# Electrification of the automobile


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**VEHICLE SOLUTION Essentials**

**INDEPENDENCE** from **Petroleum**

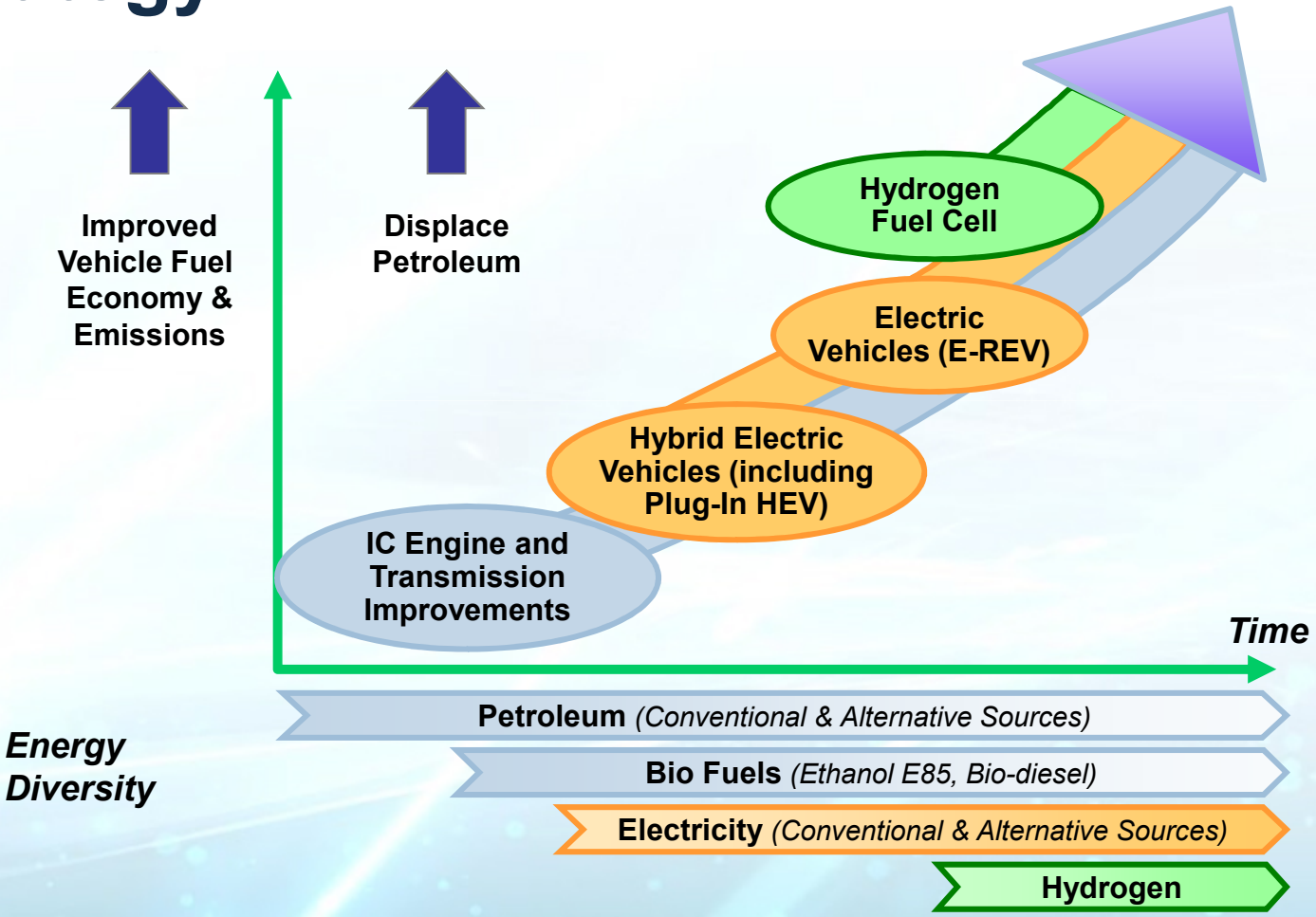
**+ SAFE**

**+ PRACTICAL**

**+ AFFORDABLE**

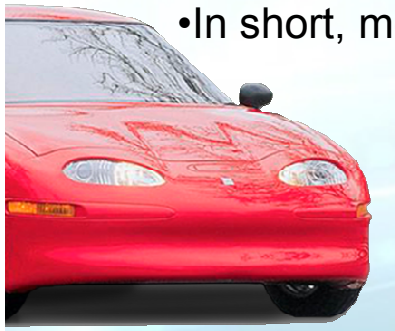
**+ FUN** to **DRIVE**

# GM's Advanced Propulsion Technology Strategy



# Overcoming Range Anxiety

- Many technologies are available to reduce CO2 emissions on a well-to-wheels basis but the challenge is always refueling infrastructure
  - Fuel providers have always been reluctant to make early investments in infrastructure before there are significant volumes on the road
  - Consumers won't buy vehicles unless fuel 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 refueling infrastructure
  - Consumers don't want to have to own/rent second vehicle for longer trips
- In short, most consumers won't make sacrifices for a low carbon car

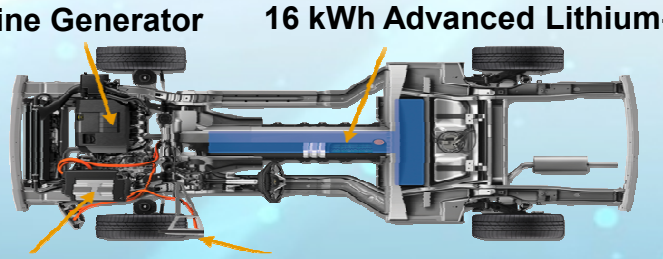


EV1

AMPERA

# Solution: Extended-Range Electric Vehicle

- Wheels always driven with an electric motor
- Operates as Battery-Electric vehicle
- Charge battery by plugging in to standard 220 -240Volt grounded outlet
  - (separately protected circuits or circuit-breaker adaptor – no multiple outlet strips)
  - 3 hours to recharge
- As battery becomes depleted…
  - Combustion engine operates automatically
  - Optimized to sustain battery charge
  - Electricity continues to drive wheels
- Fosters diversity: APU could be petrol, diesel, E85, even H2FC




VOLTEC

# Creating a New Propulsion Category:
# Extended-Range Electric Vehicle

**PHEV**
Plug-In Hybrid
Primary Fuel: Petroleum

**E-REV**
Extended-Range Electric Vehicle
Practical Zero Emission Vehicle

**EV**
Electric Vehicle
Limited Vehicle Range

# Opel Ampera
# EXTENDED-RANGE Electric Vehicle

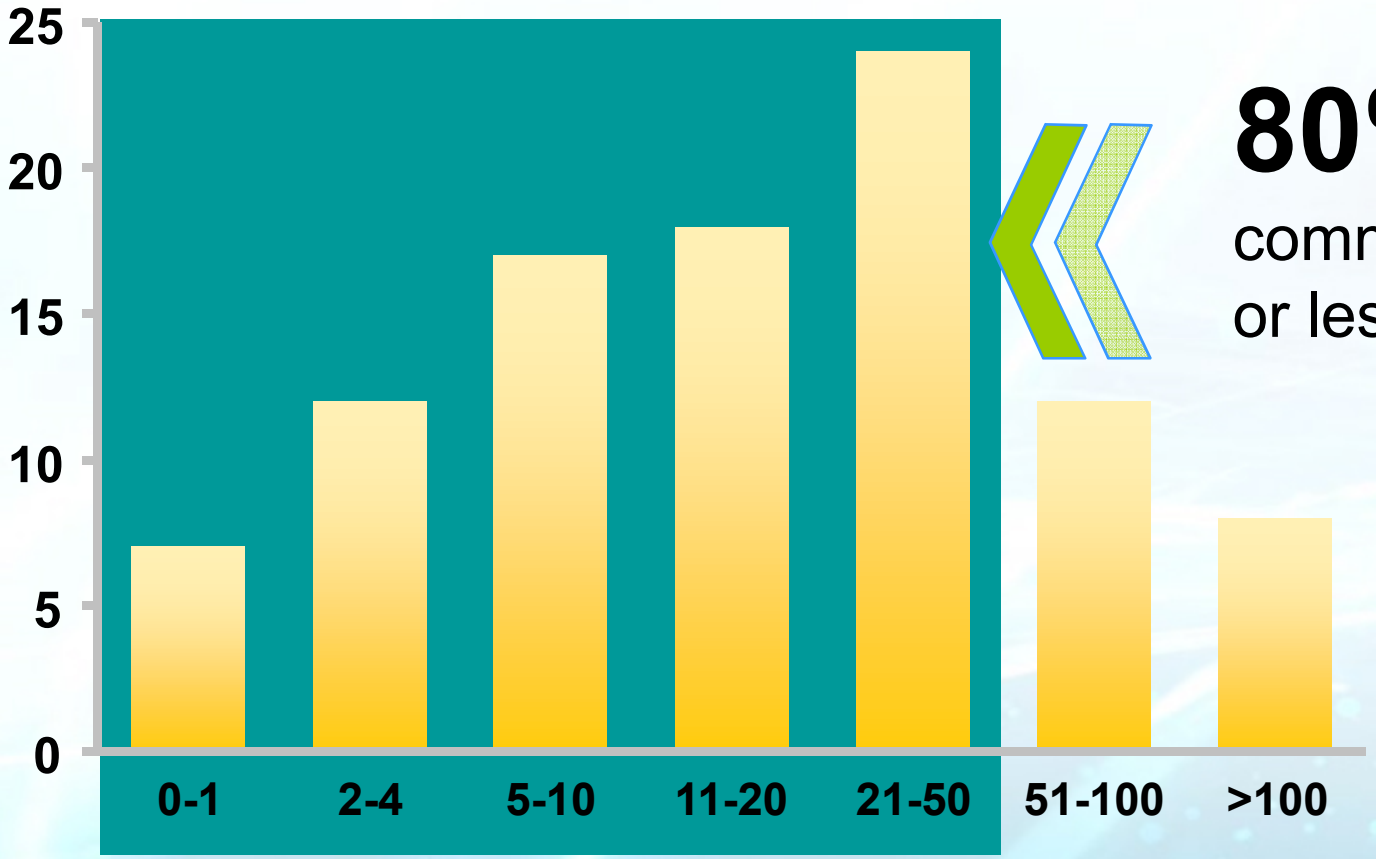
**60 km**
**BATTERY**
Electric Drive

+

**More than 500 km**
of **EXTENDED RANGE**
Driving

# Typical Daily Commute

## *60 km Is the Key*

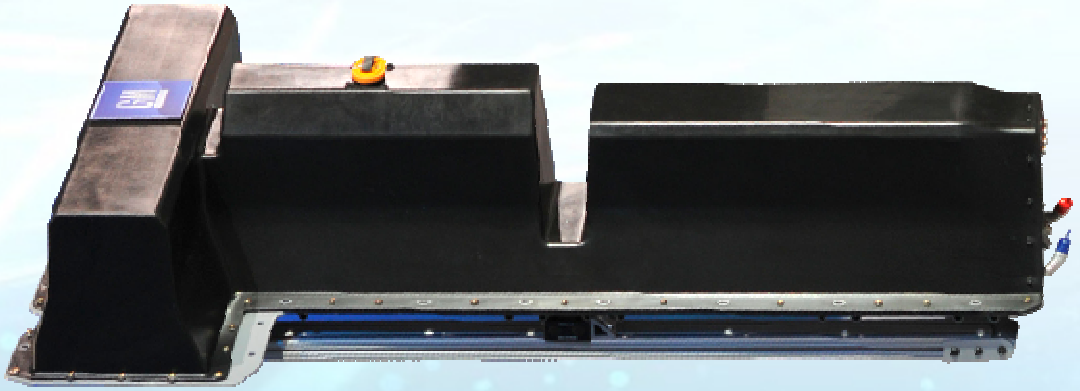



**80%** of customers commute **60 km** or less **daily**

Source: Mobilität in Deutschland 2002

# Lithium-Ion Battery Pack

- 16 kWh (8kWh usable)
  - Approximately 50% of the capacity is used to maximize battery life, performance and safety
- High energy, high power in minimized package
- Charged in approx. 3 hours @ 220 Volts
- More than 200 cells
- 10 years life/
  240.000 km



# Vehicle EFFICIENCY

## European Standard Test Cycle for Plug-ins

Under Current European Test Cycle (ECE R101):

**1.6L/100 km**

**< 40g/km $CO_2$**

# E-REV Offers Operating Cost Savings


No petrol and produce no emissions for up to 60 km, helping save approximately 1700 liters of petrol a year (compared to a similar sized vehicle that averages 7.8 l/100 km).

# Spirited Gas-Free Performance

- 111 kW of power
- 370 Nm of torque
- 161 km/h (100 mph) top speed
- Acceleration
  - 0-100 in about 9 seconds
  - Launch like a V6 250hp Mid-Size Sedan

# Enablers for early commercialization

- Strategic Policy required to send complementary signals to vehicle producers, consumers, infrastructure providers
- The Ampera and Volt are expected to arrive in the EU at the end of in 2011, therefore time for action is now.

Vehicle producers

- Support for continued research to improve battery technology and reduce costs

Market enablers

- Rebate at purchase to offset initial premium costs (e.g. €5.000 for vehicles under 50g)
- No Registration Tax and/or Annual Circulation Tax (where applicable)
- Accelerated tax depreciation to stimulate fleet buyers
- Zero congestion charges (where applicable)
- Free public parking on the street and free or reduced parking costs in parking lots
- Dedicated parking spaces with access to recharging poles
- Green Public Procurement (lead by example)
- Dealer incentives to cover retooling
- PR/Communication campaign to educate customers

# Enablers for early commercialization

Infrastructure providers

- Roll-out plan for recharging infrastructure:
    - Phase 1 - enable private home and multi-residential recharging
    - Phase 2 – Retrofit multi-residential, parking garages, shopping centres
- Uniform recharging standards around Europe (single phase 220-230V with “harmonized” plug)
- Check home electricity installation.
- Incentives to install easily accessible recharging outlets in homes, apartments and commercial spaces.
- Building standards revised to require easily accessible recharging points
- “time of day” pricing to make overnight charging more attractive


Are you Plugged In?
10 JAHRE
Opel Innovationen
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