Chrysler Group Powertrain Perspective: The Next 10 Years

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DaimlerChrysler Corporation

Edited for Web Site Posting

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Challenges Facing the Powertrain Community

GLOBAL CHALLENGES

FACTS
- Increasing world population
- Increasing energy demand
- Limited energy supplies
- Environmental effects of energy use

CONSEQUENCES
- Development of new technologies
- Efficient use of energy
- Use of all energy carriers
- Use of environment protecting technologies

REQUIREMENTS FOR THE CAR

LEGISLATION
- Safety
- Consumption
- Emissions
- Noise
- Recycling
- Resources

CUSTOMER
- Manufacturing cost
- Driving pleasure
- Operating cost
- Sound

ENVIRONMENT

CUSTOMER FACTS
- Operating cost
- Sound
Presentation Outline

- Chrysler Group Background
- Drivers for Change
  - Customer Wants
  - Legislative
  - Other Market Factors
- Chrysler Group Actions
  - Recent
  - Future
- Summary
- Q & A
Chrysler Group Background

Drivers for Change

Chrysler Group Actions
The Chrysler Group...
The Chrysler Group ...

- A Business Unit of DaimlerChrysler AG
- Over 84,000 employees
- 14 assembly plants
- 5 stamping operations
- 2 component plants
- 11 powertrain plants
- And...... over 2.7 Million vehicles sold worldwide (2004 MY)

- GM: 20%
- Toyota: 13%
- Ford: 14%
- VW: 9%
- Renault/Nissan: 9%
- Hyundai: 5%
- PSA: 5%
- Honda: 6%
- Fiat: 3%
- DC w/o CG: 2.6%
- Others: 9%

Chrysler Group Background

Source: Global Insight (12/04) figures incl. affiliates
U.S. Market Share for The Chrysler Group

Chrysler Group U.S. Sales 2004

- GM: 27.4%
- Toyota: 11.9%
- Other: 30.9%
- Ford: 17.2%
- Chrysler Group: 12.6%

Chrysler Group Background

Source: Chrysler Group Sales & Marketing
U.S. Market Share for The Chrysler Group

Chrysler Group Brand Sales 2004

- Dodge: 53.9%
- Jeep: 19.4%
- Chrysler: 26.7%

Source: Chrysler Group Sales & Marketing
Chrysler Group Powertrain Quality Improvement

2005 MY at 11 MIS

Expense per Unit Sold (EPUS)

33+ % Improvement

Chrysler Group Background
Consumer Reports

Percent of Models Recommended

Toyota

Industry 47% (51%)

Chrysler Group

Chrysler Group Background
Chrysler Group Powertrain Harbour Improvement

Chrysler Group Background

25+ % Improvement
Chrysler Group Background

Drivers for Change

Chrysler Group Actions
Chrysler Group Customer Powertrain Wants

- Rapidly changing
- Complicated by:
  - Demographics
  - Value equation for brands
  - Geographic factors, e.g. altitude, snow, etc.
  - Technical specifications versus vehicle function mentality
  - Etc.
- Sometimes, just what’s new!
- Many times disparate or confounded “wants” relative to tradition
- Affects all aspects of Powertrain including: engines, transmissions, driveline, electronic features, etc.

Drivers for Change: Customer Wants
Important Vehicle Attributes in U.S. Purchasing Decisions

Drivers for Change: Customer Wants

Source: Strategic Vision Inc. / DCC Product Strategy
Satisfaction with Vehicle Attributes in the U.S.

Drivers for Change: Customer Wants

Source: Strategic Vision Inc. / DCC Product Strategy
Engine Preference for U.S. Passenger Vehicles

Drivers for Change: Customer Wants

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Engine Preference by Segment in the U.S.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Gas</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small/Compact Car</td>
<td>65%</td>
<td>11%</td>
<td>24%</td>
</tr>
<tr>
<td>Mid-size Car</td>
<td>67%</td>
<td>6%</td>
<td>28%</td>
</tr>
<tr>
<td>Large/Luxury Car</td>
<td>74%</td>
<td>8%</td>
<td>19%</td>
</tr>
<tr>
<td>Minivan/Sport Tourer</td>
<td>66%</td>
<td>12%</td>
<td>22%</td>
</tr>
<tr>
<td>Small/Mid-size SUV</td>
<td>61%</td>
<td>11%</td>
<td>27%</td>
</tr>
<tr>
<td>Full-size/Large SUV</td>
<td>67%</td>
<td>6%</td>
<td>26%</td>
</tr>
<tr>
<td>Mid-size Pickup</td>
<td>72%</td>
<td>10%</td>
<td>18%</td>
</tr>
<tr>
<td>Large Pickup</td>
<td>61%</td>
<td>22%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Drivers for Change: Customer Wants

Analysis performed using weighted data. Source: Customer PT Research / NFO
Importance of Vehicle Attributes by Engine Size

Drivers for Change: Customer Wants

Source: 2005 New Vehicle Buyer Study-Q1 / DCC Product Strategy
Legislative Influence

- NHTSA has proposed:
  - LDT CAFE increases on the order of 0.5 mpg each year for 2008 – 2011 MYs
  - New size-based structure for truck CAFE
    - Optional starting in the 2008 MY
    - Mandatory starting in the 2011 MY
    - Manufacturers can “flip-flop” between the two for 2008 – 2010 MYs
  - Six size categories based on vehicle “footprint” (defined as wheelbase times average track width) used to calculate manufacturer fleet average standards
  - No expansion of truck CAFE to include vehicles over 8500 lbs., GVWR
  - “Clarification” of “removable seats” criteria, but no other changes to car/truck definitions
Proposed Category Targets Under Footprint CAFE (2008-2011 MYs)

<table>
<thead>
<tr>
<th>Category</th>
<th>Size (sq. ft.)</th>
<th>Targets</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Wheelbase x Track Width</td>
<td>2008</td>
</tr>
<tr>
<td>“Traditional” CAFE Std.</td>
<td>&lt;43.0</td>
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<tr>
<td>1</td>
<td>&gt;43.0-47.0</td>
<td>25.6</td>
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<td>2</td>
<td>&gt;47.0-52.0</td>
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<td>3</td>
<td>&gt;52.0-56.5</td>
<td>22.2</td>
</tr>
<tr>
<td>4</td>
<td>&gt;56.5-65.0</td>
<td>20.7</td>
</tr>
<tr>
<td>5</td>
<td>&gt;65.0</td>
<td>20.4</td>
</tr>
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</table>

Drivers for Change: Legislative
THE CO₂-POLICY OF THE EU IS BASED ON FOUR PILLARS

- ACEA Self Commitment
- CO₂ Taxation
- Labeling
- Emission Trading

Drivers for Change: Legislative
Proprietary Information not Shown
CONTENTS OF THE FOUR PILLARS OF EU-CO\textsubscript{2}-POLICY

**ACEA self commitment**
- ACEA Fleet target 140g CO\textsubscript{2}/km, 6 l/km for 2008
- 120g CO\textsubscript{2}/km target for 2012

**CO\textsubscript{2} taxation**
- First proposal of EU tax scheme 25% CO\textsubscript{2} component as part of annual tax planned for 2008
- 50% planned for 2010
- No further details on tax scheme yet

**Labeling**
- Labeling of CO\textsubscript{2} emissions (fuel consumption) on cars (in showrooms)
- No standardized concept in EU Revision under way (2006), color-coded system expected

**Emission trading**
- Enables companies to trade with emission certificates – in the EU scheme the transportation sector is excluded so far

Drivers for Change: Legislative
On August 23, 2004 NHTSA proposed new rules for Light Truck CAFE:

- Establishes higher CAFE standards for the 2008 – 2011 MYs
- Proposes to reform CAFE structure creating new categories based on vehicle size

NHTSA must finalize the standards by next April

Car CAFE standards are set at 27.5 mpg and NHTSA is not currently proposing a change

Northeast and some other states have indicated they will follow California’s lead (CA + Section 177 states currently are about 24% of DCX U.S. volume)

Canada ratified Kyoto and now that Kyoto is going into effect Canada is looking for tools to reduce GHGs
ARB defines CO₂ₑ as the sum of vehicle greenhouse gas emissions weighted by their global warming potentials minus credits for mobile A/C improvements

\[
CO₂ₑ = CO₂ \text{(exhaust)} + 296 \times N₂O \text{(exhaust)} + 23 \times CH₄ \text{(exhaust)} - \text{A/C direct emissions allowance} - \text{A/C indirect emissions allowance}
\]

CO₂, N₂O and CH₄ = measured emissions (N₂O default: 0.006g/mi)
A/C direct = credit for low leak and/or lower GWP refrigerant
A/C indirect = credit for A/C system optimized for optimized energy efficiency (high efficiency components, externally controlled compressor, etc.)

CO₂ₑ is 97% tailpipe CO₂ emissions and tailpipe CO₂ is fuel economy
Other Market Factors

- **Fuel Availability**
  - Despite recent price spikes and surging demand, gasoline and diesel fuel supplies, with the exception of periodic, regional issues, readily available for 25+ years
  - American consumer concerns over diesel fuel availability are unfounded; 40+% (and growing) of U.S. service stations sell diesel

- **Fuel Quality**
  - U.S. gasoline, and particularly diesel quality trails that of other developed economies
  - Gasoline and diesel sulfur levels are being phased down to low levels, U.S. sulfur caps are higher than those in Europe
  - Gasoline volatility varies widely across the U.S., even in areas with similar climate, complicating the development of highly precise engine calibrations
  - Diesel fuel quality in the U.S. trails even many third world countries in cetane, aromatics content and lubricity
  - As Bio- and renewable fuels play a bigger role in the U.S. fuel mix, stringent quality standards for these fuels must be developed
Gasoline & Natural Gas Prices

Drivers for Change: Other Market Factors
## Other Market Factors: Increased Competition

### Chinese Automakers 2004

<table>
<thead>
<tr>
<th>Order</th>
<th>Company</th>
<th>Volume</th>
<th>Order</th>
<th>Company</th>
<th>Volume</th>
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<td>FAW</td>
<td>993554</td>
<td>11</td>
<td>Nanjing Auto Group Corporation</td>
<td>94551</td>
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<td>2</td>
<td>SAIC Group</td>
<td>847526</td>
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<td>Geely</td>
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<td>ChangAn Group</td>
<td>582367</td>
<td>13</td>
<td>Cherry</td>
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<tr>
<td>4</td>
<td>Beijing Auto Group</td>
<td>538699</td>
<td>14</td>
<td>Soueast Motor Co.Ltd</td>
<td>57798</td>
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<tr>
<td>5</td>
<td>Dongfeng Group</td>
<td>530061</td>
<td>15</td>
<td>Changcheng Corporation</td>
<td>54904</td>
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<td>6</td>
<td>GAIG</td>
<td>209720</td>
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<td>CNHTC</td>
<td>43955</td>
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<td>Hafei Group</td>
<td>205991</td>
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<td>Shandong Kaima</td>
<td>37743</td>
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<tr>
<td>8</td>
<td>JAC</td>
<td>131300</td>
<td>18</td>
<td>Shanxi Auto</td>
<td>28111</td>
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<tr>
<td>9</td>
<td>BRILLIANCE-AUTO</td>
<td>110505</td>
<td>19</td>
<td>Qingling Motors</td>
<td>28090</td>
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<tr>
<td>10</td>
<td>CHANGHE</td>
<td>104289</td>
<td>20</td>
<td>Hebei Zhongxing</td>
<td>27536</td>
</tr>
</tbody>
</table>

**Drivers for Change: Other Market Factors**
Chinese Automotive Market for the Next 10 years

The last 10 years:
• Sales volumes rose 22% per year (fastest growing country in the world)

The next 10 years:
• Growth rate per year will be up to 10% for the next 5 years
• Market demand will achieve 8-9 million units
• Total volume will reach 55 million units, holding 15% of the world volume
Chrysler Group Background

Drivers for Change

Chrysler Group Actions
Improve Fuel Economy

Strategy

- Understand sources of energy consumption in the vehicle

- Concentrate on demand side (vehicle loads + vehicle system losses) ~3:1 return in terms of energy consumption

- Measure and assess each sub-element loss and then combine with cost/investment information to develop most effective solution

Chrysler Group Actions: Recent Actions
Proprietary Information not Shown
Recent Actions to Satisfy Disparate Customer Wants

Chrysler Group Actions:  Recent Actions

Source:  2005 New Vehicle Buyer Study-Q1 / DCC Product Strategy
5.7L HEMI® Engine

Chrysler Group Actions: Recent Actions
5.7L HEMI® Performance

- 5.7L HEMI V8 engine and 5 speed transmission
- Refined NVH, styling, and performance
- Fuel economy enhancement

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>HP</th>
<th>kW</th>
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</thead>
<tbody>
<tr>
<td>300C / Magnum</td>
<td>340</td>
<td>253</td>
</tr>
<tr>
<td>Cadillac STS V8</td>
<td>320</td>
<td>239</td>
</tr>
<tr>
<td>Lincoln LS 8</td>
<td>280</td>
<td>209</td>
</tr>
<tr>
<td>Jaguar XK-8</td>
<td>294</td>
<td>219</td>
</tr>
<tr>
<td>Audi A6 4.2</td>
<td>335</td>
<td>250</td>
</tr>
<tr>
<td>Infinity M45</td>
<td>335</td>
<td>250</td>
</tr>
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</table>
Multi-Displacement System (MDS)

- Selectively deactivate cylinders to improve fuel economy
  - 8 cylinders for acceleration
  - 4 cylinders for cruising
- Typical 7-10% fuel economy benefit
- Potential for 20% benefit

Chrysler Group Actions: Recent Actions
MDS Operation

- Transparent operation is a result of intense powertrain and vehicle integration actions
- Advanced engine and transmission control algorithms
- Electronic throttle control produces constant engine speed during mode changes
- No active exhaust elements

Chrysler Group Actions: Recent Actions
HEMI® Multi-Displacement System (MDS)

- MDS is a fuel-savings technology that gives the customer the power and capability of the HEMI® V8 they desire with the fuel economy of a less powerful engine
- Now producing more than 400,000 units per year
- By 2007, Chrysler Group will have nearly one-million vehicles on the road with MDS, and 60-million gallons of fuel will be saved annually with the HEMI® engine MDS technology

Chrysler Group Actions: Recent Actions
Recent Actions to Satisfy Disparate Customer Wants

Chrysler Group Actions: Recent Actions

Source: 2005 New Vehicle Buyer Study-Q1 / DCC Product Strategy
Dodge/Cummins Turbo Diesel

- Derivation of Cummins B Series used in commercial applications
- First used in Dodge Ram Pickup trucks in 1989
- Accounts for:
  - 25% of Ram Pickup sales
  - 75% of 2500/3500 Ram Pickup sales
- Over 1.2 million Dodge Diesel Pickups sold
- Approximately 143,000 sales in 2004 MY
Dodge/Cummins Turbo Diesel Performance Over Time

103% Increase in HP
74% Increase in Torque

Chrysler Group Actions: Recent Actions

- 1988 Intercooler
- 1992 Intercooler
- 1994 Intercooler
- 1996 24 Valve
- 1998 Intercooler
- 2000 Intercooler
- 2003 Common Rail
- 2004 Common Rail
- 2005 Common Rail

Power
Torque

103% Increase in HP
74% Increase in Torque
Dodge/Cummins Turbo Diesel

Compared to the gasoline engine options:

- Provides up to 30 percent better fuel economy especially for truck usage duty cycle
- Lowers CO₂ emissions approximately 20 percent

Chrysler Group Actions: Recent Actions
Cummins diesel volume has grown steadily since its launch in 1989, breaking 50,000 in 1995, 100,000 in 2000 and projected to exceed 200,000 in the next few years.

Chrysler Group Actions: Recent Actions
Recent Actions to Satisfy Disparate Customer Wants

Chrysler Group Actions: Recent Actions

Source: 2005 New Vehicle Buyer Study-Q1 / DCC Product Strategy
GEMA World Engine

- Family of 4-cylinder gasoline engines
- Combined, five-plant annual production volume approaching two million engines/year

Chrysler Group Actions: Recent Actions
Under the Global Engine Manufacturing Alliance (GEMA), Chrysler Group, Mitsubishi Motors Corporation and Hyundai Motor Company have jointly developed and are producing a new family of four-cylinder engines.

Production is in Japan, Korea and North America.

Two of the five plants were built and are operated by The Chrysler Group in Dundee, Michigan.
World Engine Fuel Economy and Performance

- **Fuel economy 5% better than existing L-4 engines**
- **Cost structure enables premium content to achieve fuel economy and performance objectives for entry level/value applications**

<table>
<thead>
<tr>
<th>Displacement</th>
<th>1.8 L</th>
<th>2.0 L</th>
<th>2.4 L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>140 hp (104 kW)</td>
<td>150 hp (112 kW)</td>
<td>170 hp (127 kW)</td>
</tr>
<tr>
<td>Torque</td>
<td>125 lb-ft (169 Nm)</td>
<td>140 lb-ft (190 Nm)</td>
<td>165 lb-ft (224 Nm)</td>
</tr>
</tbody>
</table>

SAE J1349 Performance Targets

Chrysler Group Actions: Recent Actions
Path to the Future

Chrysler Group Actions: Future Actions
Proprietary Information not Shown
Diesel Experimentation in the U.S.

2005 Jeep Liberty

- 2.8L 4 Cylinder Diesel with high pressure electronically controlled Common Rail Direct Fuel Injection
- Emissions will meet standards for 2006 & 2007 Model Years (45 state)
Jeep Liberty

- Production ramp up in January 2005
- 50,000 “hand raisers” before any advertising
- Major product advantages
  - Fuel Economy (25% better than V6 gasoline engine)
  - Class leading driving range & torque
  - Unsurpassed 5,000 pound towing capability
- Primary customer places significant value on fuel economy & range
- Sales expected to be more than twice the initial projected 5000 units
- Other diesel applications under serious review

Chrysler Group Actions: Future Actions
Proprietary Information not Shown
Hybrid Vehicles

Benefits Depend on Drive Cycle

Chrysler Group Actions: Future Actions
DC/GM/BMW Hybrid Cooperation

GM-DC MoU, 12/13/2004

Chrysler Group Actions: Future Actions

DC-GM-BMW MoU, 9/12/2005
DC/GM/BMW Hybrid - Common Basis for Cooperation

<table>
<thead>
<tr>
<th>Targets</th>
<th>Strategy</th>
<th>Steps</th>
</tr>
</thead>
</table>
| - Advance the state of Full Hybrid Technology  
  - FE improvement for real world (primarily US) driving conditions  
  - No compromise in towing capabilities  
  - Extended capabilities due to partner know-how and experiences | - Join forces and know-how (reduce costs)  
- Joint efforts (development, testing, purchasing)  
- Use common components/system but adapt individually  
- Generate collectively economies of scale for HEV components and systems | - Bring GM, MCG, CG - RWD HEVs into the market  
- Develop collectively FWD HEV system |
Proprietary Information not Shown
Alternative Fuels

- Biodiesel
- Bioethanol
- SunDiesel
DaimlerChrysler started a cooperation with Choren Industries in 2001 for research on BTL-diesel.

Volkswagen and lately Shell joined the cooperation.

To date, tests conducted have totaled more than 30,000 km.

For 2006 an annual production of 15,000 t SunDiesel is planned, next step will be to build a plant with capacity of 200,000 t/year in 2009.

DaimlerChrysler is going to fuel new Mercedes-Benz diesel passenger cars with SunDiesel as soon as the fuel is available in sufficient quantity.

BTL could satisfy 15 to 20% of Europe’s fuel requirements in the medium term.
Fuel Cell Technology

- Zero emissions
- Drive train efficiency twice as high as an internal combustion engine
- Driving pleasure – high dynamics through electric drive train
- Quiet driving due to electric propulsion technology
- Independence from crude oil
- Will open up opportunities to use renewable energy forms
- Significant environmental advantages only if hydrogen production renewable

Chrysler Group Actions: Future Actions
Fuel Cell Technology

- Fuel cell vehicles are part of the company’s advanced propulsion technology umbrella including advanced gasoline engines, modern diesels and hybrid powertrain systems

- DaimlerChrysler has produced fuel cell powered passenger cars, medium-duty vans and city buses for testing and demonstrations around the world

- Dodge Fuel Cell Sprinter:
  - First fuel cell powered Dodge the company has produced
  - Has a range of approximately 155 miles and a top speed of 80 mph

Chrysler Group Actions: Future Actions
Summary

- There will be no single technology solution for powertrains in the next 10 years.
- Several technologies will coexist as the global markets balance the many drivers including customer wants, legislative changes, and business influences.
- Customer “disparate wants” will continue to drive innovative approaches such as MDS to enable HEMI® power, diesels in the US market, etc.
- Cooperation is needed between governments, the fuel industry, and automakers to continuously adjust and re-optimize their products during this period of rapid change.
- Fuel economy will become an increasingly more prominent factor in the U.S. as it has already in most other areas of the world.
- The powertrains of “The Next Ten Years” are really only 5 years away since series development is now in-process for the 2010 model year!
Chrysler Group Powertrain Perspective: The Next Ten Years

Thank You