



CHEVROLET

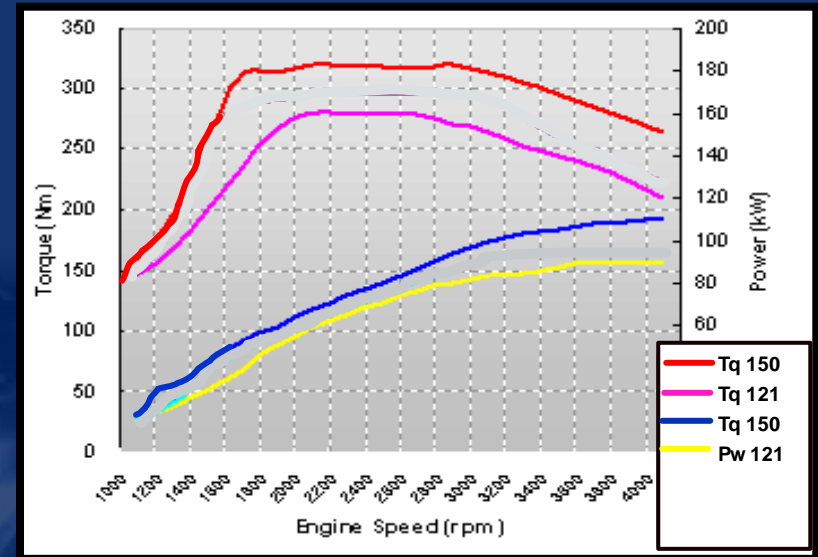
Current Diesel Production Portfolio

Sung-Chae Moon

Senior Manager, Base Engine

GM DAT, Korea

Overview



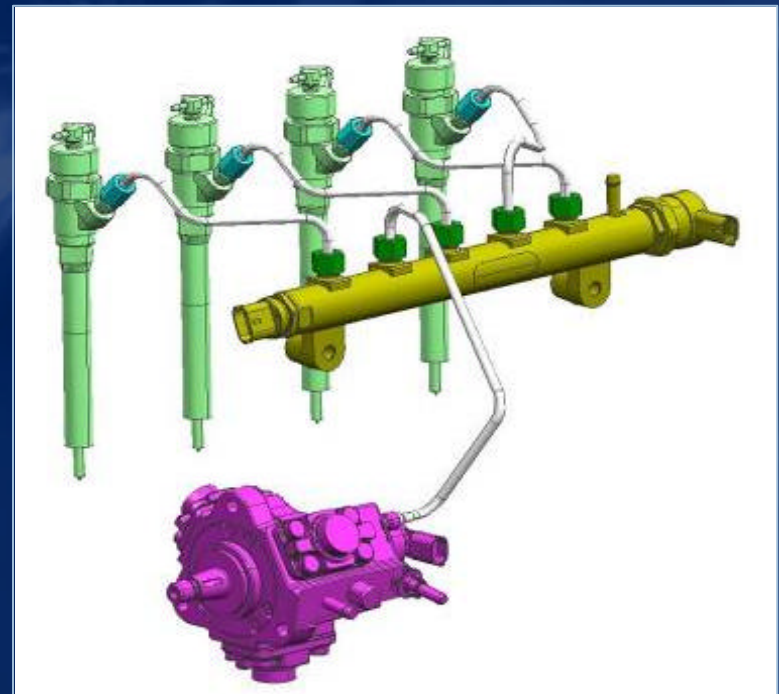
Specifications	Captiva / Epica Diesel 150 PS	Lacetti / Nubira Diesel 121 PS
Displacement (cc)	1991	?
Bore x Stroke (mm)	83 x 92	?
Compression Ratio	17.5	?
Max. Torque (Nm @rpm)	320 Nm @2000rpm	280 Nm @2000 rpm
Max. Power (kW @rpm)	110 kW @4000rpm	88 kW @4000rpm

Main Characteristics

- High performance diesel fuel injection system
 - Bosch Gen II common rail 1600 bar injection
 - 2.0L Diesel with 2 versions (150 PS / 121 PS)
- Advanced electric controlled variable geometry turbocharger with intercooler (150 PS)
- Electric vacuum controlled fixed geometry turbocharger with intercooler (121 PS)
- Advanced diesel particulate filter system
- Improved EGR system with EGR cooler
 - *Highly competitive engine performance*
 - *High flat torque area along with overall engine speed*
 - *Low emissions*

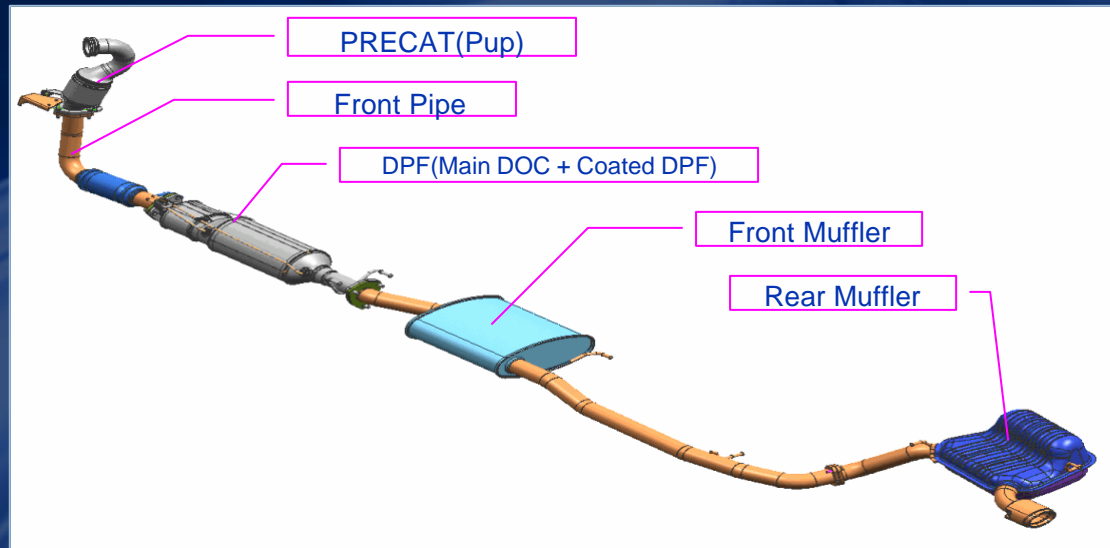
Common Rail System

- 1600 bar 2nd Generation
- Improved multiple injection performance
- Optimized injection quantity adjustment
- Improved...
 - engine performance
 - combustion noise
 - fuel economy
 - emissions



Diesel Particulate Filter System

- Active regeneration strategy
- Maintenance free for the vehicle life
- Meet the Euro-4 emission regulations (HC+Nox, CO and PM)
 - Application of the 1st and 2nd diesel oxidation catalysts and coated diesel particulate filter



Turbocharger System – 150 PS

Electronically controlled VGT (Variable Geometry Turbocharger)
with intercooler

- Improved driveability & fuel economy
and low emission accomplished

Movable vanes

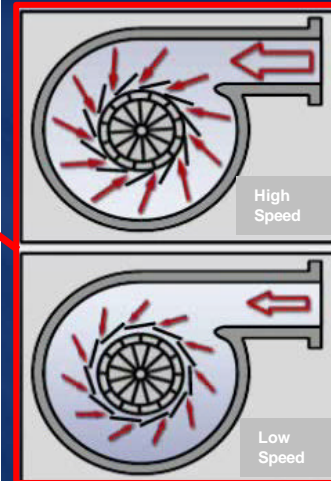
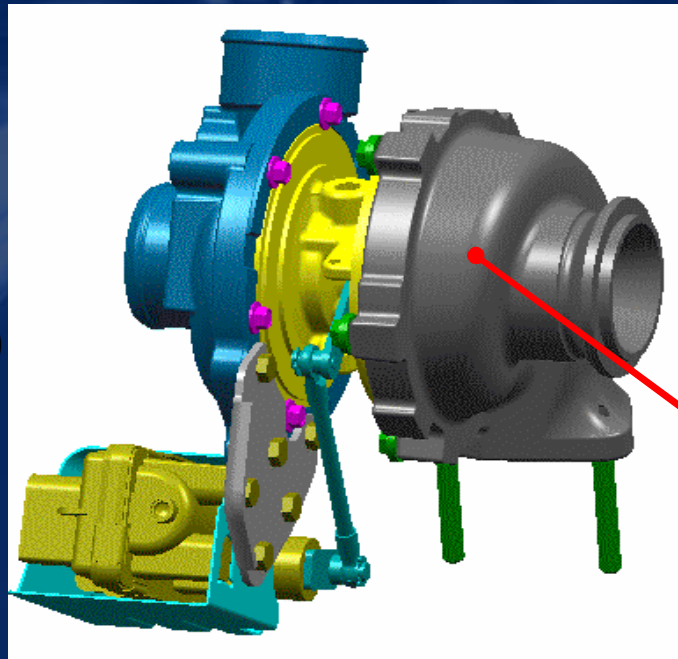
Provide optimum turbine
flow control

REA (Rotary Electronic Actuator)

Fast response & precise control

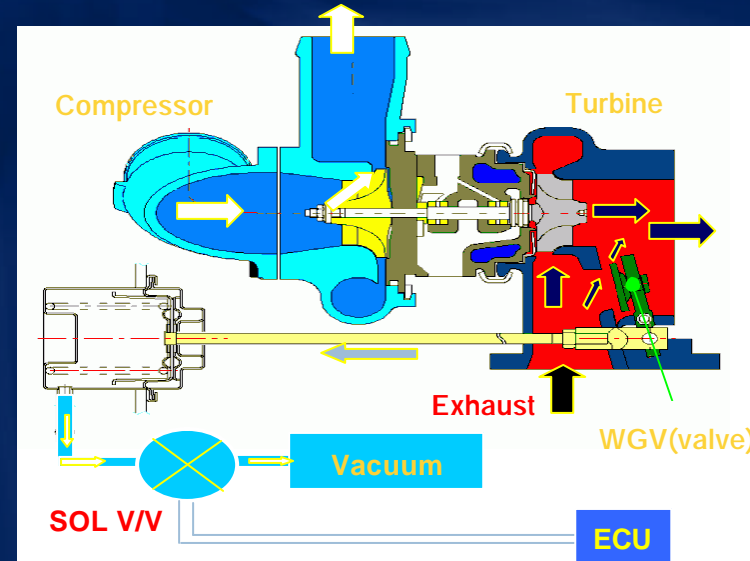
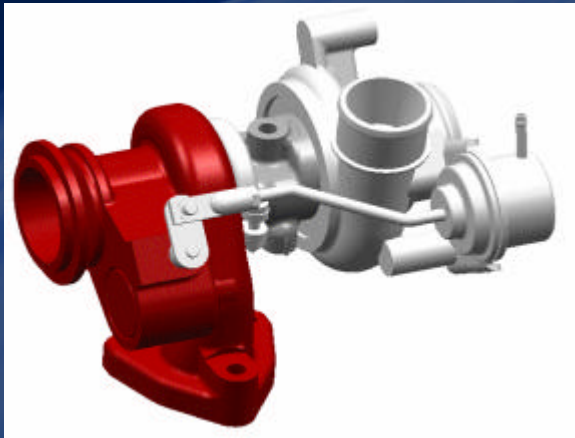
Turbine housing: SiMoCr+

Bearing housing cooling:
Oil & air cooled

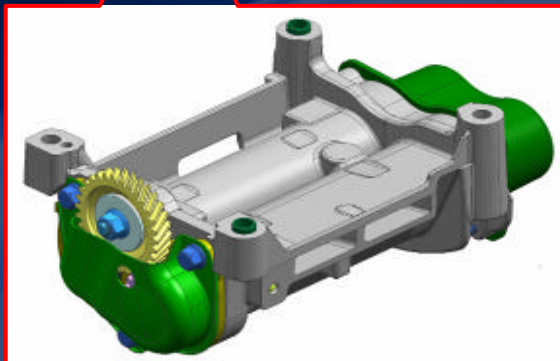
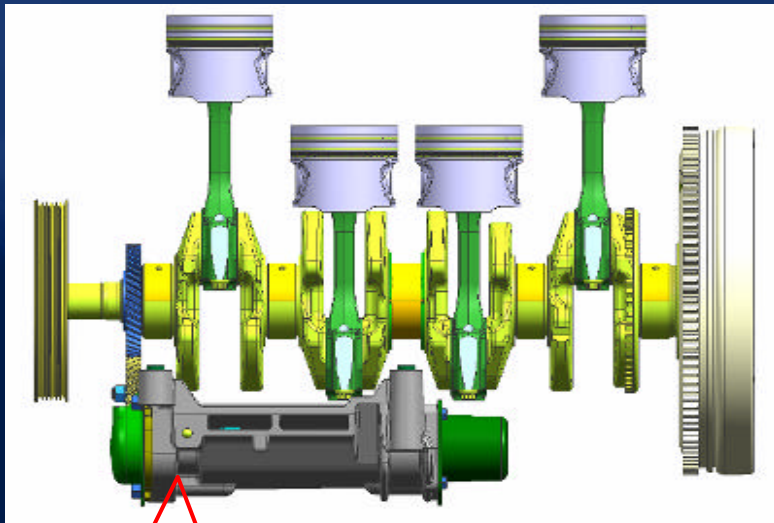


Turbocharger System – 121 PS

- Electric vacuum controlled FGT (Fixed Geometry Turbocharger) with Intercooler
- Improved driveability & fuel economy and low emission accomplished
- Vacuum actuator controlled by ECU
 - Perform the optimised boost pressure for best performance and low emission
- Turbine housing : HiSiMo
- Bearing housing cooling : Oil & air cooled



Crank-train



Dual Mass Flywheel

Improving vibration comfort

- Eliminates annoying gearbox rattle noises
- Separated mass (inertia)
- 2nd stage arc springs
- Resonance frequency below idle rpm

Balance Shaft Module

Reduces 2nd order vibration

- Balance Shafts integrated in oil sump
- Gear Drive

GMs March-To-Zero & Evolution of Propulsion Systems

Dr. Bruce D. Peters

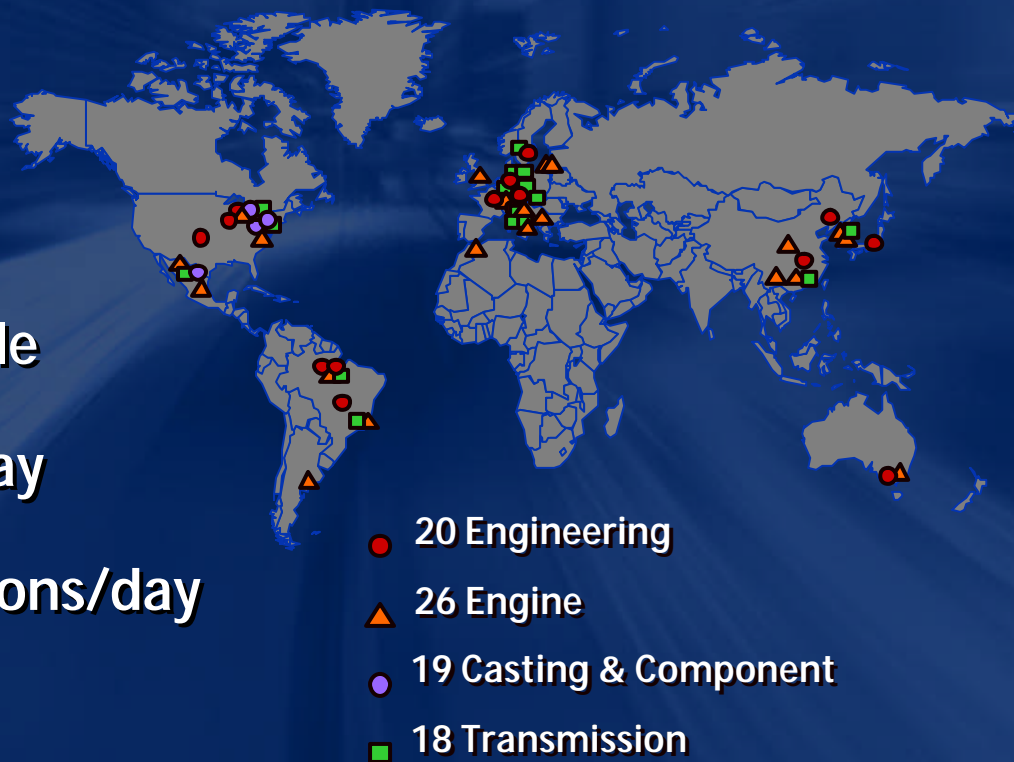
Chief Engineer

Advanced Powertrain and Technology Planning

GM Global Powertrain

Who We Are Today:

- 83 facilities
- 17 countries
- Over 52,000 people
- 36,000 engines/day
- 32,000 transmissions/day



GM Powertrain Europe

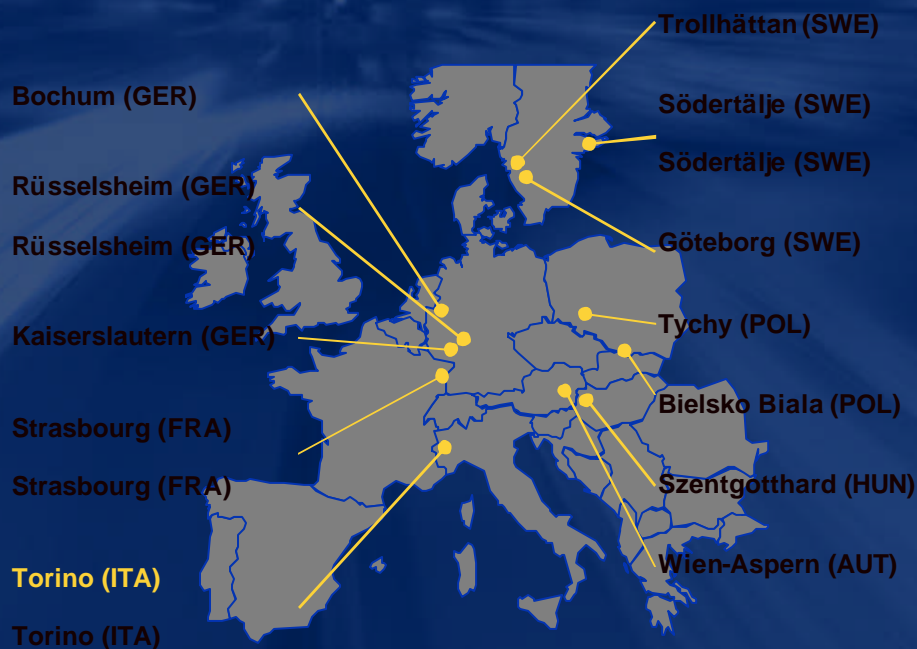
Global Lead Responsibilities:

- Small diesel engines

- Diesel controls

- Small gasoline engines

- Manual transmissions



Subsustainable Mobility Challenge

Customer & Market
Requirements



Economic / Ecologic
Aspects

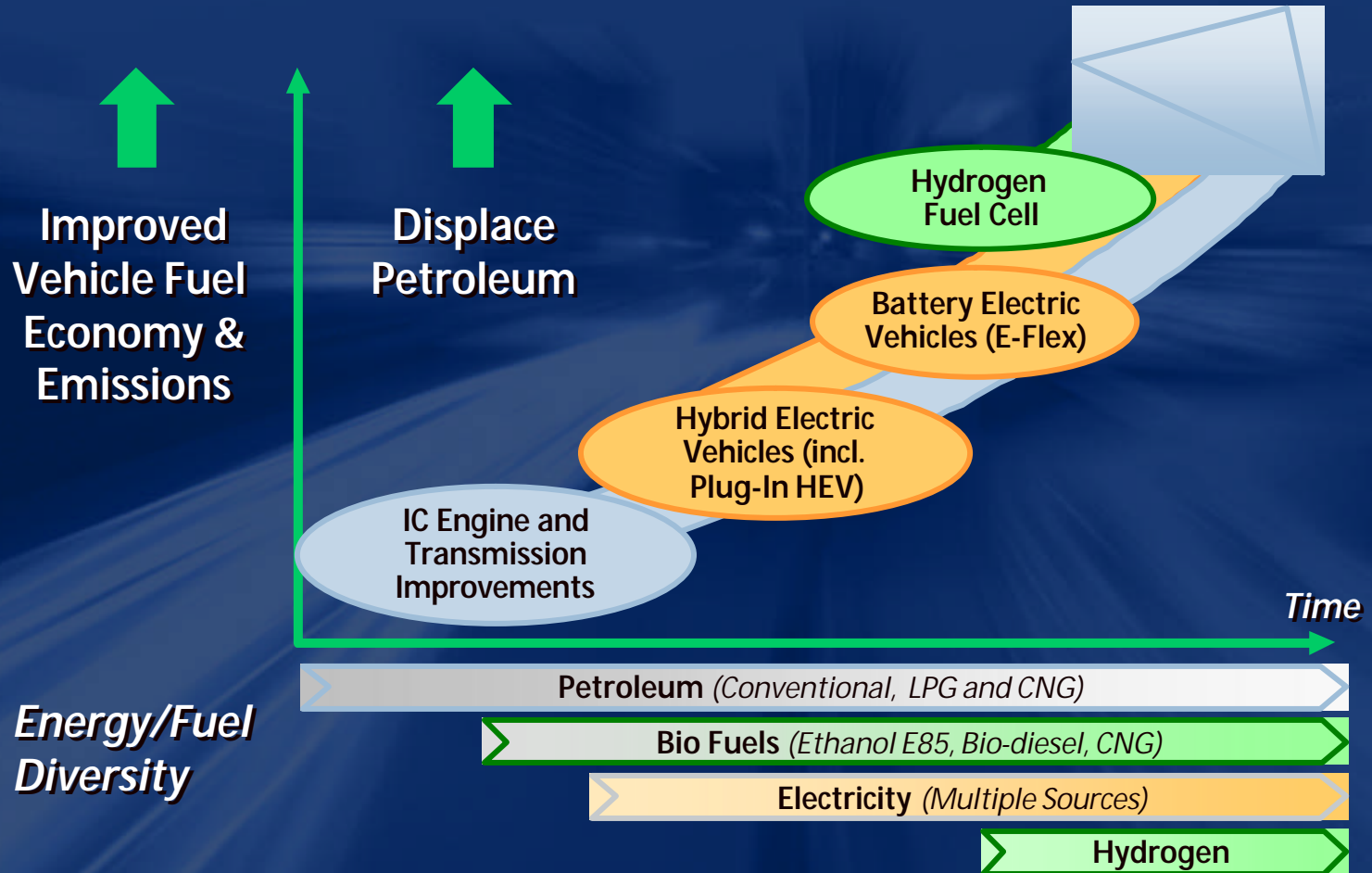
Homologation
Constraints

Automotive Powertrain Challenge

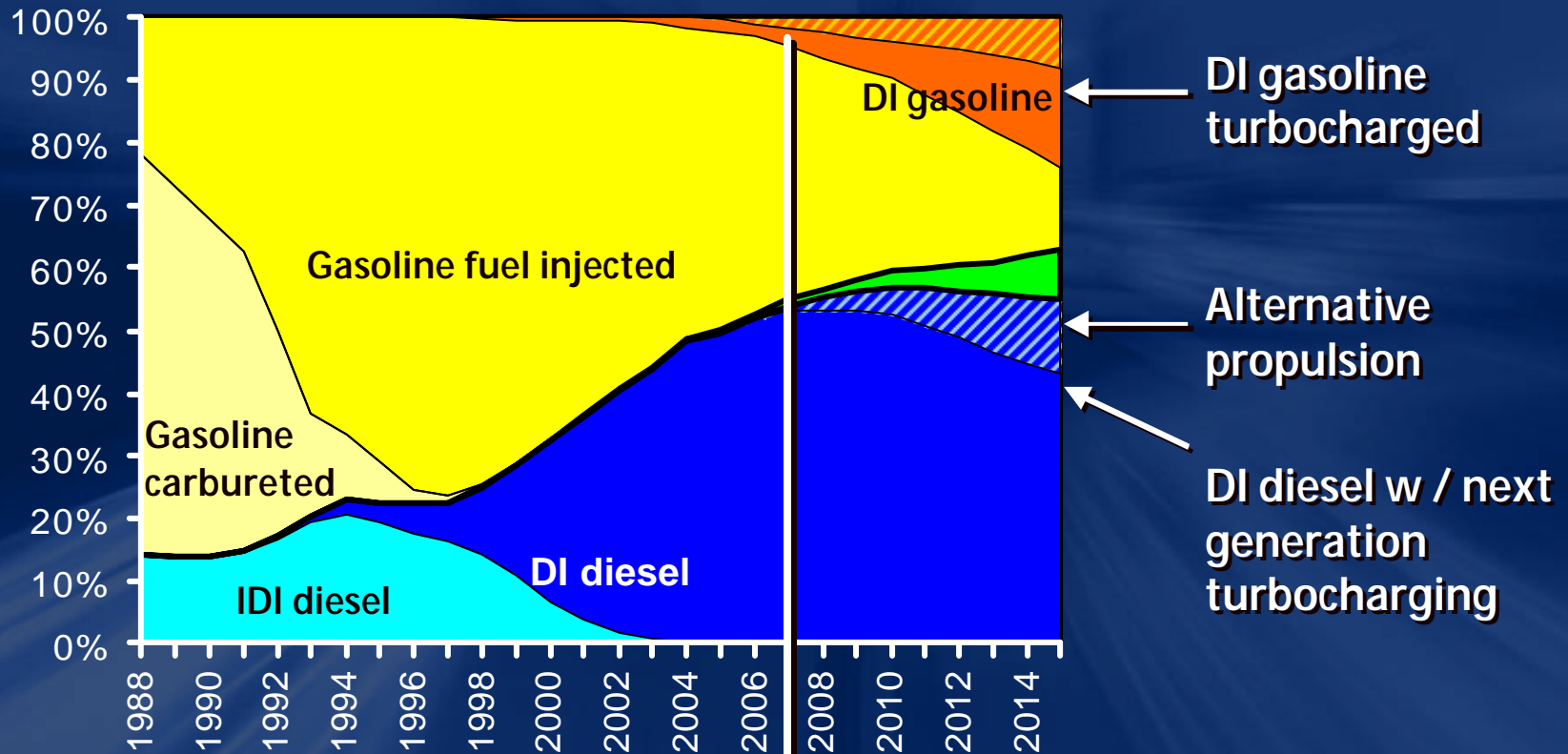
Performance

- i.e. power/torque levels, driveability, response, fun-to-drive ...
- **Environment safeguard / Energy source flexibility**
 - i.e. pollutants emission, noise, fuel economy, greenhouse effect, crude oil availability, alternative- or bio-fuels
- **Legislation / Regulations**
- **Quality**
 - i.e. flawless launch, for-life operation, reliability, durability...
- **Affordability**

Advanced Propulsion Technology Strategy



European Powertrains - Market Outlook



GM's Diesel Portfolio - Market Perspective

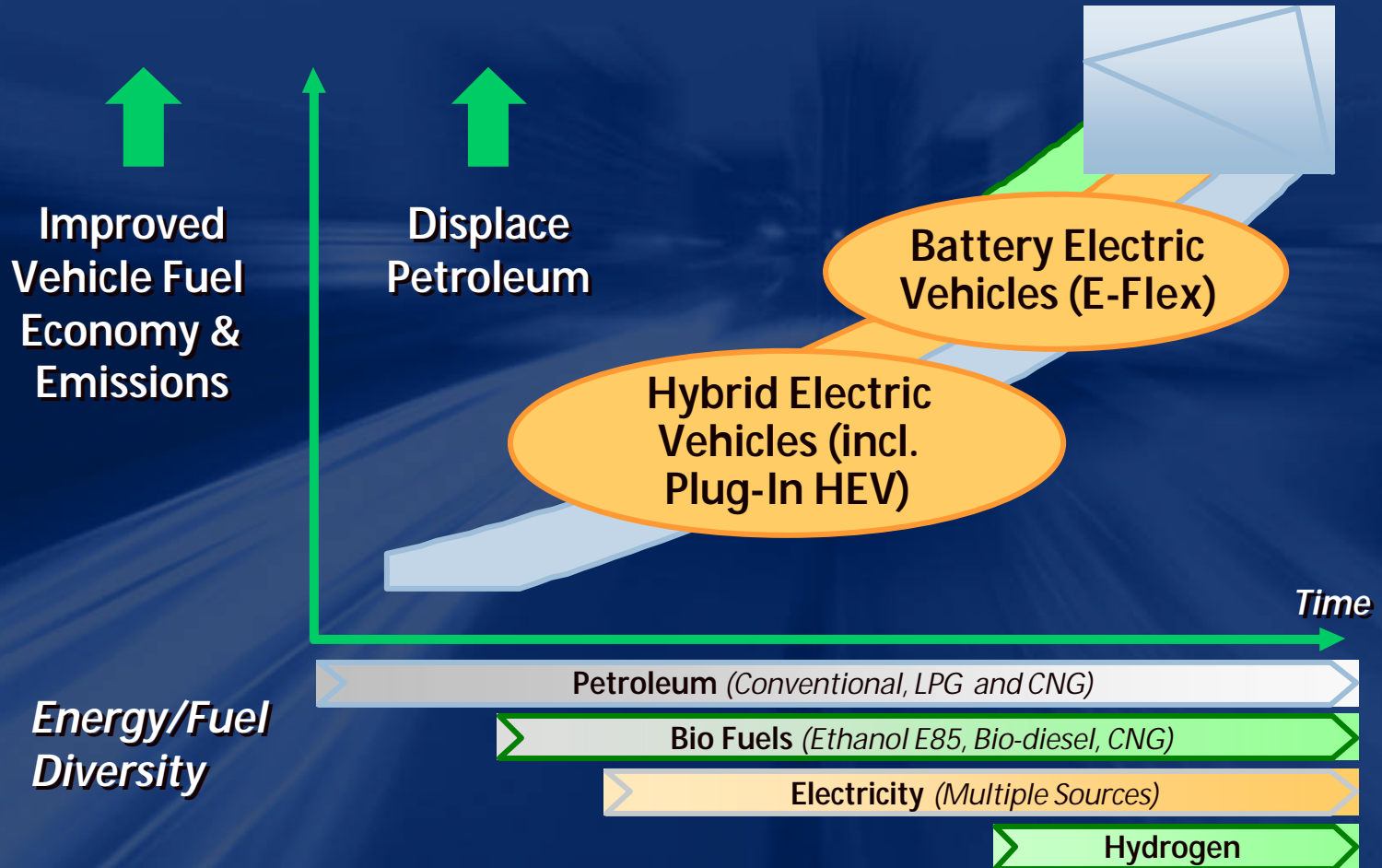
- GM is committed to developing global diesel solutions
- Diesel powertrains satisfy unique vehicle requirements
 - In Europe: Diesels are fun-to-drive, high torque powertrains with significant penetration in passenger vehicles
 - U.S.: Diesels primarily in utility and large vehicles
 - Asia Pacific: Diesels in crossovers and expanding into passenger cars
- Emission regulations, fuel price, taxation based on engine displacement and fuel consumption largely dictate markets where diesels are popular today

World Premiere at Geneva Motorshow

New GM 2.9L V-6 Diesel



Advanced Propulsion Technology Strategy



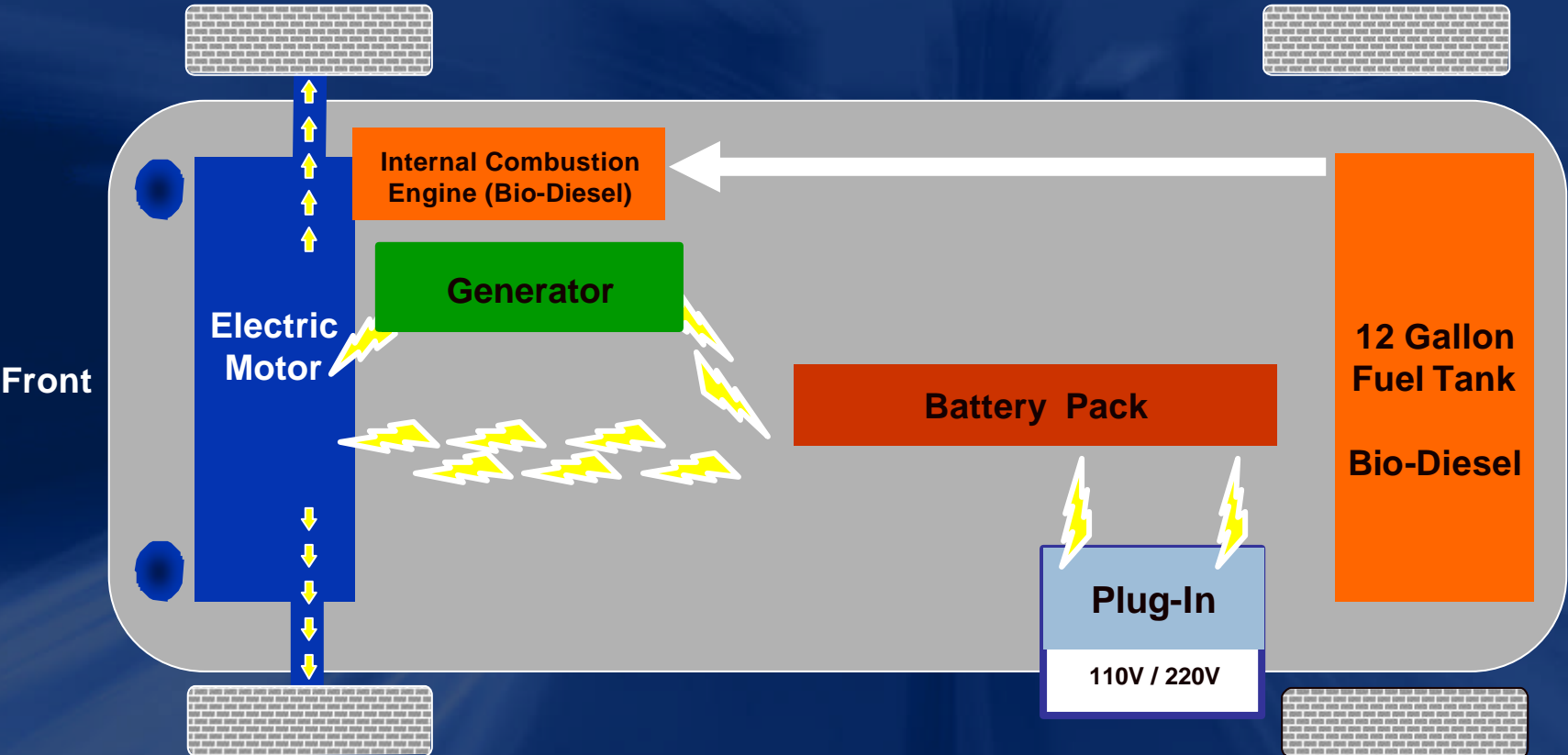
GM's E-Flex System

A family of electric vehicle propulsion systems

- Common drive train components
- Electrically driven
- Electrical energy stored in:
 - Battery
 - Hydrogen (fuel cell)
- Able to create electricity on-board
- Plug-in capable

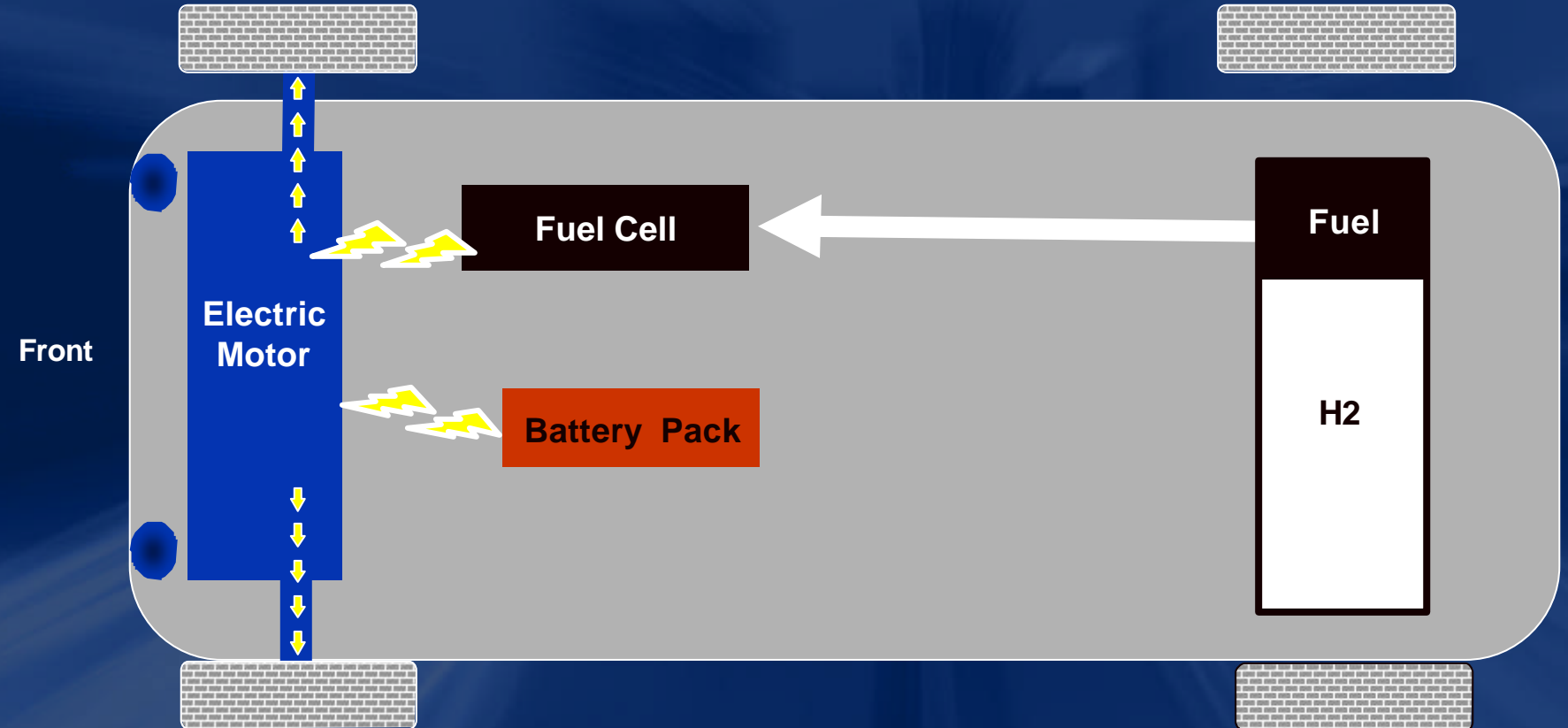
E-Flex System

Flexible Propulsion System Schematic (Petroleum Fuels)



E-Flex Systems

Flexible Propulsion System Schematic (Hydrogen Fuel)



E-Flex System

Family of Electric Vehicle Propulsion Systems

Pure electric drive...not a typical hybrid

Adaptable to a range of energy sources

- Short range EV with energy supplied by grid charging or an on-board IC (range extender)
- Fuel Cell with electricity supplied by Hydrogen
- Full battery-electric using grid charging (technology dependent)

Sets the stage for a more diverse range of energy resources

Engineering development has been initiated

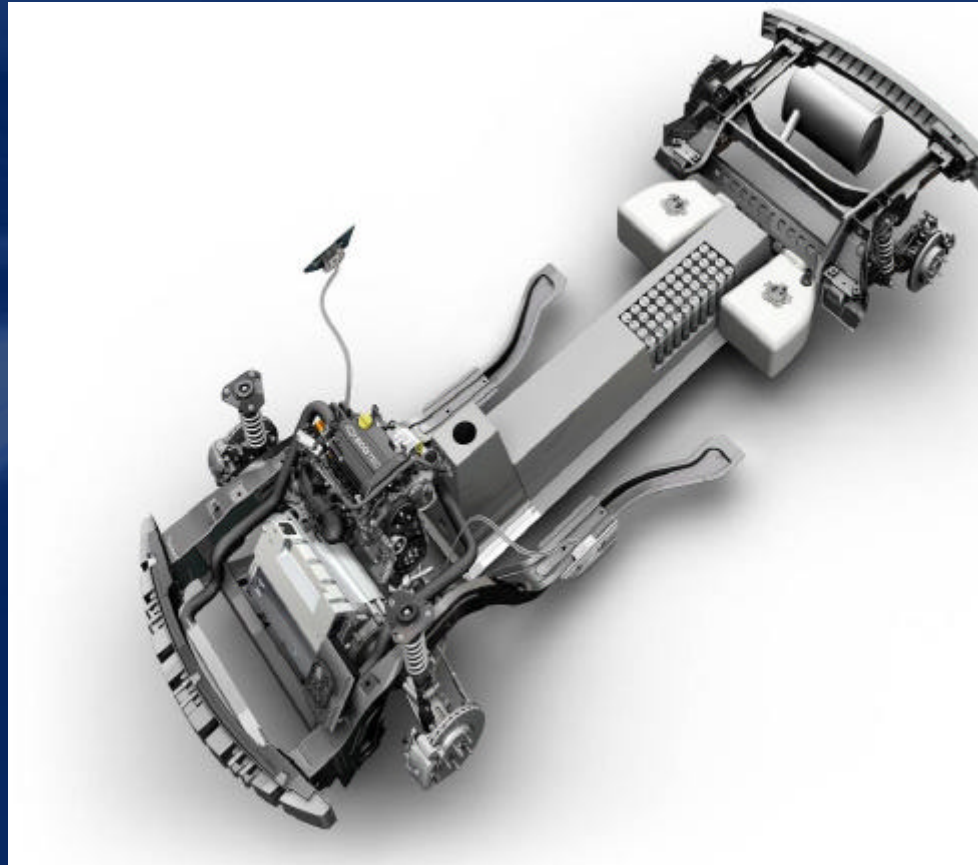


Detroit Motorshow 2007
A look into the future – Chevrolet Volt Concept

Chevrolet Volt Concept

Global Compact Vehicle Based

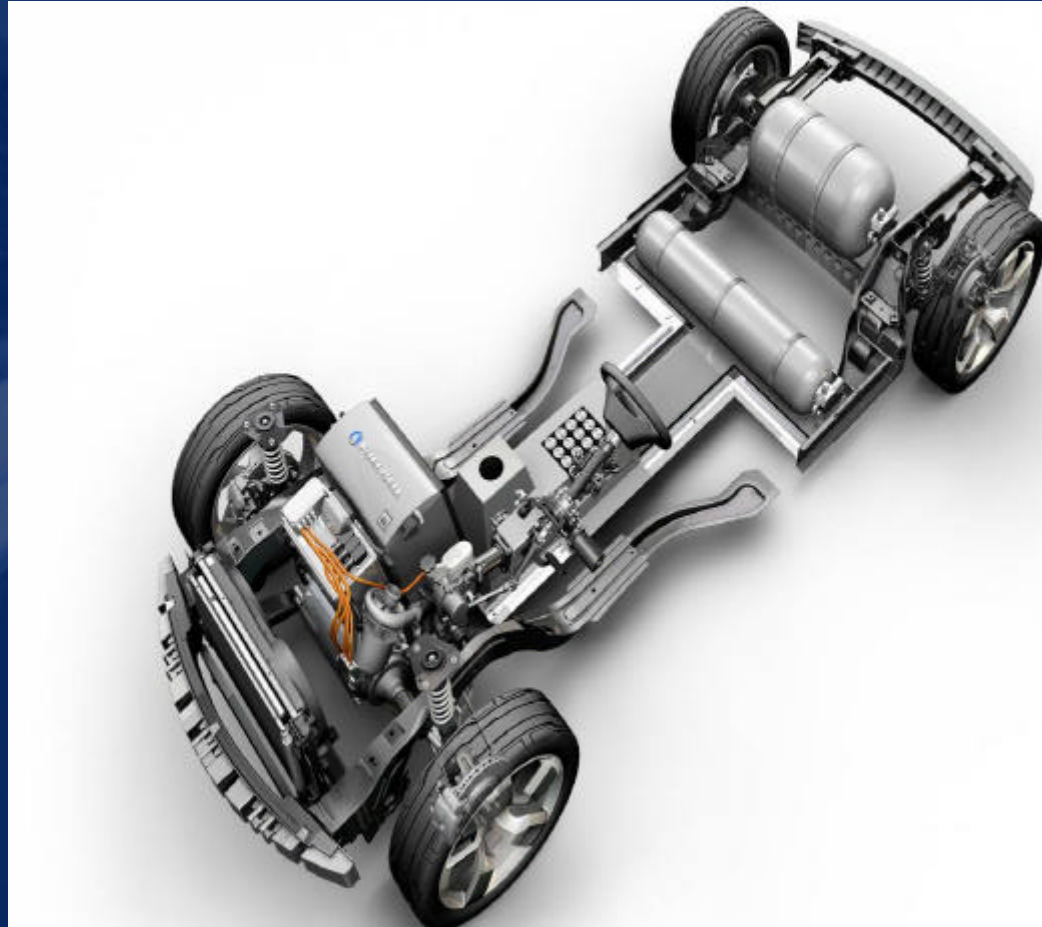
- Electric Drive Motor
 - 120 kW peak power
 - 320 Nm peak torque
- Li Ion Battery Pack
 - 136 kW peak power
 - 16 kWh energy content
 - Home plug in charging
- Generator 53 kW
- Internal Combustion Engine
 - 1.0 L 3-cylinder turbo



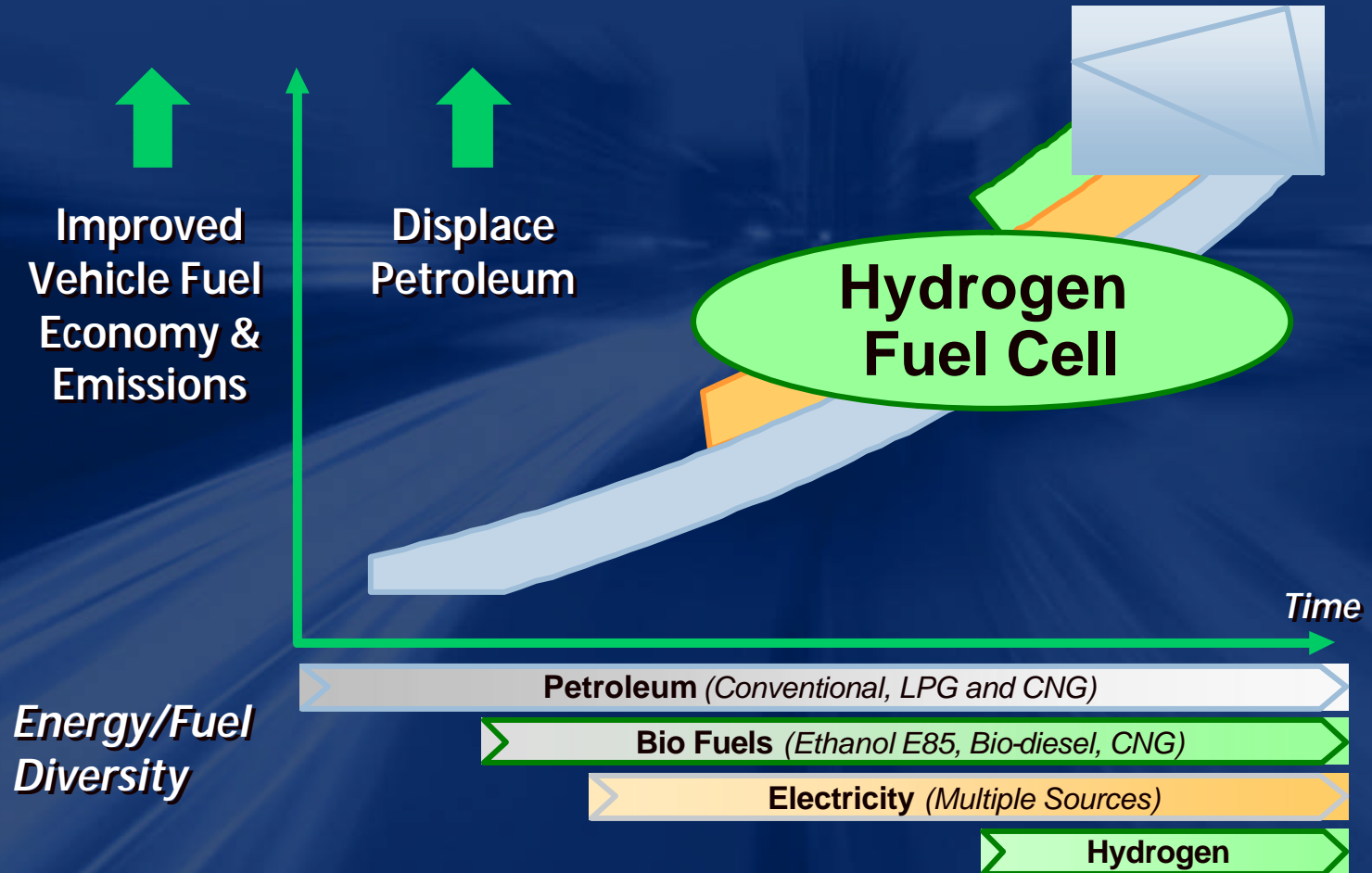
E-Flex Fuel Cell Variant

Global Compact Vehicle Based

- Electric Drive Motor
 - 120 kW peak power
 - 320 Nm peak torque
- Fuel Cell Propulsion System
 - Smaller Li Ion battery pack
 - Hydrogen storage



Advanced Propulsion Technology Strategy



GM Fuel Cell Activities



Warren (MI, USA)



Rochester (NY, USA)



Mainz-Kastel (Germany)



Torrance (CA, USA)



Tokyo (Japan)

Demonstration Programs on Three Continents

Shanghai



Berlin



Washington, DC
and California



Seoul



Tokyo



"Project Driveway"

- More than 100 Chevrolet Equinox Fuel Cell to be placed with customers starting fall 2007
- Gain comprehensive learnings on all aspects of customers experience in three U.S. locations: California, New York, Washington D.C.
- Chevrolet Equinox Fuel Cell:
 - Engineered for 80,000 km (50,000 miles) 2.5 years of life
 - Able to start and operate in sub-freezing temperatures
 - Meets all applicable 2007 U.S. Federal Motor Vehicle Safety Standards



GM Fuel Cell Concept Vehicles

GM Autonomy, 2002



GM HyWire, 2002



Chevrolet Sequel, 2006

Chevrolet Sequel

- Power: 115 kW
- Top speed: 145 km/h / 90 mph
- Fuel: 8 kg CGH_2 (700 bars)
- Range: 480 km / 300 miles

