

The Car, The Grid, The Future

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The Seattle Electric Vehicle to Grid Forum
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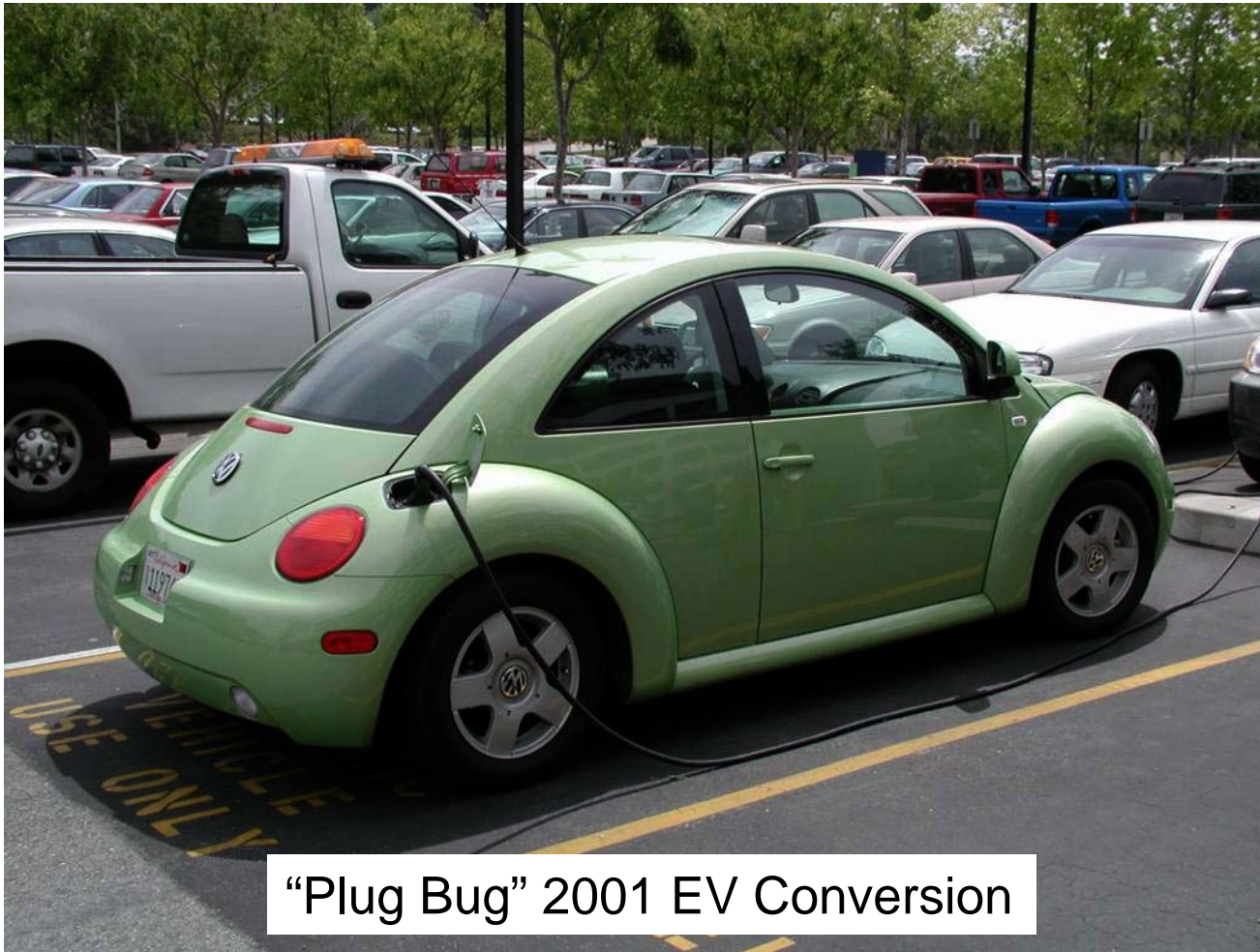


The Automotive Imperatives

- Air quality
- Global warming
- Energy security

Electricity Powers Transportation without Petroleum

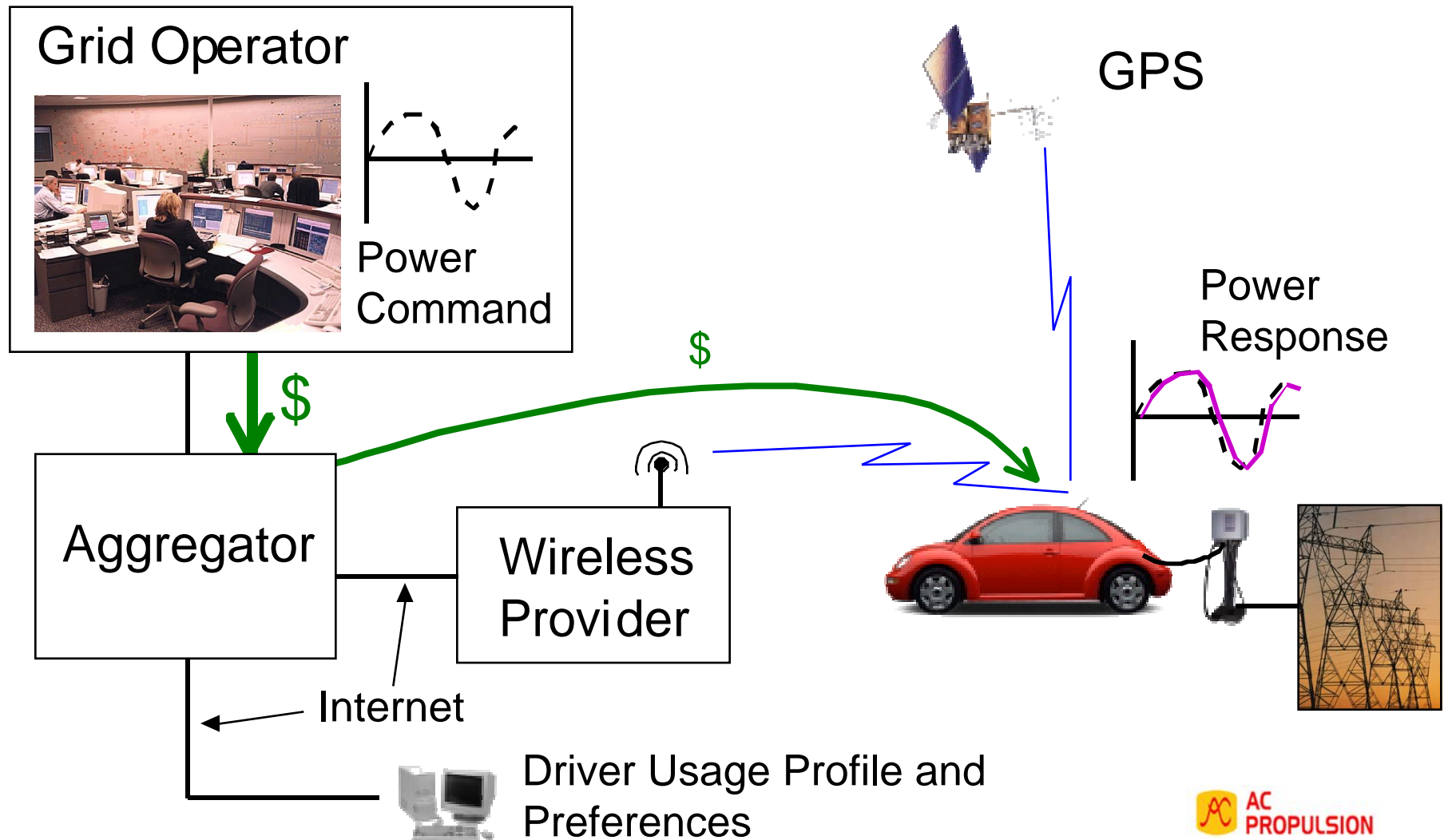
The Connected Car



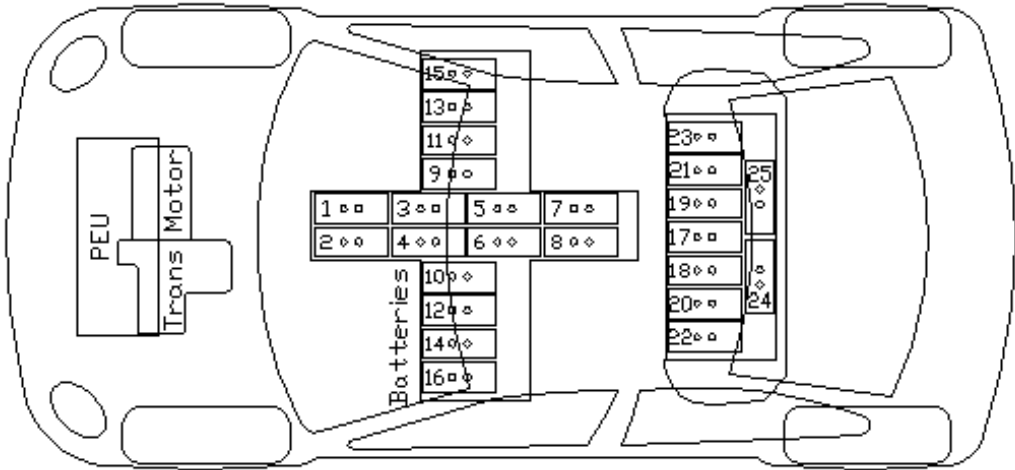
- Plugs in to the grid
- Refuels while parked
- Uses existing infrastructure
- Adds to energy diversity
- Presents off-peak load
- Provides dispatchable power asset

The Vehicle-to-Grid Concept - V2G

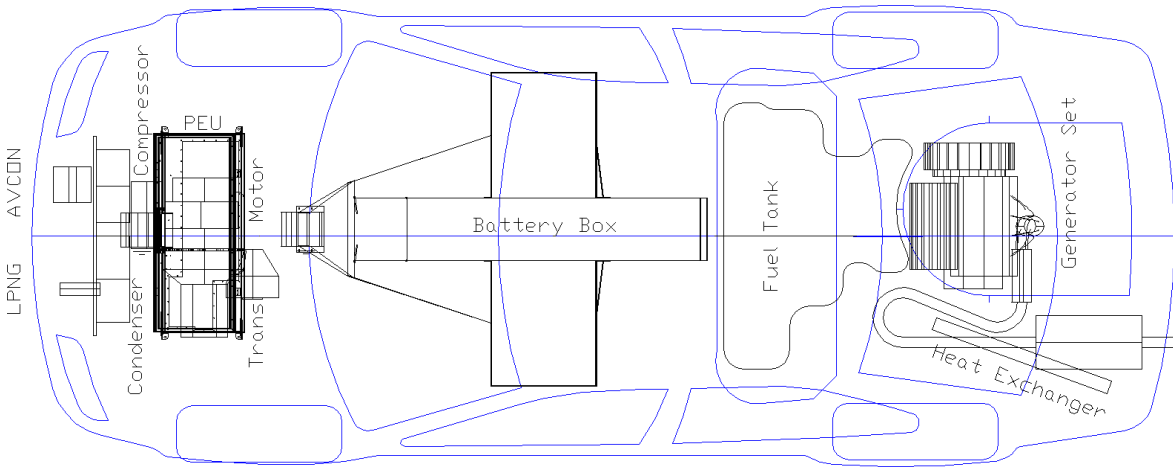
Connected vehicles serve as distributed energy resource (DER)



Connected Cars: BEV and PHEV



- 0-60 < 10 secs
- Top speed > 80 mph
- Battery 10 to 50 kWh
- Bi-directional charger
- 10 to 20 kW charger



Enabling Technology

Propulsion

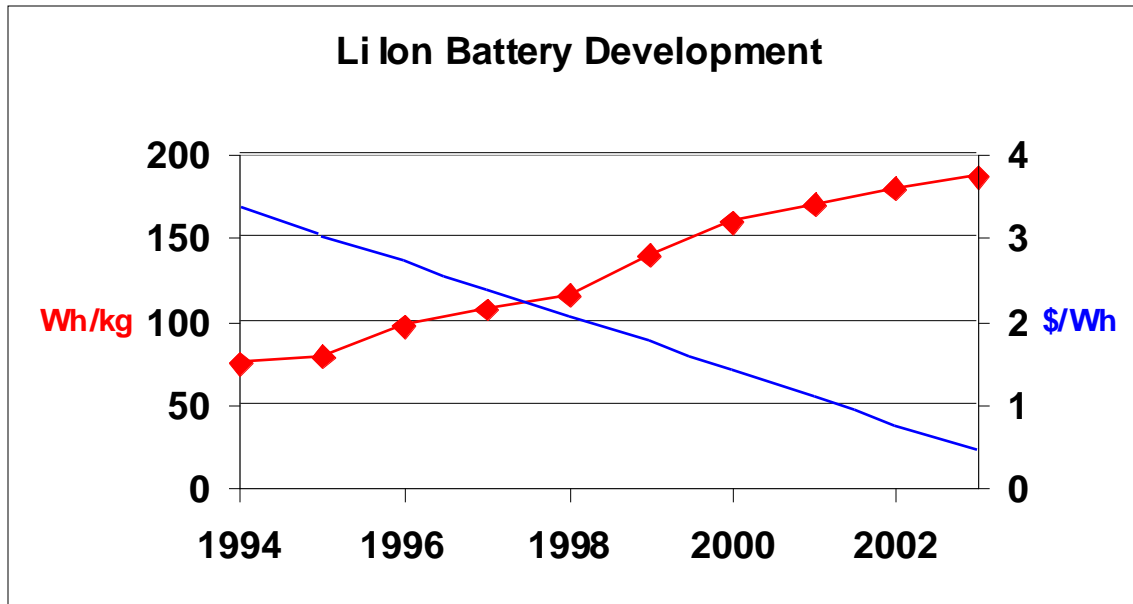


0 emissions
0-60 mph in 6.2 seconds
0-125,000 miles in 10 years

Enabling Technology

Battery Progress

Small cells
assembled
into large
packs

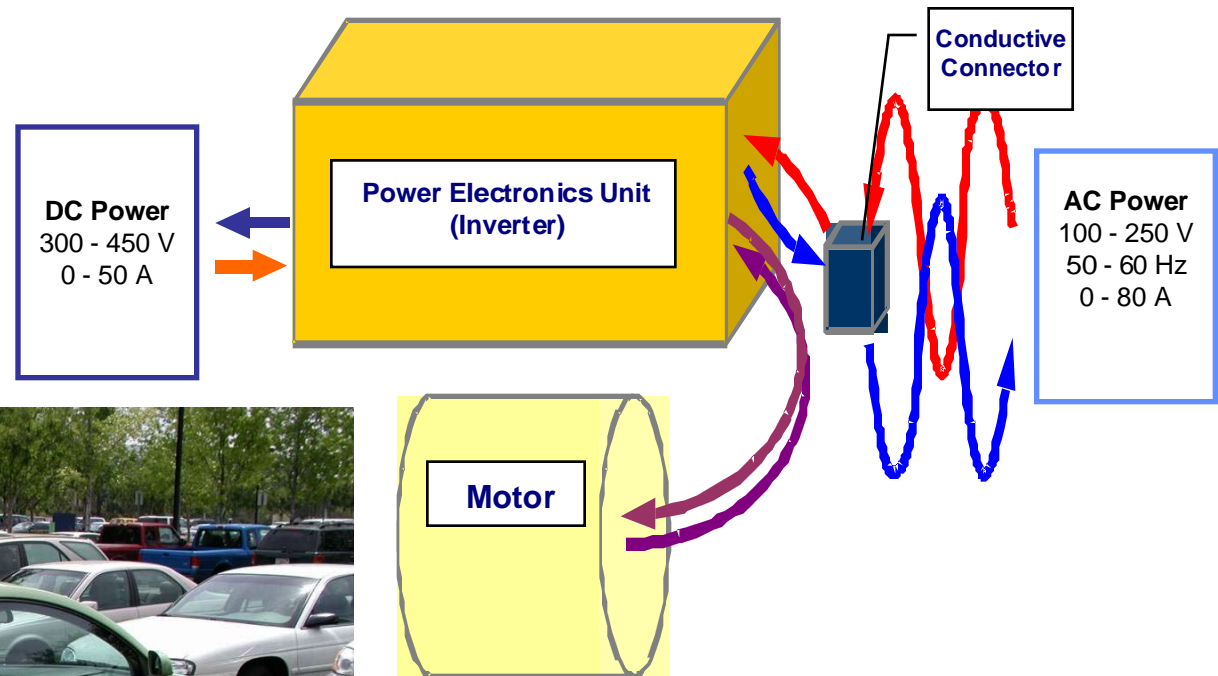


Mass markets
drive rapid
improvement
and cost
reduction

Enabling Technology

Bi-Directional Charging for V2G

- Integrated
- High power
- Low cost



- Grid tied
- Stand alone

2003: EV Availability Denied



Toyota RAV4 EV
out of production



Chevy S10 EV
out of production



Honda EV Plus
out of production



GM EV1
out of production



Ford Ranger EV
out of production



Chrysler EPIC EV
out of production

Business as Usual?



“... flattening the vehicle so it can go through the various mechanics of recycling,”
- Dave Barthmuss, General Motors, quoted in *Washington Post*, March 10, 2005

photo: www.saveEV1.org

EVs Without OEMs

- Re-power conventional vehicles
- Design for low-volume production
- Re-certify to FMVSS compliance
- Apply up-to-date technology
- Sell to receptive niches

Existing markets and technology can support EV production by the thousands

Plan for Production of EVs

Manufacture new electric vehicles by converting conventional vehicles to electric power

- Low investment
- Fast to market
- Responsive to new technology
- Product proliferation for market growth
- Process replication for capacity expansion

The Car

FMVSS-certified EV conversion of Scion xA and xB



Scion xB



Scion xA

Features

- AC Propulsion drive system
- Li Ion battery
- Bi-directional charging
- Regenerative braking
- Onboard battery diagnostics
- A/C, full power

Performance

- 160 mile range
- 0-60 < 7 sec
- 90 mph
- 20 kW bi-directional power

The Factory

**A facility to convert one car/day (250/year) –
disassembly, modification, reassembly**

- 50,000 square feet
- 10 stations
- 15 to 25 employees
- Ship in: drives, batteries, harnesses, interior and exterior hardware
- Make or buy: metal parts (battery enclosure, bracketry)
- Procure locally: cars, hardware

The Money

Investment required to start production of EV conversions

- Development - \$2 million
- Facilities - \$1.5 million
- Working capital - \$2 to 3 million

Additional requirements for money

- Subsidies
- Marketing
- Cost reduction