IPRO 311

Integration of Plug-In Hybrid Electric Vehicles and Renewable Energy Systems

Dr. Alireza Khaligh

IPRO 311

MULTIDISCIPLINARY INTERPROFESSIONAL (IPRO℠) COURSE

- Engaging multidisciplinary teams of students in semester-long undergraduate projects based on real-world topics.
- Integrating ethics as an independent part of the project.
- Teams may include 5 to 15 students
  - All academic levels
  - Across professional programs:
    - Engineering
    - Science
    - Business
    - Law
    - Psychology
    - Design
    - Architecture

IPRO 311

MULTIDISCIPLINARY INTERPROFESSIONAL (IPRO^{SM}) COURSE

- Integration of both
  - Vertical (bridging academic levels)
  - Horizontal (bridging professional programs) dimensions
- Stimulating student interaction across the boundaries of individual disciplines and experiences
- Power and energy engineering-oriented students:

  Appreciation for non-technical considerations
- Other professions:

  Greater insight concerning research and technology development

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PURPOSE & OBJECTIVES

- **Investigating the effect of integrating 20% of wind energy in current power system in terms of operational cost**
- **Determine the feasibility of using PHEVs as an electrochemical energy storage system to mitigate the natural inconsistencies of wind generated power using simulation tools**
- **Evaluate the impacts of PHEVs on operational costs**
- **Facilitating Vehicle-to-Grid (V2G) integration by taking advantage of Energy Storage System (ESS) of PHEVs**

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TEAM ROSTER

- **Team Advisor: Dr. Alireza Khaligh**
- **Team Members:**

- James Lee: Electrical Engineering, Optimal cost management

- Peter Ryszkiewicz: Electrical Engineering, Driving habit and ESS

- Malik Ajose: Architecture, Charging PHEVs and battery life

- George Pop: Architecture, Operational cost/wind energy curtailment

- Robert Veitch: Computer Science, Optimal cost management

- Byron Enriquez: Mechanical Engineering, Operational cost/wind energy curtailment

- Joseph Krause: Mechanical Engineering, Smart grid interaction of PHEVs & wind state of the charges requirements of PHEVs

- Joseph Charles: Mechanical Engineering, Driving habit and ESS

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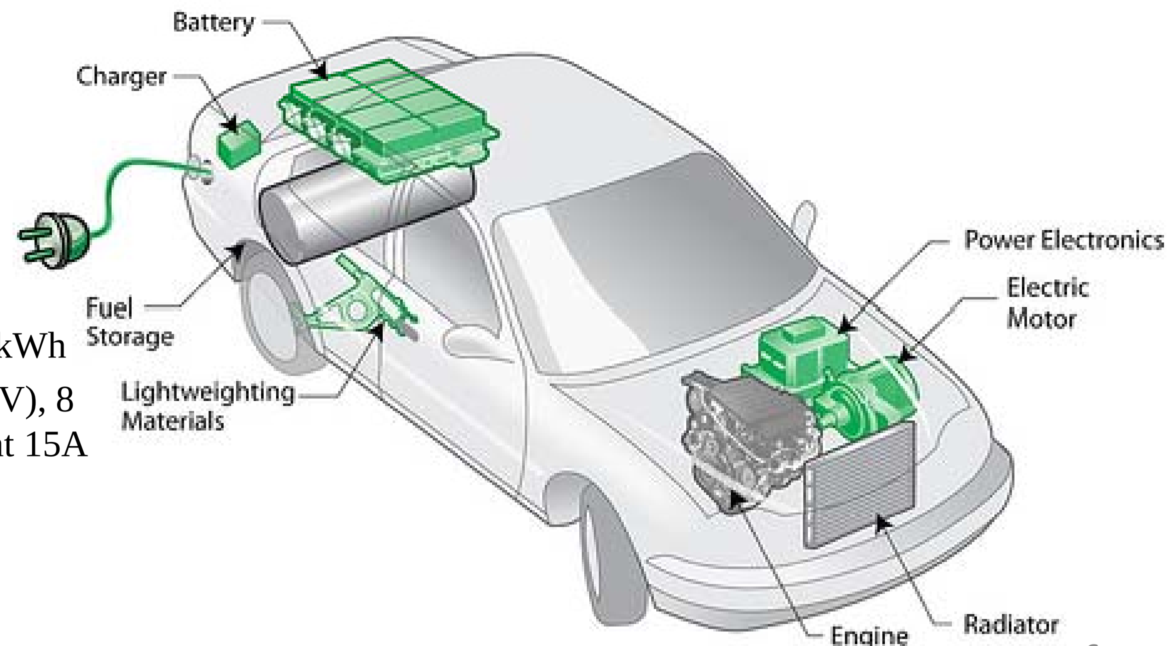
WHAT IS A PHEV?

- Combines advantages of HEVs and EVs
  - Onboard drive batteries can be charged by ICE or any 120-volt outlet for an equivalent cost of under $1/gallon.

<u>Chevrolet Volt</u>

• Battery Capacity:	16 kWh
• SOC Variation:	0.3 to 0.85
• Available Energy:	8.8 kWh
• Energy Range:	4.8 kWh-13.6 kWh
• Charge Times:	3-4 hours (240V), 8 hours (120V) at 15A



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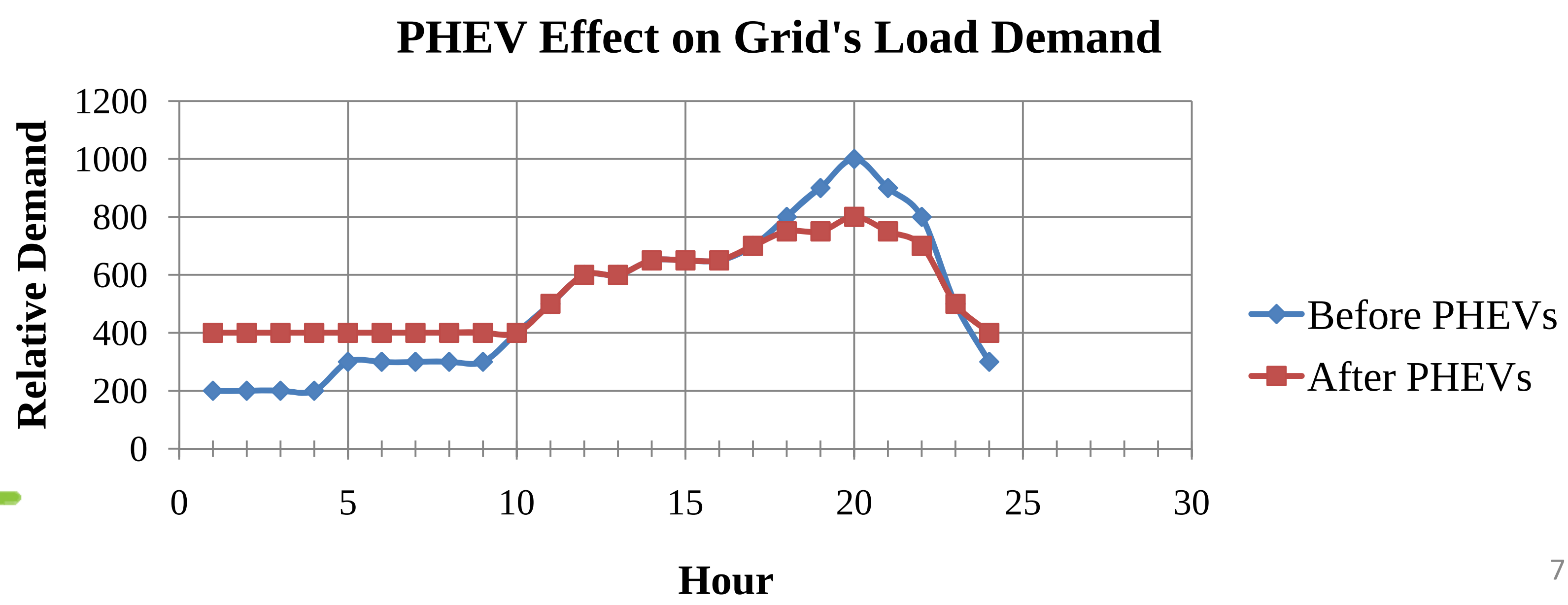
VEHICLE-TO-GRID

- Potential for Vehicle to Grid (V2G) charging
  - Offset grid demand peaks, therefore reduce operational costs of the grid
  - Affects PHEV battery capacity and battery life



ADDING PHEV TO POWER SYSTEM

Factors

- Driving patterns and habits
- Charging rate
- Time to charge/V2G and vehicular availability
- Fleet size
- Travel times
- SOC variations

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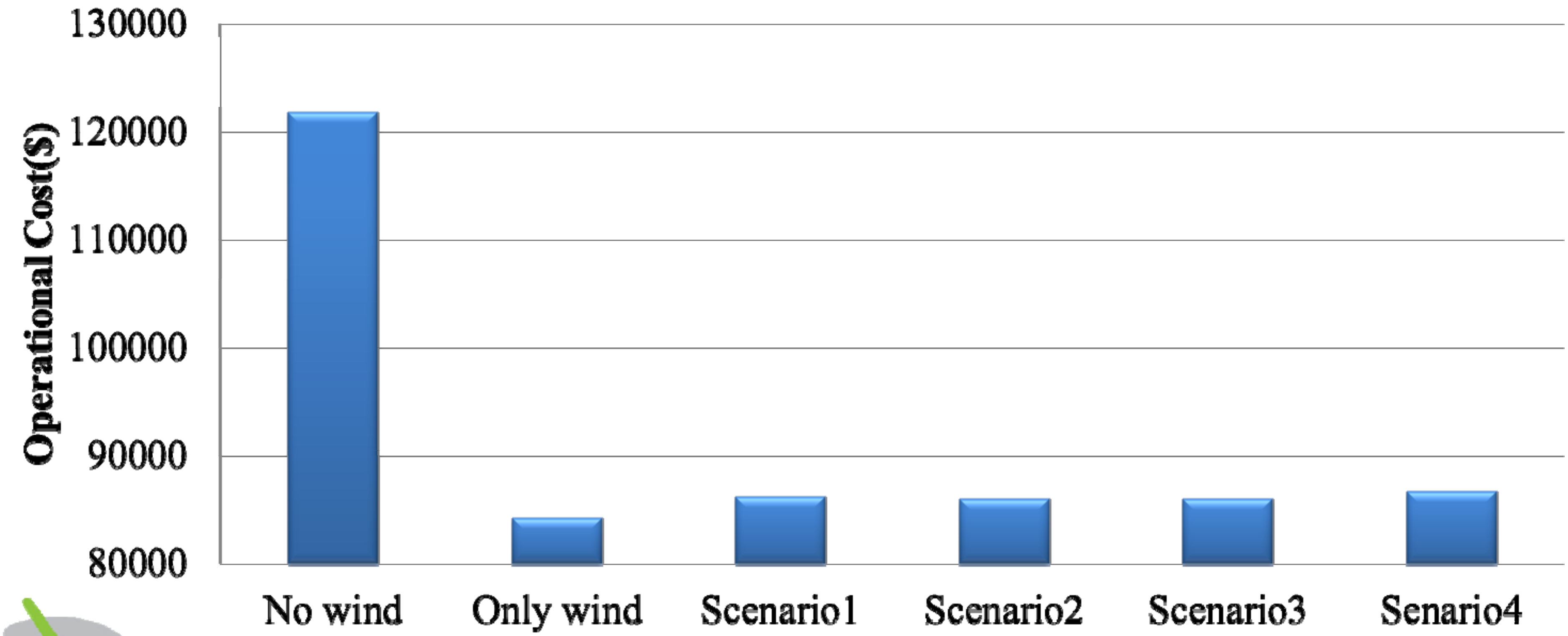
DAILY OPERATIONAL COST ON A SAMPLE 6-BUS SYSTEM



IPRO 311 ACKNOWLEDGEMENTS

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