



GM Powertrain

Advanced Propulsion Technology Strategy

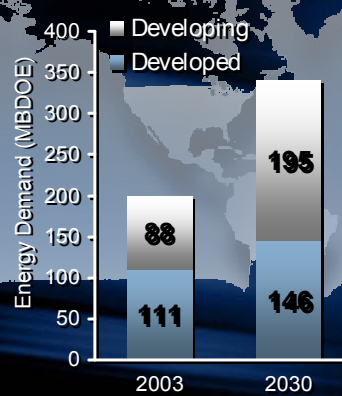
Tom Stephens

Group Vice President
Global Powertrain and Global Quality

The Challenge

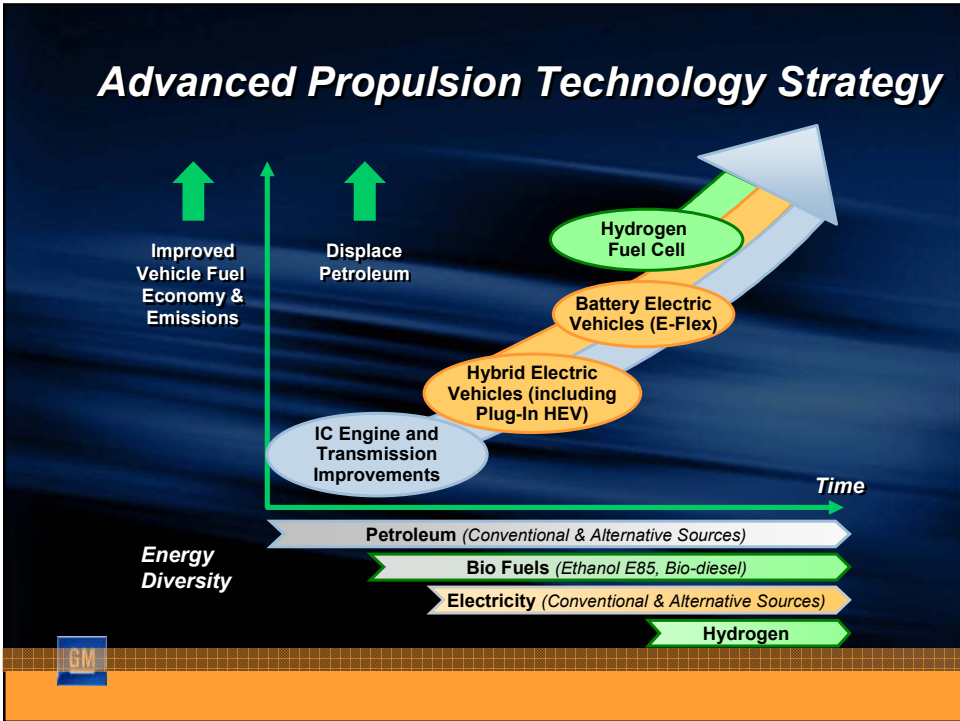
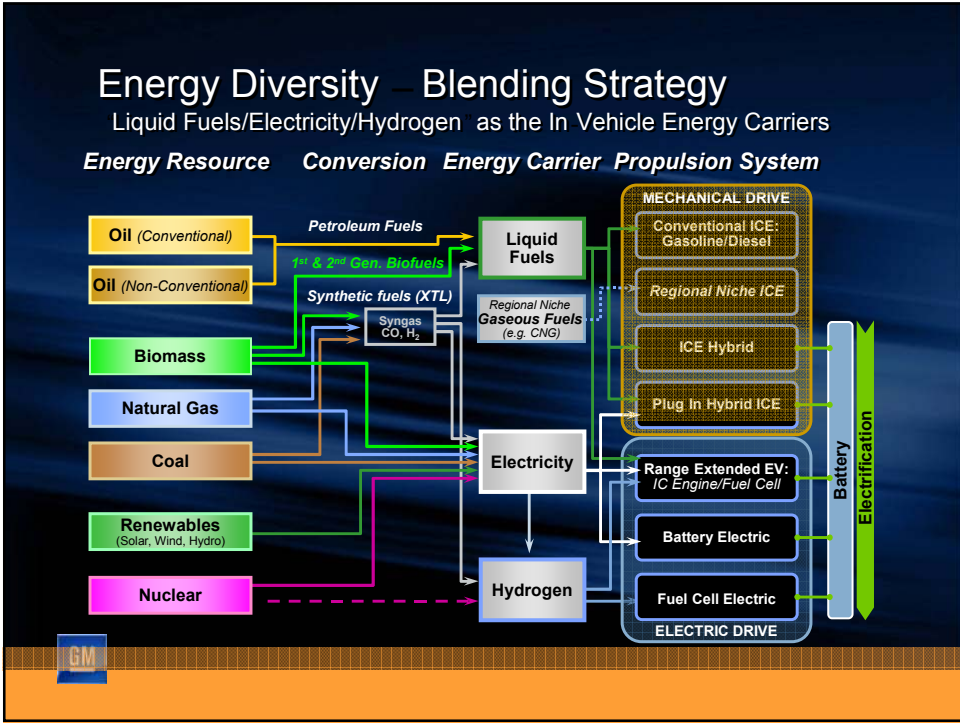
- Global energy demand exceeds our current glide path for supply
- There are several risks that can disrupt the existing supply
 - Insufficient refinery capacity
 - Geopolitical issues
 - Natural disasters, wars and hostile regimes that take a significant amount of capacity offline
- Growing concern about Global Warming due to CO₂
- Potential for regulations that exceed both technical capability and business feasibility

Global increase 2% / year,
70% increase over 2003



Source: DOE Energy Information Agency

MBDOE: Millions of barrels per day oil equivalent



Global Advanced Propulsion Technology Roll-Out

IC Engine and Transmission Improvements <i>Active Fuel Management</i>	9 engine variants in 15 models, >1.0 million annually
<i>Variable Valve Timing</i>	26 engine variants in 66 models, >2.0 million annually
<i>Spark Ignition Direct Injection</i>	2 engine variants in 9 models , >0.9 million annually by 2010 MY
<i>Port Deactivation</i>	6 engine variants in 16 models, >0.5 million annually
<i>Turbocharged Gas Engines</i>	14 engine variants in 18 models
<i>Diesel Engines</i>	17 engine variants in 45 vehicle lines, >1 million annually
<i>Six-speed Transmissions</i>	10 FWD, RWD and AWD variants, >3 million annually by 2010



Continuing to Deliver... MY 2008

14 New Engines and Transmissions

- 1.2L
- 1.9L
- 1.1L
- 2.0L with E85

... Globally



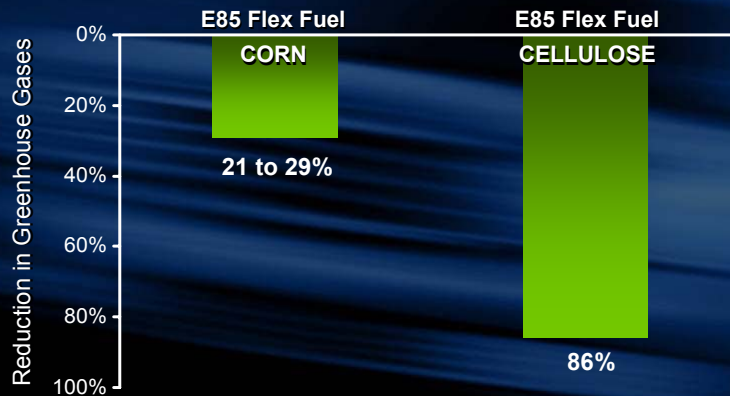
Why E85?

- Domestic renewable fuel
- Reduces greenhouse gas emissions
- Enables maximum ethanol usage



E85 Can Significantly Reduce GHG Emissions

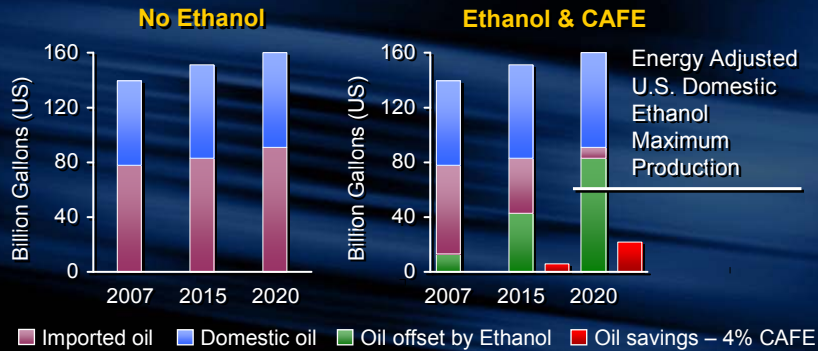
Reduction in Greenhouse Gases Per Mile Traveled Using E85 vs. Gasoline



Source: Argonne National Laboratory Wang

E85 Ethanol Has the Greatest Potential to Reduce Oil Consumption

Assumptions: All OEMs produce 90% FFV by 2020 and all vehicles used the maximum amount of ethanol



Ethanol potential assumes all OEM FFV production of 50% in 2012, 75% in 2015, and 90% in 2020, and the FFV parc uses E85. Adjusted for energy equivalency with gasoline.



Oil information source: EIA - 2007 Annual Energy Outlook Table 11

GM 2007 Ethanol Vehicles

14 **FlexFuel** models in U.S. & Canada



In LAAM, 95% of product portfolio is currently **Flexpower**

BioPower
in Europe



GM Driving Industry Standard Technology/ Performance Defining Industry Future Direction

- More than 50% of US vehicle volume will be FlexFuel by 2012 MY
- 16 new hybrids in the next 4 Years...or 1 every 3 months for the next 4 years!
 - ⇒ Cost effective hybrid in cars and small SUVs
 - ⇒ Fuel economy leadership in 2 Mode Hybrid applications
 - ⇒ Plug in 2 Mode Hybrid in medium crossover utility segment
- New applications of clean passenger car and light duty truck diesels in North America
- E Flex/Chevrolet Volt/Equinox Fuel Cell vehicles strengthen technology leadership

GM

Summary

- GM's Advanced Propulsion Technology Strategy will...
 - ⇒ Be sustainable through energy diversity
 - ⇒ Displace petroleum
 - Alleviate the issue of demand outgrowing limited supply
 - Reduce our dependence on a supply subject to uncontrollable risks
 - ⇒ Reduce GHG emissions
- By Incorporating...
 - ⇒ Continued improvement of conventional powertrains
 - Gas engines, diesel engines, and transmissions will be the principle propulsion systems for the foreseeable future
 - ⇒ Alternative fuels
 - Biofuels such as E85 ethanol and Biodiesel (i.e. B20)
 - Synthetic fuels derived from coal, natural gas, or biomass
 - ⇒ Increased electrification of the automobile
 - Rapid expansion of our hybrid portfolio, including plug ins
 - EV range extenders
 - Ultimately, hydrogen fuel cells

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