Opportunities with the use of Ethanol in Automotive

2nd BioEthanol Conference
Kjell ac Bergström

Milano March 4th 2009
GM Powertrain - Sweden
Alternative Fuels - Today and in the Future

TODAY

- Adaptations to existing Generation of Technology
- Restricted by Base Engine Specification
- Only allowed through Waiver of Legal Requirements

IN THE FUTURE

- Possible to optimize the Powertrain to the Fuel
- Higher Efficiency
- Lower Exhaust and CO₂-Emissions
Future Fuels – The Challenges

ENERGY SUPPLY & SECURITY
- Future Global Energy Demands exceeds our Prospective Supply
- Several Risks could disrupt Existing Supply
- Controlling Energy is Political Power

ENVIRONMENTAL CHALLENGES
- Stringent Regional ”Zero Emission” Requirements
- Growing Concern over Green House Effects / CO₂-emissions
- Potential for Regulations that exceed Technical Capability and Business Feasibility
Renewable Fuels – A real Alternative?

ENERGY SUPPLY & SECURITY
- Could be a part in Securing Future Energy Supply
- Dependent on Local and Regional Conditions
- Growth Possibilities for Local Industries

ENVIRONMENTAL CHALLENGES
- Could with right Process reduce the Net CO₂-emissions
- Limitations with First Generation Fuels
- Potentials with Second and Third Generation Fuels
GM Alternative Propulsion Technology Strategy

- Improved Vehicle Fuel Economy & Emissions
- Reduced Petroleum Consumption
- Engine and Transmission Improvements
- Hybrid Electric Vehicles (including Plug-In HEV)
- Battery Electric Vehicles (E-Flex)
- Hydrogen Fuel Cell

Energy Diversity

Petroleum (Conventional & Alternative Sources)
Bio Fuels (Ethanol E85, Bio-diesel)
Electricity (Conventional & Alternative Sources)
Hydrogen
GM Alternative Propulsion Technology Strategy
- Powertrain Improvements

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Powertrain Improvements

ENERGY EFFICIENCY
- Improve Fuel Efficiency of Conventional Propulsion Vehicles
- Make Big Engines act like "Small" Engines
- Make Small Engines act like "Big" Engines

CUSTOMER CHALLENGES
- Reduce Real Life Energy Consumption through Driver Behaviour
- Right Sizing of Vehicles
- Right Speeding of Vehicles
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- Hybrid Electric Vehicles (including Plug-In HEV)
- Battery Electric Vehicles (E-Flex)
- Hydrogen Fuel Cell
- Hydrogen
- Electrical (Conventional & Alternative Sources)
- Bio Fuels (Ethanol E85, Bio-diesel)

Energy Diversity
Automotive Fuels – General Requirements

DESIGN ELEMENT FOR ENGINES
- Defines the Engine Combustion Process
- Defines the limitations and Boundries for Energy Conversion
- Defines the Packaging and Storage Constraints

STANDARDIZED & WELL-DEFINED PRODUCT
- Prerequisites for stable Emissions & low Fuel Consumption
- Fuel Blending Capability
- Integral part of the Quality Assurance
- Certified Fuel
  - Origin
  - Production Process
  - Environmental Impact
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Energy Diversity – Potential Scenarios

SPARK IGNITED ENGINES
- Single hydrocarbon – ex. alcohols: M100, E100, Bu100

COMPRESSION IGNITED ENGINES
- DME (DiMethyl Ether)
- Synthetic – SynFuel Fischer Tropsch, BtL (Bio-to-Liquid)

HCCI-ENGINES – Dedicated Fuels
- Spark-Ignited Based – M100, E100, Bu100
- Compression-Ignited Based – SunFuel

OPTIMIZING THE ENGINES FOR THE FUEL
- Lower Emissions
- Higher Efficiency
Energy Diversity – Renewable Fuels

BIOFUELS

- Most significant Near-Term Solution to offset rising Vehicle Energy Demands and reduce Green House Gas Emissions
- Next-Generation BioFuels
  - Provide a clean, renewable Alternative to Petroleum
  - Not just Replacing, but better Engine Fuel than Petroleum

PRODUCTION CHALLENGES

- The Growing, Gathering and Processing of sustainable Feedstocks for these Future Fuels are critical
- Sustainable BioFuels made from Non-grain Sources could offset substantial part of Future Vehicle Energy Demand by 2030
- GM is supporting this development
Ethanol as an Engine FUEL – Pro´s & Con´s

PRO´s:

- High Concentration Blends like E85 or E100
  - Best use of the Fuels Advantageous Properties
- High E85 Octane Number - RON 105 => (R + M)/2 = 96
- High Heat of Vaporization Value - 2.8 times vs Gasoline
  - Gives Charge Cooling effect of 2.4 times vs Gasoline
  - Allows increased Compression Ratios and Spark Advance

CON´s:

- Lower Calorific Value => Shorter Driving Range
- Low Vapor Pressure => Cold Start Ability
- Liquid Ethanol is chemically more aggressive
Adopt the Engines to Renewable Fuels

OPTIMIZE THE ENGINES

- Increasing Compressions Ratios
- Increasing Charging

UTILIZE THE ADVANTAGES

- Right-sizing / Down-sizing
- Pick the Right Size of Engine
- Even higher Compressions Ratios
- Even higher Charging Level
- Leads to higher Efficiency
GM Alternative Propulsion Technology Strategy

- Improved Vehicle Fuel Economy & Emissions
  - 95g/km CO₂
  - 130g/km CO₂
  - 158g/km CO₂

- Reduced Petroleum Consumption
- Engine and Transmission Improvements
- Hybrid Electric Vehicles (including Plug-In HEV)
- Battery Electric Vehicles (E-Flex)
- Hydrogen Fuel Cell

- Energy Diversity
  - Bio Fuels (Ethanol E85, Bio-diesel)
  - Electricity (Conventional & Alternative Sources)
  - Hydrogen

- GM Powertrain – Sweden
  - Kjell ac Bergström

- 2008
- 2012
- 2020
Some concluding Remarks

- Further increase in Low-Blends, above 10%, will move the Technology slowly into the FFV area.

- High-Blends makes it possible to explore the full Fuel Characteristics.

- There are Options available to make a Difference already Today.

- Policy, Industry and Consumer needs to work together for a successful Implementation.
Welcome Aboard!!