Automobiles:

Designing the 21st century fleet

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“Isn’t Automobile Design best left to the Big Auto Companies?”

OEM Automobile Logic

- Automobile as receiver of petroleum; isolated from other energy systems
- Engine as the primary value added, owned by OEM
- Other components commodity items, from suppliers
- Current performance space inviolable

BEV and PHEV Logic

- Non-fossil carriers essential to the future
- Hydrogen unlikely, especially in the near term, thus electricity primary carrier
- CO2 displacement very large, especially with hydro or wind
- Electricity as carrier leads to V2G logic, starting with the sheer size of vehicle power...

A Power Resource

	Australia	UK	USA
Electric Capacity (GW)	45	80	811
Light vehicles (millions)	13	22	176
Vehicle GW (if electric drive @ 15 kW each)	195	330	2,640

... 4x more power in cars

V2G Logic

- Cars: A power resource too large to ignore
- Electric drive leads to compelling case for a smart, two-way connection to grid
- Dual-use makes electric capacity cheap, but electric energy may be more expensive
- Today, market value for grid management
- Future, enable very large renewable energy
- Optimize design for both transport and electric system -- OEMs will not do this

OEM Expertise

- Combustion, fluid flows
- Mechanical engineering of drive trains, suspension, etc (still necessary)
- Low-cost production
- But ...

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Electric Power Markets

Example: Power connection

- OEM: 5 kW is big enough, typically overnight charging, off-the-shelf power components
- V2G: increase to 15kW connection for fast charge, roadside boost, also increases regulation services revenue by $2,000/year

Example: BEV or PHEV?

- OEM: Battery for daily use, fuel occasional-use when longer range need. Hybrid more acceptable than BEV due to fast refuel.
- V2G for Regulation: Prefer additional range via battery, increasing V2G regulation capacity. Simpler vehicle, no emissions.
- V2G for Spinning Reserves: Prefer additional range via hybrid, providing longer duration V2G spinning reserves.

Conclusion

- V2G is not an “add on”
- Different trade offs will be made when transportation and electric functions are combined at design stage
- The OEMs will not do this
- Great societal benefit from connecting these two energy systems