Analysis of maximizing the Synergy between PHEVs/EVs and PV

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Project ID # VSS036

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Overview

Timeline

- Start – July 2011
- Finish – December 2011
- 0% Complete

Budget

- Total project funding
  - DOE/VTP share - 100k
  - DOE/OE share – 100K
- Funding Received in 2010
  - DOE share – 0K
- Funding for FY11
  - DOE – 200K

Barriers

- Cost of PEV: this analysis attempts to find new revenues to reduce operating cost to vehicle owner
- Charging Infrastructure: this analysis provides an alternative view of determining the prudent ratio of public to private charging stations

Partners

- National Renewable Energy Lab.

Objectives

The project will address the following questions:

- How can electrification of transportation support the integration of clean renewable energy technologies into the US grid, particularly, solar PV?
- Grid-friendly charging strategies can provide grid services that have a market value. How would the charging strategies work and what are the potential value streams to the vehicle owner?
- How many vehicle would it take to provide grid services at scale?
- Because solar PV technologies generate only during sunlight hours, PEV require public charging stations to charge during the day. What is an cost-optimal ratio of public to private charging stations to capture market value for PV integration?

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Technical Approach

- Estimate additional grid balancing services necessary to integration large deployment of PV rooftop capacity
- Given existing driving patterns from DOT and early results from ARRA EV/PHEV monitoring, determine the number of PEVs required to provide all (or parts) of the new balancing services using grid-friendly charging strategies?
- Determine the effectiveness of PEV engaging in grid services as a function of public to private charging stations.
- Determine the market value of grid services that could be captured by grid-friendly charging strategies.

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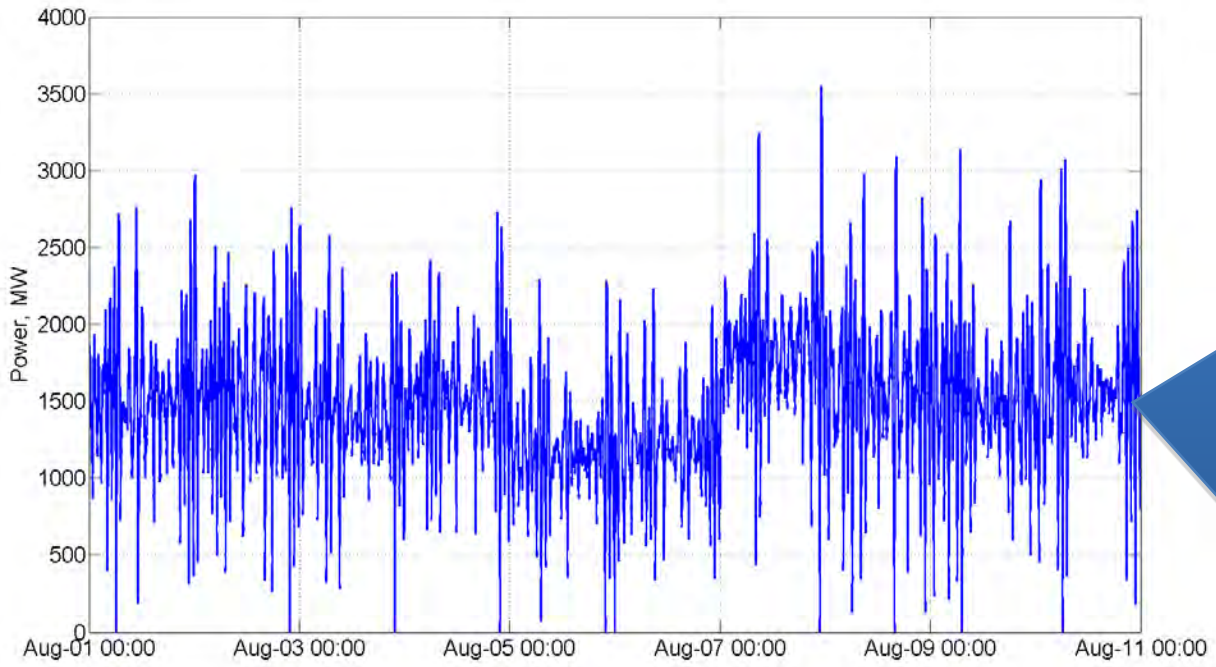
Technical Approach

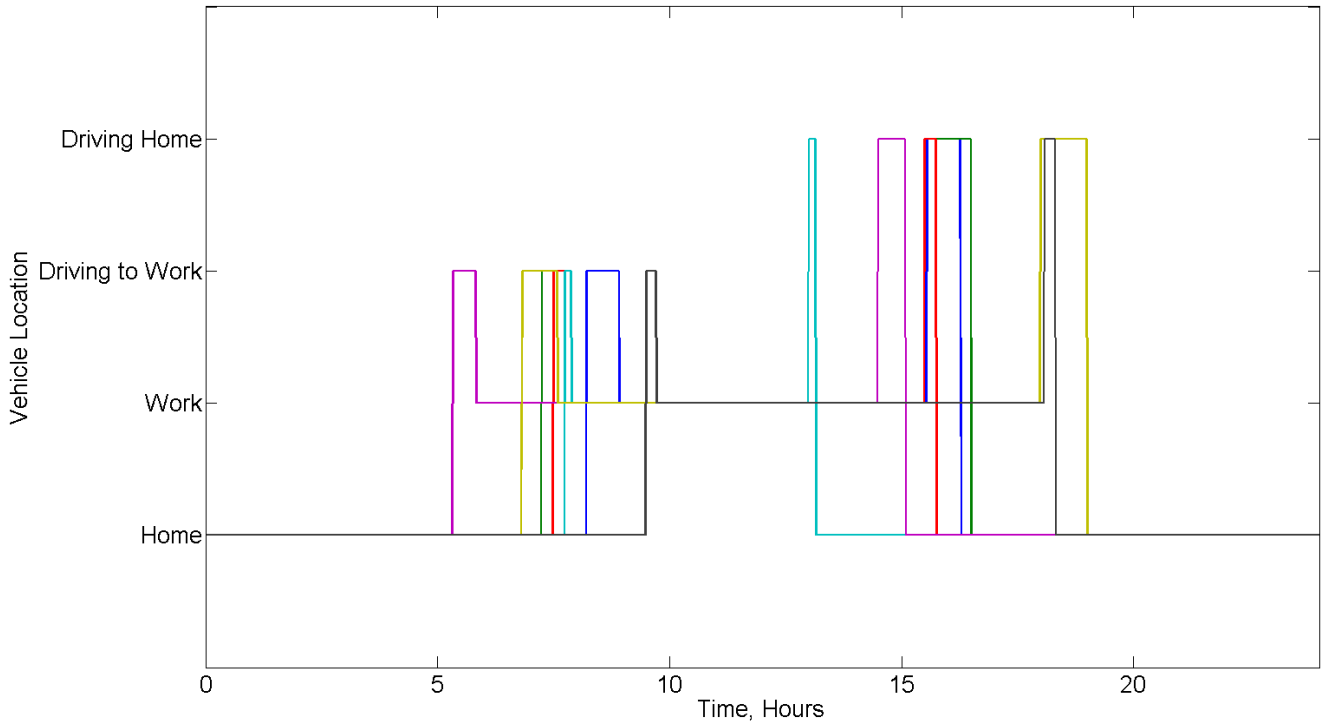
- Variability in the electricity production of solar technology result in over- and under-generation, which the grid operator must minimize with flexible grid assets: primarily hydro plants or combustion turbines.
- An alternative approach is a GRID-FRIENDLY charging strategy that modulates the charging current corresponding to over- and under-generation without harming the battery.



Balancing (regulation services) can be provided by a generator or by variable load, such as charging EVs

Technical Approach

- Sample vehicle availability extracted from 2001 NHTS Data
- NHTS Data can be replaced by current ARRA project data



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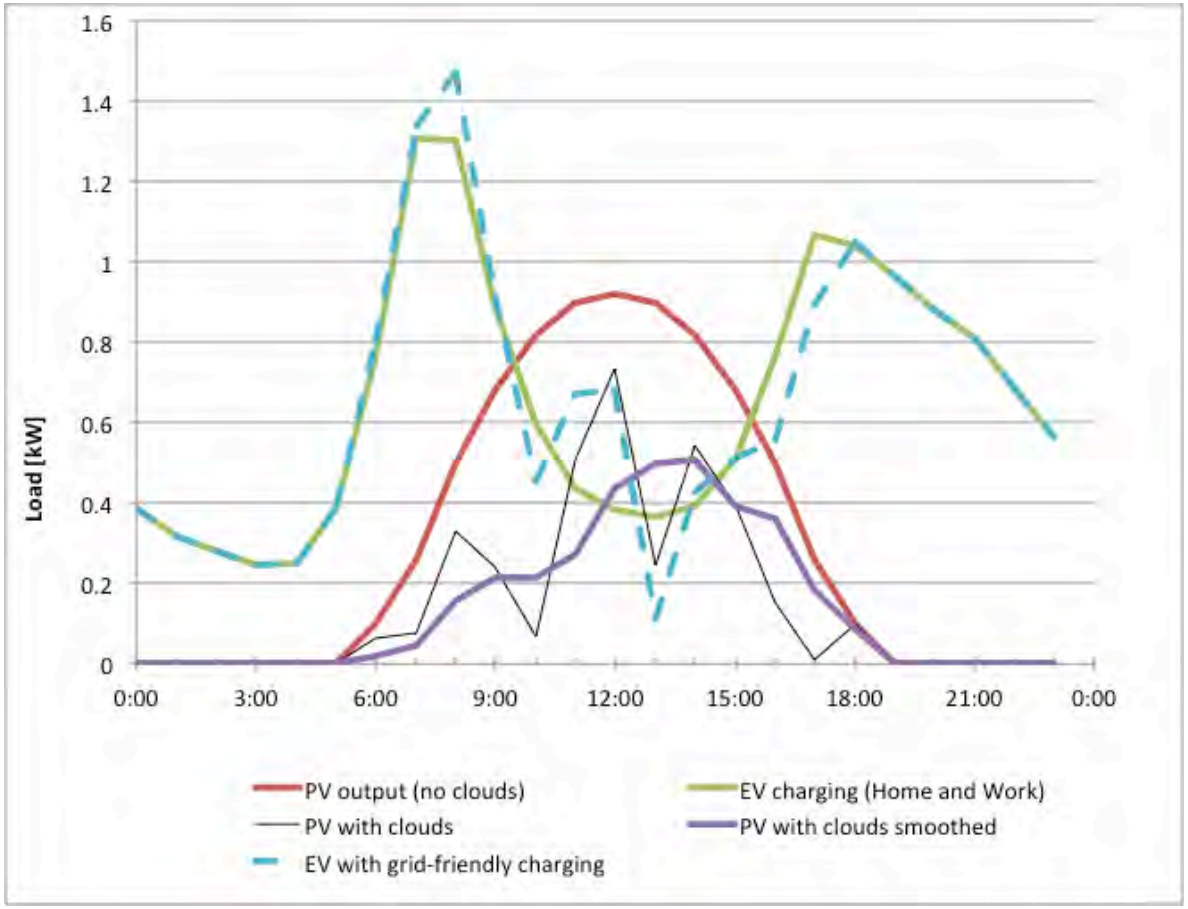
Technical Approach

Concept of grid-friendly charging



- Electricity production from PV is highly variable and needs to be smoothed
- PEV will charge to vehicle to smooth the PV production as seen by the grid.
- This is service is called regulation service and has a market value at competitive wholesale markets

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FY'11 – Leveraging

- Technology development
  - Simulation environment development completed for estimating numbers of vehicles for integration of wind in the Pacific Northwest.
  - Utilizing data from solar integration studies on Hawaii.

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On-going Activities for FY'11

- **Project has not started yet.**

Collaborators

- **National Renewable Energy Lab**
  Field demonstration and testing with Photovoltaic arrays and electric vehicle charging with smart charger controller – planned activity

- **PNNL – Environmental Molecular Sciences Lab**
  Field demonstration and testing with ten charging stations and photovoltaic arrays – planned activity cost shared with Office of Electricity

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Assumptions and Outcomes

- Assumptions
  - Battery state of charge is linear
  - Efficiencies are static for all conditions
  - Solar insolation modeling

- Outcome
  - Simulation framework for exploring PHEV/EV charging scenarios
  - Value proposition for grid-friendly charging strategies for solar integration
  - Insights into value proposition of public charging stations for grid services

Project Summary

- Significant renewable generation sources, such as wind and solar, are expected to come online
- PHEV/EVs can be used for storage and regulation capacity during the normal operation of charging the battery
- Actual work will reveal insights into contribution of grid-friendly charging strategies to the overall integration of renewable energy resources.

Questions ?

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