EREV and BEV Economic Viability vs. Household Retail Electric Pricing Strategies: Two Charges a Day?

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The Impact of PEVs on T&D Systems: Challenges and Solutions
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Ongoing work implies BEVs and EREVs Need High Daily Use & 1+ Charges/Day to “Compete” w PHEVs
(to be published at the Jan. 2011 Transportation Research Board Meeting)
Ongoing de (re) regulation is creating differing regional pressures for daytime deterrence of plug-in charging

- 1990s theory push – charge time-specific marginal cost, not regulated average cost.
- Result: Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs) are created by Federal Energy Regulatory Commission (FERC). Transmission and distribution functions of utilities are separated from generation. Many states are still not covered by ISOs or RTOs, but FERC wants a U.S. system.
  - RTOs generally operate at a multi-state level. Examples:
    - New England ISO (CT, ME, MA, NH, RI, and VT) (actually an RTO despite ISO name)
    - PJM Interconnection (DE, MD, NJ, PA, VA, WVA, parts of IN, IL, NC, MI, OH)
- Problem – consumers do not see the marginal prices (@ short time steps), only the utility requesting or providing generation. The incentive structure is imperfect.
- Aggregations of plug-in’s could join the mix of legal entities that could buy and sell electricity through the markets managed by ISO and RTOs. Set up costs are implied.
- Public Utility Commissions (PUCs) – state organizations that regulate utilities’ rate structures. Utilities so far cannot pass through varying short time prices to consumers, but multi-hour and season time of day (TOD) rate systems are being widely implemented. Note: there are many more utilities than states.
- CA’s PUC has just decided not to place charging services within utility regulation.
Vehicle and utility regulators have different goals. Conflicts between goals must be managed.

- **Vehicles (Federal CAFE) – save oil**
  - Charge PHEVs as often as possible; use EVs as much as possible
  - Sell as many plug-in vehicles and as much electricity as possible (keep costs reasonable)
    - Squeeze as many miles from batteries as possible
    - Keep electricity costs affordable

- **Regional Transmission Organizations – adopt a “smart” grid**
  - Don’t charge on-peak, charge off peak (overnight)
  - Don’t create new system peaks by bunching charge initiation or ending at specific hours
  - Don’t give electricity away – charge high rates on-peak

- **Public Utility Commissions (states) – equitable, efficient, reliable electric supply**
  - Increasing block rates for equity (and distribution cost) reasons?
  - Time-of-day (TOD) rates to reduce need for underutilized new generating capacity
  - EV specific rates with second meters to incentivize EVs?
  - Control systems to link charging and wind generation to meet RPS?
  - Don’t create new neighborhood peaks via multiple high kW chargers w/o control

- **State and city safety regulators – assure quality installation of new charge points**
Where ozone reduction for only part of the U.S. was the goal of the 1990s CA ZEV mandate, oil and GHG reductions across all of the U.S. are now top priority.

- **Ozone** – eliminate tailpipe emissions within many polluted urban airsheds on the hottest days of the year. The ZEV acronym was developed because of a tailpipe emissions reduction goal by regulators responsible for the vehicle’s contribution to the summer airshed total. This ignored powerplant emissions.

- **Oil use reduction** – fully electrify miles (EVs, ER-EVs) and implement more efficient electric drive to reduce fuel use per mile (PHEVs, HEVs). A year round national effort accounting for four season performance fluctuations. Vehicle level analysis suffices.

- **GHG reduction** – same as oil use reduction except “Life Cycle” analysis is required. Generation technology and fuel type must be tracked. Energy used in the added vehicle mass from battery packs must be accounted for. Year round widely scoped system level analysis is required, even extending beyond U.S. borders.
The value of electric drive to utilities and the grid is to make use of capacity wasted in overnight troughs.

NY-ISO Seasonal Load Profiles - Hour in Week

FERC/RTO/ISO and PUC goals – prevent more electric use at peak, fill troughs.
Time of Day (TOD) “smart” pricing is desired to keep customers from charging on peak, requiring new capacity. Smart grid advocates tout cheap rates at night (don’t mention high day rates).

Pacific Gas and Electric 2007 **summer** rate blocks as a function of time and day.
Don’t let optimism inappropriately stretch potential positives to idealized probabilities

- Smart charging (with TOD and seasonal rates) and ER-EV and BEV plug-ins are a not perfect combination

- Although marginal costs of overnight electricity for plug ins are very low, introduction costs will exist and must be kept reasonable.
  - Neighborhood transformers can overload if plug-ins cluster at that transformer; more so if they charge on-peak. This could be addressed via:
    - Charger upgrades, new meters, new rate structures, new transformers, new control systems (TOD can make 2nd daytime charge financially irresponsible)
    - Limitation to low kW level 1 overnight charging at the residence, flat rates, nightly kWh additions remaining within the low portion of the block rate (not in the interest of BEV marketers)
  - Level 2 charging upgrades in garages vary in cost, can cost thousands per upgrade
  - Level 3 “fast” charging between cities – can be very expensive
  - Some new power plants will be needed to serve PHEV, ER-EV and BEV load to 2020, but most load can be met via more intense use of existing power plants