

General Motors Electrification of the Automobile

**Helen Foord
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Environmental Strategy – removing the automobile from the energy and environmental equation



Overcoming range anxiety

❑ Many technologies available to reduce CO₂ emissions on a well-to-wheel basis but the challenge is always refuelling infrastructure.

- fuel providers have always been reluctant to make early investments before significant volumes of vehicles are on the road
- Consumer won't buy the vehicles unless infrastructure is widely available


❑ From EV-1, we learned that:

- Consumers don't want to take the risk of being stranded
- Consumers don't want to wait for a ubiquitous refuelling infrastructure
- Consumers don't want to have own/rent second vehicle for longer trips

❑ In short, most consumers won't make sacrifices for a low carbon car



EV1

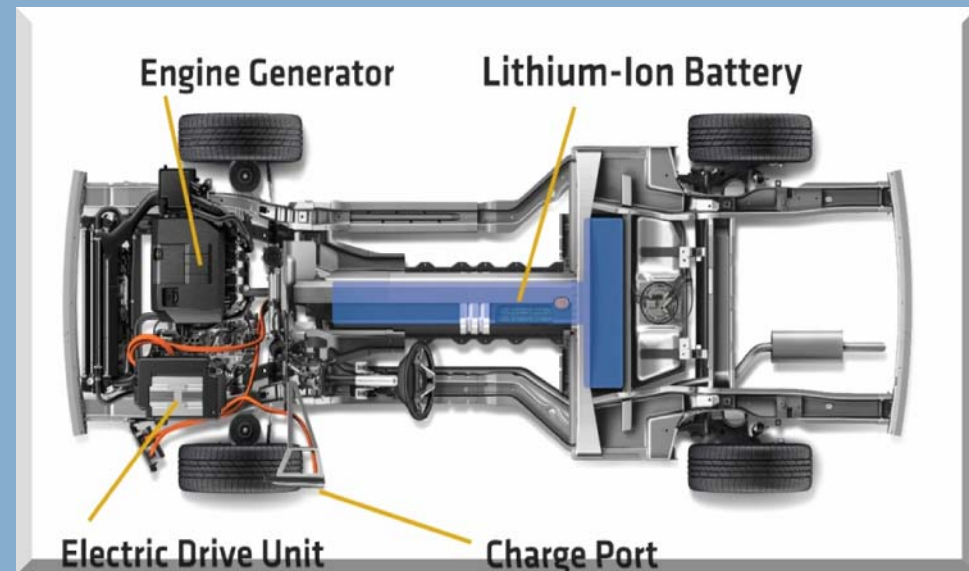


VOLT

VOLTAC

Lithium Ion Battery

- ❑ •16 kWh (8kWh usable)
- ❑ •High energy, high power in minimized package
- ❑ •Charged in approx. 3 hours @ 230 Volts,
about 8 hours @ 110 Volts
- ❑ •10 years life/240,000 km



GM's mission:
To successfully establishing
E-REV as a new propulsion
technology

PHEV

Plug-In Hybrid
Primary Fuel: Petroleum

E-REV

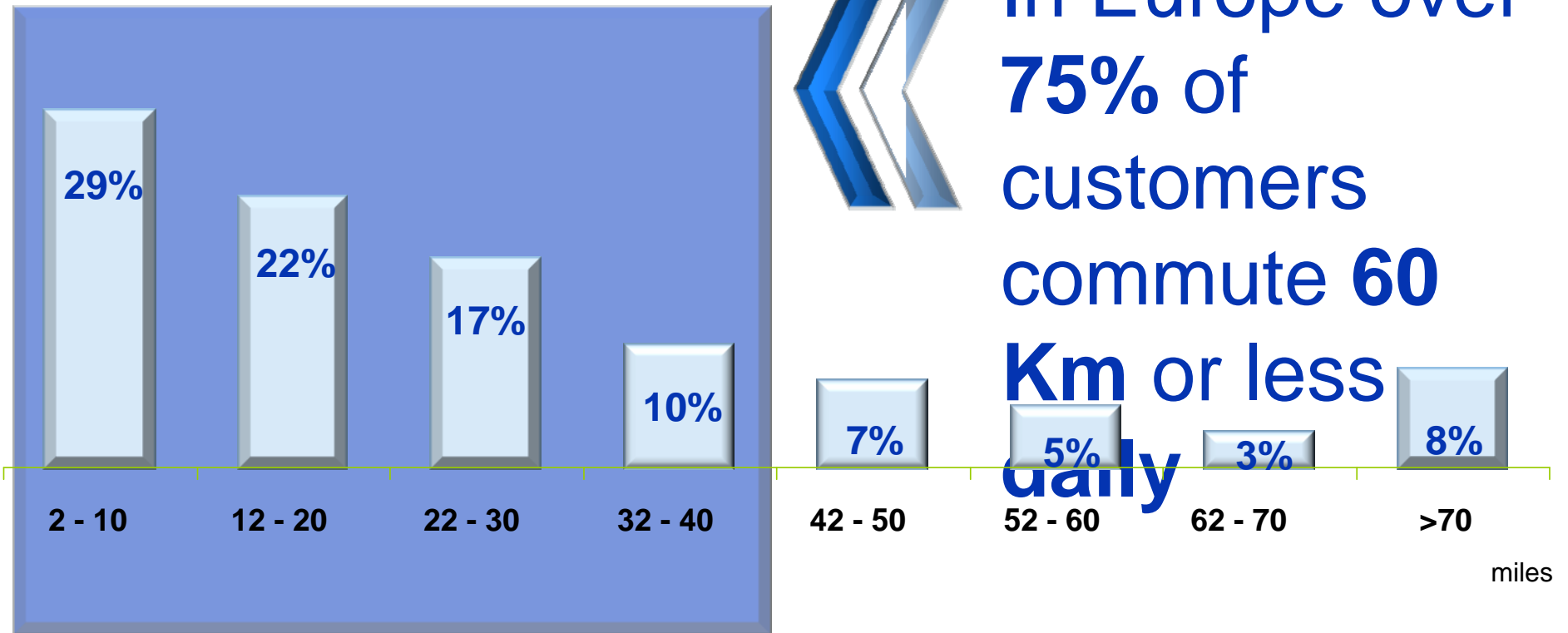
Extended-Range Electric Vehicle
Practical Zero Emission Vehicle



EV

Electric Vehicle
Limited Vehicle Range

E-Rev meets consumers needs





= No Regrets Personal

Full Utility

60 km on plug-in charge +
several hundred km of extended range driving

Under current
European test
Cycle (ECE
R101)

< 40g/km



No Compromises

Meets **all** European Safety Standards





2/19/2009

Coming soon..... the Opel Ampera

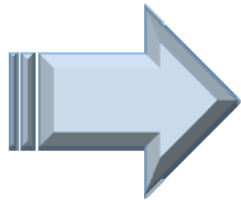


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Enablers for early commercialisation

Strategic Policy required to send complementary signals to vehicle producers, consumers, infrastructure providers



Enablers for vehicle producers:

- support for continued development via “Super Credits” in EU CO₂ legislation for cars under 50g CO₂/km
- Support for continued research to improve battery technology and reduce costs

□ Consumers;

- Rebate at purchase to offset initial premium costs
- Free access to city parking, recharging bays
- Accelerated depreciation to encourage company car fleets.

□ Infrastructure providers:

- Roll-out plan for recharging infrastructure – enable private home, multi resident, shopping centres charging
- Building standards revised to require easily accessible recharging points
- Initial volume to use off-peak power
- Match growth on demand to additional renewable energy capacity

The future – Hydrogen fuel cell

- ❑ Part of GM's fleet of over 100 4th generation Fuel Cell Electric Vehicles
- ❑ The World's largest FCEV market test
- ❑ Gain experience from "real world" driving
- ❑ Get customer feedback on vehicle and refueling



Clean Energy Partnership (CEP)

The European Lighthouse Project for Hydrogen Vehicles



DAIMLER



StatoilHydro



VOLKSWAGEN
ARTIFICE GESELLSCHAFT

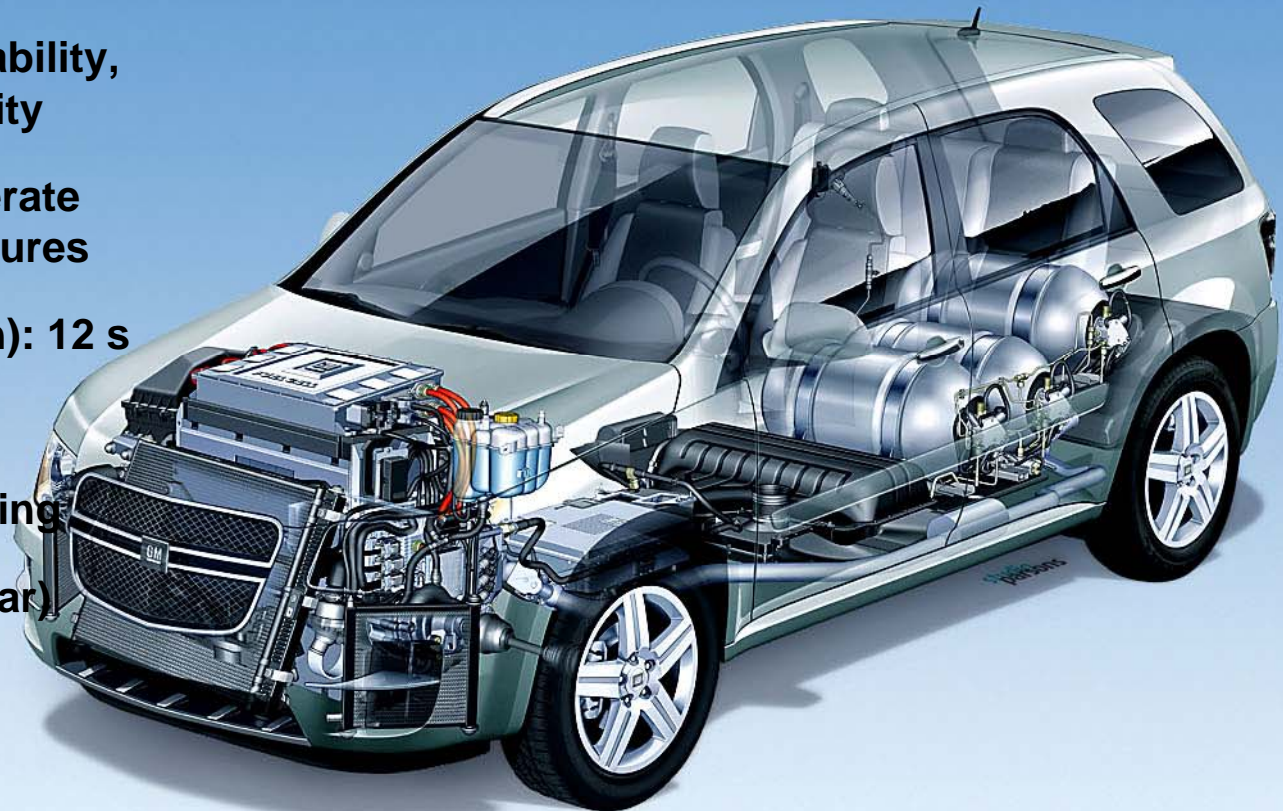
Phase II: 05/2008 – 2010

- More than 40 hydrogen vehicles
- 3 fully integrated hydrogen refueling stations:
 - Total
 - Total/StatoilHydro/Linde
 - Shell



GM HydroGen 4

- ❑ Fourth generation fuel cell propulsion system with improved every-day suitability, performance and durability
- ❑ Capable to start and operate in sub-freezing temperatures
- ❑ Acceleration (0-100 km/h): 12 s
- ❑ Top speed: 160 km/h
- ❑ Customer friendly refueling
- ❑ Fuel: 4.2 kg CGH_2 (700 bar)
- ❑ Fast fill: 3 min.
- ❑ Range: 320 km



**Thank you - any questions
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