Alternative Powertrain Sales Forecast

Mike Omotoso
Senior Manager, Global Powertrain
J.D. Power Automotive Forecasting
Outline

– Powertrain Sales Trends
  o Hybrid sales forecast
  o Diesel sales forecast
  o Alternative fuel market share

– Powertrain Production Trends
  o YTD sales by cylinders
  o YTD sales by fuel type
  o Engine and transmission production forecasts

– Technical solutions for improving fuel economy

– Conclusions
How Times Have Changed

**Then (2004)**
- Can you believe gas is $3 a gallon?
- That thing got a Hemi?
- 3-Ton Trucks
- Nav systems, rear seat entertainment
- Rollin’ on 22s

**Now (2008)**
- Can you believe gas is ONLY $3 a gallon?
- I want the 4-cylinder version
- Smart and Fit
- Fuel economy, fuel economy
- Low rolling resistance tires
Hybrid Vehicles
YTD Hybrid Sales January - October 2008

- YTD hybrid sales: 280,000
- 4% lower than YTD 2007
- 2.45% share of LV sales
- Shortage of Prius models due to strong global demand
- But Prius still accounts for 50% of all hybrid sales
- Hybrid battery shortages
- Phase out of federal tax breaks indirectly raises price of hybrids
- Competition from compacts and sub-compacts

- Honda Fit: Up 52% YTD October 08 VS. 07
- Ford Focus: Up 20.5% YTD
- Toyota Yaris: Up 26% YTD
- Smart ForTwo: up 26% from Sep to Oct 08
Monthly Hybrid Sales 2007/2008

<table>
<thead>
<tr>
<th>$/Gallon</th>
<th>Avg. gas price</th>
<th>Hybrid Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov-07</td>
<td>$3.00</td>
<td>35,000</td>
</tr>
<tr>
<td>Dec-07</td>
<td>$2.50</td>
<td>30,000</td>
</tr>
<tr>
<td>Jan-08</td>
<td>$3.00</td>
<td>25,000</td>
</tr>
<tr>
<td>Feb-08</td>
<td>$2.50</td>
<td>20,000</td>
</tr>
<tr>
<td>Mar-08</td>
<td>$3.00</td>
<td>15,000</td>
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<tr>
<td>Apr-08</td>
<td>$2.50</td>
<td>10,000</td>
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<tr>
<td>May-08</td>
<td>$3.00</td>
<td>5,000</td>
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<tr>
<td>Jun-08</td>
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<tr>
<td>Jul-08</td>
<td>$3.00</td>
<td>5,000</td>
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<tr>
<td>Aug-08</td>
<td>$2.50</td>
<td>10,000</td>
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<tr>
<td>Sep-08</td>
<td>$3.00</td>
<td>15,000</td>
</tr>
<tr>
<td>Oct-08</td>
<td>$2.50</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Sales Volume

Hybrid Vehicle Forecast
Hybrid Share of U.S. Light Vehicle Sales

Q3 2008 Hybrid Forecast Update

Source: J.D. Power Automotive Forecasting U.S. Hybrid-Electric Vehicle Sales Forecast Q3 2008
Plug-In Hybrids

• Will automakers struggling to survive abandon plug-ins altogether and play it safe?

• Cost and safety are still major issues
  – One exploding Li-ion battery would be a PR and legal nightmare

• Federal tax break will help ($7500 for the Volt)

• Will Toyota beat GM to the punch?

• Infrastructure – not everyone lives in a house with a garage where they can charge the car overnight
  – Will gas stations invite competition?
The Diesel Market
# Hybrid vs. Diesel

<table>
<thead>
<tr>
<th></th>
<th>Hybrid</th>
<th>Diesel</th>
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<tbody>
<tr>
<td>Fuel economy (city)</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Fuel economy (hwy)</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Initial price premium</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Public perception</td>
<td>![Symbol]</td>
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<tr>
<td>Infrastructure</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
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<tr>
<td>Product availability</td>
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<td>![Symbol]</td>
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<tr>
<td>Fuel price</td>
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<td>![Symbol]</td>
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<tr>
<td>Torque</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Volume models</td>
<td>![Symbol]</td>
<td>![Symbol]</td>
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According to the J.D. Power and Associates Alternative Powertrain Study, interest in alternative powertrain vehicles has changed from 2007 to 2008. The percentage of consumers who would consider a hybrid has increased from 56% to 62%.

On the other hand, the interest in diesels has dropped from 23% to 16%. High prices at the pump are the main reason.

The hybrid premium is close to $5000, while the diesel premium is approximately $2000.

We expect the gap in price between diesel and gasoline to shrink over the next 12-18 months.
But...The Diesels Are Coming

New diesel models coming in 2009/10:

- BMW 335d, X5 d
- Audi Q7 TDI
- Acura TSX
- Honda CR-V, Accord
- Nissan Maxima

Pickup trucks:

- Ford F-150
- Chevrolet Silverado/GMC Sierra 1500
- Dodge Ram 1500 Cummins diesel
U.S. Diesel Light Vehicle Market

• The U.S. market is actually bigger than the hybrid market

• Most diesels today are Big 3 heavy duty pickup trucks

• All new diesels meet the 2009 Tier II Bin 5 emission standards a year early

• Must overcome negative image with consumers

• Evidence of pent up demand for diesels in California, and possibly the other seven states where diesels were not sold before
U.S. Diesel Outlook

- Light Truck share is significantly higher than car share; volumes 3-6x higher
- Light duty pickups will be largest diesel segment, followed by SUV/CUVs
- Diesel-gas pump price gap needs to shrink for diesel sales growth to continue
- DPF and urea add to upfront costs
- Our forecast is less optimistic than a year ago, but still bullish
U.S. Light Vehicle Demand Breakdown by Fuel Type

- Flex fuel vehicles have the highest share of the alternative fuel market, but are mostly used as gasoline powered vehicles.

- We expect about 1/5 light vehicles sold in the U.S. to be an alternative fuel vehicle by 2012, with hybrids and diesels running neck and neck.

- Alt fuel market more than doubles, growing from 1.6m units in 2007 to 3.5m units in 2012.
YTD Retail Sales By Number Of Cylinders

- Four cylinder boom – 8.4% growth in one year
- Mainly at the expense of V8 engines
- Dip in four-cylinder installation with drop in gas prices in August
- Short-term thinking by consumers
- Honda’s ‘no V8’ strategy looks good now

<table>
<thead>
<tr>
<th>Cylinders</th>
<th>Q108</th>
<th>Q208</th>
<th>Q308</th>
<th>Jan-Sep 08</th>
<th>Jan-Sep 07</th>
<th>Delta</th>
</tr>
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<tbody>
<tr>
<td>4 Cyl</td>
<td>39.2%</td>
<td>44.5%</td>
<td>43.5%</td>
<td>44.4%</td>
<td>36.0%</td>
<td>8.4%</td>
</tr>
<tr>
<td>5 Cyl</td>
<td>1.8%</td>
<td>1.7%</td>
<td>1.7%</td>
<td>1.6%</td>
<td>2.1%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>6 Cyl</td>
<td>39.3%</td>
<td>37.0%</td>
<td>36.0%</td>
<td>36.4%</td>
<td>39.8%</td>
<td>-3.4%</td>
</tr>
<tr>
<td>8 Cyl</td>
<td>19.6%</td>
<td>16.7%</td>
<td>18.7%</td>
<td>17.5%</td>
<td>22.0%</td>
<td>-4.5%</td>
</tr>
<tr>
<td>10 Cyl</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Total   | 100.0%| 100.0%| 100.0%| 100.0%     | 100.0%     | 0.0%   |
YTD Retail Sales By Fuel Type

- Gasoline is the big winner, but in a shrinking market
- Hybrid demand increases with increase in fuel price and model offerings
- Diesel share drops due to collapse of pickup truck segment and $1/gallon gap between regular unleaded gas and ULSD price
- Flex fuel share drops due to shift from trucks to cars

<table>
<thead>
<tr>
<th>Cylinders</th>
<th>Percent of Total - Cylinders</th>
<th>Jan-Oct 08</th>
<th>Jan-Oct 07</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td></td>
<td>90.0%</td>
<td>88.4%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Flexible</td>
<td></td>
<td>5.3%</td>
<td>6.1%</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Hybrid</td>
<td></td>
<td>2.8%</td>
<td>2.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Diesel</td>
<td></td>
<td>1.9%</td>
<td>3.0%</td>
<td>-1.1%</td>
</tr>
</tbody>
</table>
U.S. Light Vehicle Production by Transmission Type

- Automatic transmissions remain dominant
- Manual transmission shares remain in the 7-9% range
- DCT grows at the expect of automatics
Automatic Transmissions: The More Gears the Better

- The share of 4-speed automatics drops from 46% to 17% while the share of 6-speeds grows from 18% to 53%
- Aura and Malibu I-4 switched from 4 to 6-speed automatics
- Seven-speed transmissions are for Mercedes-Benz
Advanced Powertrain Technology

- **HCCI** – Gasoline engine operating without spark ignition
  - Provides diesel-like fuel economy; 15-20% fuel econ improvement
  - Being worked on by Daimler, Volkswagen
  - Could still be 7-10 years away from commercial application

- **Forced induction**
  - Turbo charging provides 10-15% improvement
  - Supercharging provides 5-7% fuel economy improvement
  - Boosted gasoline engine share goes from 1% to 7% over the next 5 years

- **Extra forward gears**
  - 2-5% fuel economy improvement going from 4 to 5 or 6 gears

- **Stop-start systems**
  - 10-15% fuel economy improvement
  - Does not have to be in a hybrid, e.g. BMW Efficient Dynamics

- **Dual Clutch transmissions**
  - 5-10% fuel economy improvement wrt auto
Conclusions

• No single winner – there’s room for gasoline, diesel, flex fuel and hybrids. Don’t put all your eggs in one basket

• Downsizing
  – More engines below 3 liters, fewer engines above 4 liters

• Efficiency (gas, diesel, hybrids)
  – Good to the last drop

• V8s will not die, but may fade away

• Transmission technology is also important

• Weight reduction will help regardless of powertrain
  – 1-2% improvement in fuel economy for every 100 pounds