IPRO 311 – INTEGRATION OF PLUG-IN HYBRID ELECTRIC VEHICLES AND RENEWABLE ENERGY SYSTEMS

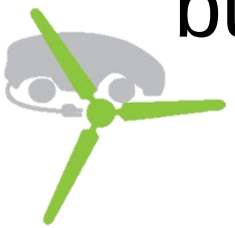
Midterm Review Presentation

Fall 2010

Faculty Advisor: Dr. Alireza Khaligh
Project Assistant: Seshadri Srinivasa Raghavan

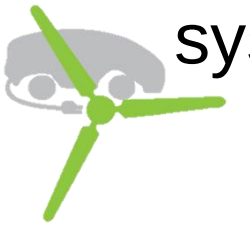
BACKGROUND

- Goal of U.S. DOE is to have 20% wind energy generation by 2030
- Government is aiming to introduce 1M PHEVs by 2015
- Plug-in hybrid electric vehicles (PHEVs) can use multiple energy sources
- Wind energy is renewable and sustainable but is volatile



PROBLEM STATEMENT

- Investigate economical effects for integration of wind powered electricity generation and PHEVs
- Determine feasibility of using PHEVs as electrical energy storage to mitigate the natural inconsistency of wind energy
- The target market consists of the automotive industry, wind power generation industry, and utilities
- Analyze the effectiveness of lowering operational costs by introducing PHEVs into power generation system



OBJECTIVE

- Research the effect of integrating wind energy with current power system
- Research the impact of Vehicle-to-Grid (V2G) integration by taking advantage of Energy Storage Systems (ESS) of PHEVs
- Supplementing additional power demand through the integration of PHEVs
- Optimizing operational cost of electric power grid

TEAM ORGANIZATION

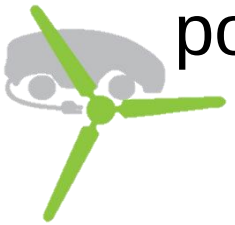
- **Malik Ajose** – PHEV charging rates, battery life, and load demand based upon various charging scenarios
- **Joseph Krause** – smart grid interaction with PHEVs
- **James Lee & Robert Veitch** – develop objective function dependent upon PHEV charging time and driving habits to determine optimal operational cost
- **Peter Ryszkiewicz & Joseph Charles** – develop expected operational scenarios for PHEVs
- **Ghita Pop** – determine operational cost for thermal and nuclear power plants
- **Byron Enriquez** – research operational cost of power transmission lines and power plant operational expenses

PROGRESS TOWARD GOALS

- Researched data relevant to driving patterns and characteristics of residential vehicular drivers
- Studied realistic driving data regarding resting times, vehicle speeds, and vehicle destinations
- Utilized driving data to calculate optimal PHEV schedules for charging as well as discharging to power grid
- Created objective function MATLAB program to model operational cost per hour for power generation

PROGRESS TOWARD GOALS

- Examined United States operational cost of power transmission lines and power plant operating expenses
- Researched smart power grid technology in relation to wind generation and interaction with PHEVs
- Researched different components related to PHEV battery charging
- Examined PHEV load demand and charging scenarios
- Analyzed 6 bus small-scale power system for power generation for initial approach verification



TEAM OBJECTIVE FUNCTION

- Input
  - Preference of fast charging, slow charging, and charging schedule
  - Charging demand, time, and duration
  - Load demand curve
- Output
  - Optimal time to charge PHEV battery
  - Optimal operational cost versus each hour
  - The contribution of each power generator to satisfy the load demand

MAJOR OBSTACLES ENCOUNTERED

- Developing plan to integrate PHEVs into power grid utilizing both charging and discharging to grid
  - *Solution: Focus on small set of discharging and charging scenarios*
- Obtaining power generation and transmission operational cost data
  - *Solution: Develop assumptions based on real-world data from IEEE to simplify relevant data*

MAJOR OBSTACLES ENCOUNTERED

- Developing simulations that consider multiple variables
  - *Solution: Limit number of scenarios to be considered during simulation*
- *Understanding and making assumptions necessary to formulate valid objective function within scope of project*

ANTICIPATED MAJOR CHALLENGES

- Prediction of PHEV adoption rate
- Prediction of future price of energy
- Determination of long-term environmental and financial benefits of PHEVs
- Narrowing scope of objective function to develop meaningful and accurate results

QUESTIONS/COMMENTS

? ? ?