Electric Vehicles: Supporting Renewable Integration as a Grid Resource

California Energy Commission
IEPR Committee Workshop
Energy Storage for Renewable Integration

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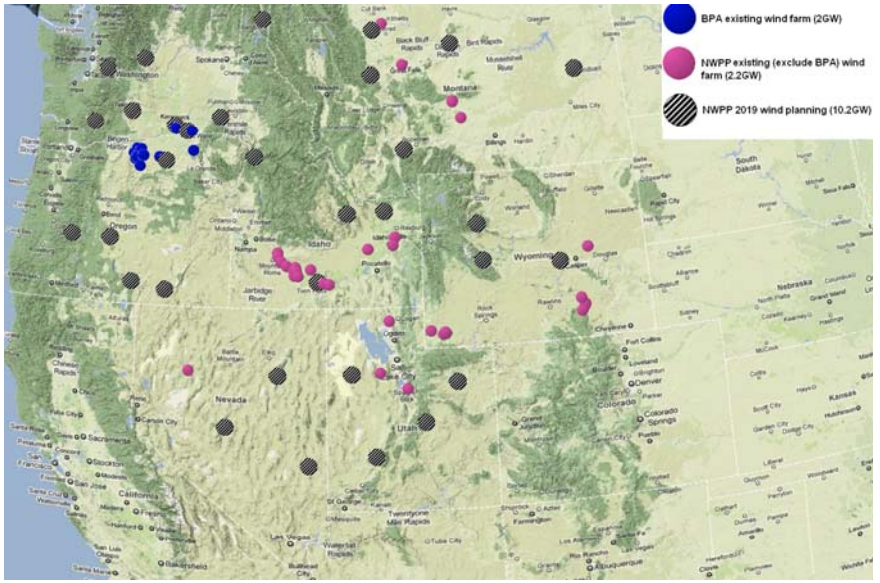
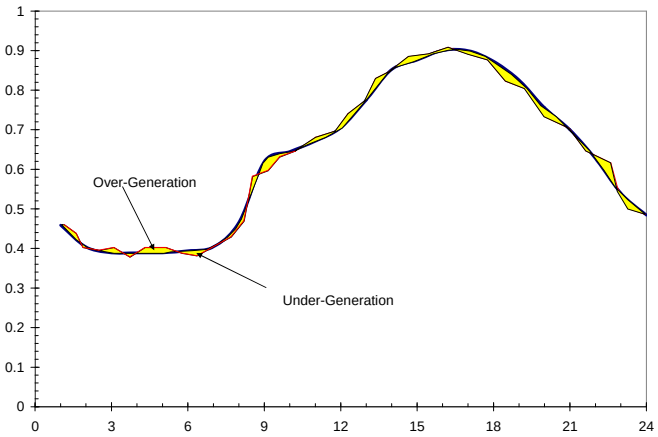
Case Study: Storage Opportunity in the NWPP

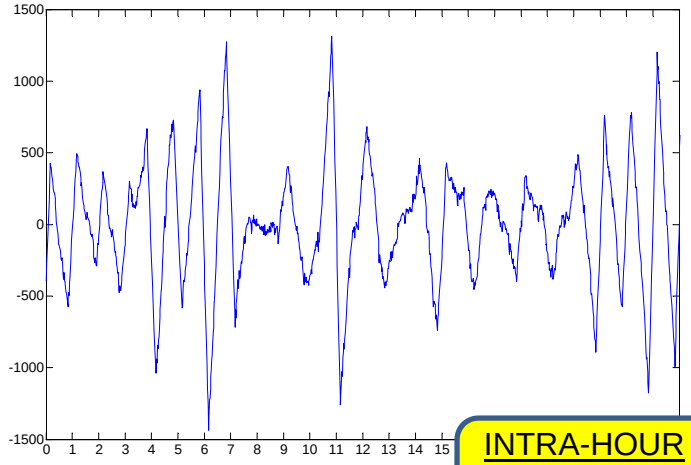
What questions did we address?

- What are the likely balancing requirements for the NWPP in a 14.4 GW wind scenario for 2020 **(35% wind capacity compared to total installed, about 12% based on generation)**
- Relative cost competitiveness of different energy storage compared with DR and GT
- Optimal batteries sizes (right-sizing) and hybridizing
- What are the energy arbitrage opportunities?
- How much does location of storage matter?

Locations of existing and presumed capacity expansion of wind







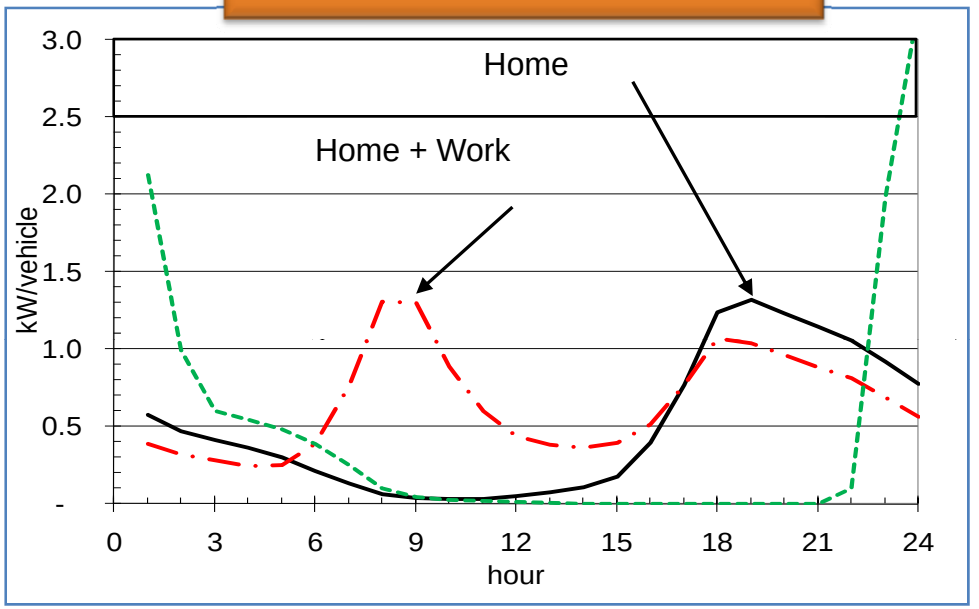
INTRA-HOUR requirements:
- 1.85 GW increment
- -1.85 GW decrement

Source: **Energy Storage for Power Systems Applications: A Regional Assessment for the Northwest Power Pool (NWPP).** PNNL-19300. April 2010

Assessment: Benefits of PHEVs for Integrating Renewable Energy Resources

- Question to answer:
  - How many electric vehicles are necessary to meet new balancing requirements for integrating wind generation?
- Assumptions
  - Basic assumptions from PNNL report on storage integration into NWPP[(1)]
  - Balancing requirements for wind capacity to increase from 4.2 to 14.4 GW (RPS of 12%)
  - Requires 1.8 GW up and 1.8 GW down for intra-hour balancing
  - NHTS 2001 travel patterns[(2)]

Charging profiles



Number of vehicles performing V2G half to meet new balancing requirements[(3)]

	BEV (110 miles range) 240V (50%) 120V (50%) charging	
	home	home+work
No of Vehicles	xx mill	yy mill
% of today's vehicle stock	> 100%	<100%

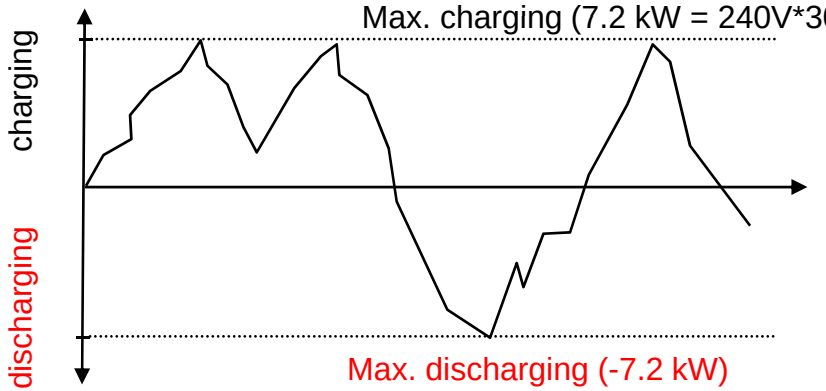
(1): Source: PNNL-19300. Energy Storage for Power Systems Applications: A Regional Assessment for the Northwest Power Pool (NWPP)

(2): Source: Department of Transportation: 2001. National Household Travel Survey

(3): Report expected to be published in July, 2011

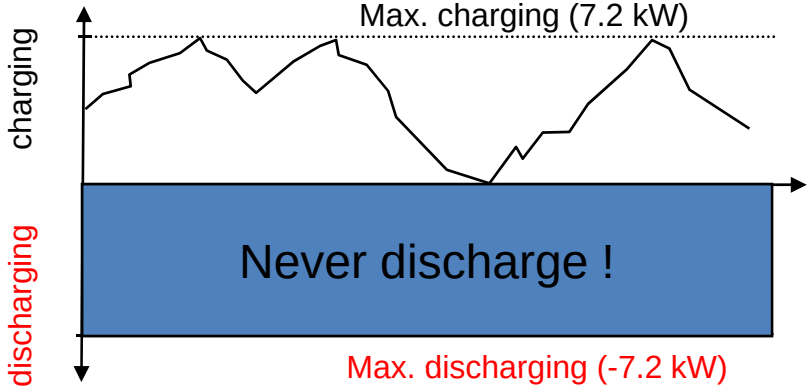
Assessment: Load can provide balancing/regulation services (V2G half) – Definition and value

V2G
- provides regulation service as a load and generator
- requires charging and discharging according to grid operators signal



Capacity value
(-7.2 to 7.2=14.4kW)

V2G half
- provides regulation service as a load only
- requires only charging
- modulates charging



Capacity value
(0 to 7.2=7.2 kW)

Attribute of "V2G half":
- provides regulation service with ½ the capacity value of V2G
- however, less than half the cost because
  - no interconnection gear with grid necessary because no electricity goes back into grid
  - removes any uncertainties regarding battery life reduction because of extra cycling

Demonstrate Grid Friendly™ Charging Technologies

- Question to answer:
  - What are the implementation issues of grid friendly charging strategies
- Implementation
  - Grid Friendly Charger Controller
    - PNNL Test Vehicle
    - Coulomb Charging Station
- Scope
  - Demonstrate Grid Friendly Charging
    - Strategies
      - Regulation services (V2G half)
      - Price-based
    - Communications
      - Utilize emerging SAE standards
  - Collaborate with ANL and NREL
  - Collaborate with ARRA Projects