William P. Cox
Senior Attorney
Florida Power & Light Company
700 Universe Boulevard
Juno Beach, FL 33408-0420
(561) 304-5662
(561) 691-7135 (Facsimile)

FPL

June 1, 2012

Ms. Ann Cole
Division of the Commission Clerk and
Administrative Services
Florida Public Service Commission
Betty Easley Conference Center
2540 Shumard Oak Boulevard, Room 110
Tallahassee, FL 32399-0850

120000-OT

Re: Electric Vehicle Charging Station Data Request dated May 2, 2012

Dear Ms. Cole:

Please find enclosed for filing an original and five (5) copies of Florida Power & Light Company's responses to Staff's Data Request No. 1 in the above-mentioned matter.

Thank you for your assistance. Please contact me should you or your staff have any questions regarding this filing.

Sincerely,

William P. Cox
Senior Attorney
Florida Bar No. 0093531

WPC/bag
Enclosures
cc: Benjamin Crawford (w/attachment)

COM ____
APA ____
ECR ____
GCL 1
RAD 4
SRC ____
ADM ____
OPC ____
CLK ____

Florida Public Service Commission
Electric Vehicle Charging Station Data Request
June 1, 2012

Background and Present Situation
In response to market activity, Florida Power & Light (FPL) launched its Electric Vehicle (EV) program in November 2010. The program adopted the following three objectives: 1) meet customer EV expectations; 2) ensure reliable service; and 3) support expansion of the EV market. Each objective is supported by a number of FPL initiatives. FPL holds a seat on the board of the Electric Drive Transportation Association (EDTA), the preeminent US industry association dedicated to electric transportation. FPL has acquired a substantial amount of experience in this industry and its responses will draw on those experiences and the work that has been done to support FPL EV program objectives.

FPL welcomes the opportunity to meet with FPSC staff, Florida electric utilities, and other stakeholders, to share FPL's experiences and provide additional information about the industry and FPL's program.

Note: Commission Staff's data request asks about plug-in hybrid electric vehicles (PHEVs) and PHEV charging stations. However, PHEVs make up only a portion of the plug-in electric vehicle market that requires charging from the grid.

FPL's responses to Commission Staff's data request pertain to *all* plug-in electric vehicles that charge their batteries from an external source and *do not* include hybrid electric vehicles. Definitions of these vehicle types for purposes of FPL's responses to Staff's data request are as follow:

- Hybrid electric vehicles (HEVs) – *e.g. the Toyota Prius, the Hyundai Sonata Hybrid, and the Toyota Camry Hybrid.* These vehicles are often considered electric vehicles; however, their batteries do not need to be charged from the grid. An HEV has dual drive trains using both an internal combustion engine (ICE) and a large battery powered electric motor to drive the vehicle's wheels. The ICE also charges the vehicle's battery, in addition to driving the wheels.

- Plug-in hybrid vehicles (PHEVs) – *e.g. the upcoming Toyota Plug-In Prius.* These are HEVs with a battery that can be recharged by plugging into an electric source. The battery is relatively small (*e.g.*, 4.4kWh for the Prius) with generally no more than 10-30 miles of range running on battery only.

  Battery electric vehicles (BEV) – *e.g. the Nissan Leaf, Ford Focus Electric, or the Tesla Model S.* These cars run solely on a battery powered electric motor which drives the vehicle's wheels. A BEV typically features a large lithium-ion battery (*e.g.*, 24kWh for the Leaf and up to 85kWh for the Tesla Model S) that is recharged by plugging into an electric source.

- Extended-range electric vehicles *(EREV) – e.g., Chevrolet Volt and the Fisker Karma. These are si*milar to a BEV, having a battery powered electric motor to drive the vehicle's wheels. Additionally, like a BEV, the battery is recharged by plugging into an electric source. However, an EREV also has an ICE powered generator that produces enough electricity to power the electric motor when the battery is depleted. Unlike an HEV or a PHEV, the ICE for an EREV does not directly drive the vehicle's wheels, nor does it recharge the battery. The battery sizes for EREVs are currently about 10.2kWh giving a range of 30-40 miles on the battery, plus an additional range of approximately 300 miles on the ICE generator.

1. How many Plug-in Hybrid Electric Vehicle (PHEV) charging stations are currently located in the utility's service territory?
   a. How many charging stations are "Public Chargers," e.g. available to the general public?
   b. Does this include charging available to RV parks, rest areas, and campgrounds?
   c. How many are in-home, private charging stations?
   d. How many charging stations are "Private," e.g. not available to the general public, excluding in-home charging?
   e. How many charging stations are owned by the utility?

FPL typically breaks Electric Vehicles Supply Equipment (EVSE) into three categories as defined by the Department of Energy (DOE) Plug-In Electric Vehicle Handbook[1]:

- Level 1: AC charging – 120V / up to 15amps at a rate of up to 1.8kW
- Level 2: AC charging – 240V up to 80amps at rates from 3.3kW-19.2kW
- DC Fast Charging: – TBD but generally assumed to be 480V 3-Phase AC up to 200 amps at rates of 50kW – 150kW.

There is currently no reporting system in place that provides consistent, reliable information about the location of EVSE – including public, private and residential charging stations.

The most reliable source can be found on the DOE Alternative Fuels and Advanced Vehicles Data Center (AFDC) website. This information is obtained by the DOE through the National Renewable Energy Laboratory (NREL) from trade press sources, Clean Cities coordinators, and a submittal form on the AFDC website.

a. DOE reports that there are 146 existing public charging stations in FPL's service territory.
b. Yes, the DOE count includes all reported charging stations including those at campgrounds, rest areas, and RV parks.
c. Since DOE does not track residential charging stations, FPL can only estimate the number of such in-home, private charging stations based on the number of vehicles registered in Florida. All EVs ship with a Level 1 charging station, and many owners opt to install a Level 2 charging station as well. GM and Nissan estimate that, approximately 50 percent of Volt owners and 15 percent of Leaf owners only use Level 1 charging at home[2]. Therefore FPL estimates that there are 432 Level 1 and 257 Level 2 residential charging stations in its service territory.
d. We estimate that there are 54 non-residential private stations in FPL's service territory (including private stations owned and operated by FPL).
e. FPL has 45 operational charging stations and 9 more that are under construction. All are private.

FPL's summarized estimate by level and category is as follows

Table 1

Known/Estimated EVSE Installations in FPL Territory			
Access	**Level 1**	**Level 2**	**SOURCE**
FPL Installed (Private)	–	45	FPL
FPL Under Construction (Private)	–	9	FPL
PUBLIC	57	89	DOE
PRIVATE	1	8	DOE
Public/Private PLANNED	1	10	DOE
Residential	432	257	estimate
TOTAL	**491**	**418**	

[1] National Renewable Energy Laboratory. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. (n.d.). Plug-in electric vehicle handbook for consumers. P8-9. (DOE/GO-102011-3274). Retrieved from website: http://www.afdc.energy.gov/afdc/pdfs/51226.pdf
[2] Email response from General Motors and from Nissan in May, 2012.

2. Please complete the table below describing the projected number of PHEV charging stations that are anticipated to be located in utility's service territory.

FPL presently has not projected EVSE growth due to the many uncertainties in the charging station market. At this point, it is uncertain what public and private EV charging infrastructure will be deployed, or at what rate that such infrastructure will grow. In FPL's view, the more important metric with regard to FPL's system is the number of vehicles, and accordingly, the number of vehicles charging at a given time.

See FPL response to Q1 for charging station definitions.

Number of Projected PHEV Charging Stations

	Level 1	Level 2	Level2+	Level 3	Level 4	Total
2012	—	—	—	—	—	—
2013	—	—	—	—	—	—
2014	—	—	—	—	—	—
2015	—	—	—	—	—	—
2016	—	—	—	—	—	—
2017	—	—	—	—	—	—
2018	—	—	—	—	—	—
2019	—	—	—	—	—	—
2020	—	—	—	—	—	—
2021	—	—	—	—	—	—

Note: PHEV Charging Station Energy Specifications:

Level 1 - 1.1 kW, 15 amp, 110 V (< 15 amps delivered)
Restricted to at home only, overnight full charge
9 pm to 9 am, randomized start, full plug-in PHEV charge

Level 2 - 3.3 kW, 15 amp, 220 V
Restricted to home and work
Charge anytime, charge until full
Effectively two plug-in PHEV charges per day

Level 2+ 6.6 kW, 30 amp, 220V
Unrestricted location; wherever you park
Charge anytime; charge until full
Several plug-in PHEV charges per day

Level 3 50 kW, 100 amp, ~400V
Refueling station concept for PHEVs
Charge anytime; charge until full
Up to hundreds of charges per day

Level 4 Not currently defined
Will use DC Technology

3. Please describe the impact PHEV charging stations had on the utility's load in 2011. Please include contribution to peak demand, a typical hourly profile for load from PHEV charging stations, and a typical hourly profile for the electric system as a whole for comparison purposes, for each month of 2011.
Please provide this information for:
In-home charging stations.
Other private charging stations
Public charging stations.

EV charging had an insignificant impact on FPL's load in 2011. Based on Nissan Leaf and Chevy Volt title issue dates from the Florida Department of Transportation, there were only 199 EVs in FPL territory by the end of 2011[3]. The individual hourly load broken out by in-home charging stations, public charging stations, and other private charging stations is unknown at this time, as there is currently no feasible way to track individual charging station use.

The estimated hourly profile for EVs and average FPL hourly load profile are as follows.

Estimated Hourly Charge EV profile and Average FPL hourly Profile by Month - in mW

	EV	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
Hour 1	0.05	8,769	8,549	8,831	10,698	11,084	12,093	12,569	12,667	11,983	10,031	9,183	8,689
Hour 2	0.02	8,375	7,977	8,128	9,802	10,179	11,192	11,677	11,822	11,150	9,327	8,289	8,060
Hour 3	0.01	8,188	7,688	7,723	9,229	9,572	10,563	11,063	11,241	10,598	8,869	7,932	7,697
Hour 4	0.00	8,185	7,587	7,528	8,891	9,192	10,168	10,681	10,873	10,250	8,628	7,762	7,534
Hour 5	0.00	8,377	7,691	7,555	8,793	9,053	10,010	10,519	10,746	10,143	8,603	7,789	7,573
Hour 6	0.00	9,022	8,272	8,014	9,114	9,306	10,230	10,689	10,998	10,476	8,993	8,219	7,991
Hour 7	0.00	10,284	9,453	9,056	10,005	10,049	10,765	11,132	11,715	11,304	9,906	9,116	8,861
Hour 8	0.00	11,199	10,321	9,856	10,619	10,670	11,478	11,725	12,224	11,735	10,495	9,847	9,537
Hour 9	0.02	11,597	10,947	10,480	11,543	11,768	12,768	13,087	13,408	12,676	11,005	10,660	10,319
Hour 10	0.02	11,781	11,551	11,246	12,748	13,031	14,220	14,628	14,977	14,126	11,980	11,576	11,128
Hour 11	0.02	11,826	11,955	11,936	13,846	14,227	15,622	16,079	16,475	15,507	12,945	12,342	11,747
Hour 12	0.01	11,733	12,185	12,378	14,700	15,233	16,815	17,294	17,667	16,678	13,608	12,859	12,126
Hour 13	0.00	11,597	12,334	12,692	15,454	16,018	17,732	18,188	18,491	17,591	14,130	13,230	12,366
Hour 14	0.00	11,402	12,399	12,948	15,955	16,678	18,420	18,785	19,003	18,263	14,520	13,464	12,478
Hour 15	0.02	11,210	12,425	13,164	16,397	17,147	18,774	19,079	19,196	18,625	14,761	13,544	12,498
Hour 16	0.05	11,096	12,465	13,365	16,697	17,464	18,839	19,122	19,159	18,709	14,912	13,488	12,439
Hour 17	0.13	11,113	12,455	13,493	16,906	17,588	18,667	19,008	18,934	18,588	14,916	13,258	12,287
Hour 18	0.25	11,575	12,465	13,465	16,733	17,404	18,246	18,677	18,514	18,180	14,679	13,257	12,638
Hour 19	0.34	12,640	13,006	13,386	16,202	16,853	17,615	18,103	17,936	17,492	14,360	13,665	13,415
Hour 20	0.37	12,565	13,128	13,350	15,553	16,107	16,834	17,346	17,310	17,100	14,568	13,355	13,066
Hour 21	0.30	12,125	12,557	13,213	15,550	15,925	16,490	16,964	17,175	16,816	14,150	12,771	12,517
Hour 22	0.22	11,406	11,722	12,387	14,732	15,204	15,898	16,379	16,391	15,805	13,286	11,877	11,787
Hour 23	0.14	10,502	10,683	11,258	13,451	13,901	14,711	15,232	15,166	14,536	12,217	10,888	10,817
Hour 24	0.08	9,530	9,566	10,015	12,005	12,412	13,431	13,943	13,824	13,208	10,992	9,819	9,702

4. Has the utility estimated the number of PHEVs in Florida at present, both in its service territory and statewide?

FPL has obtained registration data for Leafs and Volts, the only two commercial EVs readily available in Florida through early 2012[4]. Others are either registered in another state, conversions, or of another model. The numbers for these is likely very low given the infancy of commercially available EVs and the low incidence of conversions.

	Nissan Leaf	Chevy Volt	Total
Florida	285	648	933
FPL	115	317	432

5. Has the utility estimated the number of PHEVs that are expected to be in use in Florida through 2021?

[3] Florida Department of Transportation Vehicle Registration Query. Run April, 2012 Vehicles parsed by zip code to separate those in FPL territory zips from the rest of the state. – 152 Volts, 47 Leafs (Titled in 2011).

[4] Florida Department of Transportation Vehicle Registration Query, Run April, 2012.

Yes, while updating its ten-year site plan in September of 2011, FPL forecasted the number of EVs expected in Florida through 2021 as provided in the table below. The Florida forecast was then refined to get FPL's forecast for its service area (see answer to question #6).

FL EV Forecast	
	Current FL Forecast
2012	6,048
2013	11,704
2014	20,042
2015	31,748
2016	47,622
2017	73,020
2018	98,578
2019	131,108
2020	196,664
2021	294,994

If yes, please provide and include source of estimates and how derived.

Projections on the number of plug-in electric vehicles in Florida were developed using the following methodology. First, projections of the U.S. market for plug-in electric vehicles were developed based on a review of multiple forecasts from industry experts and FPL's discussions with knowledgeable professionals in the automotive industry. Florida's share of the U.S. market for plug-in electric vehicles was then estimated based on the share of U.S. hybrid electric vehicles (excluding plug-in electric vehicles) that is currently located in the state.

6. Has the utility estimated the number of PHEVs that are expected to be in use in its service territory through 2021?

Yes, also created in September 2011 as part of the ten-year site plan updating process.

If yes, please provide and include source of estimates and how derived.

FPL assumed 50 percent of the EVs in Florida would be in its territory based on the population in FPL's territory relative to Florida overall. Early uptake has been more brisk in the Orlando area due to it being an early launch area and receiving DOE funding, giving FPL territory slightly less than a 50 percent share to date. However, 2012 issued titles are showing a distribution closer to the predicted 50 percent.

If yes, please complete the table below describing the projected number of PHEVs in Utility's service territory through 2021.

FPL EV Forecast	
	Current FPL Forecast
2012	3,024
2013	5,852
2014	10,021
2015	15,874
2016	23,811
2017	36,510
2018	49,289

2019	65,554
2020	98,332
2021	147,497

7. Explain how load management or rate design tools may mitigate the demand impacts of PHEV charging on peak demand.

At present, in territories where EVs have been in the market for some time, *e.g.*, California, 80 percent of all charging occurs at home[5]; therefore, the most effective rate structure or program would likely be a residential program. The EV Project[6] has shown that time of use (TOU) rates can support a shift in EV charging to off-peak when the price differential between on-peak and off-peak rates is sufficiently large. However, there are also some drawbacks to EV TOU rates at this time:

a) An EV-only TOU rate requires separate metering, or sub-metering, which presents some technical issues as well as an added expense for the customer and for the utility (which can offset any consumer savings). In the future, other alternatives may include smart EVSE/smart-grid integrations or connection with vehicle telematics. However, these solutions are not yet viable or cost-effective.
b) The TOU rate needs to be sufficiently lower than peak rates to incent off-peak usage. While this can be effective in areas such as California where rates are relatively high, it will likely be less so in territories where rates are relatively low since the TOU incentive would be much less.
c) TOU rates will likely cause a new peak when the TOU rate is implemented with significant uptake. Whereas charging start times are randomly staggered at present, charging times will be concentrated to all begin as soon as the TOU rate takes effect. The EV Project has shown that in San Diego, where TOU rates are implemented at a significant savings, there is a demand spike at 12:00 am when the TOU rate begins[7]. While this is not an issue with few EVs in the market, it could become an issue with the advent of significant numbers of EVs charging – creating an additional system peak.
d) Initial projections and early data[8] show that the bulk of charging currently occurs off-peak even without TOU rates – people tend to use their cars during the day and will likely plug in to charge their vehicles after they return home in the evening. The main difference will likely be that TOU rates shifts the bulk of charging to the middle of the night, whereas non-TOU charging was randomly staggered and tended to peak between 8:00pm and 10:00pm. More analysis is needed to assess the overall benefits, if any, versus the implementation costs of an EV-related TOU rate.

At this time, FPL does not feel that it has a need for a new EV TOU Rate. FPL already offers a residential TOU rate option which EV owners, like all residential customers, are eligible for without the added expense mentioned above.

Load control solutions for EV charging are currently in the development and pilot stage, so their impact on peak demand is largely speculative at this time. However, two potential drawbacks are the expense of implementing this type of program and the times when people are charging. Load control

[5] Kjaer, E. (2012, May). Positioning Electric Drive to Thrive: Transition to Mass Market. Quote from presentation of Paper presented at EVS26, Los Angeles, CA.

[6] The EV Project is the largest deployment of electric vehicles and charge infrastructure in history. It is funded by the DOE and participating partners. The EV Project collects and analyzes data to characterize vehicle use in diverse topographic and climatic conditions, evaluates the effectiveness of charge infrastructure, and conducts trials of various revenue systems for commercial and public charge infrastructures. The ultimate goal of The EV Project is to take the lessons learned from the deployment of the first thousands of EVs, and the charging infrastructure supporting them, to enable the streamlined deployment of the next generation of EVs to come, www.theevproject.com .

[7] The EV Project. (2012, February 17). Q4 2011 report. P22. Retrieved from http://www.theevproject.com/downloads/documents/Q4 INL EVP Report.pdf.

[8] The EV Project. (2012, February 17). Q4 2011 report. P34. Retrieved from http://www.theevproject.com/downloads/documents/Q4 INL EVP Report.pdf.

requires equipment - either a separate load control device or smart charging equipment – through which the utility can manage load, potentially adding significant expense. Additionally, given current forecasts for when people will be charging, there may be limited numbers of people actually charging during FPL's peak hours. A third potential drawback to load control (or even vehicle to grid/vehicle to home applications) is consumer acceptance of third-party control over their vehicle, charging, and battery. The battery is one of the most expensive components of the car, and there will likely be consumer concern about the impacts of load control on battery life. Furthermore, since range limitation is an issue in today's market, BEV drivers in particular will likely be concerned about having charging interrupted, which could potentially mean that their car is not sufficiently charged when they need to drive it.

Please describe any load management programs the utility currently offers.

- Residential On-Call
  - The objective of the Residential On-Call Program is to provide FPL with a means to reduce coincident peak demand on the FPL system, thus deferring the need for generation capacity additions. Customers who choose to participate receive a credit on their monthly electrical bill in exchange for allowing FPL to remotely control the operation of the following electrical appliances/equipment during times of high demand on the FPL system: central electric air conditioners, central electric space heaters, conventional electric water heaters, and swimming pool pumps. Electric space heating is eligible only in combination with one of the other equipment types.

- Business On-Call
  - The objective of the Business On-Call Program is to provide FPL with a means to reduce coincident peak demand on the FPL system, thus deferring the need for generation capacity additions. This program addresses FPL's General Service (GS) and General Service Demand (GSD). Customers who choose to participate receive a credit ($2.00 PER AC ton) on their monthly electrical bill in exchange for allowing FPL to remotely control the operation of DX air conditioning equipment during times of high demand on the FPL system.

- Commercial/Industrial Demand Reduction Programs
  - FPL offers three types of Demand Reduction Programs to its Commercial and Industrial customers. These are Curtailable Service (CS), Commercial Industrial Load Control (CILC), and Commercial Industrial Demand Reduction Rider (CDR). The objective of these three programs is to reduce peak demand during capacity shortages or system emergencies by reducing each participant's electrical loads by a pre-determined amount. Participants receive a monthly incentive in exchange for controlling their selected electrical loads when requested by FPL. The incentive amount varies by program and by the method in which the customer controls his electrical loads.

8. Does utility currently plan to offer to its customers programs designed specifically for PHEVs?

   No, not at this time.

   If yes, please describe these programs including participation and peak reduction.

   NA

   If no, does utility have plans to offer any programs designed for PHEVs?

   No, not at this time.

9. What type of additional policies and processes does the utility currently have in place to manage the addition of charging facilities to the system?

Planning for long-term increases in electricity demand is part of FPL's core business. Electric utilities have prepared for and met incremental demand from new mass market electrical equipment for generations, and electric vehicles are no different. In fact, FPL has included the load from plug-in electric vehicles in its Ten-Year Site Plan forecast since 2009.

Today, many of FPL's existing departments are handling EV-related issues as part of their regular duties, including Service Planning, Customer Care Center, and Load Forecasting.

One of the stated objectives of FPL's EV program is to ensure reliable service.

* FPL will continue to evaluate the best approach to meet the emerging needs of EV technologies, while keeping service reliability high.
  - FPL is studying the market and is actively engaged in discussions with automotive manufacturers, charging infrastructure providers, and others in the industry.
  - FPL is analyzing the EV charging impacts to its system and will take the appropriate steps to ensure it is fully prepared to meet the new electrical demand created by EVs. To date, FPL has or is engaged in the following relevant activities:
    (a) Continually assessing processes for projecting future load from EV charging;
    (b) Conducting a reliability study to understand a number of EV charging issues, including, but not limited to, power quality, charging times, and impacts to customer load, impacts to FPL equipment; and.
    (c) Launched a residential EV charger pilot to capture information from early EV buyers to ensure FPL understands all aspects of EV charging.
  - FPL is involved with a number of industry organizations that are performing studies and/or have influence over policies associated with EVs and EV charging.
  - FPL is attempting to identify and track EV buyers/owners in its service territory.

10. Based on the utility's experiences, what challenges do PHEVs present to utility and grid operation?

Many recent forecasts show that EV adoption rates will be gradual[9]. Experts, including the Electric Power Research Institute (EPRI), agree that this slow EV adoption rate will afford utilities time to prepare for generation, transmission, and distribution impacts. [10]

The biggest near term challenge for utilities is what is referred to as "the last 100 feet". Given the relative limited volume of EVs being sold over the next five to ten years, if utilities were to experience a problem, it is expected to be at the transformer level. This is particularly true if geographic clustering of EV owners creates problems in specific neighborhoods.

Therefore early notification of EV purchase is important, and currently utilities are facing a challenge getting timely, accurate and complete notifications from automakers (including address-level data). Other sources of this information could include customers self-reporting their purchase, permitting authorities' notifying the utility for EVSE installations, or Departments of Motor Vehicles/Transportation notifying when and where an EV has been registered. However, some of these solutions present consumer privacy and legal hurdles.

FPL has a robust EV program, with reliability as a major focus, and is doing a number of things to ensure it continues to provide reliable service as more EVs enter FPL's service territory. See FPL's response to Staff Question No. 9 above for more details.

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[9] For example, J.D. Power: Drive Green 2020: More Hope than Reality?, Center for Automotive Research: Deployment Rollout Estimate of Electric Vehicles 2011-2015, or the Department of Energy: One Million Electric Vehicles By 2015.
[10] Duval, M., Alexander, M., Maitra, A., Saucedo, D., Jungers, B., Halliwell, J., Entriken, R., & Davis, M. Electric Power Research Institute, (2011). *Transportation Electrification a Technology Overview. P1-4.* (2011 TECHNICAL REPORT)

Long term challenges for utilities, and the EV industry as a whole, include standards, policies, and programs associated with things such as load management, vehicle to grid, and vehicle to home activities.

Generation and Transmission

11. What additional generation or transmission assets will the utility require if 1 percent of vehicles in the utility's service area are replaced with PHEVs for each year through 2021?

As mentioned in question No. 9, FPL has included load from EV charging in its Ten-Year Site Plan. FPL used a number of credible sources[11] to arrive at this forecast and believe it to be a realistic estimate of the number of EVs that will be on the road through 2021. In this forecast, FPL would see 1 percent of electric vehicle penetration in its service territory between 2017 and 2018.

What if the figure reaches 5 percent, 10 percent, 25 percent, or 50 percent?

FPL has not performed any analysis responsive to this question and further does not believe that 5 percent, 10 percent, 25 percent or 50 percent EV penetration levels are realistic within this timeframe. Some of the reasons for this conclusion are as follows.

1. EVs will remain expensive in comparison to gasoline-powered vehicles for the foreseeable future.
2. Consumer acceptance of EVs requires education, and this process will take time.
3. Based on information FPL has received to date from auto manufacturers, production plans will remain low in the early years.

FPL carefully monitors and tracks monthly sales of electric vehicles in the United States and is positioned to make revisions to its forecast as needed. And although FPL does not foresee it happening, if for any reason EV penetration reached these levels between now and 2021, additional generation could be needed to manage the load.

What are the costs of these additional generation assets expected to be?

As noted previously, FPL's current generation plan includes the electric vehicle forecast. This forecast assumes electric vehicle penetration in FPL's service territory will reach 1 percent between 2017 and 2018. No additional generation is required as a result of this level of electric vehicles. However, there is an incremental impact in fuel and environmental compliance costs of approximately $116 million (CPVRR 2012-2021, 2012$) of this scenario versus a scenario with no EV penetration as shown in the table in response to the following question.

What effect will these additional costs have on the general body of ratepayers?

FPL estimates the effect of the incremental fuel and environmental compliance costs on the general body of ratepayers to be negligible as shown by the tables below.

[11] See Footnote 8 above.

Impact of EV Scenario
CPVRR, 2012-2021 in 2012 $Millions)

		(1)	(2)	(3) = (1) - (2)		
Year	Annual Discount Factor 7.290%	EV (2012 TYSP) Scenario Total Fuel & Env. Costs (Millions)	No EV Scenario Total Fuel & Env. Costs (Millions)	Nominal Difference (Millions)	NPV Difference (Millions)	CPVRR Difference (Millions)
2012	1.000	2,890	2,889	1	1	1
2013	0.932	3,014	3,012	2	2	3
2014	0.869	3,366	3,363	3	3	5
2015	0.810	3,686	3,681	5	4	10
2016	0.755	4,053	4,045	8	6	16
2017	0.703	4,390	4,376	14	10	25
2018	0.656	4,811	4,791	20	13	39
2019	0.611	5,153	5,125	28	17	56
2020	0.570	5,676	5,634	42	24	80
2021	0.531	6,324	6,255	69	37	116

Average Annual Rate Impact ¢/KWH of EV Scenario
(Total Fuel and Environmental Costs)

	(4)	(5)	(6) = $(1)*10^6/((4)*1000))$	(7) = $(2)*10^6/((5)*1000))$	(8) = (6) - (7)
Year	EV (2012 TYSP) Scenario Retail Billed Sales (MWh)	No EV Scenario Retail Billed Sales (MWh)	EV (2012 TYSP) Scenario Average Rate (¢/KWH)	No EV Scenario Average Rate (¢/KWH)	Average Rate Impact (¢/KWH)
2012	101,808,369	101,791,211	2.84	2.84	0.001
2013	103,464,791	103,429,357	2.91	2.91	0.001
2014	105,903,320	105,838,364	3.18	3.18	0.001
2015	108,691,459	108,580,697	3.39	3.39	0.001
2016	110,503,656	110,332,392	3.67	3.67	0.002
2017	111,972,223	111,716,101	3.92	3.92	0.004
2018	113,332,554	112,982,840	4.24	4.24	0.005
2019	114,840,648	114,374,573	4.49	4.48	0.006
2020	117,336,065	116,669,343	4.84	4.83	0.008
2021	120,127,299	119,175,459	5.26	5.25	0.016

12. Has the utility adjusted its load forecast to account for additional load from PHEVs?

Yes.

If yes, please describe the basis for the projected load adjustment and provide resources relied upon for this adjustment.

The contribution to net energy for load from plug-in electric vehicles was derived from FPL's vehicle forecast (see answer to question No. 6,) using an estimated kWh per vehicle. It was assumed that charging would take place 365 days per year with an average daily charge of 12.3 kWh. The 12.3 kWh per day is based on EPA's estimate of 34 kWh per 100 miles of driving and the typical driver going about 36 miles per day. This estimate of miles driven per day is consistent with actual data provided by Nissan on the Leaf[12]. The resulting kWh forecast was then grossed up to account for losses.

For summer and winter peaks, an estimate was made, based on the most likely charging schedule, for the percent of vehicles that would be charging during the forecast summer and winter peak times. A forecast of kW per vehicle was developed based on knowledge of the specific charge rates of plug-in electric vehicles already on the market and those soon to be available in Florida. The number of vehicles multiplied by the percentage of vehicles charging during FPL's peak hour, multiplied by the kW per vehicle, grossed up for losses, provided the summer and winter coincident peak forecast.

Sources used to arrive at these numbers include The Center for Automotive Research, JD Powers, Pike Research, the Department of Energy, the Electric Power Research Institute, and discussions with key industry stakeholders such as major auto manufacturers and electric utilities.

If yes, please complete the table below summarizing the incremental projected load from PHEVs.

[12] Doggett, S. (2011, October 11). Nissan Says Long-range EV Unnecessary. *Edmunds Auto Observer*, Retrieved from http://www.autoobserver.com/2011/10/nissan-says-long-range-ev-unnecessary.html

	Summer Peak MW	Winter Peak MW	Annual GWH
2012	2.9	1.1	18
2013	6.0	2.2	38
2014	11.1	3.9	69
2015	19.2	6.3	118
2016	29.8	9.6	182
2017	44.3	14.6	272
2018	60.6	19.8	371
2019	80.8	26.3	495
2020	114.8	38.9	707
2021	162.6	57.6	1,010

13. Is the utility's existing electric generation system adequate to accommodate the PHEV demand based on the estimated number of PHEVs expected to be in use through 2021?

    Yes, based on FPL's 2012 Ten-Year Site Plan EV charging load forecast.

    Please explain.

    Based on the most likely projections of load currently available, the number of vehicles projected in FPL's service territory through 2021 will not be large enough to put any significant demand on FPL's generation system, even if there is substantial EV charging during peak hours.

14. Is the utility's existing electric transmission system adequate to accommodate the PHEV demand based on the estimated number of PHEVs expected to be in use through 2021?

    Yes.

    Please explain.

    Because it is anticipated that no additional generation will be required to meet projected EV load requirements, the existing transmission system is adequate to accommodate expected EV demand.

15. Has the utility performed any analysis or prepared any studies examining the magnitude and nature of PHEV charging, especially regarding whether different levels (as delineated in question 2) of charging are more or less likely to occur at specific times of day?

    Yes.

    If yes, please provide the analysis or study and describe the results.

    FPL is in the process of conducting a study that assesses the impact of EV charging on the utility grid. This study will use EV owner field data to providing the most reliable results possible. This study will include understanding at what times customers begin charging, how long they charge, impact on FPL's distribution and transmission assets, and power quality.

    FPL also completed a market assessment and potential impacts study of EVs in 2008. The study was based on a most likely scenario (at the time) and concluded that EVs did not present any significant challenges to FPL from a resource planning, transmission, distribution, or environmental standpoint. For an aggressive scenario of 600,000 EVs in FPL's service territory in 2020, the impacts are greater, but manageable. Note that FPL's more recent forecast of EVs in 2020 is only 98,000 vehicles. A copy of this study is attached.

The new study is expected to be completed in late 2013.

16. Has the utility performed any analysis or prepared any studies related to the potential impacts of PHEV charging on its transmission system?

Yes.

If yes, please provide the analysis or study and describe the results.

Transmission impacts were considered in the 2008 study described in the response to question No. 15 above and are being analyzed in the reliability study that is currently underway, due to be completed by 2013.

17. Has the utility performed an analysis or prepared any studies related to the potential impacts of PHEV charging on its generation system?

Yes.

If yes, please provide the analysis or study and describe the results.

FPL has included EV load into its Ten-Year Site Plan and therefore is accounting for the associated generation need.

Distribution

18. What improvements will be required for the utility's distribution network if 1 percent of existing vehicles are replaced with PHEVs for each year through 2021?

As previously mentioned, FPL is conducting a reliability study on electric vehicle charging to better understand the impact this may have on its distribution system. This study will help identify potential reliability, power quality, and/or load concerns brought about as a result of EV charging. It will also help evaluate the risks associated with increased load requirements on distribution transformers and conductors, as well as potential impacts from clustering and larger installations. Upon completion of the study, FPL expects to have the necessary data to better define system improvement requirements to successfully integrate mass deployment of EVs.

What if the figure reaches 5 percent, 10 percent, 25 percent, or 50 percent?

The current study underway referenced above will help evaluate impact of EVs through various penetration levels.

What will the costs of these distribution improvements be?

The total costs for potential distribution improvements are unknown at this time. A projection of these costs will be developed as part of the referenced system study and various levels of adoption.

Does the utility believe that a Contribution in Aid of Construction would be appropriate?

Contribution in Aid of Construction should be considered amongst the various alternatives for costs recovery related to improvements to FPL's distribution network necessitated by increased EVs in FPL's service territory through 2021.

19. To what extent will "clusters" of PHEVs in the same geographic area cause localized distribution problems, especially in residential areas?

The current study underway referenced above will help FPL evaluate the impact of clustering. To date, FPL has seen initial signs of geographical clustering, and at this time there is no evidence that clustering will cause significant problems.

Explain how many PHEVs on a single residential transformer will necessitate upgrades to the utility's distribution network.

There is no set number of EVs on a single transformer that will require an upgrade to distribution facilities. Facility upgrades will likely be dictated by a combination of EV quantities and charging rates (3.3kW, 6.6kW or 19.2kW), as well as the available capacity of the existing facilities serving specific locations. Through FPL's reliability study presently underway, FPL expects to be able to better understand the relationship of all of these factors and to identify higher risk portions of its distribution network.

Describe the methods to minimize any additional costs for distribution upgrades.

There are a number of potential options to minimize the cost of distribution upgrades, the most obvious being off-peak charging. Another option could be programs that spread EV charging out over a wider time period.

Another approach that some utilities have undertaken is to upgrade construction standards and gradually replace equipment as needed.

20. What effect will quick-charge stations (Level 3 or above) have on the utility's distribution network?

At this time, the effect of DC Fast Charging stations is not fully understood. There are different charge rates within the DC fast charge. Where these stations are located will also have an impact. Many areas where these stations could be located already have sufficient service. Other areas may require significant upgrades. If available, these types of charging stations will be examined by FPL as part of the reliability study.

Will this effect vary in urban, suburban, or rural areas? If so, how?

As mentioned above, location could have a significant impact on the distribution network and the cost to provide the EV charging service.

Off-Grid Solar Charging

21. Provide the location and describe the utility and non-utility off-grid solar PHEV charging stations in operation in the utility's service area.

There are no known off-grid solar EV charging stations in operation in FPL's service area, as customers are not required to register off-grid solar arrays or EVSE installations. FPL, as part of its Living Lab at its Juno Beach headquarters, has a 50kW solar carport with eight Level 2 charging stations, capable of charging at up to 6.6kW. The solar panels indirectly power the charging stations by feeding back into the grid while the charging stations are powered directly from the grid to maintain a constant load.

22. How many utility and non-utility off-grid solar photovoltaic PHEV charging stations are planned to be installed in the utility's service area?

There are no known off-grid solar EV charging stations planned in FPL's service area at this time.

23. How does the production cycle of solar photovoltaic align with the load profile of PHEV charging demand?

Peak solar photovoltaic (PV) output occurs before both FPL's peak demand and the expected peak charging times. According to the National Renewable Energy Lab's (NREL) PVWATTS Calculator[13] Hourly PV Performance Data, the West Palm Beach Airport on average sees its peak PV performance from 11:00 am to 3:00 pm. In the summer months, PV output trails off significantly by 5:00 pm during FPL's summer peak demand. For EV charging, current forecasts put the bulk of EV charging after FPL's peak time of 5:00pm.

24. Explain the extent to which solar photo voltaics can meet the energy requirements of PHEVs?

While it is possible to meet the demand requirements for EV charging at peak output given enough panels, it is economically unrealistic that PVs alone can meet the overall energy requirements. To provide consistent power, it is likely that either an additional feed from the grid, or a method of storage is required for PV to be a viable solution to power charging stations. An additional feed from the grid will allow the EVSE to maintain a constant charge, regardless of the load produced by the PV, and could feed power back to the grid when the EVSE is not in use. Storage, such as a large battery system, could allow the charging station to maintain a constant charge, and could enable the storage of power from the PV when the charging station is not in use. A combination system that pulls energy first from the PV array, then from the battery and finally from the grid would be the most viable system allowing maximum utilization of renewable technology while providing constant power for any time charging.

25. Please estimate the load and number of solar photovoltaic panels needed for Level 1, Level 2, Level 2+, and Level 3 charging stations.

Minimum Number of 220w[14] Panels at Peak Output Necessary for EV Charging at Various Charge Rates *(assuming no derate factor)*

Charge Rate	220W Panels	Load (kW)
L1 - 1.2kW	6	1.32
L2 - 3.3kW	15	3.3
L2 - 6.6kW	30	6.6
L2 - 10.2kW	47	10.34
L2 - 19.2kW	88	19.36
DCFC - 25kW	114	25.08
DCFC - 50kW	228	50.16

[13] http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/US/code/pvwattsv1.cgi

[14] http://www.gogreensolar.com/products/gogreen-1-2kw-solar-electric-vehicle-charging-station

Plug In Hybrid Electric Vehicles

2008 Assessment of Market and Potential Impacts for FPL

September 2008

Oscar Gans, Customer Service

John Wehner, Finance

Rene Silva, System Planning

Jim Glass, Power Systems

Richard Shaheen, Power Systems

Bradford Goar, Marketing

George Survant, Power Systems Fleet

Joe Miakisz, Environmental

Joe Mango, Transmission

Hector Sanchez, Transmission

Alex Zappani, Strategy and Policy

1. Executive Summary

Plug-in hybrid electric vehicles have been receiving increased visibility in the media and are receiving political attention in Washington. They have been mentioned by President Bush during his 2007 State of the Union address as well as Barack Obama during his presidential campaign. In addition, there are several versions of incentives or subsidies being discussed – lower price differentials. The commonly sited reasons for the increased attention are environmental benefits, reduced fuel consumption, and energy security.

The basic proposition that has been gaining attention of utilities and the market is that PHEV's can: Save the energy equivalent of ~10-20 MWh annually at the user; Displace 20-25 barrels of petroleum annually, per unit; Significantly improves air quality and reduces greenhouse gas emissions; They are highly intelligent; They can act like flexible, manageable load and storage; They can improve asset utilization; Have a potential market of 230 million units and growing.

Many major auto manufacturers (Ford, Saturn, Toyota, Daimler Chrysler, and Chevrolet) have leveraged this attention to announce plans to offer PHEV's. PHEV's are being designed to literally plug into a home standard outlet with a charging load between 1.5 and 2.0kW for 120V and for 4 to 6 hours . The primary technology challenges will be to improve battery performance while minimizing price premiums versus conventional and existing hybrid vehicles. PHEV's are expected to deliver an equivalent of less than 30% cost per gallon than conventional vehicles.

PHEV's are among several different technologies which can provide environmental, economic, and energy security benefits. The current competitors include, conventional hybrid electric vehicles, bio-diesel, compressed natural gas, propane and hydrogen vehicles. The most significant competition will be against hybrid electric vehicles against which PHEV's have a $10,000 incremental cost. PHEV's become economically competitive at a $3,400 incremental cost and gasoline prices above $4.50 per gallon.

2010 has been publicized as the launch year for GM and Toyota. At the time of this white paper, there is significant uncertainty regarding the forecast of the number of vehicles that will be available by 2020 (10,000 DOE to 800,000 2x EPRI). FPL territory includes approximately 3% of the registered vehicles in the United States. Using this percentage, FPL's forecast range would be at a maximum 25,000 vehicles by 2020. Mr. Obama's goal of 1,000,000 PHEV's by 2015 would equal 30,000 PHEV's within the FPL service area which would be insignificant at a system level. Due to the low forecast levels, the team developed an aggressive stress test scenario reaching 600,000 PHEV's (this is equivalent to 3% of over 19 million PHEV's within the U.S.) on FPL's system within 6 years to model potential system impacts

Based on charging load configurations and commuter arrival patterns, the diversified summer coincident peak demand impacts from a single vehicle are expected to be between 0.44kW and 0.65kW (for the 1.5kW and the 2.0kW scenario respectively). The "most likely" forecast of 25,000 PHEV's does not present any significant challenges to FPL from a resource planning, transmission, distribution or environmental perspective.

For the aggressive scenario of 600,000 PHEV's, the 2020 summer coincident peak impact will be 387MW and does not result in the reserve margin falling below 20%, utilizing the August 18th 2008 sensitivity and corresponding resource plan. The transmission impacts are equivalent to just less than one year typical load growth and when spread out over several years are readily manageable.. At a system level, the distribution impacts from PHEV's do not present any significant issues. PHEV's

are most likely to be concentrated in several neighborhoods and in some cases may require transformer upgrades if multiple PHEV's are connected to the same transformer.

The potential emissions impact from PHEV's requires attention by FPL. While overall net emissions (i.e., emissions from the displaced internal combustion vehicles and the fossil fuel-fired generating plants powering the PHEVs) resulting from PHEV's are projected to be significantly reduced, SO_2, NOx and CO_2 emissions at power plants will increase as a result of the incremental energy sales. PHEV penetration in the Aggressive Scenario will result in increases in emissions from FPL's fossil fuel-fired power plants. It is projected that SO_2 emissions will increase by a maximum of 0.63% relative to 2006 emission levels, NOx emissions will increase by a maximum of 2.3% and CO_2 emissions will increase by a maximum of 1.5%. This will make compliance with existing (in the case of SO_2 and NOx) and prospective (in the case of CO_2) emissions limitations correspondingly more difficult and costly. Projected incremental compliance costs for CO_2 alone range from $8 million to $17 million (0.4 -1.3% increase) annually between 2013 and 2020.

While the initial analysis is favorable for FPL, the market is still loosely defined and close monitoring should be performed along four primary areas: manufacturer development and volume projections; lithium-ion battery performance and incremental costs; advances in competing technologies (HEV's, compressed natural gas, bio-diesel); and other utility tests and support activities. To achieve this FPL should consider joining the EPRI PHEV collaborative or other industry groups. FPL should also monitor developments by international markets that may be further experienced on infrastructure issues.

2. Background

Plug-in hybrid electric vehicles (PHEV) have gained public awareness over the last few years as an effective way of reducing greenhouse gas emissions including CO_2 by comparing grid fuel versus internal combustion engines in cars. The most commonly sited policy objectives are environmental benefits, the nation's energy security, and recently as gas prices have reached, or are hovering around $4.00 per gallon, economics.

Media attention has increased and car manufacturers have capitalized on this attention with highly publicized announcements such as General Motors announcement of the Chevy Volt and Toyota's intent to create a PHEV version of the very popular Prius model. These announcements could signal a global race for car manufactures to gain market share for this car segment. Utility companies have also capitalized on the increased attention with public announcements by Duke, Xcel Energy, and PG&E. These utility initiatives have been typically tied to the broader concept of a Smart Grid.

Plug-in hybrid vehicles are becoming a recognized phrase in energy policy and political discussions and were written in the Energy Policy Act of 2005. President Bush has called upon Congress to provide funding to advance PHEV technology, and recently confirmed his support for PHEV's in his 2007 State of the Union address. In September 2006, the House of Representatives unanimously approved legislation (H.R. 6203) that authorized appropriations for PHEV demonstration projects. It is probable that the 110th Congress will take the next step by providing critical funding to help complete the development of PHEV technology and deploy PHEV's for widespread commercial use this may include up to $7,500 in tax rebates. Presidential candidate Barack Obama has proposed to put 1 million PHEV's on the road by 2015 with a consumer $7,000 tax rebate per vehicle.

While auto manufacturers are at the center of the PHEV market development, their dependence on electricity creates many related questions regarding impacts and opportunities available to electric utilities. These include impacts to the Transmission and Distribution systems, potential impacts to Generation Resource Planning, implications regarding emissions levels and necessary support infrastructure.

In June of 2008 the following cross functional team was formed to investigate and prepare this initial evaluation for FPL:

Distribution	Richard Shaheen, Jim Glass, George Survant
Transmission	Joe Mango, Hector Sanchez
Environmental	Joe Miakisz
System Planning	Rene Silva
Finanace	John Wehner
Marketing	Brad Goar
Information Management	Phil Slack
Strategic Initiatives	Alex Zappani
Customer Service	Oscar Gans

3. Technology

There are three related classes of vehicles Hybrid Vehicles, Battery Electric Vehicles, and Plug-in Hybrid Electric Vehicles. Vehicles using both electric motors and internal combustion engines (ICE's) or fuel cells are called hybrid electric vehicles. The battery electric vehicle or electric car is a vehicle that utilizes chemical energy stored in rechargeable battery packs, and electric motors and motor controllers instead of ICE's. The primary limitations of battery electric vehicles, compared to conventional vehicles, were a high price differential, long charge times, and limited range. Hybrid vehicles with batteries that can be charged externally to displace some or all of their ICE power and gasoline fuel are called plug-in hybrid electric vehicles[1].

PHEV's combine the benefits of HEV's and pure electric vehicles (EV's): They are less reliant on petroleum than conventional HEV's and they avoid the challenges of pure electric vehicles[2]. PHEV's can power the vehicle with electricity from the electrical power grid, gasoline (or another liquid fuel), or both. This flexibility also complicates vehicle designs and possible ways of using energy from two different systems.

PHEV's are designed for easy charging without the need for additional hardware. A PHEV sedan can be charged through a 120-V outlet in three to four hours, and a commercial delivery van charges in about four to five hours on a 240-V connection typically found in commercial garages. The PHEV will have an onboard charger that plugs into an electric outlet, or it can be plugged into a charger installed in a service garage. In the future, automakers may offer docking stations: when the vehicle arrives at a workplace parking lot or in a home garage, it rides onto docking platform and charges automatically, without a plug[3].

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[1] Wikipedia, "Plug-in Hybrid Electric Vehicles, and Battery Electric Vehicle definitions"
[2] Denholm, P., Short, W., "An Evaluation of Utility System Impacts and Benefits of Optimally Dispatched Plug-In Hybrid Electric Vehicles", NREL, DOE, October 2006.
[3] EPRI, NRDC, "Technology Primer: The Plug-in Hybrid Electric Vehicle", 2007

PHEV's can be designed to emphasize energy or power requirements (or both) of batteries. At this time auto manufacturers seem to be focusing a significant R&D on battery technology. PHEV's utilize advanced battery technology, principally the nickel metal hydride (NiMH) and the lithium ion (Li-Ion). These battery technologies demonstrate the high energy storage, power delivery, and longevity. Higher performance is achievable, but higher cost exacerbates the cost differential of PHEV's. Full performance compared to ICE's must be available on demand so safety is not compromised (e.g., crossing a busy street, freeway merging or passing).

There is currently a technological race to develop advanced Lithium-ion batteries between three consortiums in Japan, Europe, and the United States. The Japanese is a consortium of Toyota, Panasonic EV, and Sanyo sponsored by MITI. South Korea, China and the European Union also have government-supported advanced battery projects; Johnson Controls and French battery cell producer SAFT have formed a joint venture. The United States formed the US Advanced Battery Consortium between Ford, GM, and Chrysler along with the US Department of Energy. Other independent battery manufacturers ...

Ultimately, the commercial success of the PHEV depends on the development of appropriate battery technologies. There is much uncertainty about what exact requirements a battery must meet to produce a successful PHEV and where different battery technologies stand in meeting such requirements.

4. Auto Manufacturers

Car manufacturers such as GM, Ford and Chrysler have experienced severe economic pressure as SUV and truck sales have plummeted. GM has recently announced the selling or closure of its popular SUV Hummer line. As Detroit reports major losses from the "big three" auto makers, and the increase of Federal government pressure to support PHEV's, they seem to be turning to PHEV's as a way to reinvent their business plans. Several manufacturers have announced plans to develop PHEV's to be introduced into the market starting in 2010. They are being led by General Motors with the Volt, Ford with the Escape, Toyota with the Prius, Saturn with the Vue and Honda with the possibility of modifying the Insight. Figure 1 illustrates sample PHEV's from several manufacturers.

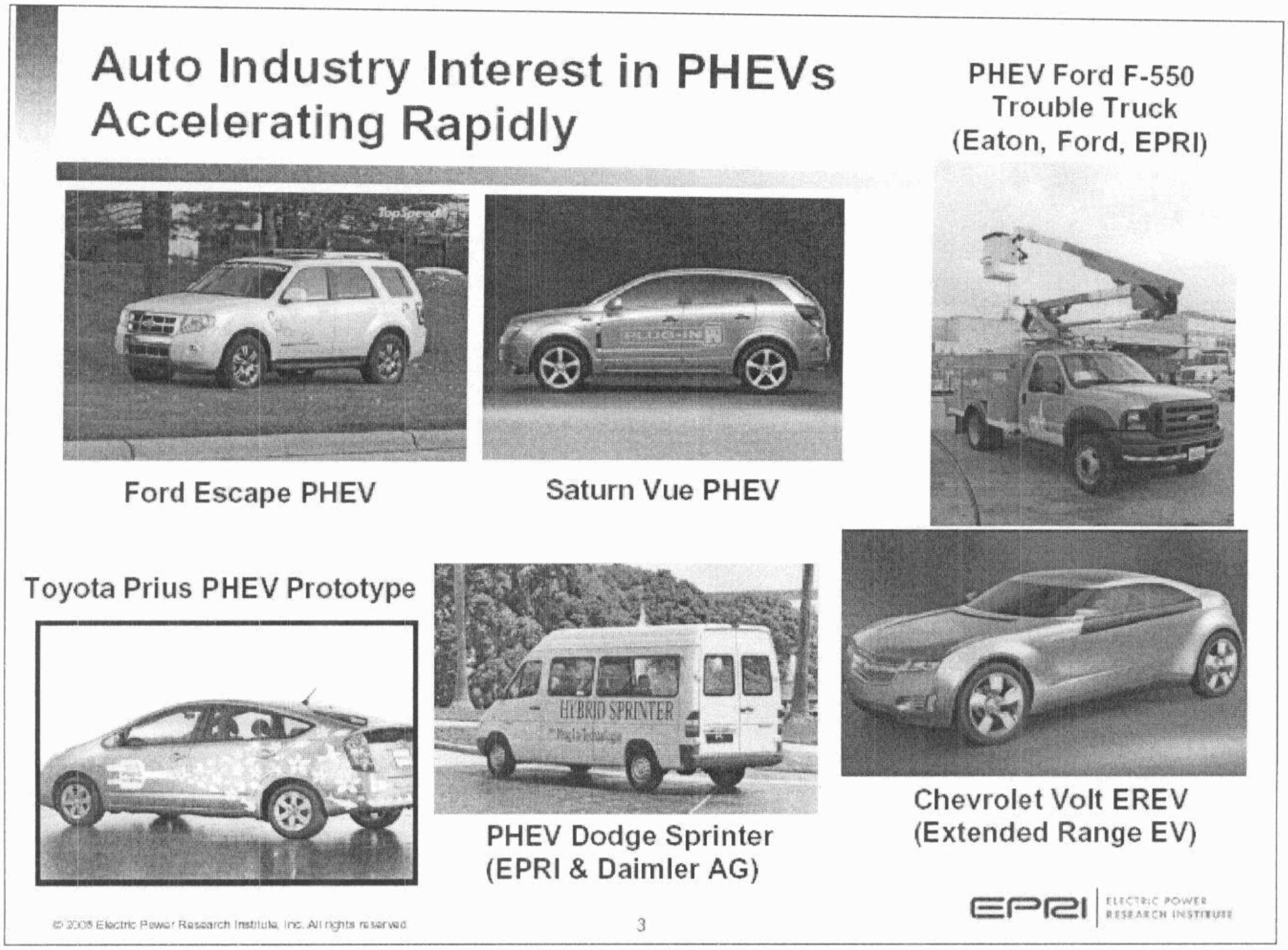

Figure 1. EPRI Illustration of PHEV's from several manufacturers.

In addition to large car manufacturers start up companies such a Fletcher are entering the PHEV market with high-end luxury PHEV's. Aftermarket companies are selling retrofit kits for conventional hybrids and for ICE only vehicles[4]. The kits range from $4,000 up to $36,000 with a median price of approximately $10,000. Figure 2 demonstrates a Toyota Prius HEV to PVEV conversion kit from Hymotion available for $9,995.

[4] Rubens, C., "How to Eco-Pimp Your Prius with a Plug", eart2tech.com

Figure 2. Aftermarket Prius PHEV conversion kit from Hymotion.

The PHEV's will be available with a significant premium driven primarily by battery technologies. According to Edmunds.com, the Chevy Volt was originally estimated to cost $30,000. Due to unexpected increases in costs, it is now expected to cost $48,000 and full market deployment may not occur until 2014. This would equate to a $7,000 to $18,000 premium over a conventional HEV. The average premium over a conventional vehicle is expected to be $10,000[5] and probably more. The price premium will continue to be a primary challenge for the manufacturers.

5. Competing Technologies

PHEV's fall into the broad category of alternative fuel vehicles which include Natural Gas, Bio-diesel, Propane, Hydrogen powered vehicles and conventional Hybrid Electric Vehicles (HEV's). The competition can be categorized as modified internal combustion engines, natural gas, hybrid electric drive vehicles, and new fuel vehicles. A detailed comparison of the alternative fueled vehicle technologies can be found in Appendix 2. All of the alternative fuel vehicles in this section are benefiting from laws and incentives to encourage research, development, and purchases. A list of Florida and Federal laws and incentives are included in Appendix 3 and 4 respectively.

The modified internal combustion engine vehicles category includes current flex fuel vehicles, Biodiesel, ethanol, clean diesel, and natural gas. These have a common competitive cost advantage over PHEV's arising from the lower incremental cost of modifying the engine components by manufacturers.

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[5] Markel, T. and Simpson, A.,"Cost-Benefit Analysis of Plug-In Hybrid Electric Vehicle Technology", WEVA Journal, Vol.1, 2006.

Natural gas vehicles include Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) vehicles. The benefits include gas availability in more than 25 states - energy security and fewer emissions. They currently account for 2.2% of energy used for transportation primarily in mass transit applications and there were approximately 150K vehicles in U.S. as of 2007. These vehicles require significant infrastructure investments for fuel. There are 1,100 refueling stations as of 2008 – mainly in California. Only one car model is commercially available (Honda Civic GX) plus OEM conversion kits. These are being heavily promoted by T. Boone Pickens.

Conventional hybrid electric vehicles (HEV's) that are technically the most similar to proposed PHEV designs will be significant competition for PHEV's. These differ primarily on the size of batteries and ability to plug in. The intermediate price point and similar consumer benefits are forecasted to result in this being the most significant competition to PHEV's.

New fuel vehicles include hydrogen powered vehicles and fuel cell vehicles. These technologies are currently in research stages. These technologies still need to resolve issues with fuel availability, storage, and a practical fuel cell design.

6. PHEV Market Drivers

Economics and Energy security

One of the primary drivers for PHEV's will be the expected reduction in operating expense as a result of lower fuel expenses. By GM's calculations, the Volt would save the typical driver 500 gallons of fuel a year over an ICE vehicle. At $3.85/ gallon that would save the average consumer $1,925 dollars per year and would raise the average electric bill by $300/year (Edmunds) At a $7,000 premium over a conventional hybrid vehicle, the simple payback for the PHEV would be achieved in 3.6 years. However, the payback over an ICE vehicle is 5.7 years and puts the PHEV out of range for the average consumer. If the price of a PHEV increases the additional, $18,000 that was noted by Edmunds market acceptance for the PHEV will be very limited. Figure 3 demonstrates that the current price premium projections are above the breakeven point against HEV's and the target for the United States Advanced Battery Consortium (USABC) would have an advantage above $4.50 per gallon gasoline prices. Figure 4 compares the operating costs of alterbative fueled vehicles and conventional internal combustion engines.

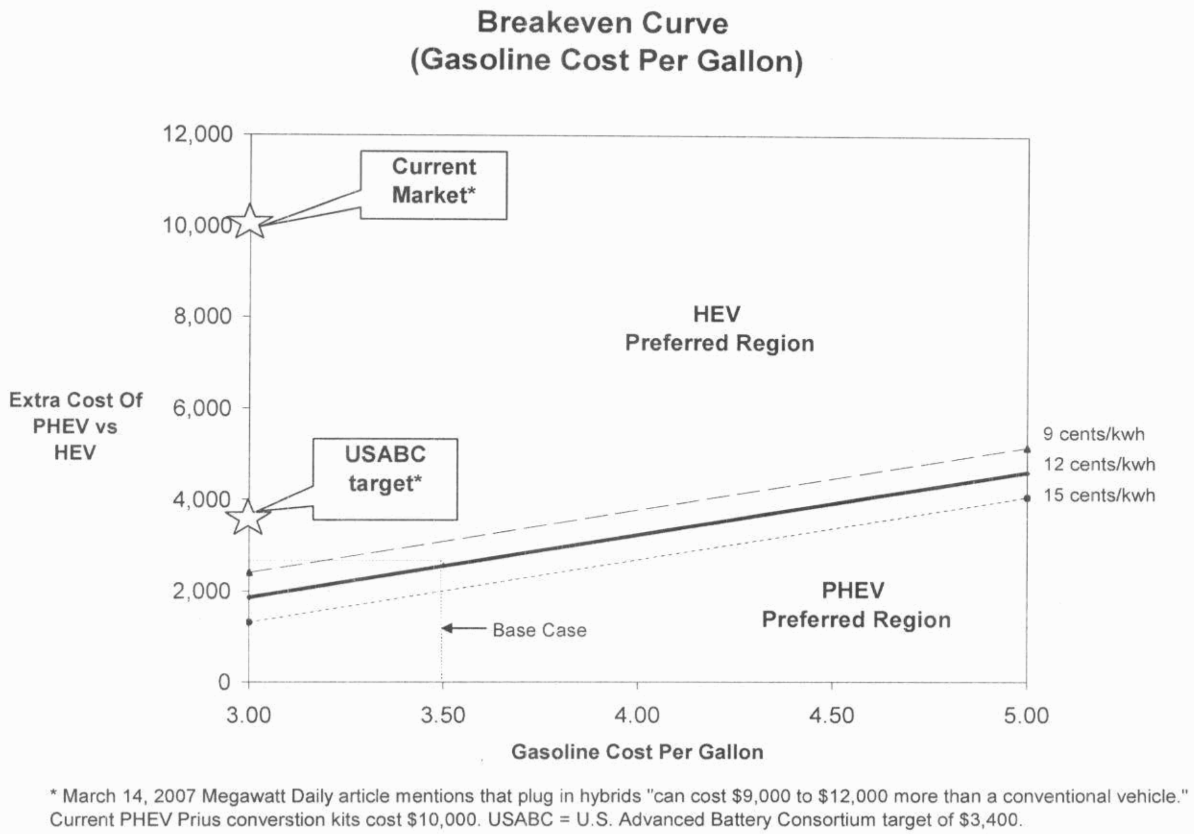

Figure 3. Fuel Cost Breakeven Analysis between PHEV's and HEV's

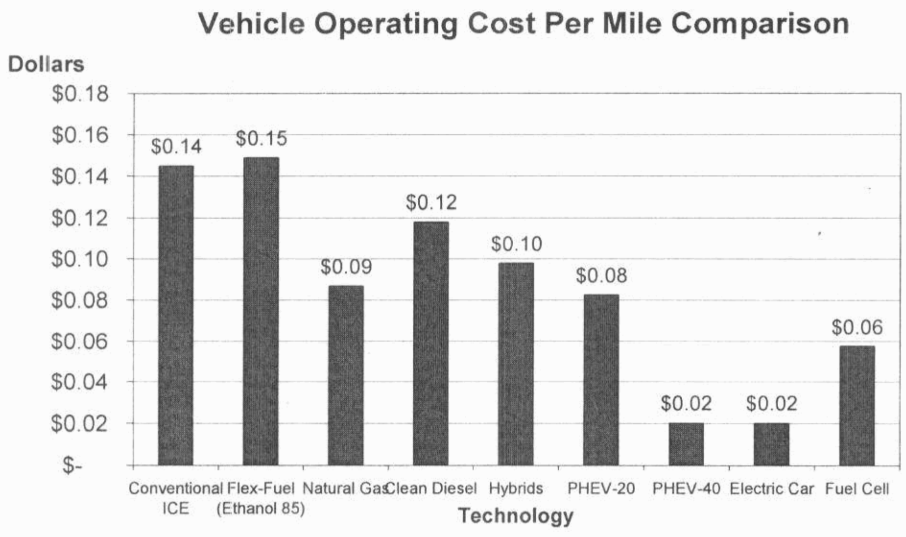

Figure 4. Vehicle technology operating cost per mile comparison.

Another driver for market acceptance of PHEV's is the concern over air pollutants and global warming. Once perceived as a "fringe" theory, global warming is now a mainstream concern. Plug-in vehicles that can be recharged through the electric power grid will use significantly less gasoline than current hybrids and standard vehicles—and therefore will release fewer air pollutant and greenhouse gas emissions.

Several studies[6,7] have examined the potential impacts of significant penetration of PHEVs on air pollutant and greenhouse gas emissions. In 2007, the Electric Power Research Institute (EPRI) and the Natural Resources Defense Council (NRDC) collaborated to conduct the most comprehensive environmental assessment of electric transportation to date, examining the greenhouse gas emissions and air quality impacts of PHEVs. The joint EPRI/NRDC study focused on the likely environmental impacts of bringing a large number of PHEVs onto American roads over the next 50 years.

The first part of the study employed a scenario-based modeling analysis to determine how PHEVs would change U.S. greenhouse gas emissions between 2010 and 2050 under various circumstances. This comprehensive "well-to-wheels" analysis tracked emissions from the generation of electricity to the charging of PHEV batteries and from the production of motor fuels to their consumption in internal combustion vehicles. Researchers used detailed models of the U.S. electricity and transportation sectors to create a range of potential scenarios and changes in both sectors.

Results of the study were unambiguous: greenhouse gas emissions were reduced significantly over all of the scenario combinations examined. Nationally, the cumulative greenhouse gas emissions reductions by 2050 was projected to be at least 3.4 billion metric tons (Gt) assuming a persistently high level of CO_2 intensity in the electric sector and a low level of PHEV fleet penetration. Assuming low CO_2 intensity and a high level of fleet penetration, the cumulative GHG reduction was projected to be 10.3 Gt. Reductions were realized for each region of the country.

Figure 5 presents an emissions comparison between a conventional internal combustion engine (ICE) vehicle at 450 grams of per mile, a standard Hybrid Electric Vehicle (HEV) at approximately 300 grams per mile and PHEV's which are expected to emit between 150 and 325 grams of CO_2 per mile depending on the power plant generation mix. Bottom line, PHEV's including emissions from power plants will emit somewhere between 0% and 50% less emissions than a HEV and between 20% and 70% less than an ICE. Note that Pacific Northwest National Laboratory estimates that in Florida, PHEV's would emit about 29% less CO_2 than ICEs[8]. This information conflicts with the Fall 2005 EPRI Journal article[9] stating that PHEV's emit 1/3 the green house emissions of a gasoline vehicle.

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[6] "Allowance price projections", ICF International's U.S. Emission and Fuel Markets Outlook, 2007.
[7] Duval,M and Knipping, E. . "Environmental Assessment of Plug-In Hybrid Electric Vehicles" Vol's 1 and 2, EPRI, NRDC, July 2007
[8] Kintner-Meyer, M, "Impacts Assessment of Plug-In Hybrid Vehiciles on Electric Utilities and Regional U.S. Power Grids Part 1: Technical Analysis", page 13
[9] EPRI, article…

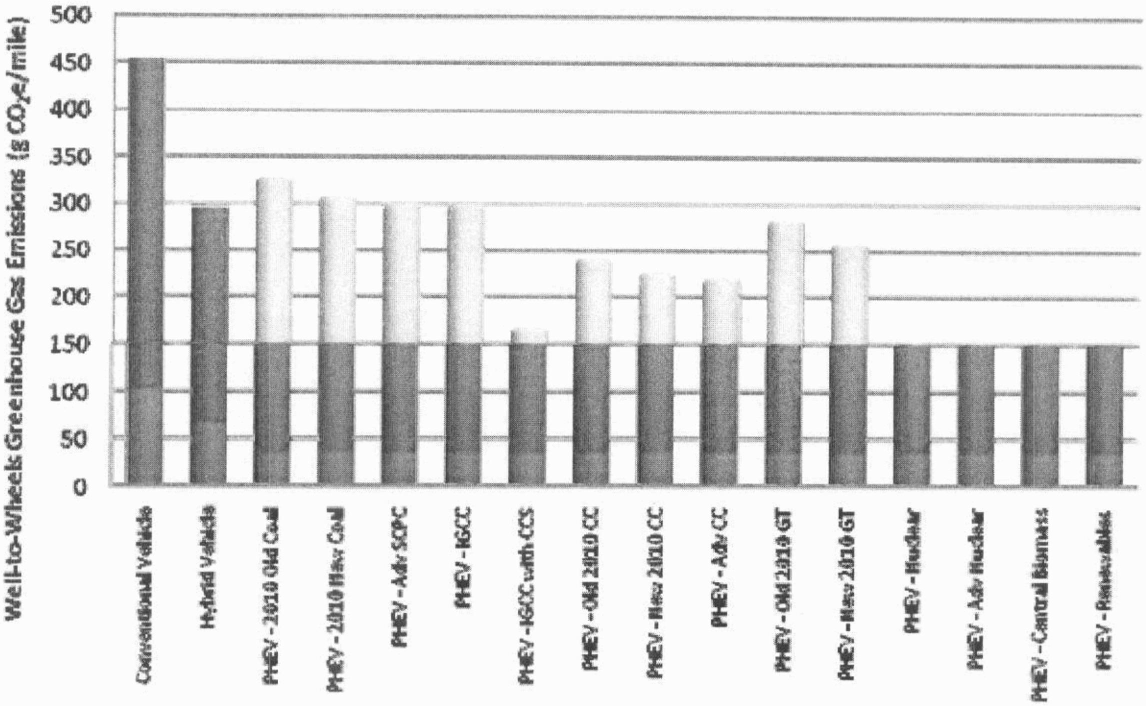

Figure 5. Vehicle CO2 Emission Comparison - EPRI, NRDC

The second part of the EPRI/NRDC study focused on determining the effect of aggressive PHEV fleet penetration on overall air quality in a single year, 2030. It compared a base case that assumed no PHEV penetration with an aggressive penetration case in which PHEVs achieve 50% of new vehicle sales and constitute 40% of on-road vehicles by 2030.

The analysis found that, for most regions of the U.S., increased PHEV penetration use would result in modest but significant improvements in ambient air quality and reduction in deposition of various pollutants. Considering the electricity and transportation sectors together, PHEVs would help reduce emissions of volatile organic compounds, nitrogen oxides, and sulfur dioxide. Ozone levels were projected to decrease substantially for most regions, although there would be very minor increases in some local areas. Ambient levels of particulate matter were also projected to decrease in most regions.

7. PHEV Markets

Business Fleet Market

Fleet vehicle owners may be a market that has not been openly discussed as potential purchasers of PHEV's. Certain fleets of 20 or more of centrally fueled light duty vehicles are under requirements to acquire alternative fuel vehicles under the Energy Policy Act (EPAct) of 1992 or the 2007 Executive Order (E.O.) 13423: Strengthening Federal Environmental, Energy, and Transportation Management. Vehicles that weigh less than 8,500 lb gross vehicle weight rating (GVWR) are considered LDVs.

Fleet owners have several options for compliance. The EPAct defined alternative fuels include:
- Methanol, ethanol, and other alcohols;
- Blends of 85% or more of alcohol with gasoline;
- Natural gas and liquid fuels domestically produced from natural gas;
- Liquefied petroleum gas (propane);
- Coal-derived liquid fuels; and
- Hydrogen and electricity.

The detailed requirements are beyond the scope of this analysis. Fleets that are subject to acquisition requirements include:
- Federal agencies
- State government agencies
- Alternative fuel provider (this includes businesses "selling electricity at wholesale or retail")
- Certain private and local government fleets[10]

Based on the many options for compliance available to affected fleet owners, it is expected that economics will have the highest weighting on PHEV purchase decisions. Other factors such as the publicity and the branding value of PHEV's may accelerate the strategic adoption of small numbers of vehicles. For example, FPL has Bio-diesel; HEV's and has experimented with a conversion kit to PHEV's.

Consumer Purchaser Profiles

Early adopters will be sufficiently affluent to make their purchases based on emotional drivers vs. pragmatic ones. These emotional drivers are being driven by the current oil situation and are fortified by environmental concerns. There are several potential profiles of a person who would be most likely to purchase a PHEV as an early adopter.

Though estimates of the number of vehicles vary, given the demographic profiles of likely purchasers it is anticipated that the initial distribution of vehicles will be in discrete neighborhoods. A model was created to identify customers who would most likely purchase a PHEV based upon the above information. "Boomers and X-ers" were selected with an annual income of $75,000 or more and who did not have children and were in the range of 30-66 years old. This profile was determined as the most likely profile to purchase a PHEV based upon attitude and income within the first 5 years of market launch.

PHEV Neighborhoods

With such a large price differential between a conventional internal combustion engine vehicle and the PHEV ($8,000-$11,000) it is very doubtful that THE PHEV is going to achieve mainstream status in the next five years. Due to the initial limited purchases, it is important to understand where they live within the FPL service territory.

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[10] DoE "10 CFR Part 490 RIN 1904–AB69 Alternative Fuel Transportation Program; Private and Local Government Fleet Determination", Office of Energy Efficiency and Renewable Energy, Department of Energy (DOE), Federal Register Vol. 73, No. 51, March 14, 2008

This profile was then layered over the FPL database to understand where they live and if there would be extremely dense populations within specific areas. From this exercise, it was discovered that there are only two zip codes within our service area where there may be more than 300 PHEVs by 2020. The zip codes are 33414 (West Palm Beach) with a potential of 345 PHEVs and 33186 (Miami) with 317 potential PHEV owners.

The following 13 zip codes within FPL's service area where identified to have the potential to have 200 or more PHEVs by 2020.

Zip Code	PHEVs	Neighborhoods/City
33414	345	West Palm Beach
33186	317	Miami
33076	218	Pompano Beach
33067	200	Pompano Beach
33156	239	Miami
33071	221	Pompano Beach
34119	205	Naples
33176	274	Miami
33458	261	Jupiter
33418	235	Palm Beach Gardens
33433	243	Boca Raton
33411	264	West Palm Beach
33467	244	Lake Worth
33308	233	Fort Lauderdale
32174	222	Ormond Beach

8. Other Utilities

Utility activities range from public PHEV demonstrations to experimentation with PHEV line trucks. There have been press releases from several utilities such as Duke, PG&E, SDG&E regarding PHEV's. These are typically associated with information regarding SmartGrid deployments. Activities vary significantly: Some utilities are involved directly with manufacturers – PG&E, SCE; Other utilities have partnered with EPRI and car manufacturers in pilot programs; and ohers are participating with Electric Drive Transportation Association – a lobbying organization to promote electric transportation. Appendix 5 lists all of the participating utilities in EPRI's PHEV collaborative program.

The disparate activities by the utilities indicate an opportunity for unifying efforts for addressing common legislative and infrastructure issues.

9. FPL Forecast

The projections for the actual number of vehicles that will be available by the year 2020 in the United States range from a DOE forecast 10,000 PHEV's, and an EPRI forecast of 400,000 PHEV's.

Three forecasts were developed for the potential number of PHEV's within FPL starting with the following base assumptions: 1. Approximately 6.1% of the registered vehicles in the United States are registered in Florida[11]. 2. Approximately 50% of the State of Florida's population is located within FPL's service territory. 3. The adoption for PHEV's would resemble the historical adoption curves for consumer durable goods in the United States.

The low scenario based on the 10,000 PHEV DOE forecast would result in 305 PHEV's in FPL by the year 2020. The "most likely" scenario was developed by applying a 200% factor to the 400,000 PHEV EPRI forecast and rounding to 25,000 vehicles by the year 2020. Figure 6 displays the annual forecasted number of vehicles for the three forecast ranges.

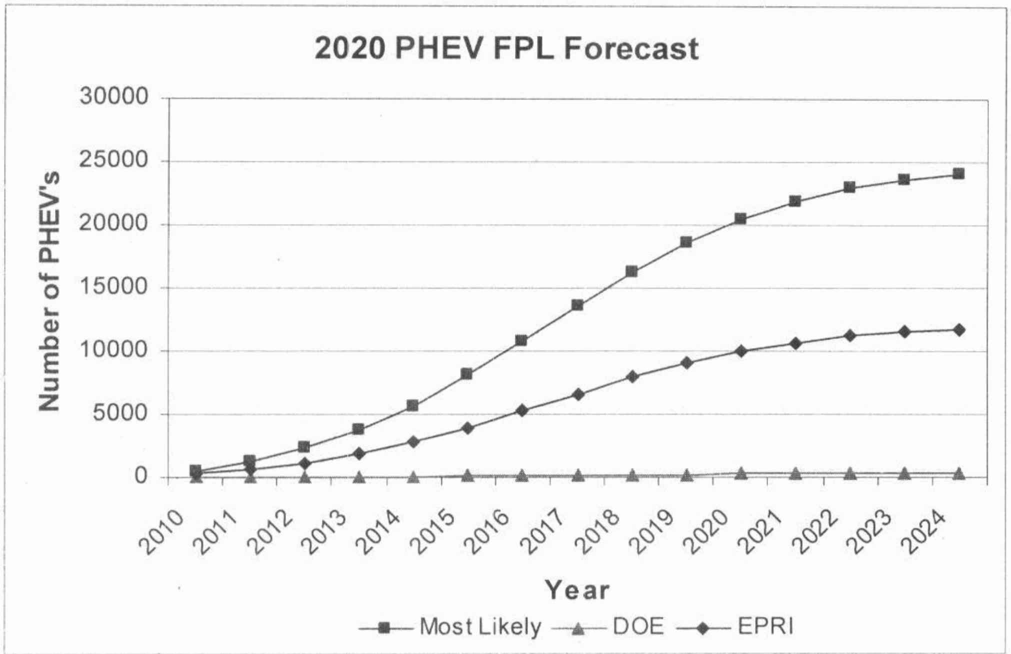

Figure 6. Forecasts for the number of PHEV's within FPL by 2020.

10. FPL "What If" Analysis

Based on the fact that the maximum forecast resulted in a total of 25,000 vehicles, the team developed the following scenario intended to stress the system by a larger number of vehicles occurring by 2020 and achieving adoption and saturation at a much more rapid rate. This was developed by starting with a DOE analysis that evaluated the potential effects on the US electric grid if 25% of vehicles became PHEV's[12] which would result in 1,200,000 in Florida and 600,000 PHEV's in FPL's territory (this would be roughly equivalent 3% of 19.6 million PHEV's in the United States). A severe accelerated market adoption was modeled based on the market adoption of cellular phones which reached market saturation levels in 6 years. Figure 7 illustrates the "what if" scenario.

[11] Energy Information Administration, "2008 Annual Energy Outlook Reference Case Forecast", U.S. Department of Energy

[12] Hadley, S., " Potential Impacts of Plug- in Hybrid Electric Vehicles on Regional Power Generation", U.S. Department of Energy, Oak Ridge National Laboratory, January 2008.

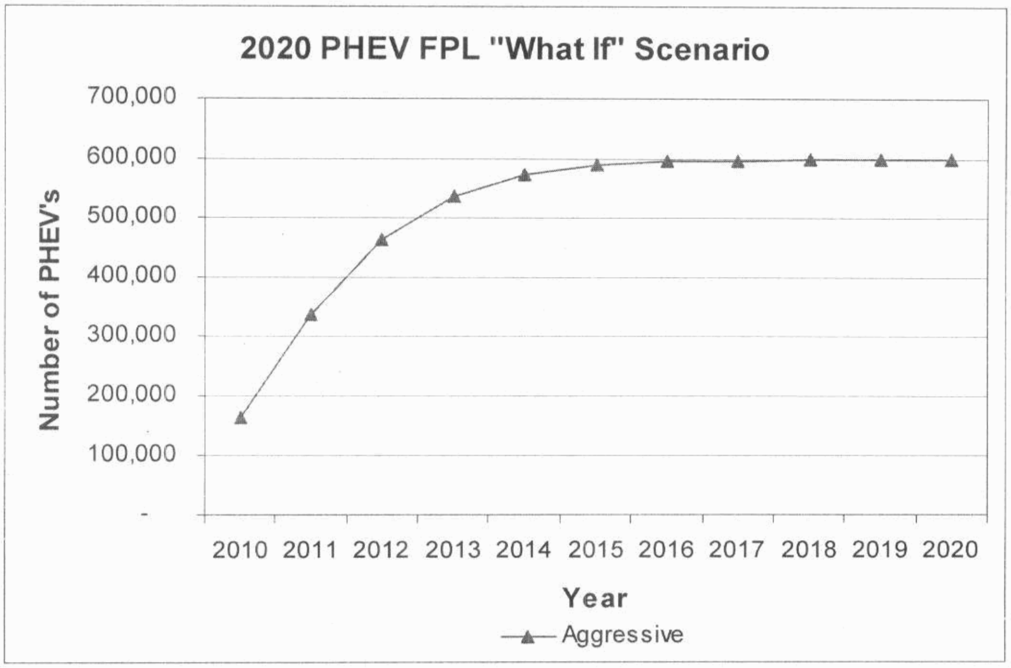

Figure 7. FPL aggressive scenario illustrating rapid adoption of a large number of vehicles.

11. FPL Load Impacts and Forecast

Individual Charger Loads

Car manufacturers are currently evaluating 120V and 240V residential charger designs in 120V / 15A, 120V / 20A, and 208/240V / 30A. As Figure 8 below indicates, the amount of time required and the kW load will significantly change between the designs with the higher voltage units being able to provide a faster recharge time (2 hours vs. 5 hours) but with a greater demand (4.2kW vs. 1.8kW). The advantage of the 120V units is that this configuration is the most common in garages and the customer can avoid additional rewiring expenses. The higher voltage units may be more attractive for commercial fleet vehicles because of the rapid recharge. Commercial fleet owners pushed for rapid recharge designs with the original all electric vehicles.

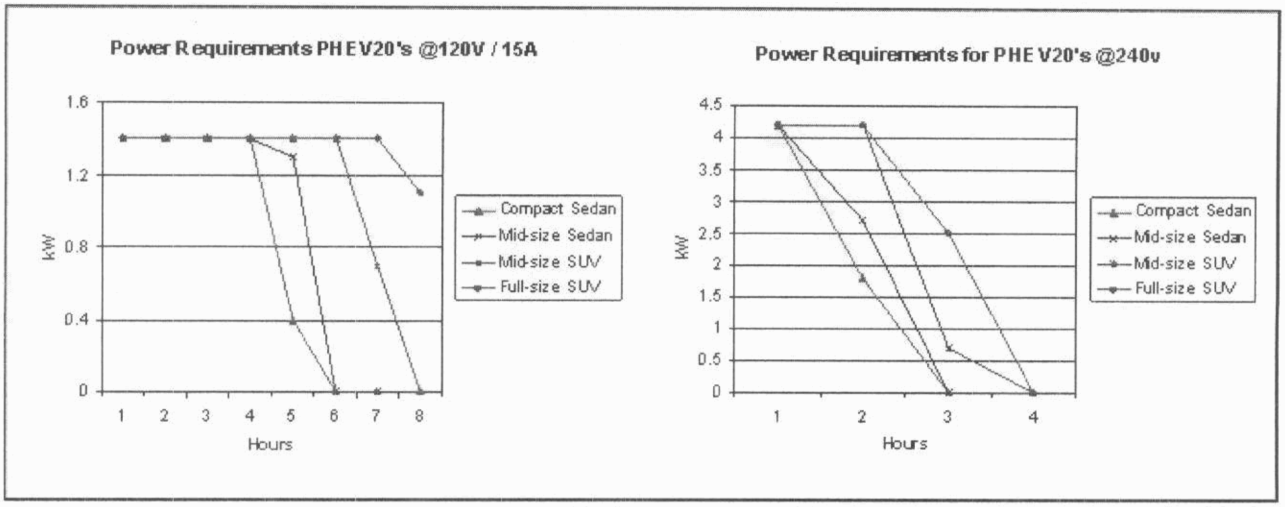

Figure 8. Charger Load Duration Comparison for 120V and 240V Designs

System Charger Loads

The timing of the when charger loads will appear throughout the day on the FPL system will diversify the load impacts. A preliminary load shape was adapted from daily charging curves developed by applying the charger profiles to the distribution of commuter trips per day[13,14]. Figure 9. shows that the resulting peak impacts per charger would be: 0.44 kW Summer Coincident demand and 0.06 kW for the Summer demand for the 120V charger and 0.65 kW Summer Coincident demand and 0.08 kW for the Summer demand for the 240V.

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[13] Kintner-Meyer, M., Technical Potential Assessment of Plug-In Hybrid Vehicles on Regional Power Grids, NARUC Meeting Summer Committee Meeting, Pacific Northwest laboratories, U.S. Department of Energy, July 2008.
[14] United States Department of Transportation. "The 2001 National Household Travel Survey, daily trip file".

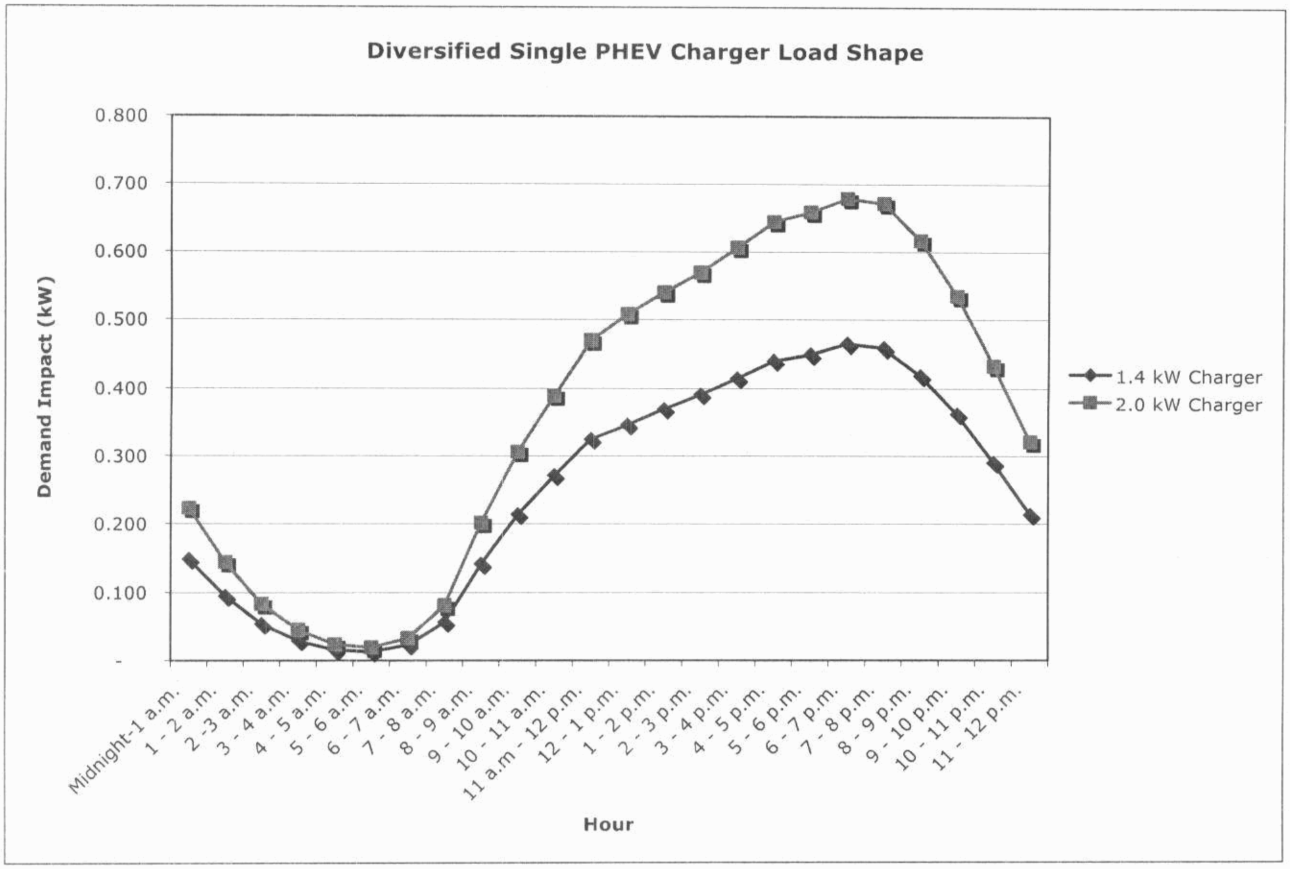


Figure 9. Diversified Single Charger Load Profiles

FPL Load Projections

The PHEV load impacts for the "most likely" forecast and aggressive "what if" scenarios result in potential 9.0 and 387 Summer Peak MW respectively by the year 2020. Figure 10 displays the annual impacts.

MOST LIKELY FORECAST											
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Vehicles	502	1240	2299	3763	5691	8070	10782	13606	16285	18610	20478
Summer Peak	0.22	0.55	1.01	1.66	2.51	3.56	4.75	5.99	7.17	8.20	9.02
Winter Peak	0.03	0.07	0.13	0.21	0.32	0.45	0.61	0.77	0.92	1.05	1.15
GWH	1	3	5	8	12	18	24	30	36	41	45

AGGRESSIVE SCENARIO											
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Vehicles	162,268	335,401	464,789	538,064	573,201	588,705	595,293	598,048	599,192	599,666	599,862
Summer Peak	105	216	300	347	369	379	384	385	386	386	387
Winter Peak	13	27	38	43	46	48	48	48	48	48	48
GWH	521	1,077	1,493	1,728	1,841	1,891	1,912	1,921	1,925	1,926	1,927

Figure 10. FPL Annual PHEV Incremental Load Impact Models

12. Discussion of Load Forecast Implications

Distribution System

The load projections from PHEV for the most likely and aggressive scenarios do not present significant issues for the broad distribution system based upon the 120v charging profiles. Based on the variation in transformer and service conductor sizes and loading, there could be isolated cases in which the PHEV load could be an impact at peak. Based on the profile of PHEV buyers there may be increased local concentrations of these vehicles in specific neighborhoods. There is a potential for localized transformer issues which could result in the replacement of some transformers to larger sizes. Similarly, if a commercial fleet owner transitions to PHEV's and needs to charge a large number of vehicles, it would most likely require a larger infrastructure – both for FPL and for the customer. The 240v charging profile would likely result in the upgrade of some service conductors – especially if there is not an incentive for the customer to charge their vehicle off-peak.

Transmission System

On average, over the long-term, the system experiences 1.5-2% increase in peak load per year. Based on approx. 30,000MW peak summer load by the year 2020, this amounts to a 450-600MW increase in peak load per year in the 2020 time-frame.

Transmission and substations are constructed to serve FPL customers and transmission service obligations in a reliable manner (i.e., compliant with NERC Reliability Standards) during all load levels (valley, shoulder and peak).

Generally, 3-5 years advance notice is required to plan, site, permit and construct new transmission or substations facility.

Over the past 5 years transmission/substation expansion budget to meet load growth of approx. 400-500 MW per year has resulted in capital expenditures of approx. $100-150M per year. It is reasonable to presume that with similar annual load growth increase in the 2020 time-frame this level of capital expenditures will continue (adjusted from 2008 to 2020).

If increased valley or shoulder period load levels due to PHEVs would result, these increased loads would not be expected to require additional transmission or substation facility requirements.

Since transmission expansion plans for the system are available for up to about 2014-2015 (except for the Turkey Point 6/7 plans) time frame, it would not be possible to assess the impact of accelerating certain projects due to increased loads resulting from PHEVs. Therefore, the table below is used to represent a high level indication of capital transmission expenditures that could be required for different increases in load levels based the discussion of capital expenditures above:

Increases in peak load due to PHEVs:	Estimated Capital Expenditures (2020)
100 MW at peak	$0 – 10 M
400-600 MW at peak	$100 – 150 M
800-1200 MW at peak	$200 – 300 M

System Planning

The PHEV "most likely" forecast and the "aggressive" scenario were evaluated against the August 18, 2008 base load sensitivity. The "most likely" model will have no effect on the resource planning process. Even with 100% coincident charging, each requiring 1.5 kW, the maximum contribution to peak load would only be 31 MW

The aggressive scenario is aggressive, not only because of the magnitude but also because of the very early adoption. Under this scenario, the nominal capacity requirements for 599,862 vehicles by 2020 would be 464 MW. The corresponding impact on the need for additional capacity to maintain a 20% reserve margin will depend on the growth of peak demand absent the PHEVs, and on the coincidence of the PHEV load. Figure 11 below illustrates that based on the August 18, 2008 load sensitivity, the aggressive scenario does not result in any years with a capacity need below the 20% reserve margin.

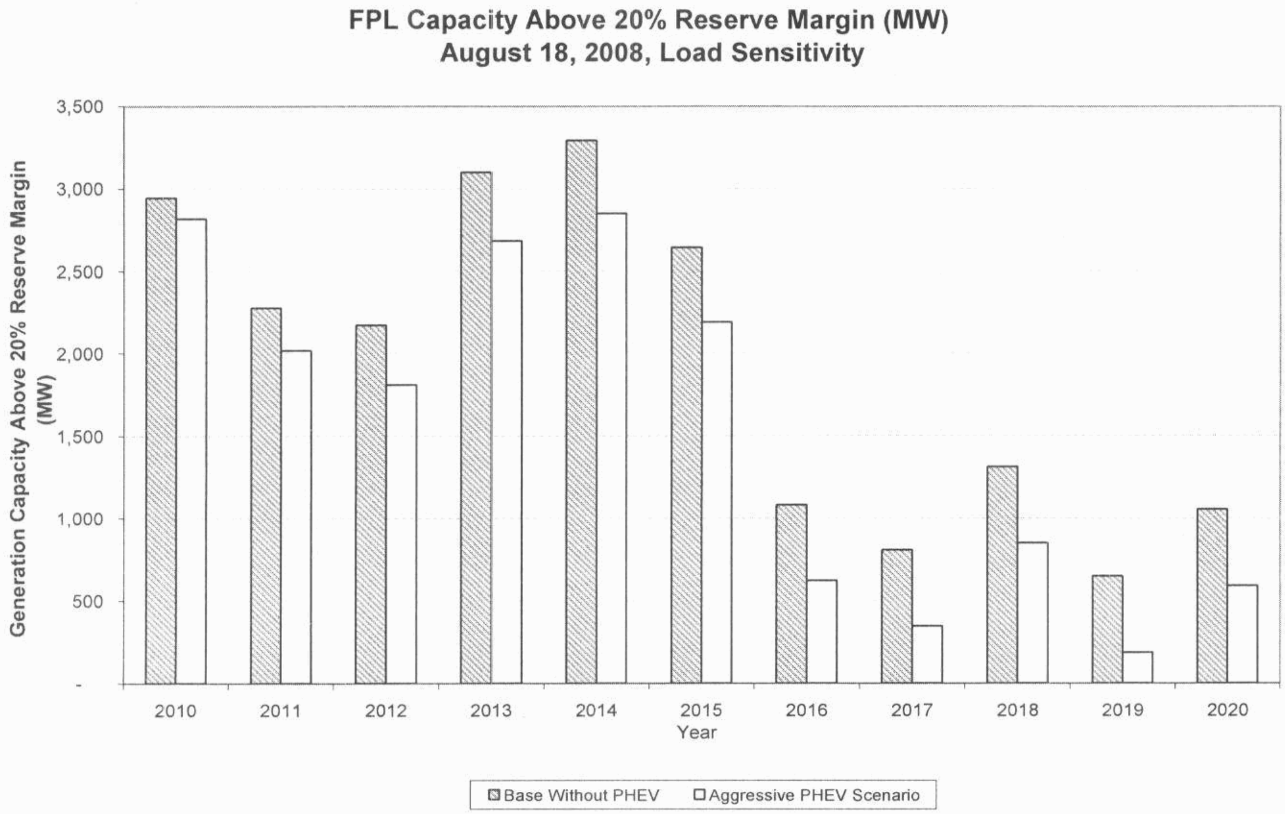


Figure 11. Effect of Aggressive PHEV Scenario on Generation Capacity Need Using August 18, 2008 Load Sensitivity

Even if the result is that we are exactly at 20% reserve margin, FPL still has about 4,000 MW of reserves, between DSM and generation, combined.

Potential Emissions Impact

Increased load associated with future penetration of PHEVs in FPL service territory will result in corresponding increases in fossil fuel-fired power plant air pollutant (i.e., SO_2 and NOx) and greenhouse gas (CO_2) emissions. Based on the "most likely" PHEV penetration level being examined, the resulting emissions increases will be insignificant relative to current FPL fleet emission levels.

As indicated in the table below, projected emissions impacts become more pronounced in the "aggressive" PHEV penetration scenario. However, the incremental increases in emissions associated with PHEV penetration still represent a relatively small percentage of total emissions from fossil fuel-fired generation serving FPL's customer load in Florida. For example, relative to 2006 emission levels, the maximum projected increases in annual emissions associated with PHEV penetration are a 0.63% increase in SO_2 emissions, a 2.3% increase in NOx emissions and a 1.5% increase in CO_2 emissions[15].

Aggressive Scenario Emission Impacts

Year	Total # Vehicles	Incremental SO_2 Emissions (tons)	Incremental NOx Emissions (tons)	Incremental CO_2 Emissions (tons)
2010	162,268	190	295	212,000
2011	335,401	280	403	350,000
2012	464,789	372	566	499,000
2013	538,604	413	730	583,000
2014	573,201	419	716	594,000
2015	588,705	424	663	622,000
2016	595,293	347	851	641,000
2017	598,048	339	949	659,000
2018	599,192	330	820	659,000
2019	599,666	322	900	642,000
2020	599,862	313	748	643,000

Nonetheless, the projected emissions increases associated with PHEV penetration in the Aggressive Scenario will make it more difficult, and costly, for FPL to comply with existing (in the case of SO_2 and NOx) and anticipated future (in the case of CO_2) federal and state emission limitations. Since SO_2 and NOx emissions are currently regulated under an emissions cap-and-trade program (the Clean Air Interstate Rule) and CO_2 emissions are anticipated to be regulated under either a national or state/regional cap-and-trade program, one way of quantifying the potential additional compliance costs associated with PHEV penetration is to estimate the cost of acquiring additional emission "allowances" to cover the incremental emissions. The table below presents projected annual SO_2, NOx and CO_2 allowance price forecasts and the additional allowance purchase costs that FPL would incur to cover the incremental emissions associated with PHEV penetration in the aggressive scenario.

Aggressive Scenario Incremental Allowance Purchase Costs

[15] 2006 emissions from FPL's fossil fuel-fired generating fleet = 67,167 tons SO2, 41,791 tons NOx and 42,894,343 tons CO2.

Year	SO_2 Allowance Price Forecast (2006$)2	SO_2 Allowance Cost (2006$)	NOx Allowance Price Forecast (2006$)2	NOx Allowance Cost (2006$)	CO_2 Allowance Price Forecast (2006$)2	CO_2 Allowance Cost (2006$)
2010	1,129	214,837	1,348	396,986	-	-
2011	1,206	337,620	1,440	580,320	-	-
2012	1,289	478,889	1,538	870,508	-	-
2013	1,377	569,073	1,643	1,198,569	12	6,996,000
2014	1,472	617,033	1,756	1,257,296	13	7,722,000
2015	1,573	666,181	1,876	1,242,850	14	8,708,000
2016	1,681	582,954	2,005	1,706,255	15	9,615,000
2017	1,794	608,668	2,141	2,031,809	16	10,544,000
2018	1,916	631,935	2,286	1,874,520	17	11,203,000
2019	2,046	658,955	2,442	2,196,579	18	11,556,000
2020	2,184	682,937	2,607	1,948,733	19	12,217,000

The projected additional allowance purchase costs associated with PHEV penetration are relatively modest for SO_2 and NOx, ranging from approximately $200,000 to $700,000 per year for SO_2 and from approximately $400,000 to $2.2 million per year for NOx. However, for CO_2, the projected costs are substantial, ranging from approximately $8 million to $17 million annually (0.4--1.3% increase)

Based on the joint EPRI/NRDC study discussed earlier, as well as other similar environmental studies of PHEVs that have been conducted, it appears that on a net basis (i.e., considering emissions from both the transportation sector and the electric generating sector), PHEVs hold the promise of reducing overall air pollutant and greenhouse gas emissions. This, of course, is beneficial from a societal point of view. However, as demonstrated above, electrification of the transportation sector will result in a transfer of emissions from conventional gasoline- and diesel-fueled vehicles to power plants. Insofar as the electricity that is generated to meet the additional load associated with PHEV penetration comes from fossil fuel-fired sources, owners of these power plants, including FPL, will face increases in plant emissions and corresponding increases in costs of compliance with applicable emission limits, including anticipated federal and/or state/regional regulation of CO_2 emissions.

Currently, there is no mechanism whereby electric generating companies could be credited with the emissions reductions from the vehicles that are displaced by PHEVs. This issue is addressed in the following section of the report.

13. Possible Actions to Address Implications

Emissions Implications

As indicated in the previous section, while market penetration of PHEVs may result in overall net decreases in air pollutant emissions (SO_2 and NOx) and CO_2 emissions (the major contributor to climate change) associated with vehicular travel, aggressive penetration of PHEVs in FPL's service territory will result in significant increases in emissions from the Company's fossil fuel-fired power plants. This will make compliance with existing (SO_2 and NOx) and prospective (CO_2) emissions limitations more difficult and costly. Projected incremental compliance costs for CO_2 alone range from $8 million to $17 million (0.4 -1.3%) annually between 2013 and 2020.

Since studies to date have indicated that society at large will benefit from the net emission reductions associated with widespread marketing of PHEVs, equity considerations dictate that there should be some mechanism in place to allow electric generating companies like FPL to offset part or all of the emission increases resulting from additional PHEV load by crediting concomitant decreases in emissions from the displaced internal combustion engine vehicles. Currently, such a mechanism does not exist.

Accordingly, in the context of the national debate on climate change legislation, as well as other state and federal public policy forums, FPL should advocate for the adoption of some type of mechanism that allows electric utilities to net out (or offset) emissions increases associated with increased PHEV load with emission reduction credits from the displacement of conventional internal combustion engine vehicles.

This is anticipated to be a very contentious issue as the automakers and fuel suppliers will be strongly advocating that they be credited with the emissions reductions associated with displacement of conventional vehicles with PHEVs.

14. Next Steps

As was shown in this initial analysis, the initial vehicle forecast does not present significant challenges to FPL's system but it does present the company to consider possible opportunities to leverage PHEV's. There are potentially positive Marketing and Brand positioning opportunities. Listed below are potential next steps in the creation of an FPL/PHEV strategy.

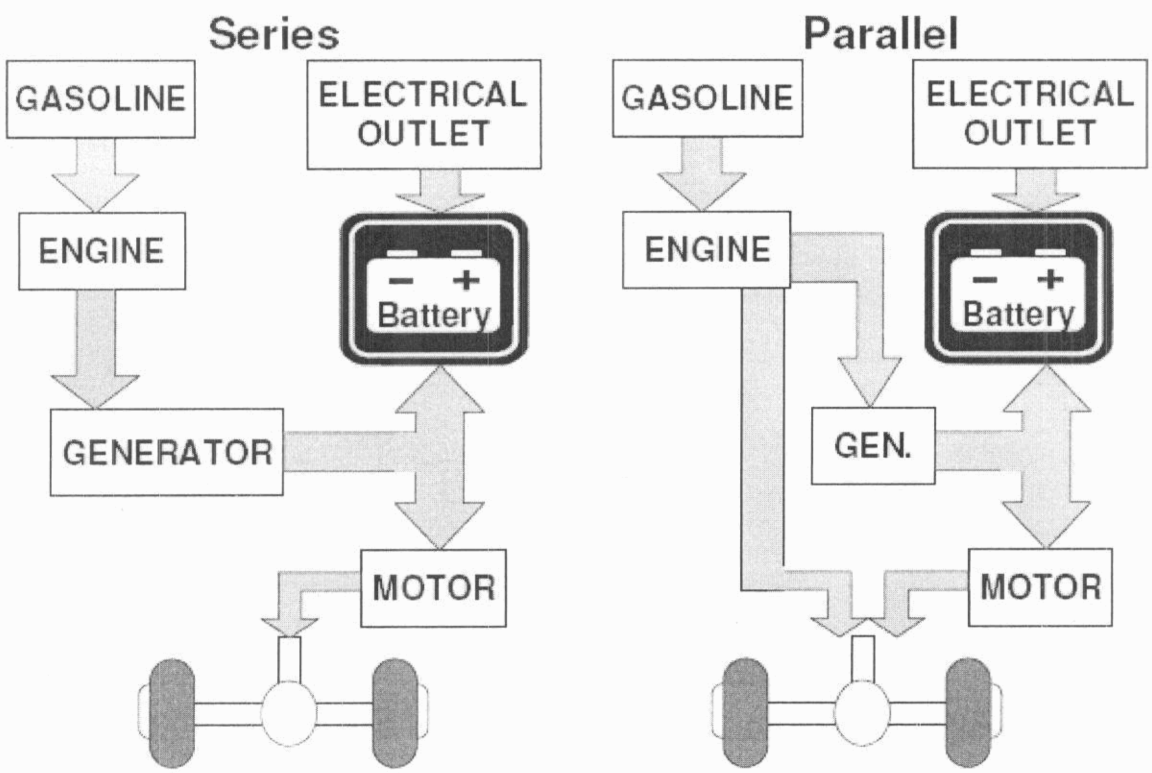
- Formalize PHEV Team to monitor sign posts and update schedule
- Join EPRI or other industry consortium to gain access and monitor advancements by car manufacturers, and battery manufacturers. Monitor battery price premiums, battery life and reliability, manufacturer launch schedules and forecasts.
- Collaborate with other utilities that are investing in PHEV's, and governmental agencies to address common infrastructure, policy, and legislative issues necessary to facilitate the development of the PHEV's market.
- Evaluate international markets that may be further advanced in infrastructure and policy support for PHEV's.
- Evaluate options to educate and influence policy to balance the trade-offs between societal emissions impacts and power plant impacts. Monitor CO_2 emission requirements and policies.
- Evaluate the possibility of leveraging the Smart Grid development for offering off peak charging rates.
- Work with manufacturers Smart charger/ charging profiles
- Need to work with dealers to become aware of large fleet developments to anticipate potential localized distribution concerns.

APPENDIX

APPENDIX 1 – PHEV Drive Train Configurations

Two drive train designs are being used by PHEV manufacturers to utilize the gasoline and electrical fuels. The figure below shows two simple schematics of possible PHEV architectures, the overall design of the PHEV system to supply power from two different sources [16]. A series drive train architecture powers the vehicle only by an electric motor using electricity from a battery. The battery is charged from an electrical outlet, or by the gasoline engine via a generator. A parallel drive train adds a direct connection between the engine and the wheels, adding the potential to power the vehicle by electricity and gasoline simultaneously and by gasoline only.

These two power train designs also reflect two different discharge strategies. Toyota is currently developing a PHEV with a parallel architecture, i.e. a plug-in version of the Prius, The Toyota strategy is most likely to operate for PHEV's similar to the HEV with a "blended" operation where the electric motor supplies low-speed operation, supplemented by the ICE at high speed. General Motors is working with a series architecture, i.e. the Chevy Volt. The GM strategy is to operate the vehicle purely on electric current from the battery until it reaches some design level of discharge and then charge and supplement the battery current from the ICE driven generator.



PHEV drive train options - Series versus Parallel design.

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[16] Axsen, J. et-al, "Batteries for Plug-in Hybrid Electric Vehicles (PHEVs): Goals and the State of Technology circa 2008", Institute of Transportation Studies, University of California Davis, CA, May 2008.

APPENDIX 2 – Alternative Fueled Vehicle Comparison

Technology	Pros	Cons	Vehicles	Availability Starting Prices
Conventional Vehicles Internal Combustion Engine (ICE)	Existing proven technology. Long range. Infrastructure available	Emissions, high cost of gasoline.	All manufacturers' models.	On the market now.
Flex Fuel Vehicles Have standard internal combustion engines that can run on gasoline or a mix of gasoline and ethanol.	No price premium, can be used in vehicles of all sizes. Reduce greenhouse gas emissions.	Ethanol not widely available. A gallon of ethanol has less energy content than a gallon of gas, so MPG is lower.	Almost all GM, Ford and Chrysler models.	On the market now.
Natural Gas	Increased fuel economy. Cheaper than gasoline.	More expensive than models with gas engines. No readily available infrastructure to refuel.	Honda Civic GX	Starts at $ 29,000
Clean Diesel New, advanced diesel engines that burn fuel more cleanly and use low-sulfur fuel.	20% to 40% more miles per gallon and more torque than gas engines, reduced greenhouse gas emissions.	More expensive than models with gas engines. Diesel fuel more expensive than gasoline. Unclear if Americans will embrace diesel.	Jeep Grand Cherokee and Volkswagen Jetta are two examples. BMW and Mercedes-Benz also offering clean diesel models.	VW Jetta diesel $21,999 Grand Cherokee $31,390
Hybrids Have a battery and electric motor to power the car at low speeds and a gas engine for accelerating and highway driving.	Increases fuel-economy significantly, especially in heavy stop-and-go driving.	Price premium over standard models can be $2,500 or more for a Toyota Prius, $8,000 and up for large hybrid SUVs. Mileage improvements modest in some larger vehicles.	Toyota Prius Ford Escape Hybrid GMC Yukon ,Hybrid Lexus LS600h Lexus RX400h Chrysler Aspen Hybrid Dodge Durango Hybrid Honda Civic Hybrid Chevrolet Malibu Hybrid, Saturn Aura Hybrid	On the market now: Prius $23,375 Yukon $50,920 LexusRX400h $43,480 Honda Civic $22,600, Chevy Malibu $24,695, Saturn Aura $24,930.

Plug-In Hybrids A full hybrid with a large battery that drivers can recharge by plugging the car into an AC outlet.	Dramatic boost in fuel economy– can go up to perhaps 120 miles on the battery alone.	The advanced batteries required are not yet available. They are also expensive and can overheat.	Conversion kits for Prius	Many auto makers working to offer them in 2-4 years.
Electric Car Powered by a long-lasting battery and electric motor. Can have a small gas engine on board to charge the battery.	Practically no emissions or engine noise. Can be recharged from AC outlet.	Technology still unproven. Batteries not available.	GM working on Chevy Volt. Also start-up electric car makers Tesla, Fisker and others.	Volt due by 2011 Tesla, Fisker and others possibly sooner.
Fuel Cell Vehicles Use hydrogen gas and a chemical process to generate electricity that powers an electric motor	Uses no fossil fuel, hydrogen is widely available and the only tailpipe emission is water vapor.	Still in experimental stage, hydrogen not widely available as fuel, technology still far too expensive for commercial use.	Models now in tests include Honda FCX Clarity and Chevrolet Equinox among others.	Small number of Clarity and Equinox available for lease through test programs.

APPENDIX 3 – Florida Alternative Fuel Related Laws and Incentives[17]

Alternative Fuels Production Incentive

The Innovation Incentive Program is created within the Office of Tourism, Trade, and Economic Development to provide resources for business projects that allow the state to effectively compete for high-value research and development, including alternative and renewable energy projects. To qualify, an alternative and renewable energy project must involve collaboration with an institution of higher education; provide the state a minimum full return on investment within a 20-year period; include matching funds provided by the applicant or other available sources; and be located in the state of Florida. Additional criteria may apply. For the purposes of this incentive, alternative and renewable energy means electrical, mechanical, or thermal energy produced from a method that uses one or more of the following energy sources: ethanol, cellulosic ethanol, biobutanol, biodiesel, biomass, biogas, hydrogen fuel cells, ocean energy, hydrogen, solar, hydro, wind, or geothermal. (Reference House Bill 7135, 2008, and Florida Statutes 377.804)

Renewable Energy Grants

The Renewable Energy Technologies Grants Program provides matching grants for demonstration, commercialization, research, and development projects relating to renewable energy technologies, including those generating or utilizing hydrogen or biomass resources. (Reference Florida Statutes 377.804)

Hydrogen and Biofuels Tax Exemption

Through July 1, 2010, the sale or use of the following is exempt from Florida state sales, rental, use, consumption, distribution, and storage tax: 1) hydrogen powered vehicles and related materials, and hydrogen fueling stations, up to a maximum of $2 million in taxes in each fiscal year in aggregate; 2) materials used in the distribution of biodiesel (B10-B100) and ethanol (E10-E100), including fueling infrastructure, transportation, and storage, up to a maximum of $1 million in taxes in each fiscal year for all taxpayers. Gasoline fueling station dispenser retrofits for ethanol (E10-E100) distribution also qualify for this exemption. (Reference Florida Statutes 212.08)

Hydrogen and Biofuels Investment Tax Credit

A credit against the state sales and use tax is available for costs incurred between July 1, 2006, and June 30, 2010, for the following: 1) 75% of all capital, operation and maintenance, and research and development costs incurred in connection with an investment in hydrogen-powered vehicles and hydrogen vehicle fueling stations in the state, up to a maximum of $3 million in each fiscal year for all taxpayers; and 2) 75% of all capital operation and maintenance, and research and development costs incurred in connection with an investment in the production, storage, and distribution of biodiesel (B10-B100) and ethanol (E10-E100) in the state, up to a maximum of $6.5 million in each fiscal year

[17] "State & Federal Incentives & Laws, Alternative Fuels & Advanced Vehicles Database, Energy Efficiency and Renewable Energy, U.S. DoE. http://www.afdc.energy.gov/afdc/progs/view_ind_mtx.php/tech/BIOD/FL/0.

for all taxpayers. This includes the costs of constructing, installing, and equipping such technologies; gasoline fueling station dispenser retrofits for ethanol (E10-E100) distribution also qualify.

Credits may be used in tax years beginning January 1, 2007, and ending December 31, 2010. If the credit is not fully used in any one tax year because of insufficient tax liability on the part of the corporation, the unused amount may be carried forward and used in tax years beginning January 1, 2007, and ending December 31, 2012. For tax years beginning January 1, 2009, any entity which is allowed the investment tax credit may transfer the credit, in whole or in part, to any taxpayer by written agreement without transferring ownership interest in the qualified property. (Reference House Bill 7135, 2008, and Florida Statutes 220.192)

Fuel-Efficient Vehicle Acquisition and Alternative Fuel Use Requirements

When procuring new vehicles under a state purchasing plan, all state agency, state university, community college, and local government fleets must select the vehicle with the greatest fuel efficiency available for a given use class. Exceptions may be made for emergency responder vehicles when documentation is provided. In addition, all state agencies must use ethanol and biodiesel blended fuels when available. State agencies administering central fueling operations for state-owned vehicles must procure ethanol and biodiesel fuels to use in their vehicle fleet to the greatest extent possible. (Reference House Bill 7135, 2008)

Alternative Fuels Study

The Florida Energy and Climate Commission (FECC) is required to conduct a study to evaluate and recommend lifecycle greenhouse gas (GHG) emissions associated with all renewable fuels including biodiesel, renewable diesel, biobutanol, and ethanol derived from any source. FECC must also evaluate and recommend that all renewable fuels introduced into state commerce reduce lifecycle GHG emissions by an average percentage. FECC may also evaluate and recommend the benefits associated with the creation, banking, transfer, and sale of GHG emissions credits among fuel refiners, blenders, and importers. FECC must submit specific recommendations to the state legislature no later than December 31, 2010. (Reference House Bill 7135, 2008)

Biofuels Promotion

The Florida Department of Management Services (DMS), in coordination with the Florida Department of Transportation (DOT), is required to conduct an analysis of fuel additives and biofuels use by the DOT through its central fueling facilities. The DMS is required to encourage other state government entities to analyze transportation fuel usage, including the types and percentages of fuels consumed, and report such information to the DMS. (Reference House Bill 7135, 2008)

Provision for Renewable Fuels Investment

In order to create jobs and improve the state's general infrastructure, the Florida State Board of Administration may identify and invest up to 1.5% of the net assets of the system trust fund in technology and growth investments of businesses housed in the state of Florida, including biofuels, renewable energy, and other related applications. The State Board of Administration may offer opportunities to small, state-based investment management firms to facilitate their development and growth. (Reference Senate Bill 2310, 2008)

State Energy Task Force

The Florida Renewable Energy Technologies and Energy Efficiency Act is established to increase the state's energy stability and protect public health by advancing the development of efficient and renewable energy technologies, including those related to hydrogen, ethanol, and biodiesel. The Act creates the Florida Energy Commission, which is responsible for developing recommendations for legislation to establish a state energy policy, focusing on energy-efficiency issues including the encouragement of in-state research, development, and deployment of alternative fuels for motor vehicles. As required by the Act, the Florida Department of Environmental Protection provided a report entitled Leadership by Example: Energy Efficiency and Conservation (PDF 188 KB), which includes a description of state programs designed to achieve energy conservation and energy efficiency through the inclusion of alternative fuel vehicles in state fleets. (Reference Florida Statutes 377.801-377.806 and 377.901)

Point of Contact
General Inquiries
Florida Energy Office
Phone (850) 245-8002
http://www.dep.state.fl.us/energy

Alternative Fuels Tax

A person operating an alternative fuel vehicle (AFV) must purchase an annual decal from the Florida Department of Motor Vehicles in lieu of the excise tax on gasoline. Fueling stations are not allowed to fuel an AFV that does not display the proper decal. State and local government AFV fleets are exempt from paying the decal fee. In addition to the state alternative fuel fee imposed by this section, a person fueling a vehicle from their own facility is required to pay a local alternative fuel fee in lieu of each cent of excise tax levied by a county (Reference Florida Statutes 206.877)

Alternative Fuel License

An individual who wishes to be a wholesale distributor of an alternative fuel must first obtain a license from the Florida Department of Revenue. (Reference Florida Statutes 206.89)

APPENDIX 4 – United States (Federal) Incentives and Laws[18]

View All Federal Summaries

Our federal incentives and laws are categorized here as either Incentives, Laws and Regulations, or Programs, which could be funding opportunities or other federal initiatives related to alternative fuels and vehicles, advanced technologies, or air quality. To sort information by sponsoring agency instead of category, click the Agency radio button below. Additional incentives may also be available on the Clean Cities Financial Opportunities Web page.

Incentives

Alternative Fuel Excise Tax Credit
Alternative Fuel Infrastructure Tax Credit
Biobased Transportation Research Funding
Biodiesel Income Tax Credit
Biodiesel Mixture Excise Tax Credit
Biomass Research and Development Initiative
Fuel Cell Motor Vehicle Tax Credit
Heavy-Duty Hybrid Electric Vehicle (HEV) Tax Credit
Light-Duty Hybrid Electric Vehicle (HEV) and Advanced Lean Burn Vehicle Tax Credit
Qualified Alternative Fuel Motor Vehicle (QAFMV) Tax Credit
Renewable Energy Systems and Energy Efficiency Improvements Grant
Small Agri-Biodiesel Producer Tax Credit
Small Ethanol Producer Tax Credit
Value-Added Producer Grants (VAPG)
Volumetric Ethanol Excise Tax Credit (VEETC)

Laws and Regulations

Aftermarket Alternative Fuel Vehicle (AFV) Conversions
Alternative Fuel Definition
Alternative Fuel Definition - Internal Revenue Code
Alternative Fuel Tax Exemption
Clean Air Act Amendments of 1990
Corporate Average Fuel Economy (CAFE)
High Occupancy Vehicle (HOV) Lane Exemption
Idle Reduction Facilities Regulation
Import Duty for Fuel Ethanol
Renewable Fuel Standard (RFS) Program
Tier 2 Vehicle and Gasoline Sulfur Program
Updated Fuel Economy Test Procedures and Labeling
Vehicle Acquisition and Fuel Use Requirements for Federal Fleets
Vehicle Acquisition and Fuel Use Requirements for Private and Local Government Fleets
Vehicle Acquisition and Fuel Use Requirements for State and Alternative Fuel Provider Fleets
Vehicle Incremental Cost Allocation

[18] "Federal Incentives & Laws, Alternative Fuels & Advanced Vehicles Database, Energy Efficiency and Renewable Energy, U.S. DoE. http://www.afdc.energy.gov/afdc/progs/fed_summary.php/US.

Programs

Air Pollution Control Program
Alternative Transportation in Parks and Public Lands Program
Biobased Products and Bioenergy Program
Clean Agriculture USA
Clean Cities
Clean Construction USA
Clean Fuel Fleet Program (CFFP)
Clean Fuels Grant Program
Clean Ports USA
Clean School Bus USA
Congestion Mitigation and Air Quality (CMAQ) Improvement Program
Loan Guarantee Program
National Clean Diesel Campaign (NCDC)
National Fuel Cell Bus Technology Development Program (NFCBP)
Pollution Prevention Grants Program
SmartWay Transport Partnership
State Energy Program (SEP) Funding
Voluntary Airport Low Emission (VALE) Program

APPENDIX 5 – United States (Federal) Incentives and Laws

Argonne National Laboratory
Austin Energy
CenterPoint Energy, Inc.
Clark Public Utilities
Consolidated Edison, Inc.
Constellation Energy Group, Inc. (Combined)
Consumers Energy
CPS Energy
Dairyland Power Cooperative
Detroit Edison Co.
Dominion Resources, Inc.
Duke Energy Corp.
FirstEnergy Service Co.
Georgetown University
Golden Valley Electric Assn., Inc.
Great Plains Energy Services, Inc. (Kansas City Power & Light Co. Only)
Great River Energy
Hawaiian Electric Company, Inc.
Hetch Hetchy Water & Power
Hoosier Energy Rural Electric Coop., Inc
Hydro-Quebec
Lincoln Electric System
Manitoba Hydro
Nebraska Public Power District
New York Power Authority
NOACA
Pacific Gas & Electric Co.
PacifiCorp
PNM Resources
Portland General Electric Co.
Progress Energy (CP&L/FPC, Excl PV)
Public Service Enterprise Group, Inc.
Sacramento Municipal Util. Dist.
Salt River Project
San Diego Gas & Electric Co.
Seattle City Light
Snohomish County Public Util. Dist. No 1
Southern California Edison Co.
Southern Company (all operating companies)
Tennessee Valley Authority (TVA)
Tri-State G&T Association, Inc.
United Illuminating
University of Delaware
We Energies