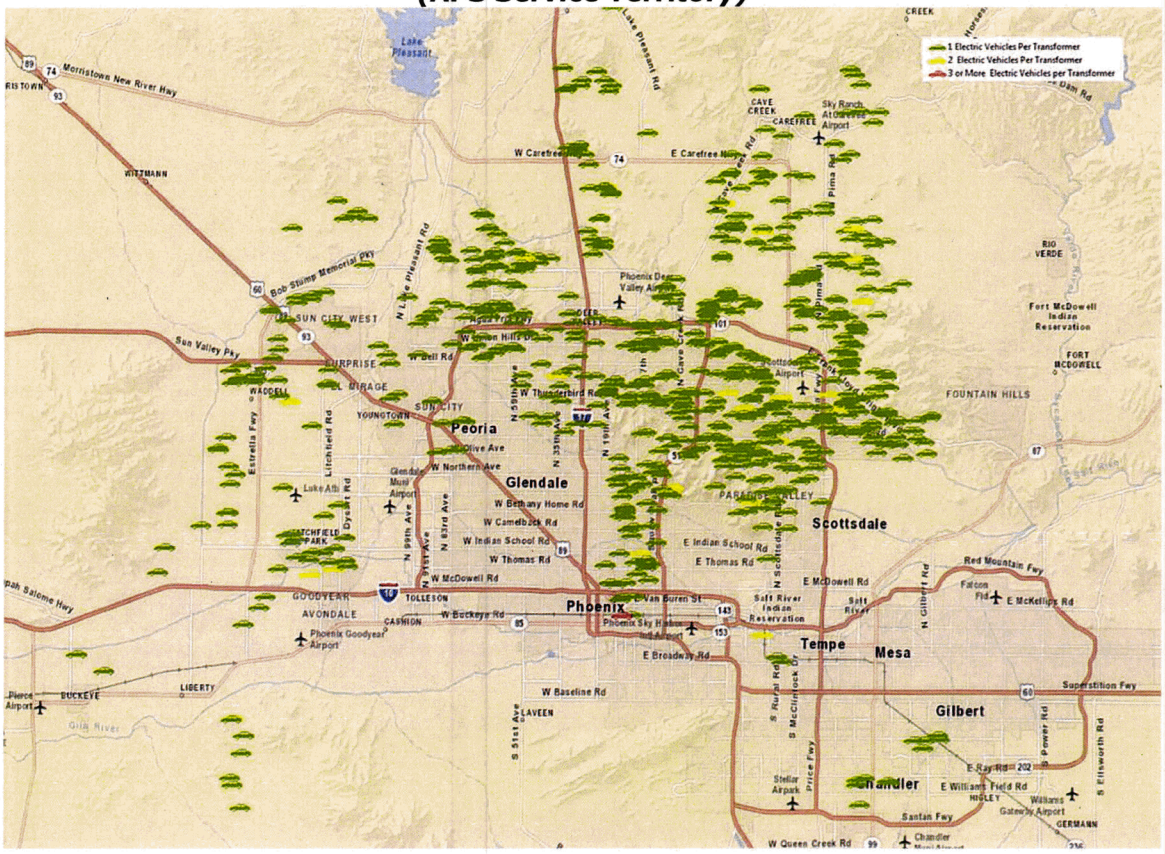


Figure 9. ***Distribution of Known Transformers Serving EVs in Metro Phoenix (APS Service Territory)***



As explained in the Company's ev-READY Study, it is unlikely that a single vehicle charging during peak demand hours will create reliability issues on the distribution grid.[19] However, in a situation in which several EVs are clustered within a neighborhood, the probability of reliability issues increases.

Clustering refers to the adoption of EVs by additional homeowners in areas where one or more than one household has already adopted an EV, resulting in the potential for overload and failure of transformers. This phenomenon is also referred to as geographic clustering, which can occur long before EV market penetration matures.

To date, APS is aware of limited clustering of EVs. The Company has identified 30 neighborhood transformers that are carrying electric load for more than one EV – 23 of these in cases where a single household has purchased more than one EV. One transformer on the Company's distribution system hosts 11 electric vehicles at a commercial site that has the ability to handle the increased load. Of the seven instances where the transformer is carrying the load of two different electric vehicle owners, four

[19] The timing of EV charging is a key determining factor of possible grid impacts in neighborhoods. For residential customers, it is likely that an EV will begin charging as soon as it reaches home absent an incentive to charge at a later time.

are at an apartment complex. The other three are traditional clustering situations where multiple neighbors have purchased an electric vehicle.

As the EV market matures and more vehicle models are released, the Company expects to encounter greater concerns with geographical clustering. As mentioned previously, the inclusion of the 1,600 EVs identified by the Polk sales data may indicate significantly more geographic clustering on the Company's distribution grid. The Company is considering additional methods to identify electric vehicles by service address in the future.

B. Availability of Public EV Charging Stations

While the electric vehicle market is ramping up in Arizona, there has been a slower than expected deployment of public charging infrastructure. In 2013, the EV charging infrastructure market went through a decline as high profile charger manufacturers Ecotality and Better Place filed for bankruptcy. In contrast, Tesla, NRG EVgo and ChargePoint expanded their market throughout the country.

In 2009, Ecotality was awarded $99.9 million from the American Recovery and Reinvestment Act of 2009 for *The EV Project.* Through *The EV Project*, approximately 920 publicly available charging stations were estimated to be installed in the state as of the end of 2012; however, as of the end of 2014 only 556 public chargers had been deployed. These stations have been installed in the metropolitan areas of Phoenix and Tucson, Arizona and on the Interstate 10 corridor between the two cities.

This network of charging stations, known as the Blink Network, is the largest deployment of EV infrastructure in the state. In the Metro Phoenix area, Blink public charging stations have been installed largely at government or business properties. For example, several Blink Network stations are available in downtown Phoenix at the Burton Barr Library, the Phoenix City Hall garage, the downtown campus of Rio Salado College, the Two Renaissance office building, and the Arizona Department of Environmental Quality office.[20]

In 2012, Ecotality started charging fees for use of the charging stations as *The EV Project* funding was coming to a close. With the number of EVs using the Ecotality stations declining, a poor deployment record, and high levels of debt, Ecotality filed for bankruptcy in September of 2013. Their assets and *The EV Project* responsibilities were purchased by Car Charging Group in October 2013 for $3.3 million. Since acquiring Blink, Car Charging Group has

[20] A map of existing Blink Network public charging stations throughout the United States can be found at www.blinknetwork.com/locator.html. The map is notable because the number of stations at each installation site is provided, along with real-time usage information to allow consumers to both find a station and know in advance if that station is available for immediate use.

increased the number of public charging stations in Arizona to 584 as of April 2016.

Table 3. ***Public Chargers on Blink Network in Arizona as of 4/15/2016***[21]

	Public Level 2	Public DC	Total
Metro Phoenix	456	30	486
Tucson	92	0	92
Rural AZ	6	0	6
Total Arizona Deployment	554	30	584

Additional public EV infrastructure has been installed in the state by Coulomb Technologies, now known as ChargePoint. ChargePoint was the sponsor of the national EV infrastructure program *ChargePoint America*, which provided host families and businesses with charging stations at no cost and was funded through the American Recovery and Reinvestment Act (ARRA) through 2011. The charging stations installed in Arizona by ChargePoint have not been part of either *ChargePoint America* or *The EV Project*. ChargePoint brand charging stations operate on a proprietary network; currently access to stations requires a ChargePoint account and a ChargePoint RFID card or smart phone app.

Table 4. ***Public Chargers on ChargePoint Network in Arizona as of 4/15/2014***[22]

	Public Level 2	Public DC	Total
Metro Phoenix	97	0	97
Tucson	7	0	7
Rural AZ	4	0	4
Total Arizona Deployment	108	0	108

In 2014, Tesla began deploying a network of Superchargers throughout the country. The Superchargers are DC fast chargers that are available for free to Tesla brand EVs with a Supercharger port. The Superchargers can provide Tesla vehicles with approximately 170 miles of range in as little as 30 minutes. Currently, no other brand of EV is compatible with the Tesla chargers. Tesla has completed installations throughout the country to facilitate cross-country travel. As of April 15th, 2015 Tesla has installed Superchargers at 10 locations in Arizona along the I-40, I-17, I-10, and I-8 corridors. These chargers are only accessible to Tesla brand EVs and are unavailable for other EV models. Tesla has installed a total of 3,628

[21] Blink Network Charging Station data gathered from Blink website at https://www.blinknetwork.com
[22] ChargePoint Network Charging Station data gathered from ChargePoint website at https://www.chargepoint.com

Supercharger stations at 613 locations across North America, Europe, Asia and Australia as of April 15th, 2016.[23]

Figure 10. ***Tesla Superchargers in Arizona***

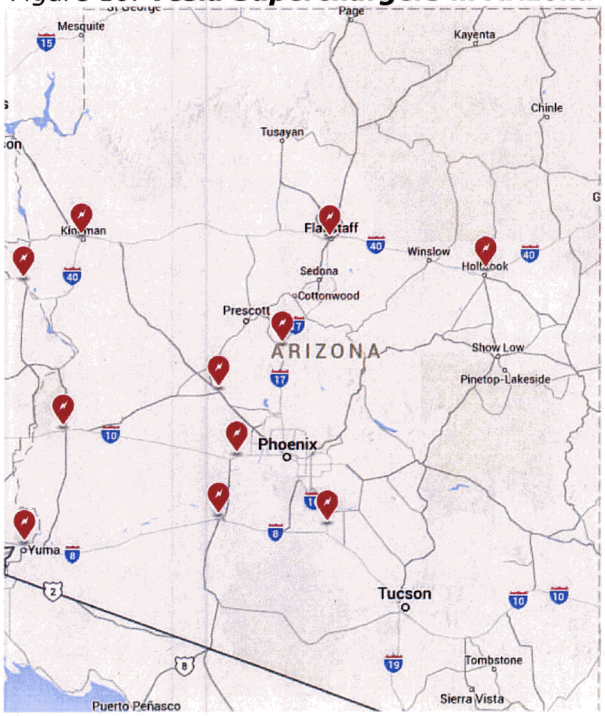
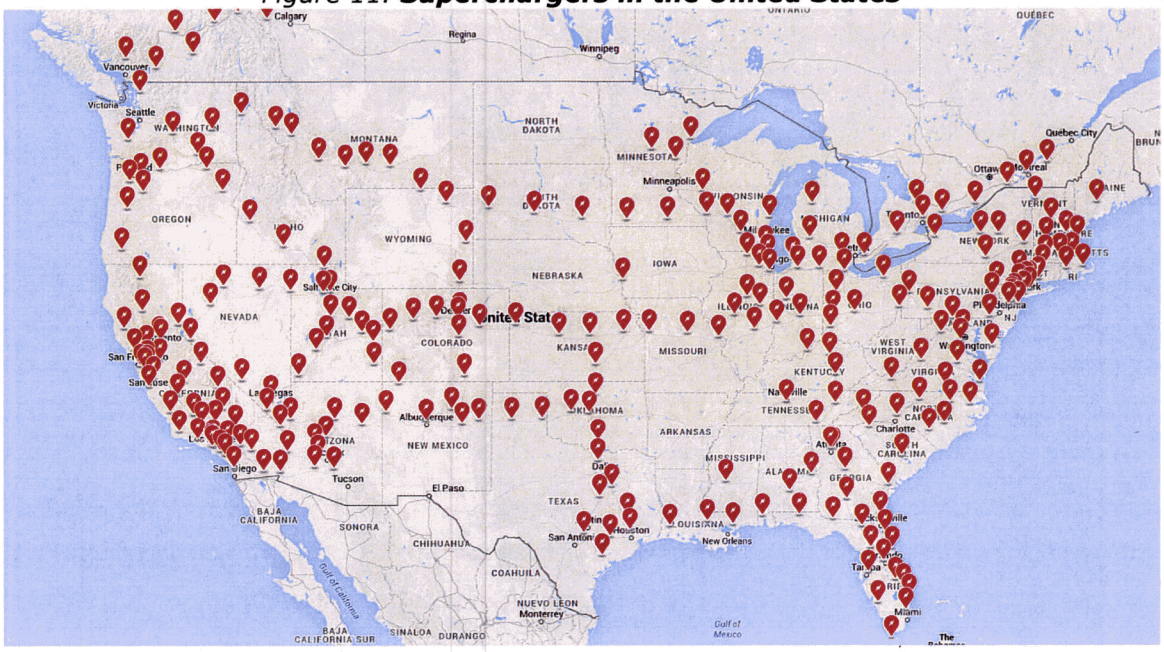


Figure 11. ***Superchargers in the United States***



[23] Tesla Supercharger information gathered from Tesla's website at https://www.teslamotors.com/supercharger

Figure 12. ***Planned Total Superchargers in the United States Through 2016***

The Department of Energy's (DOE) Alternative Fuels Data Center maintains a map and list of EV charging stations throughout the United States. According to the list, there are 334 public EV charging locations in the state and 846 charging outlets.

Table 5. ***Public Chargers in Arizona as of 4/15/2014***[24]

	Public Level 1	Public Level 2	Public DC	Total
Total Arizona	9	717	120	846

The charging stations in Arizona listed by the DOE Alternative Fuels Data Center are from a variety of network providers and charging station manufacturers. Some of the companies included are: NRG EVgo, Greenlots, SemaConnect, EV Connect, GoE3 and Volta Charging. It is not mandatory for charging station providers or hosts to lists their charging stations on DOE's Alternative Fuels Data Center, therefore the accuracy of this data cannot be guaranteed.

[24] Data based on DOE Alternative Fuels Data Center on April 15th, 2016.
http://www.afdc.energy.gov/fuels/electricity_locations.html

Figure 13. ***Arizona EV Charging Stations as mapped by the Department of Energy***[25]

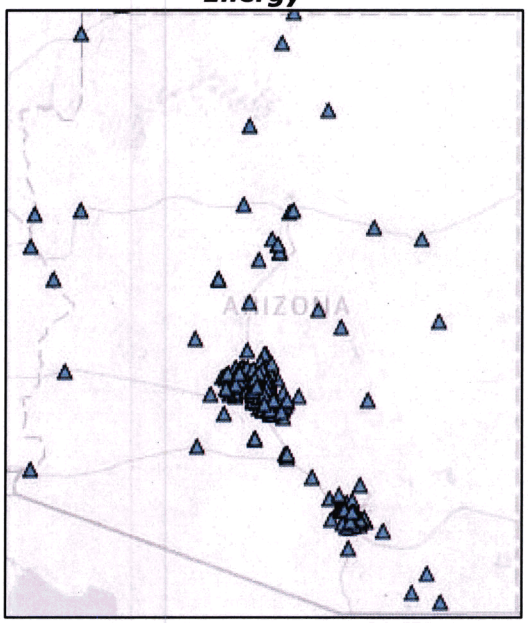
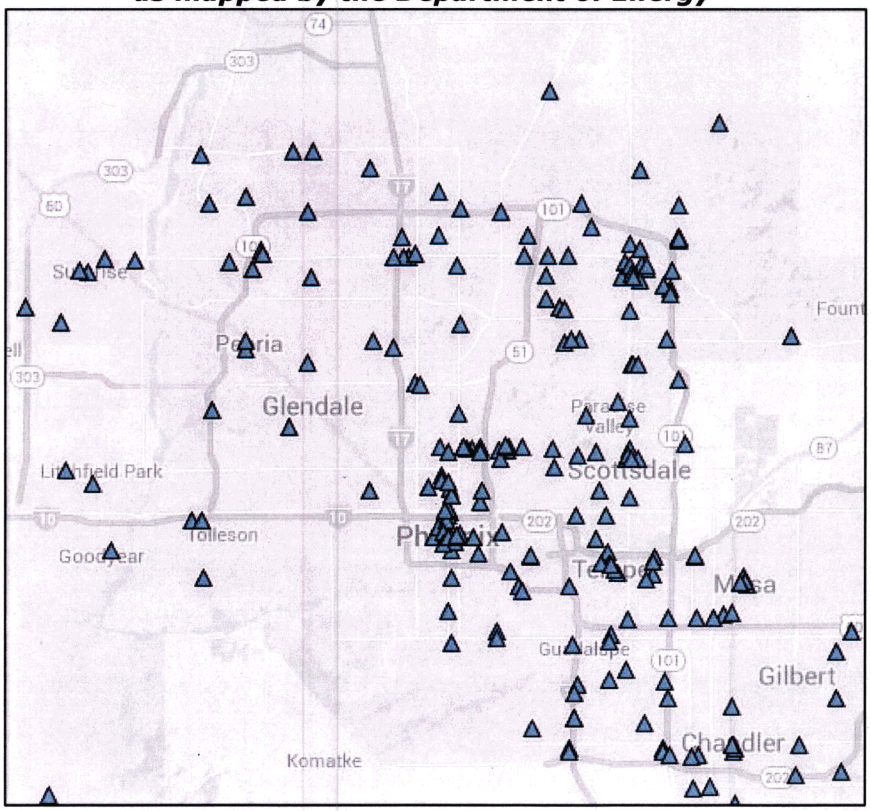


Figure 14. ***Metro Phoenix Area EV Charging Stations as mapped by the Department of Energy***[26]



[25] For this and similar maps, please see www.afdc.energy.gov/afdc/locator/stations.
[26] For this and similar maps, please see www.afdc.energy.gov/afdc/locator/stations.

The Company's original ev-READY Study included a proposal to deploy APS-owned public EV charging stations throughout the APS service territory. This portion of the Study was designed to complement The EV Project by placing charging stations in locations where the project did not have plans to install EV infrastructure (to fill in gaps within cities and more evenly distribute availability of charging stations, and to place in APS service territory outside of the metropolitan Phoenix area). The proposed public charging station acquisition and deployment timeline was based on a forecast of EV sales in the Company's service territory. The Commission declined to approve this portion of the ev-READY Study, citing the uncertainty surrounding market penetration and customer adoption of EVs.

APS continues to believe utility-owned public charging stations may be appropriate in the future to complement infrastructure deployment by federally funded projects and privately-owned chargers. The conclusion of *The EV Project* in 2012, lower than expected public charging station deployment through 2015, and commitments by auto manufacturers to continually offer lower cost and longer range EVs may illustrate a need for the Company to have an expanded role in EV infrastructure support and development for Arizona to realize the potential benefits of widespread EV adoption.

However, at this time the Company does not have plans to install Company-owned public charging stations nor request approval of a point-of-sale pricing methodology for energy usage at these stations.[27] The Company will continue to monitor deployment of electric vehicle chargers and the number of EV sales in the APS service territory. In addition, the Company will evaluate potential programs in which the Company could play an increased role in EV infrastructure support and development and may request a charging station deployment program in the future.

C. Customer Education and Outreach

APS has developed several methods of communication in order to reach out and inform customers regarding the availability of EVs and their contribution to a cleaner environment, the various types of charging stations and under what circumstances a residential customer may wish to install a station at home, and the impacts EV ownership may have on individual electricity usage and neighborhood distribution systems.

APS maintains a robust website (www.aps.com/ev) which provides information about EVs, EV charging, and other basic information regarding EV ownership, including customer rate options appropriate for the EV owner.

[27] "Should APS identify a gap in charging infrastructure deployment, or other deficiency in the federally-funded EV infrastructure efforts, APS may request approval of a public point-of-sale rate in APS' first annual report of Study findings to the Commission." *Decision No. 72582, page 15, lines 7-9.*

This website was redesigned in 2013 for greater customer ease of use. A dedicated e-mail account, electricvehicles@aps.com, is available for EV owners to ask specific questions regarding their EV and their APS account. The Company has also partnered with leading automobile makers, other utilities, and battery and charging station manufacturers to establish a website to educate consumers, policymakers, and key industry sectors on the benefits of EVs. This website (www.GoElectricDrive.com) contains comprehensive information about owning and operating an EV, including available federal and state incentives and other EV benefits.

Additionally, APS has developed a brochure to help explain Rate ET-EV. This brochure is available at public events, electric vehicle dealerships, and upon demand. A copy of the brochure is provided in Appendix A.

APS personnel also attend public events with Company-owned EVs to broaden public awareness of available vehicles, answer questions, and demonstrate the benefits of EVs.

APS personnel have also met with automobile dealers to discuss electric vehicles, discuss Rate ET-EV, and deliver ET-EV brochures. In 2016, APS will renew efforts to educate automobile dealers on the benefits of electric vehicles (including Rate ET-EV), as well as the importance of customers notifying utilities of their EV purchase.

II. Rate ET-EV Analysis

The ev-READY study is designed to assist the Company and its customers in preparing for the expected increase in market penetration of EVs. Deployed as part of the ev-READY study, Rate Schedule ET-EV is designed to encourage drivers through financial incentives to move electric vehicle charging to super-off peak demand periods.

Rate ET-EV has an on-peak time period (Noon to 7PM), a super-off peak time period (11PM to 5AM), and off-peak time period (all other times). The rate is a whole house time-of-use rate that applies to all electricity used in the home. Currently, there are 258 APS customers on Rate ET-EV.

Table 5. Rate ET-EV Time Periods

TIME-OF-USE	MON. - FRI.[1]	WEEKENDS[2]
5 a.m. to Noon	Off-peak	Off-peak
Noon to 7 p.m.	On-peak	
7 p.m. to 11 p.m.	Off-peak	
11 p.m. to 5 a.m.	Super Off-peak	

[1] Excludes qualifying holidays [2] Includes qualifying holidays

A comparison between customer usage patterns for the standard rate and Rate ET-EV TOU is shown in Figure 11 below. This graph compares the average of all customers on the standard Rate E-12 and the average of all customers on Rate ET-EV from January 1, 2015 to December 31, 2015.

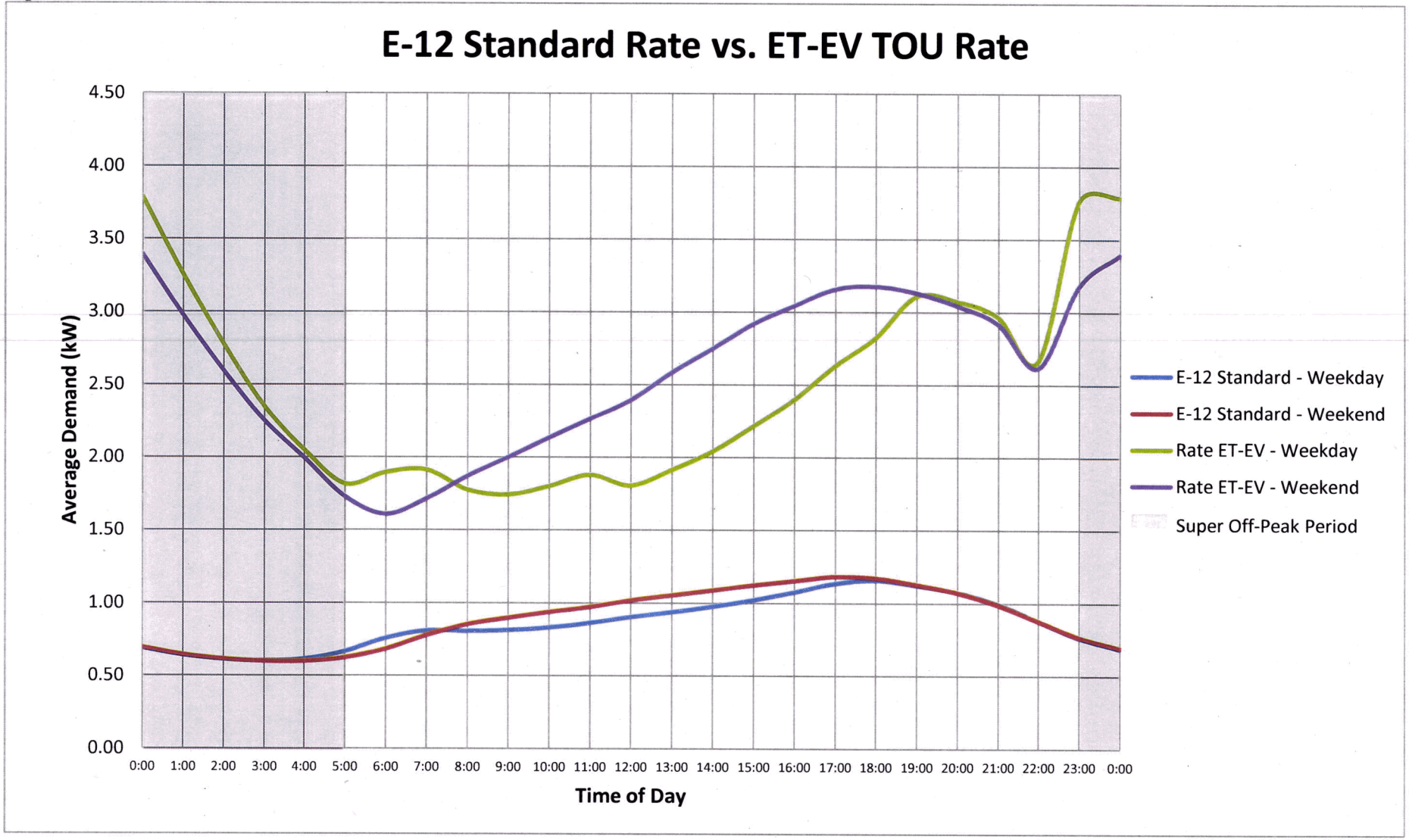
The graph shows that customers on Rate ET-EV have higher peak energy demand on average (3.94 kW) than customers on the standard E-12 rate (1.22 kW). This is consistent with expectations that early adopting EV customers are more likely to live in larger usage single family dwellings.

The observed peak for Rate ET-EV occurs around Midnight for both the weekday and weekend, as opposed to 6:00 PM for the standard E-12 rate. This is particularly interesting for Rate ET-EV, because the super-off peak period only occurs on week days. APS believes that customers are simply programming their vehicles to charge during the super-off peak time period and allowing charging at that time regardless of the day of the week.

Customers on Rate E-12 use an average of 21.5 kWh per day on the weekdays and 22.3 kWh per day on the weekends. This compares with 62.3 kWh per day on the weekdays and 64.9 kWh on the weekends for customers on Rate ET-EV.

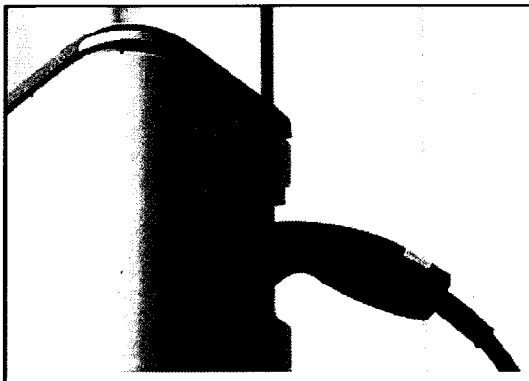
Rate ET-EV has been an effective means of incentivizing customers to charge EVs in the super-off peak period where demand on the system as a whole is at its least. It appears that the current design of Rate ET-EV (i.e., a super off-peak differential of 2.265 cents/kWh) was adequate to achieve the Company's goal of driving EV charging to coincide with the time of lowest demand on the system.

Figure 11. *Standard Rate vs. Rate ET-EV*



III. Appendices

A. Rate ET-EV Brochure



Who's Eligible

The Electric Vehicle Time-of-Use Service Plan is available to APS residential customers who own an electric vehicle and have an automated meter installed at their home.

To see if you qualify, please visit aps.com/ev or call the APS Green Team at 602 216 0318 or 877 850 8358.

Did You Know

Charging an EV at the super off-peak rate of 4.195 cents per kWh is equivalent to filling it up at a cost of roughly 37 cents per gallon.

Source from EPRI 2007

The Electric Vehicle Time-of-Use Service Plan is a trial plan available through December 31, 2014. APS reserves the right to discontinue this service plan prior to the end of the trial period. Although the EV TOU service plan is designed to lower costs by offering a lower rate from 11:00 p.m. to 5:00 a.m. for EV charging and other purposes, APS is unable to guarantee that switching to this service plan will lower your actual energy cost. Neighborhood Electric Vehicles (golf carts) as described in A.R.S. §28-101(36) do not qualify for this rate schedule.

aps

CS#1209019

Plug in for Less

ELECTRIC VEHICLE TIME-OF-USE SERVICE PLAN

aps

Maximize your savings with the APS Electric Vehicle Time-of-Use Service Plan

You may already be saving on fuel. Now you can also save on electricity, too. The Electric Vehicle Time-of-Use (TOU) Service Plan is designed to help you reduce the cost of charging your electric vehicle. Not only does the service plan apply to the energy used to charge your vehicle—it also applies to your home's total energy usage, which means the savings can be significant.

How it Works

APS residential customers who own an electric vehicle and have an automated meter can sign up for the Electric Vehicle Time-of-Use Service Plan. Customers who sign up for this trial plan are billed at rates which vary depending on the time of day when electricity is used. So, those who charge their electric vehicle during super off-peak hours will reduce the cost of charging the electric vehicle. Check the owner's manual or ask your dealer to determine if your electric vehicle can be programmed to automatically charge during super off-peak hours.

TIME-OF-USE	MON. - FRI.[1]	WEEKENDS[2]
5 a.m. to Noon	Off-peak	Off-peak
Noon to 7 p.m.	On-peak	
7 p.m. to 11 p.m.	Off-peak	
11 p.m. to 5 a.m.	Super Off-peak	

[1] Excludes qualifying holidays [2] Includes qualifying holidays

Additional Savings

This plan can save you the most money on your household energy use, if you can:

- Keep your home's energy use to a minimum during on-peak hours.
- Set your programmable thermostat to a warmer temperature during summer on-peak hours and a cooler temperature during winter on-peak hours.
- Set times for major electric-powered equipment such as pool pumps, spa heaters and electric water heaters with timers set to run only during off-peak hours and super off-peak hours.
- Use major appliances (oven, range, dishwasher, clothes washer and dryer) mostly during off-peak hours.

Please visit aps.com/ev for more information regarding electric vehicles and the Electric Vehicle Time-of-Use Service Plan.