COST EFFECTIVE PEV CHARGING IN THE REAL WORLD – PHEVS AND BEVS

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KEY CHARGING CONCEPTS

- **Desirable charging** - steady low power L1 overnight charging *consistently* every evening without need for utility control

- **Most valuable charging** – controlled intermittent L2 charging at the times and power levels desired by utilities and systems operators

- **Passive management** – technology imposes desirable behavior w/o active control

- **Active management** – utilities can vary minute-to-minute, hr-to-hr and day-to-day

- **Unmanaged** (typical today) – intermittently imposes problematic grid loads

- To meet regular everyday driving needs, PHEVs must be recharged every night.

- L1 charging in 11 hrs connected overnight in garages meets daily PHEV needs

- BEVs using L2 charging can charge every few days and meet everyday driving needs. To change to consistent overnight charging requires control.
BEVS AND PHEVS REQUIRE DIFFERENT PUBLIC & RESIDENTIAL CHARGING TECHNOLOGY. RESIDENTIAL IS FUNDAMENTAL TO BOTH. DCFC IS NECESSARY FOR BEV SUCCESS.

Intercity DC fast charging serves a minority of PEVs

BEVs (& 1 PHEV) with DC Fast Charging
Best technologies for L2 with active control

PHEVs and BEVs without DC Fast Charging
Best technologies for L1 with passive control

L2 = 2-19 kW
L1 = 1-2 kW
PHEVS AND BEVS DIFFER SIGNIFICANTLY FOR BEST “COMPOSITE” CHARGING STRATEGY (NIGHT + DAY)

– Daytime opportunity charging needs are different
  • BEVs benefit from DC fast charging, today’s PHEVs cannot
  • 2014 PHEV sales benefitted more from workplace charging than BEVs (but both benefitted)

– Passive management via L1 charging is least costly, works nicely for PHEVs
  • To drive miles electrically, PHEVs need to charge regularly – the technology & L1 requires regular, steady, long duration night charging
  • BEVs can charge intermittently, leading to bunching of charging and disconnection from grid

– Active management via L2 costs utilities more, but can have high grid load smoothing value when provided to long-range BEVs
  • Long range BEVs can flexibly charge a few times a week, at a high rate at large high kW houses
  • Controlled BEVs can provide a large charging demand “cushion” during low system load
  • Connected, controlled BEV owners should be compensated for hours opted in, kW capability, and negative price purchases
PROPER NIGHT & DAY CHARGING MANAGEMENT WILL GREATLY INCREASE ODDS OF PLUG-IN VEHICLE SUCCESS

- Overnight residential charging is fundamental. Daytime ‘opportunity charging” enhances success, is best done differently for PHEVs vs. BEVs.
- Passively managed low power (L1) overnight “valley filling” charging via PHEVs can reduce average electricity production cost. With active management BEVs can reduce costs even more.
- Unmanaged high kW (L2) charging drives cost up (EVSE, electric generation), resale market down (fewer houses have adequate existing kW).
- Early morning charging increases wind use (onshore wind energy is maximum in early morning) and clean natural gas generation.
- Education & proper price incentives cost-effectively promote early morning charging.
- Plugged in BEVs offer best opportunities for smart L2 grid-to-vehicle controls.
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