Powertrain Strategies for the 21st: How Are New Regulations Affecting Company Strategies?

University of Michigan
Focus on the Future Conferences

7/15/2009

Bruce M. Belzowski
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UMTRI’s “Window to the Industry”

Economic and Demographic Analysis

Industry Structure

Advanced Manufacturing and Training
Automotive Analysis Division
University of Michigan
Transportation Research Institute

Affiliates

**IT Organizations**
Oracle Corporation
IBM
HP
Siemens-PLM
QAD

**OEMs**
General Motors
Toyota
Nissan Tech Center

**Government**
NREL / EPA
NSF
Motor Carrier

**Consultants**
Deloitte
About Consulting

**Suppliers**
Chevron
Visteon
Denso
Dana
Delphi
Peterson Spring
Continental
TRW
Valeo

Automotive Analysis Division
UMTRI
Automotive Analysis Division
University of Michigan
Transportation Research Institute

Research work - covering a broad range of topics

- Globalization
- Manufacturing validation, quality
- Powertrain Strategies
- IT/e-Business
- Human Capital
- Heavy Truck

Key Research Partners

- IBM, Bosch, TRW, Tenneco
- GM, NIST, CogniTens
- Denso, EPA, Nissan, NRDC, UCS
- Oracle, IBM
- Watson Wyatt
- Federal Motor Carrier, NPTC

UMTRI
Upcoming UMTRI-AAD Conferences

- **September 22, 2009**: *The Business of IT: Transforming the Organization and the Vehicle.* Sponsored by Hewlett-Packard
- **November 18, 2009**: *The Role of the Government in the U.S. Automotive Industry.*
- **February 17, 2010**: *Advancements in 3D Measurement and its impact on Digital Engineering and Manufacturing Process Validation*
- **April 22, 2010**: *Inside China: Understanding China’s Current and Future Automotive Industry*
- **July 14, 2010**: *Powertrain Strategies for the 21st Century*
Panelists

• **Bruce Belzowski**: Assistant Research Scientist, Automotive Analysis Division, University of Michigan Transportation Research Institute

• **Walter McManus**, Director and Research Scientist, Automotive Analysis Division, University of Michigan Transportation Research Institute

• **William Charmley**, Deputy Director, Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency

• **Justin Ward**, Advanced Powertrain Program Manager, Toyota Technical Center, Toyota Motor Engineering and Manufacturing, North America

• **Daniel Kapp**, Director, Ford Motor Company, Powertrain Research and Advanced
Panelists

- **Robert Czarnowski**, Business Development Manager, Advanced Technology, BorgWarner Incorporated

- **Bryan Krulikowski**, Vice-President, Morpace Incorporated

- **Dennis Assanis**, University of Michigan Mechanical Engineering; Director, Michigan Memorial Phoenix Energy Institute, Automotive Research Center, W.E. Lay Automotive Laboratory; Co-Director, GM Engine Systems Research Laboratory, College of Engineering

- **John Ettlie**, Benjamin Forman Professor for Research in the Saunders College of Business, Rochester Institute of Technology
Schedule

– Bruce Belzowski: Introduction

– Walter McManus, Automotive Analysis Division, University of Michigan Transportation Research Institute, will provide an insightful analysis of the current CAFE regulations.

– William Charmley, U.S. Environmental Protection Agency, will describe the complexity of the new fuel economy regulations.

Break

– Justin Ward, Toyota Motor Company, will talk about how Toyota’s sustainable mobility goals and how they link to meeting new U.S. regulations.
Schedule

– **Daniel Kapp**, Ford Motor Company, will discuss Ford’s vision for future powertrains that will allow it to meet new regulations.

Q&A

Lunch Break: Noon-1:30

– **Robert Czarnowski**, BorgWarner, will talk about what his company doing to support manufacturers in the area of powertrains.

– **Bryan Krulikowski**, Morpace Market Research, will present the results of his company’s consumer research entitled, “Powertrain Acceptance and Consumer Engagement”
Schedule

Break

- **Dennis Assanis**, University of Michigan, will provide an overview of UM powertrain research
- **John Ettlie**, Rochester Institute of Technology will discuss their upcoming research on powertrain R&D/Innovation processes
Powertrain Strategies for the 21st Century

A research project focused on providing the global automotive industry with insights into the future of powertrains

- A continuing study measuring expert opinions over many years

- A global study measuring experts opinions separately across North America, EU, and Asia
Powertrain Strategies for the 21st Century

What makes this study unique?

• Global panel of powertrain experts
• Annual updates of forecasts and deep dives into current topics
• All electronic survey administration and report out.
• Weighted responses based on expertise of respondent and new methods to measure point estimates for forecasts
Sample Respondents:

36 managers
20 CEOs, presidents, and vice-presidents
28 chief engineers and directors
14 researchers and scientists
25 engineers and technicians

Sample Respondents:

29 manufacturers
45 suppliers
44 other experts
CAFE
Mandates and tax incentives are considered the most feasible, while gas taxes and mandates are considered the most successful.

Policy Instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Feasibility</th>
<th>Success</th>
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</thead>
<tbody>
<tr>
<td>Gas Taxes</td>
<td>3.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Mandates (e.g. CAFE)</td>
<td>3.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Feebates</td>
<td>3.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Tax Incentives</td>
<td>4.1</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Feasibility and Success are rated on a scale from 1 to 5, with 5 being the most feasible or successful.
Foreign-owned manufacturers are considered more likely to meet the new CAFE goals.
Fuel Prices

(Influenced by a fleet CAFE of 35 mpg using an attribute-based System)
The predicted price of unleaded regular gas for 2020 has increased by 8% in one year.

*Source: Energy Information Administration (Jan–Dec ’06)
Experts report a wide range of possible prices for fuel in 2020

- **Unleaded**
  - Lower Bound: $4.06
  - Upper Bound: $7.97

- **Premium**
  - Lower Bound: $4.41
  - Upper Bound: $8.67

**Dollars per Gallon**
Consumer Fuel Sensitivity

At $3.95 per gallon, consumers will make fuel economy a primary concern in vehicle purchase.
In 2007, experts see continued growth in diesel and ethanol fuel use for light duty vehicles to reach CAFE goals for 2020.

<table>
<thead>
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<tbody>
<tr>
<td>Hydrogen</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>LPG/CNG</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Ethanol (&gt;10% ethanol)</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Diesel/Biodiesel</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Unleaded</td>
<td>45</td>
<td>57</td>
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</tbody>
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Powerplants

(Influenced by a fleet CAFE of 35 mpg using an attribute-based System)
In 2007, experts report continued growth of hybrid and diesel powertrains for light duty vehicles for 2020

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Electric</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Fuel Cell</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>HCCI</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Hybrid</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Advanced Diesel</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>Spark-Ignited</td>
<td>43</td>
<td>52</td>
</tr>
</tbody>
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Percent Penetration
# Cost of New Powertrains

The percentage increase in the cost of powerplants after reaching economics of scale compared to a spark ignited engine:

- Fuel Cell: 462%
- Diesel Hybrid: 109%
- Electric: 89%
- Plug-In Hybrid: 80%
- Full Hybrid: 64%
- Advanced Diesel: 35%
- Mild Hybrid: 30%
- Homogeneous Charge Compression Ignition (HCCI): 30%
Strategies and Technologies: Weight Reduction
Taking out 20 percent of the weight of a vehicle by 2020 will be difficult.
Powertrain Strategies for the 21st Century

• Areas of analysis from the 2009 study:

  • Continuing to measure the penetration of future types of fuels and powertrains, including engines and transmissions
  • Facilitating technologies for different types of engines
  • Future gas prices, emissions issues, federal and state regulations
  • Consumer acceptance
  • OEM and supplier development capabilities
Powertrain Strategies for the 21st Century

Powertrain Innovation in the 21st Century

- A National Science Foundation Grant
- Studying the powertrain innovation process
  - How do companies develop the capabilities to create new products?
  - How do they partner with other companies in the R&D process?
  - How do companies manage their R&D portfolio to sustain competitive advantage?
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