



# Chrysler Group Powertrain Perspective: The Next 10 Years

**Robert Lee**  
**Vice President**  
**Powertrain Product Engineering**  
**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

### CUSTOMER

Manufacturing cost  
Driving pleasure  
Operating cost  
Sound



Recycling  
Resources  
**ENVIRONMENT**

# 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...

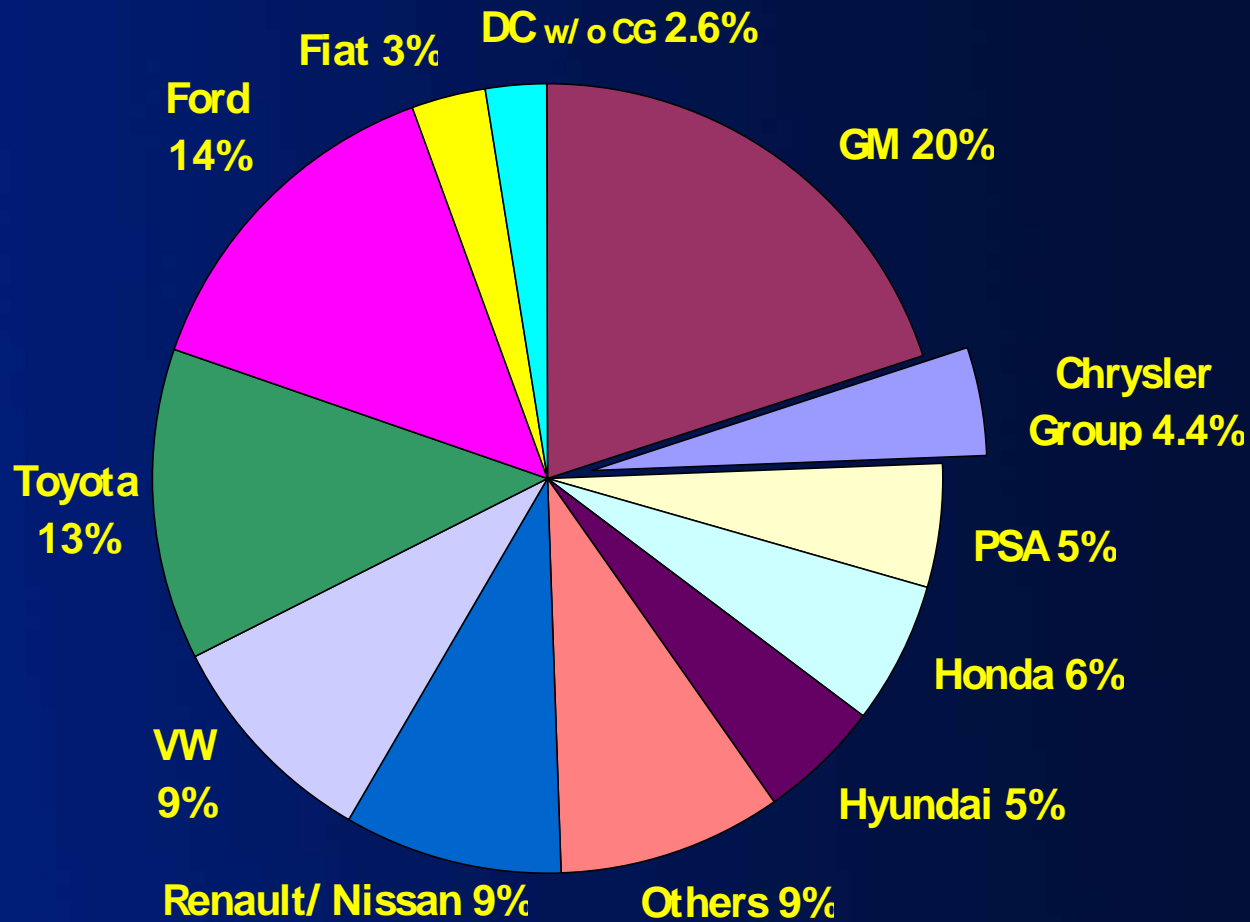


# The Chrysler Group ...



- **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)**

# Global Market Share for The Chrysler Group (2004)

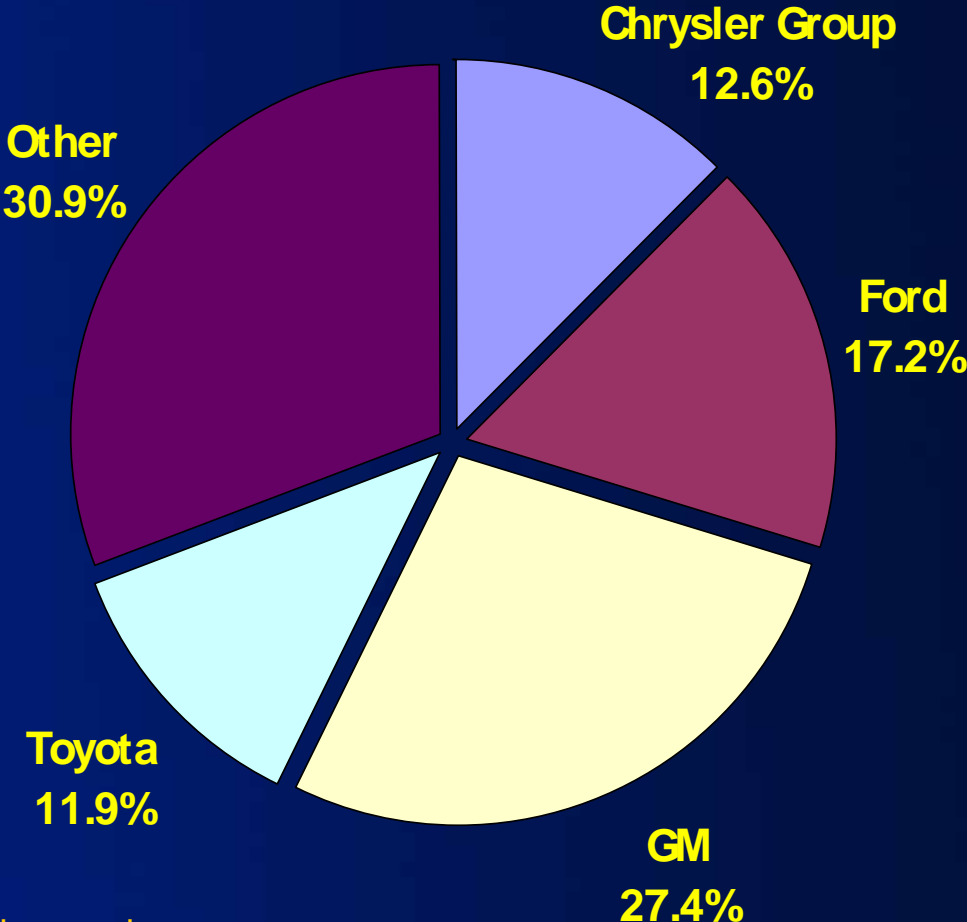




# U.S. Market Share for The Chrysler Group



## Chrysler Group U.S. Sales 2004

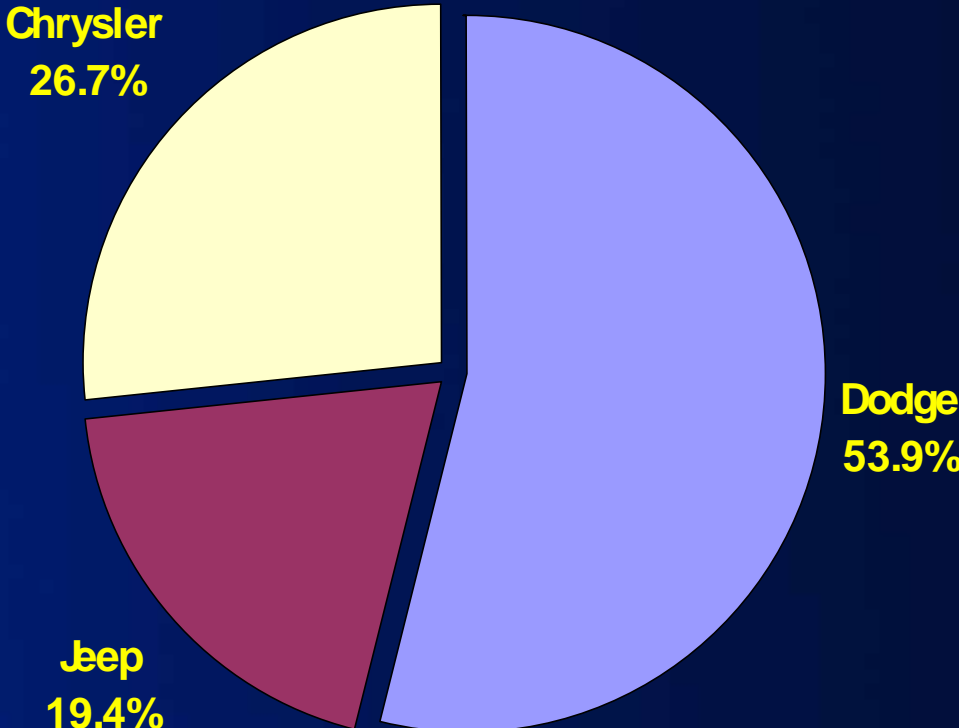




# U.S. Market Share for The Chrysler Group



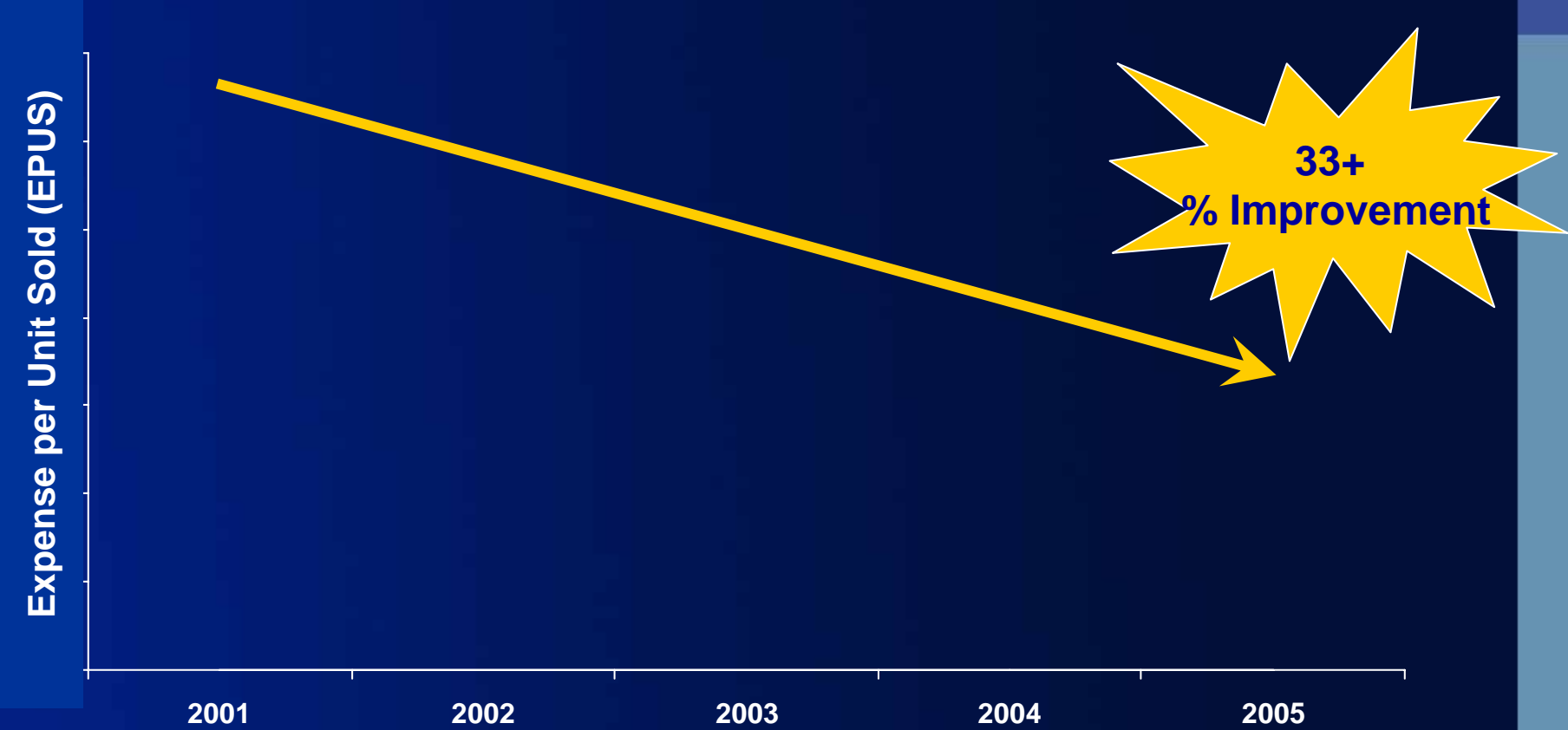
## Chrysler Group Brand Sales 2004



# Chrysler Group Powertrain Quality Improvement



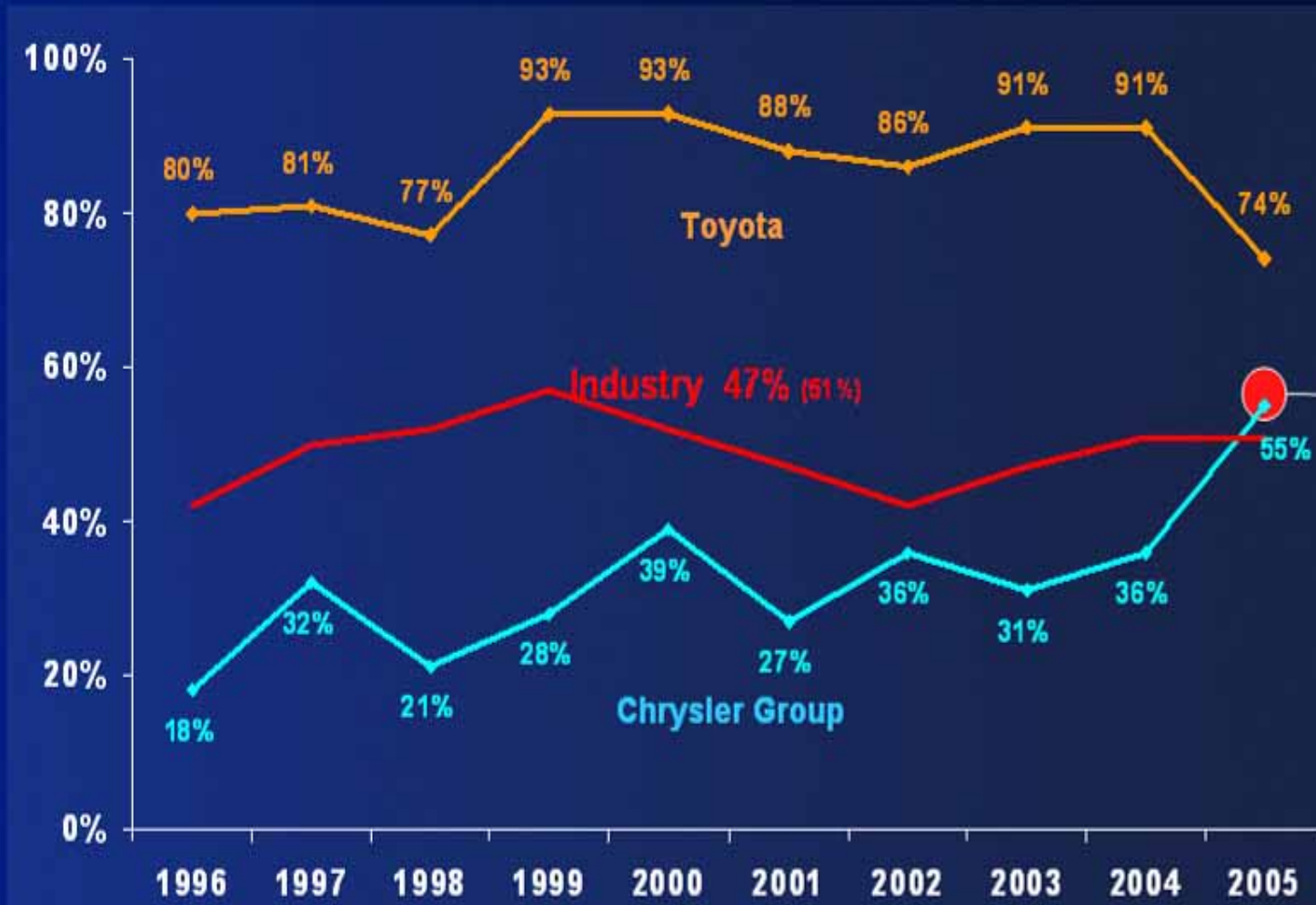
2005 MY at 11 MIS



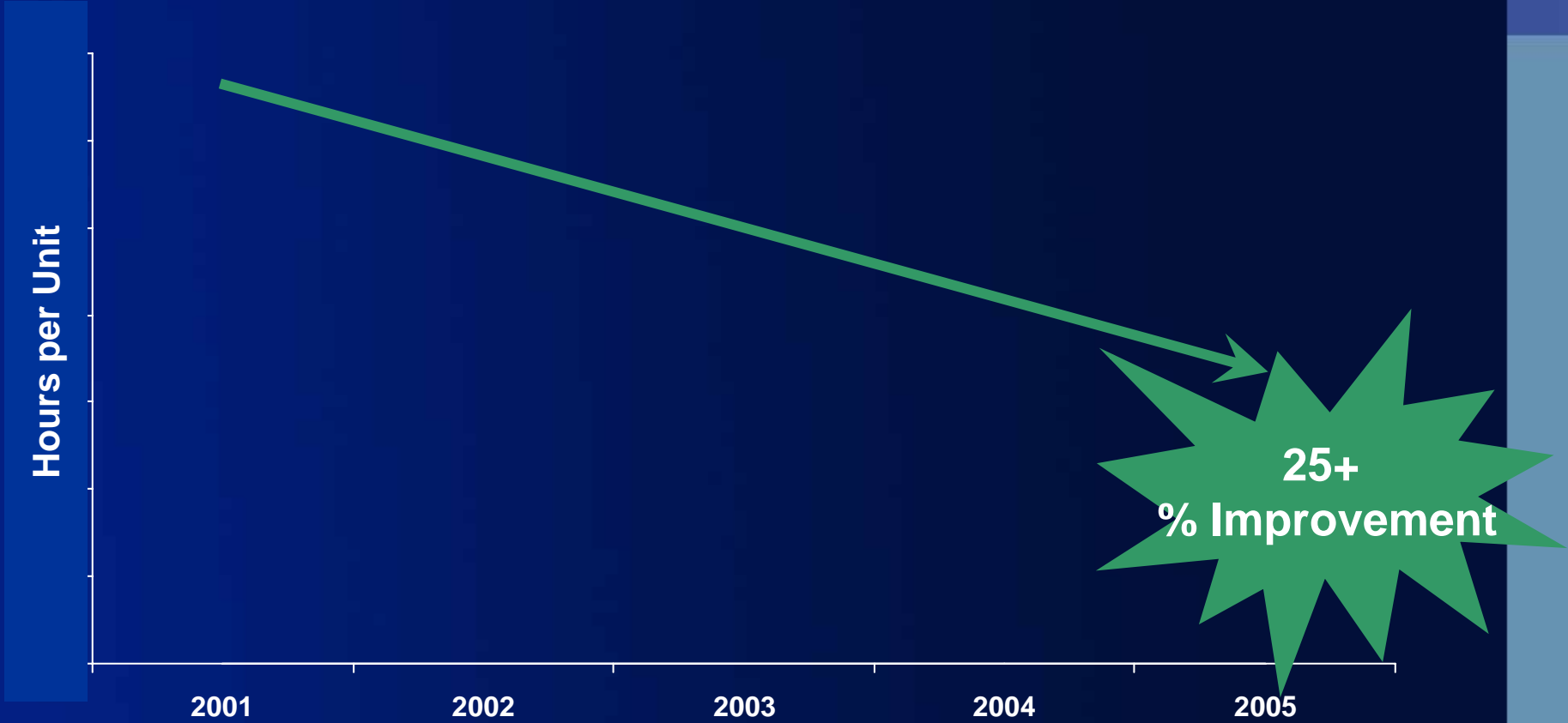
# Consumer Reports



## Percent of Models Recommended



# Chrysler Group Powertrain Harbour Improvement



## Chrysler Group Background



## Drivers for Change



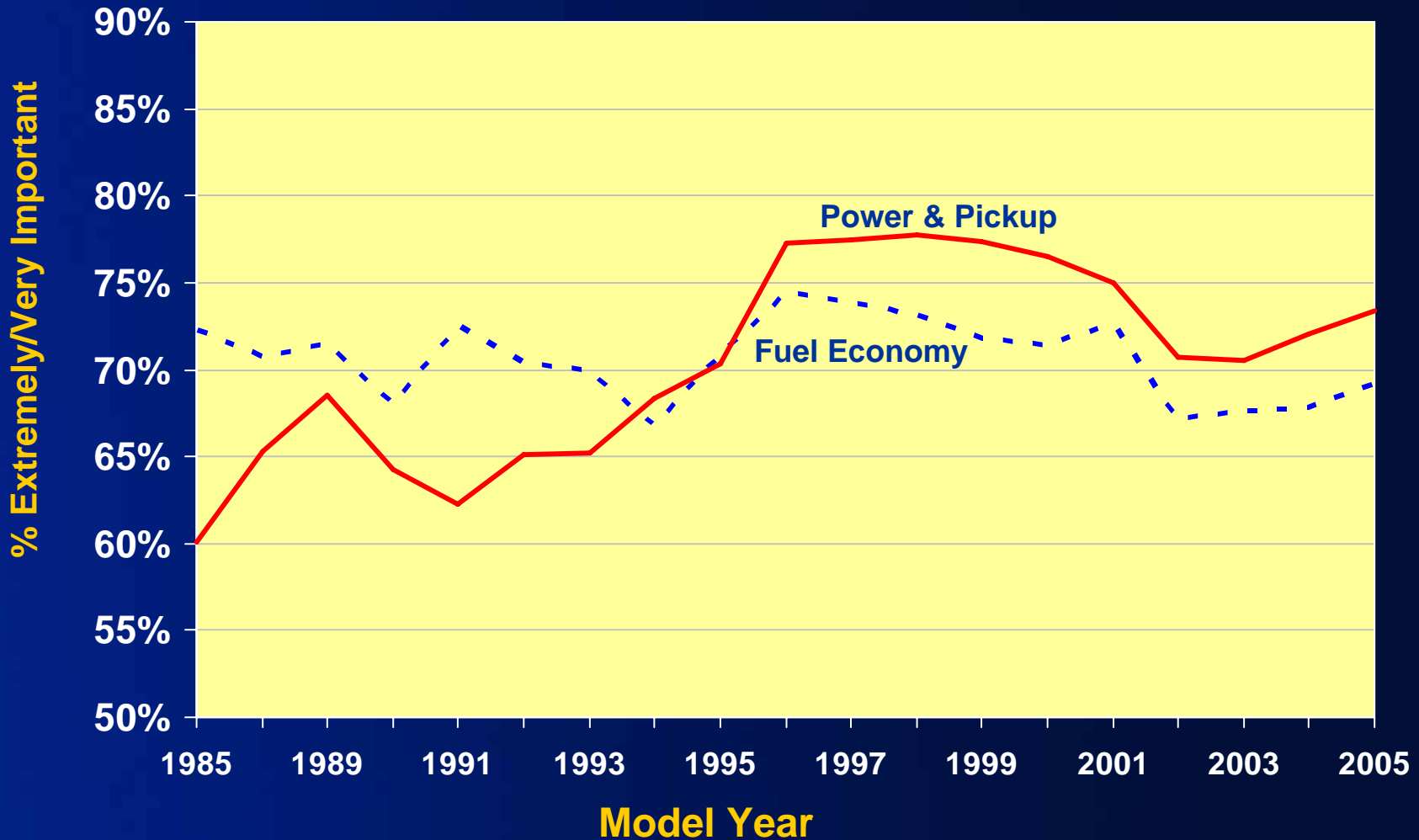
## Chrysler Group Actions

# 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.

# Important Vehicle Attributes in U.S. Purchasing Decisions

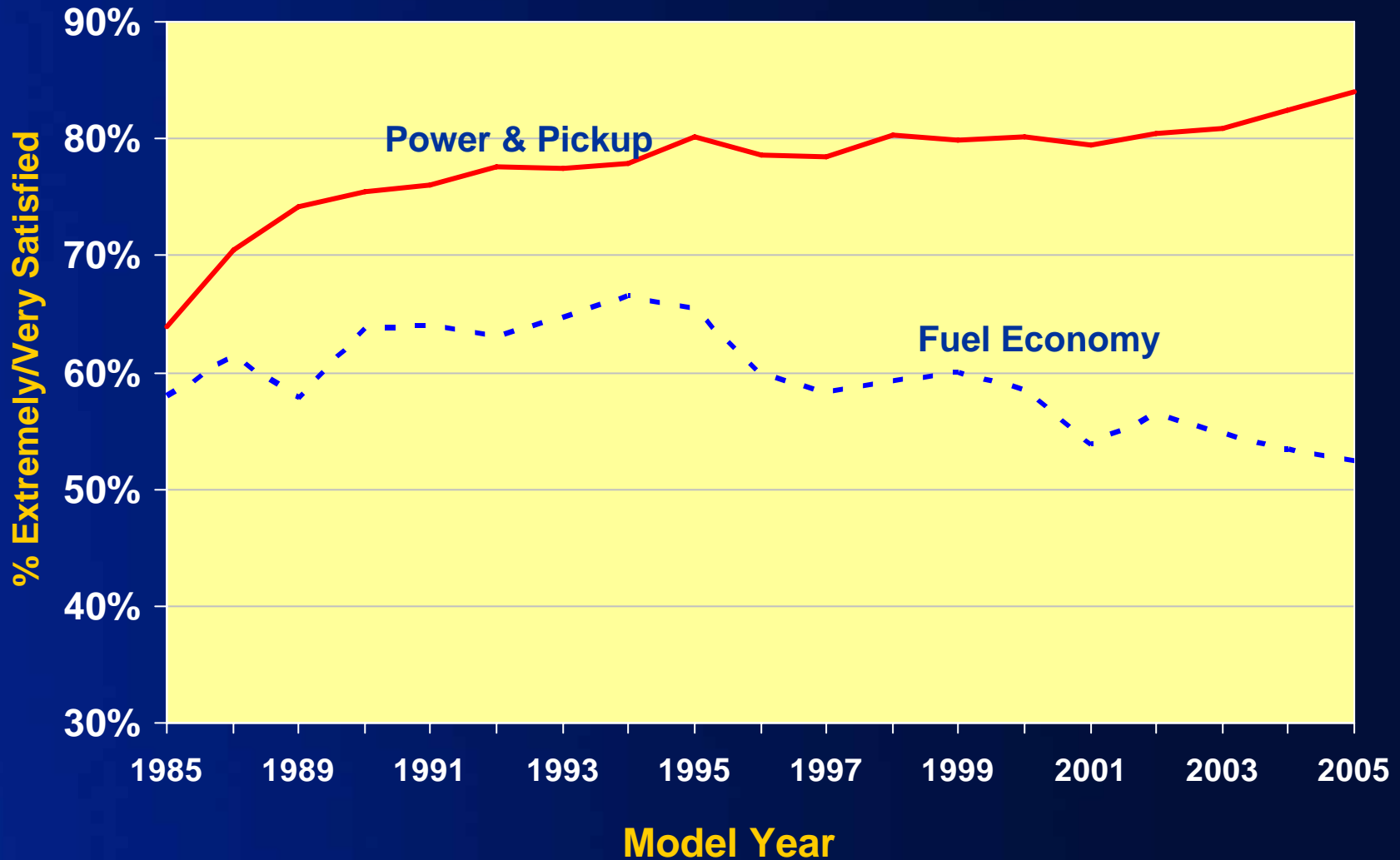


Drivers for Change: Customer Wants

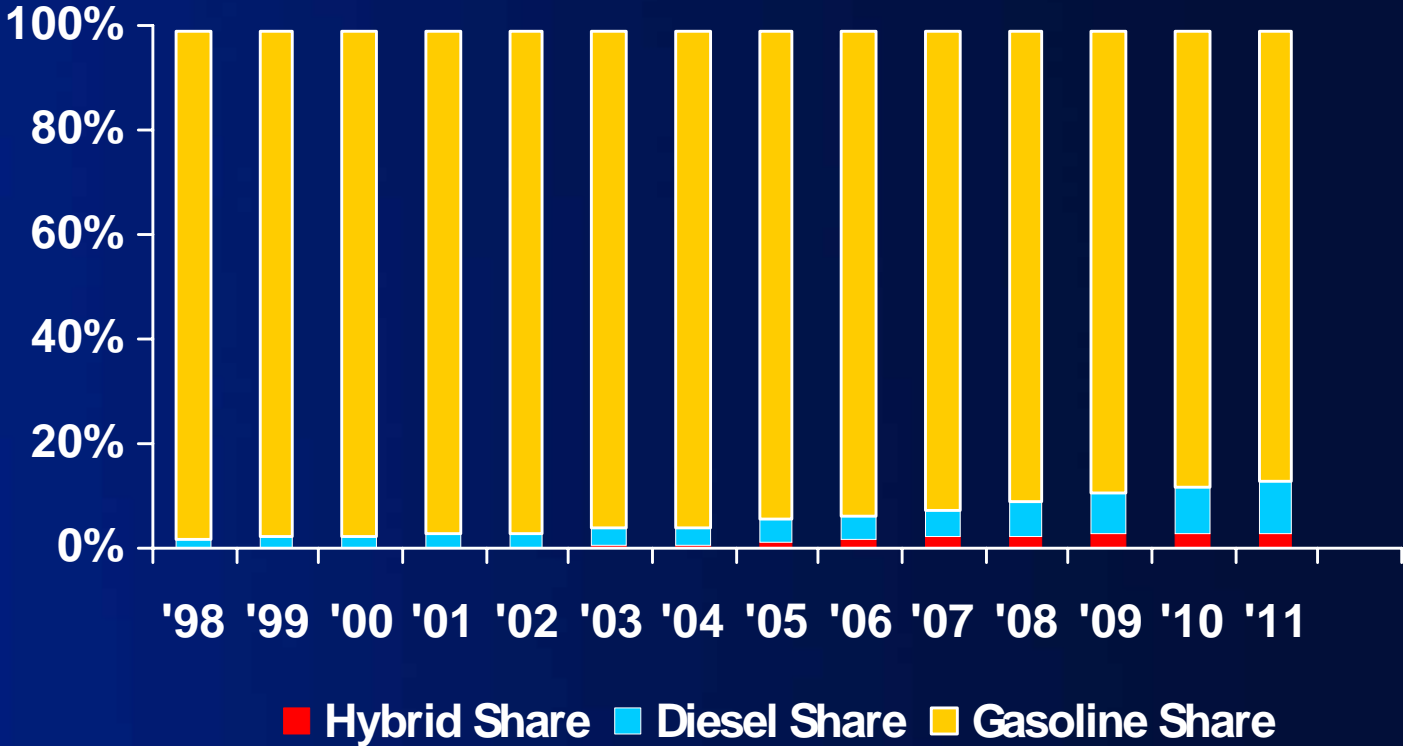
Source: Strategic Vision Inc. / DCC Product Strategy



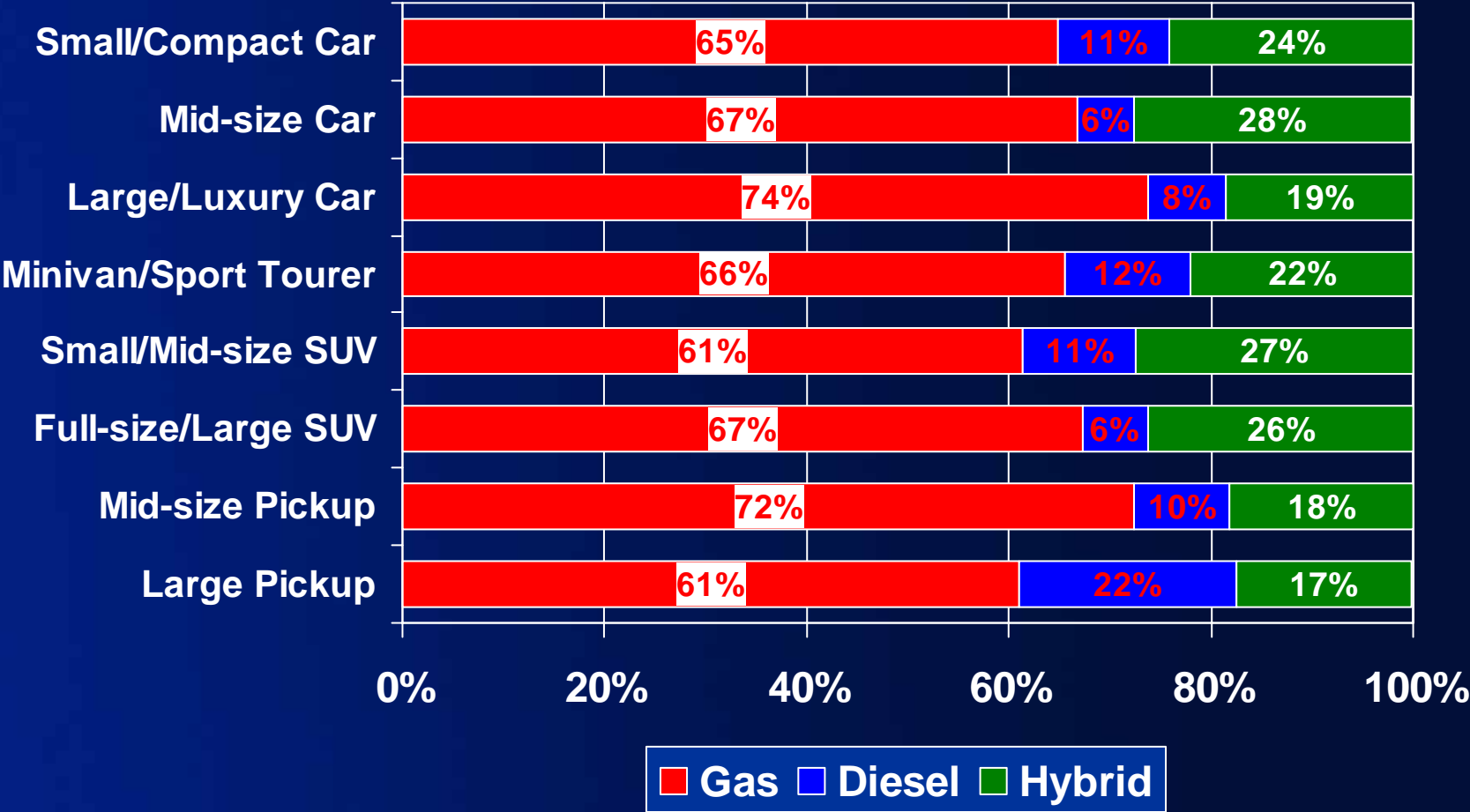
# Satisfaction with Vehicle Attributes in the U.S.



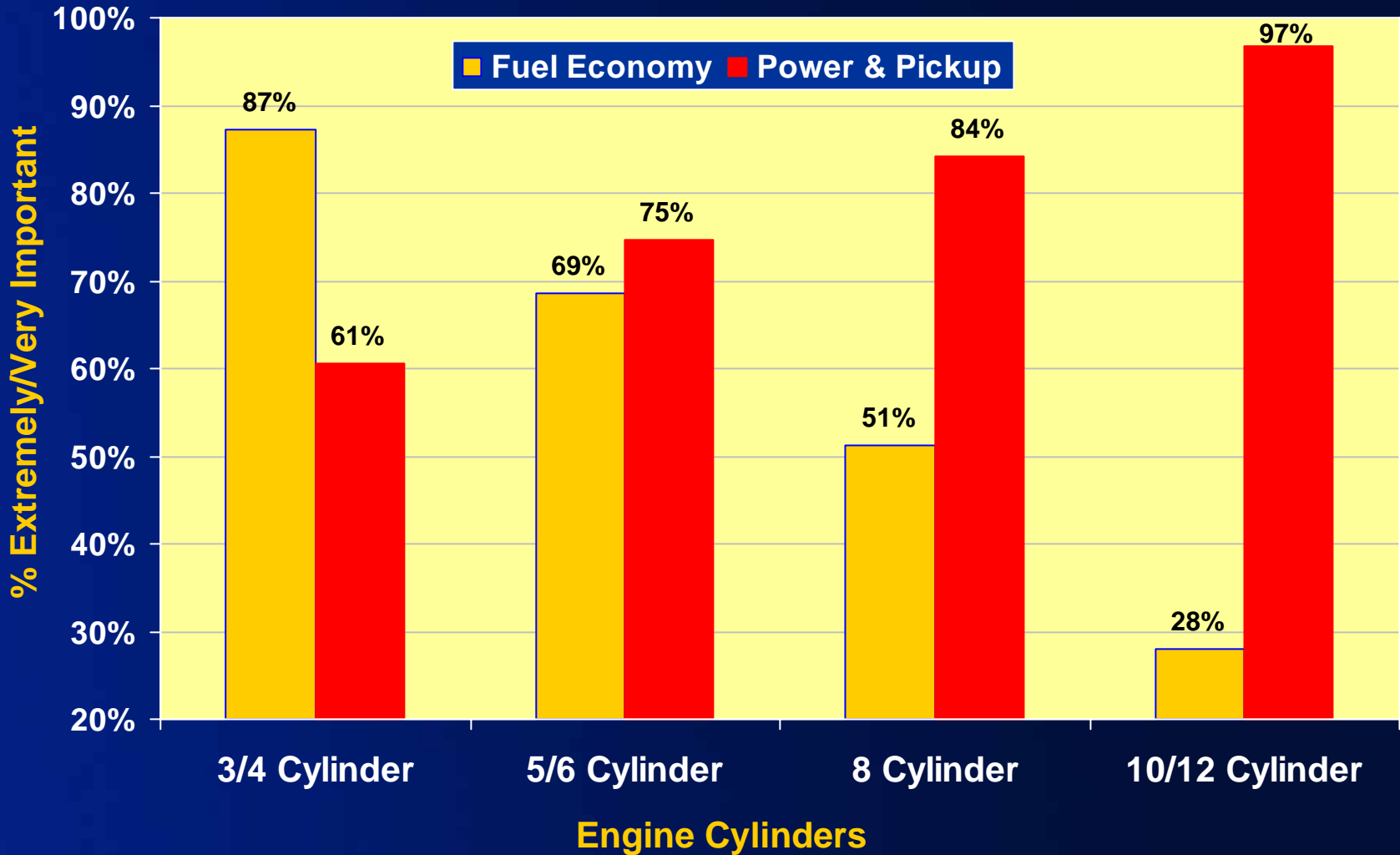
# Engine Preference for U.S. Passenger Vehicles



# Engine Preference by Segment in the U.S.



# Importance of Vehicle Attributes by Engine Size



Drivers for Change: Customer Wants

# 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

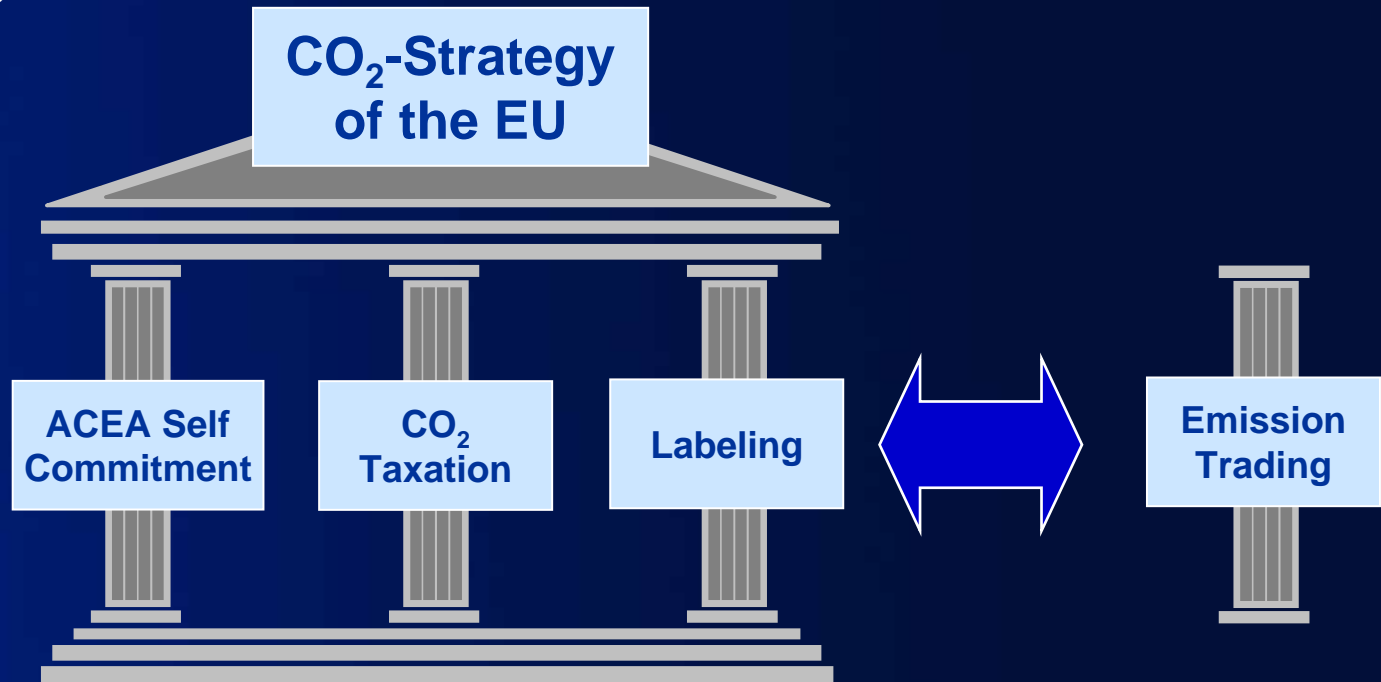
# Proposed Category Targets Under Footprint CAFE (2008-2011 MYs)



Category	Size (sq. ft.) Wheelbase x Track Width	Targets			
		2008	2009	2010	2011
"Traditional" CAFE Std.		22.5	23.1	23.5	n/a
1	≤43.0	26.8	27.4	27.8	28.4
2	>43.0-47.0	25.6	26.4	26.4	27.1
3	>47.0-52.0	22.3	23.5	24.0	24.5
4	>52.0-56.5	22.2	22.7	22.9	23.3
5	>56.5-65.0	20.7	21.0	21.6	21.9
6	>65.0	20.4	21.0	20.8	21.3



## EU - CO<sub>2</sub> Policy



**THE CO<sub>2</sub>-POLICY OF THE EU IS BASED ON FOUR PILLARS**





**Proprietary Information not Shown**

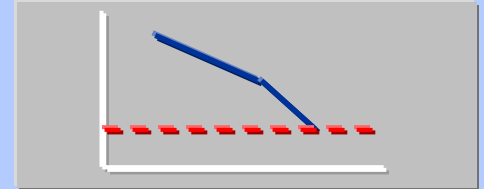


**Principle**

## CONTENTS OF THE FOUR PILLARS OF EU-CO<sub>2</sub>-POLICY

### ACEA self commitment

- ACEA Fleet target 140g CO<sub>2</sub>/km, 6 l/km for 2008
- 120g CO<sub>2</sub>/km target for 2012



### CO<sub>2</sub> taxation

- First proposal of EU tax scheme 25% CO<sub>2</sub> component as part of annual tax planned for 2008
- 50% planned for 2010
- No further details on tax scheme yet



### Labeling

- Labeling of CO<sub>2</sub> 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



# Legislative Influence



## AB 1493 Overview

- 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

# Legislative Influence



## AB 1493 – New “CO<sub>2</sub> Equivalent” Metric

ARB defines CO<sub>2</sub>e as the sum of vehicle greenhouse gas emissions weighted by their global warming potentials minus credits for mobile A/C improvements

$CO_2e = CO_2 \text{ (exhaust)} + 296 \times N_2O \text{ (exhaust)} + 23 \times CH_4 \text{ (exhaust)} - A/C \text{ direct emissions allowance} - A/C \text{ indirect emissions allowance}$

CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> = measured emissions (N<sub>2</sub>O 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.)

CO<sub>2</sub>e is 97% tailpipe CO<sub>2</sub> emissions and tailpipe CO<sub>2</sub> is fuel economy

# Other Market Factors



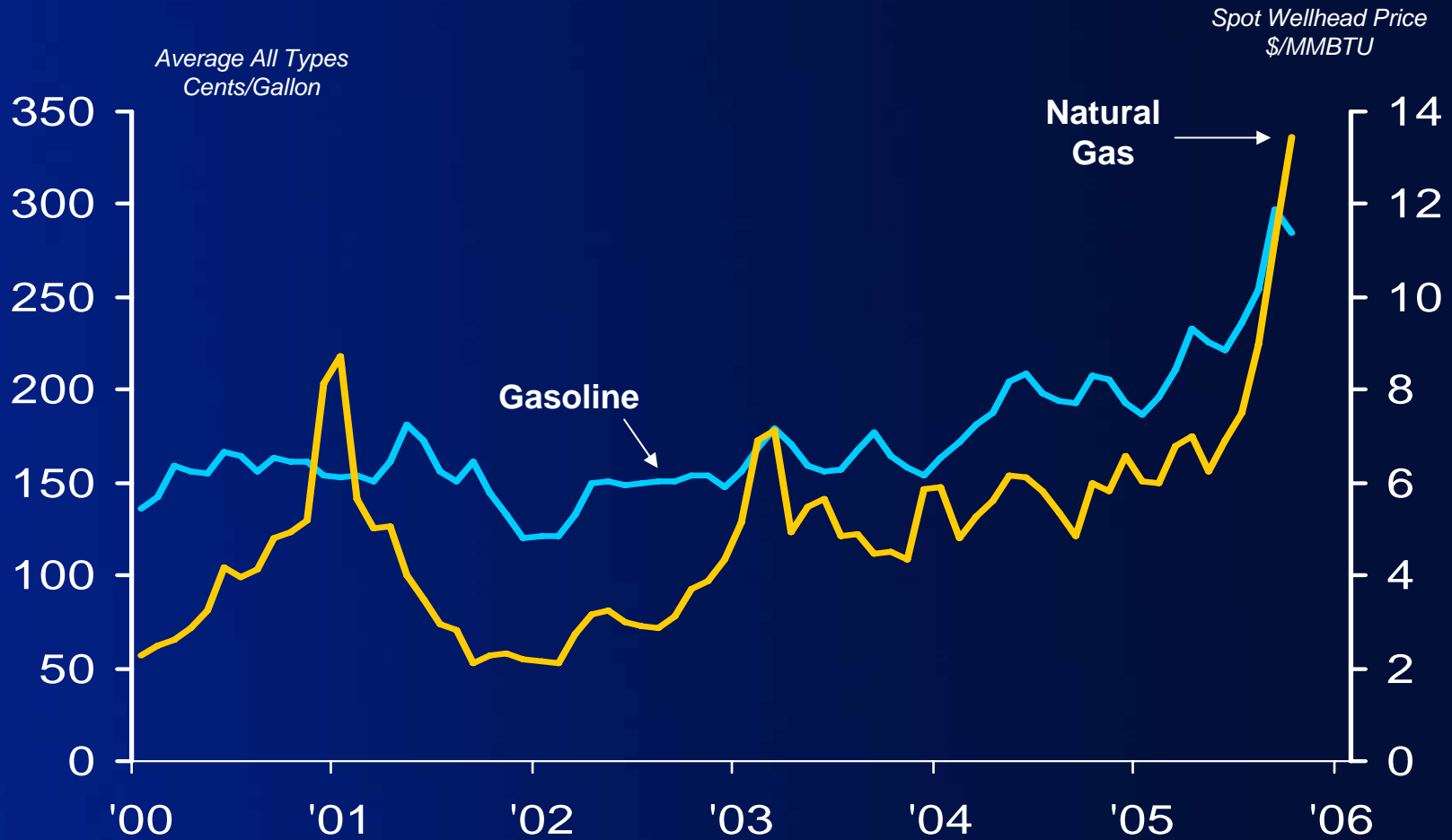
## ▪ Fuel Availability

- 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

Order	Company	volume	Order	Company	volume
1	FAW	993554	11	Nanjing Auto Group Corporation	94551
2	SAIC Group	847526	12	Geely	91744
3	ChangAn Group	582367	13	Cherry	79565
4	Beijing Auto Group	538699	14	Southeast Motor Co.Ltd	57798
5	Dongfeng Group	530061	15	Changcheng Corporation	54904
6	GAIG	209720	16	CNHTC	43955
7	Hafei Group	205991	17	Shandong Kaima	37743
8	JAC	131300	18	Shanxi Auto	28111
9	BRILLIANCE-AUTO	110505	19	Qingling Motors	28090
10	CHANGHE	104289	20	Hebei Zhongxing	27536



# Chinese Automotive Market for the Next 10 years

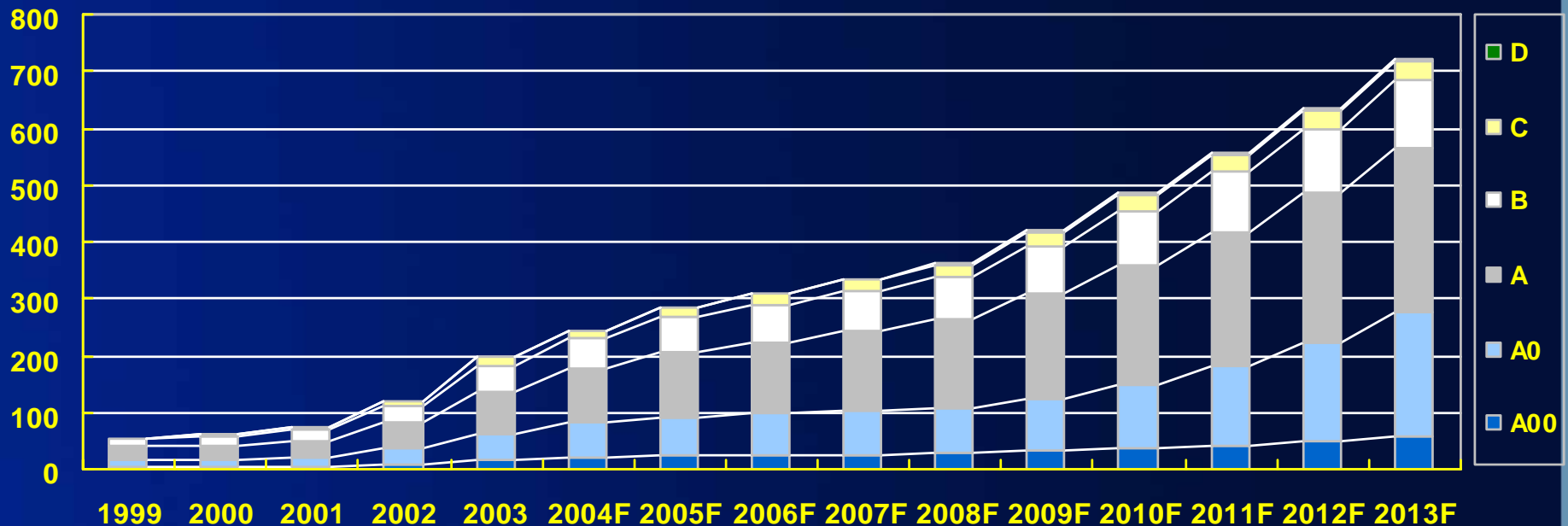


## The last 10 years:

- 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



Drivers for Change: Other Market Factors

## Chrysler Group Background



## Drivers for Change



## Chrysler Group Actions



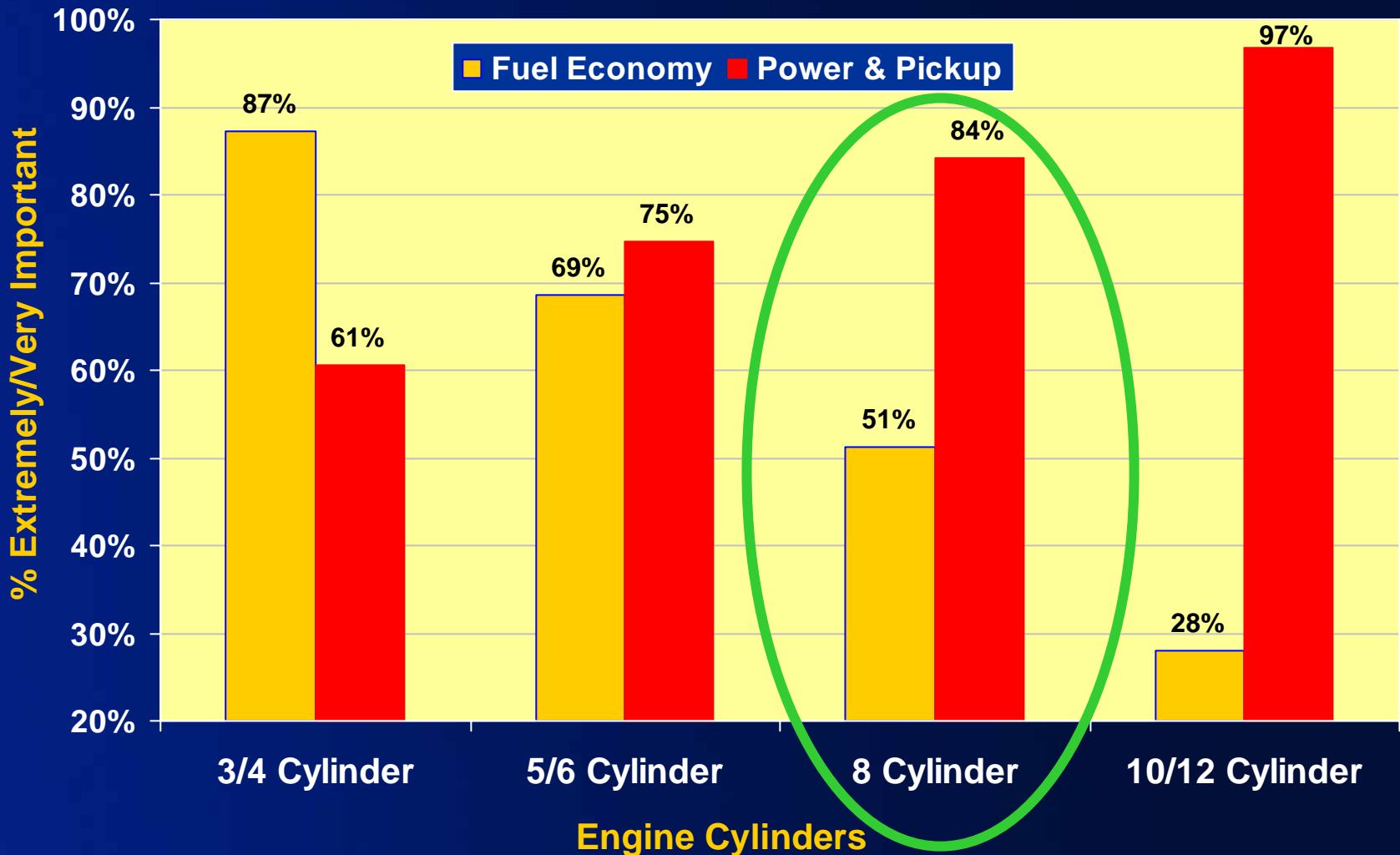
## Strategy

- 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



**Proprietary Information not Shown**

# Recent Actions to Satisfy Disparate Customer Wants



# 5.7L HEMI® Engine



# 5.7L HEMI® Performance



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

Vehicle	HP	kW
300C / Magnum	<b>340</b>	<b>253</b>
Cadillac STS V8	320	239
Lincoln LS 8	280	209
Jaguar XK-8	294	219
Audi A6 4.2	335	250
Infinity M45	335	250



# Multi-Displacement System (MDS)

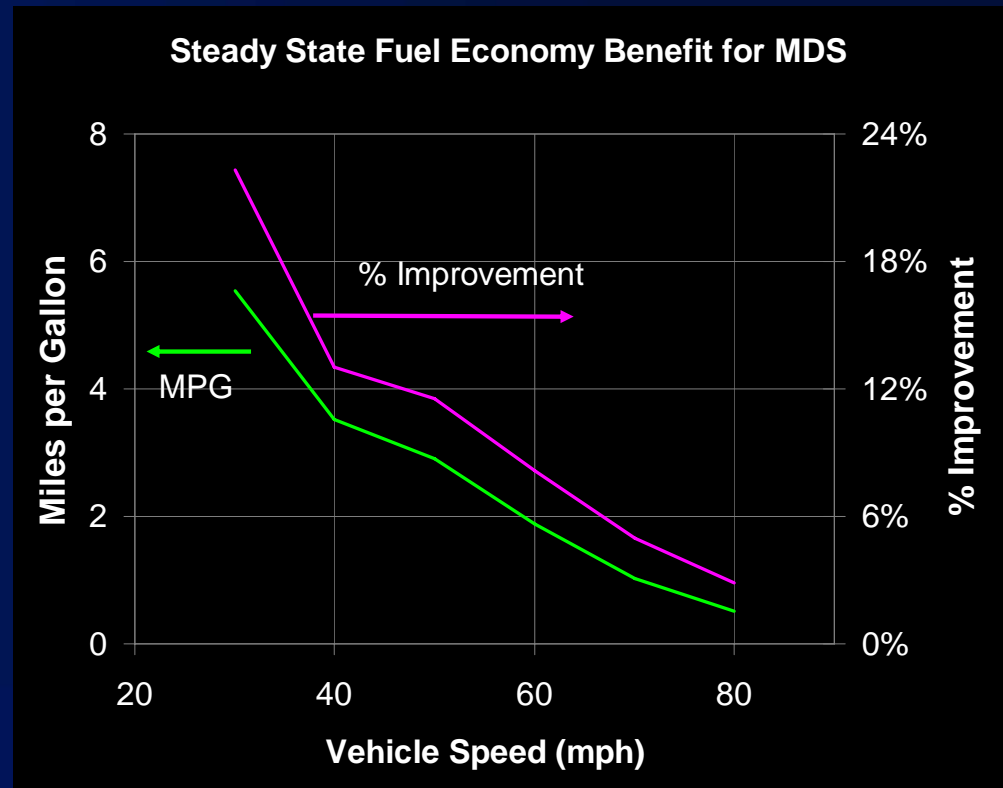


- **Selectively deactivate cylinders to improve fuel economy**

- 8 cylinders for acceleration
- 4 cylinders for cruising

- **Typical 7-10% fuel economy benefit**

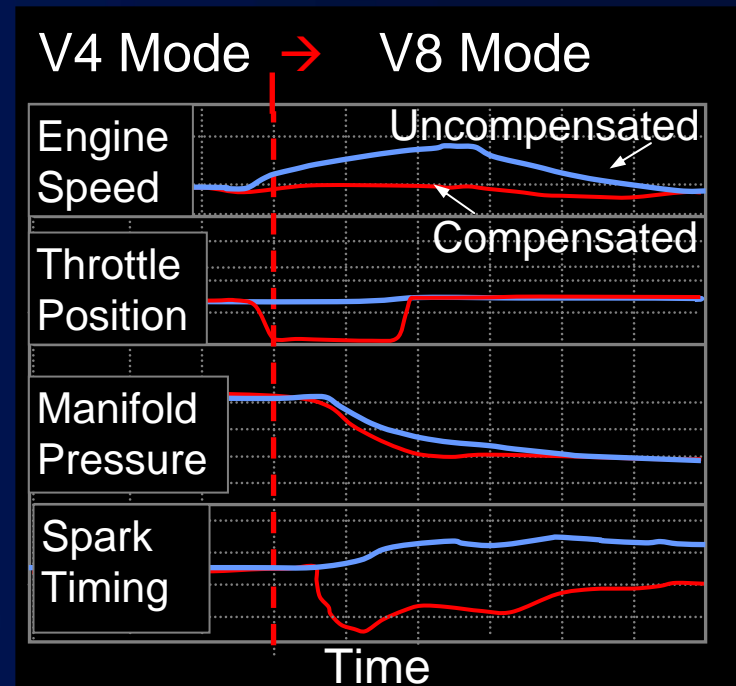
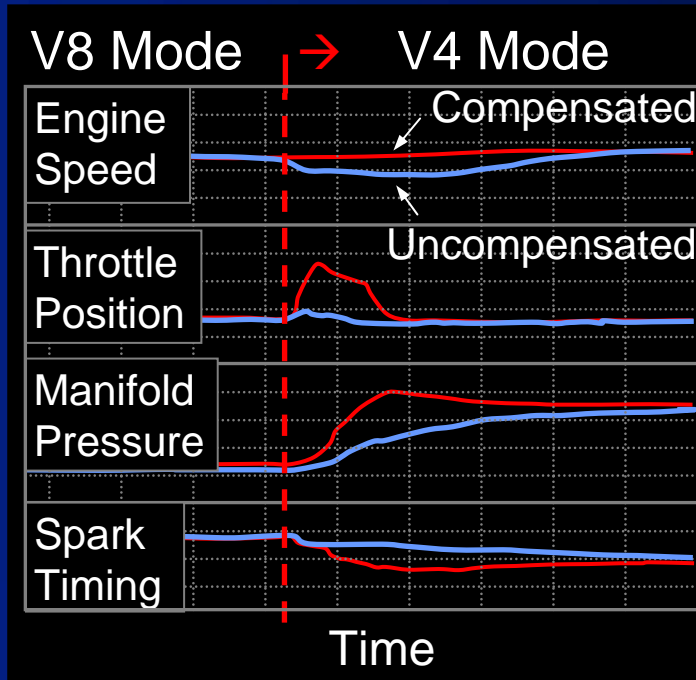
- **Potential for 20% benefit**



# 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



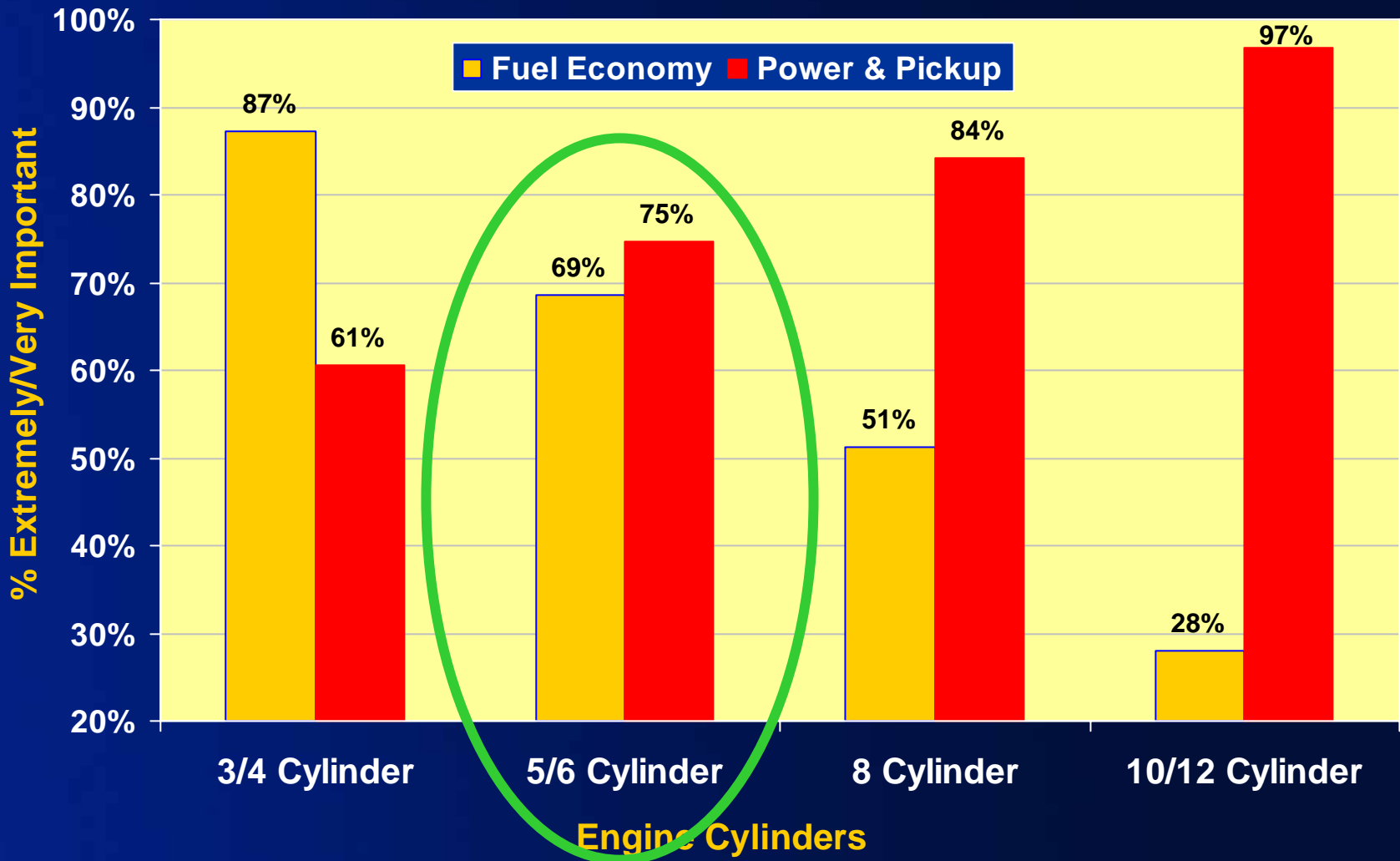
# HEMI® Multi-Displacement System (MDS)



- 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



# Recent Actions to Satisfy Disparate Customer Wants



# 5.9L Dodge/Cummins Turbo Diesel

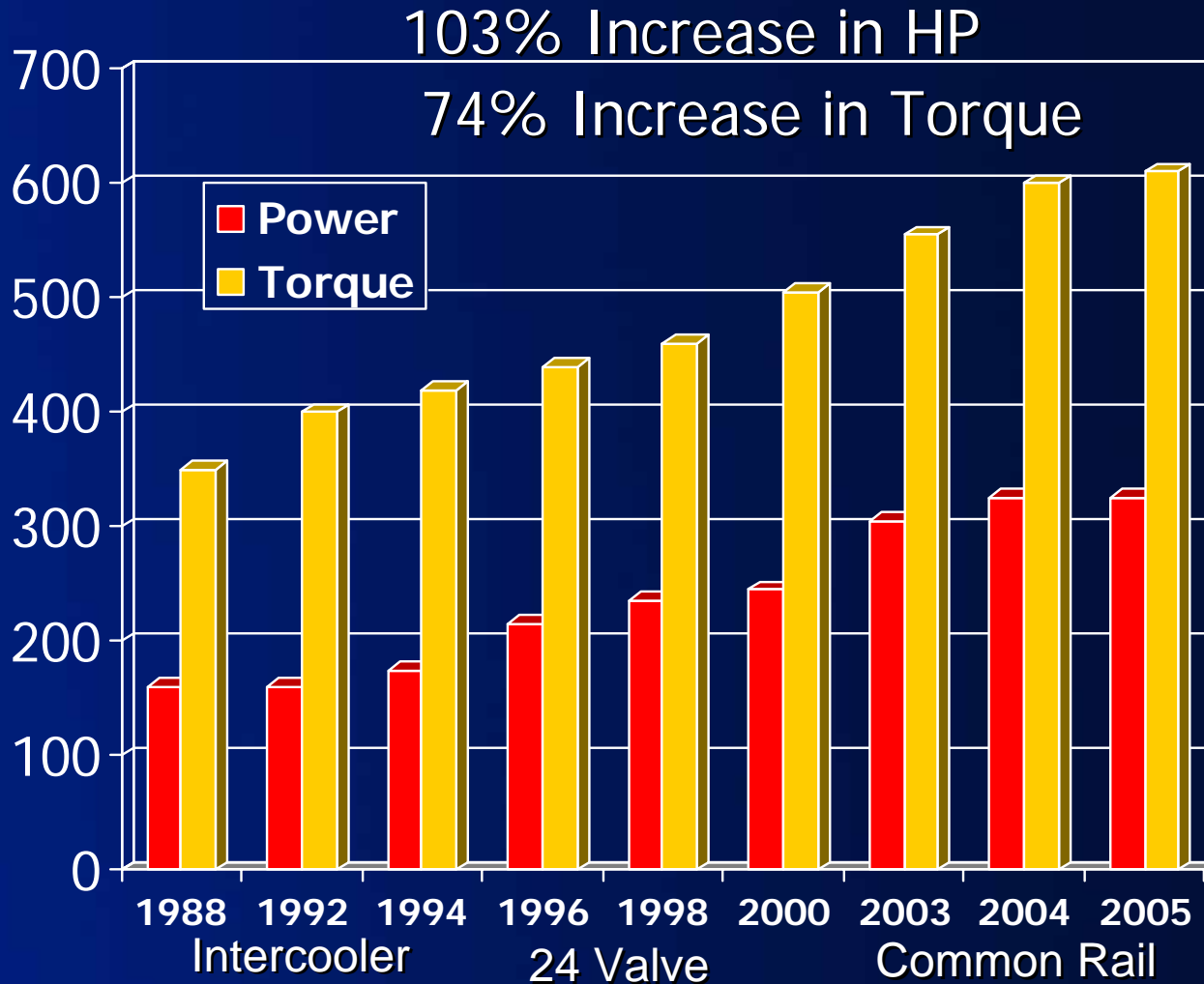


# Dodge/Cummins Turbo Diesel



- 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





# 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 CO<sub>2</sub> emissions approximately 20 percent**





# Dodge/Cummins Diesel Sales

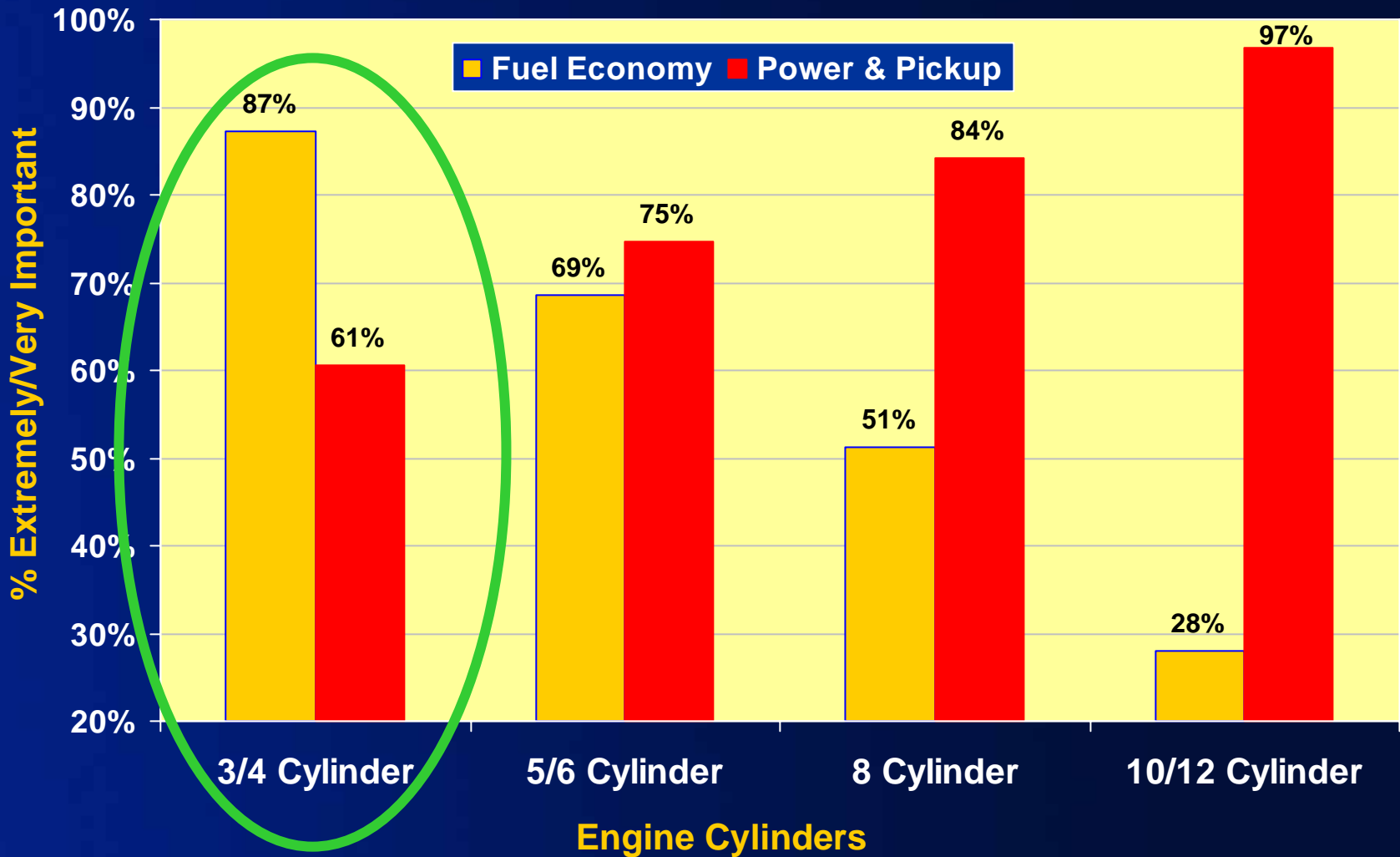


## Cummins Diesel Ram Total Volume 1989-2005



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

# Recent Actions to Satisfy Disparate Customer Wants



# GEMA World Engine



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

# GEMA World Engine



- 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



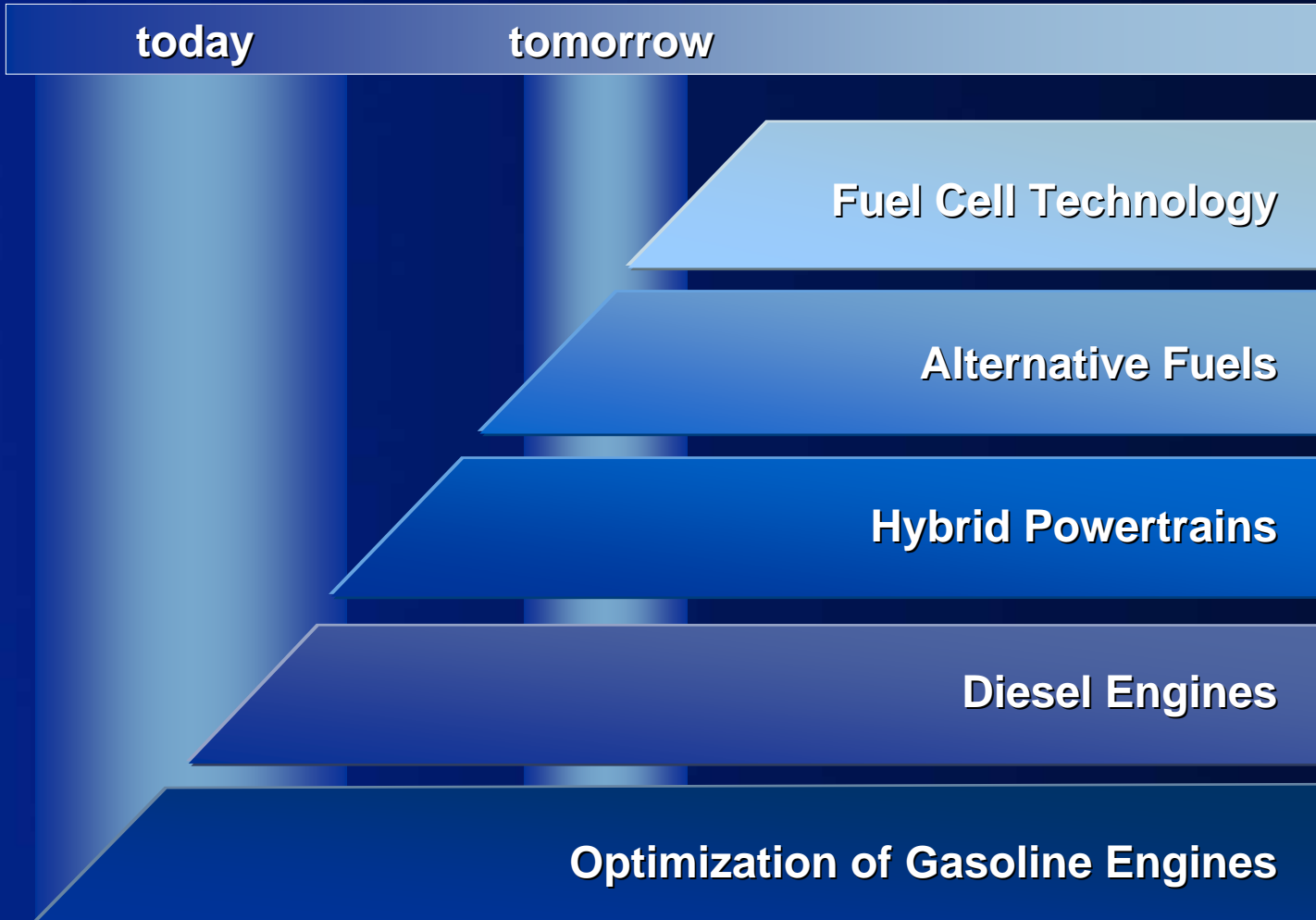
- *Fuel economy 5% better than existing I-4 engines*
- *Cost structure enables premium content to achieve fuel economy and performance objectives for entry level/value applications*

1.8 L
2.0 L
2.4 L

	1.8 L	2.0 L	2.4 L
<b>Displacement</b>	1798 cc	1998 cc	2360 cc
<b>Output</b>	140 hp (104 kW)	150 hp (112 kW)	170 hp (127 kW)
<b>Torque</b>	125 lb-ft (169 Nm)	140 lb-ft (190 Nm)	165 lb-ft (224 Nm)

**SAE J1349 Performance Targets**

# Path to the Future





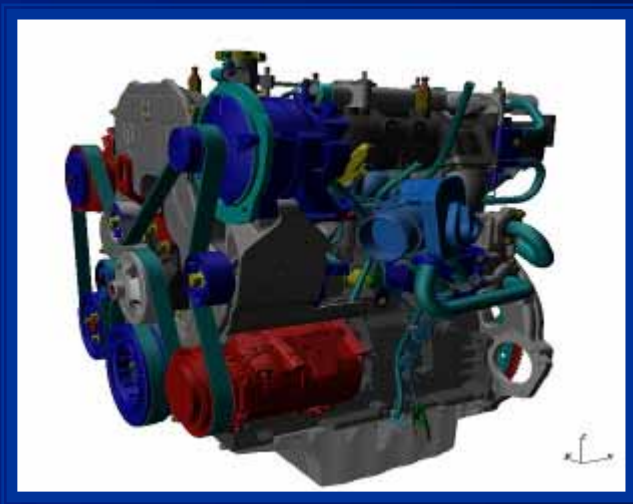
**Proprietary Information not Shown**

# 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

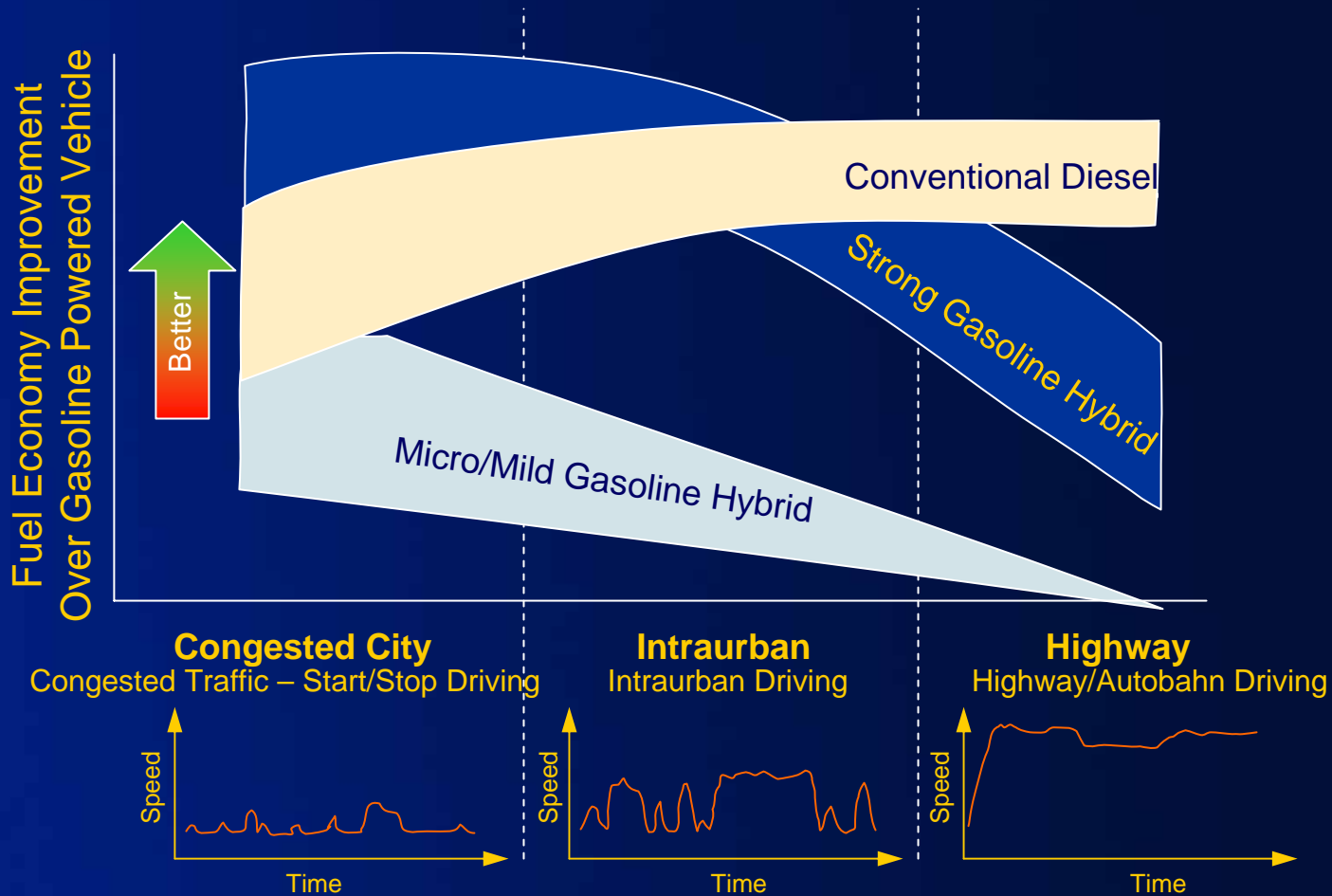


**Proprietary Information not Shown**

# Hybrid Vehicles



## Benefits Depend on Drive Cycle



# DC/GM/BMW Hybrid Cooperation



GM-DC MoU, 12/13/2004



washingtonpost.com  
**BMW joins DaimlerChrysler/GM hybrid project**  
 By Michael Shields, European Automotive Correspondent  
 Reuters  
 Wednesday, September 7, 2005: 9:04 AM

sueddeutsche.de  
 BMW schließt sich Hybrid-Allianz von GM und  
 DaimlerChrysler an



**BMW joins DaimlerChrysler, GM in hybrid car project**  
 FRANKFURT (Reuters) — German luxury carmaker BMW has joined DaimlerChrysler (DCX) and General Motors (GM) in an alliance to develop hybrid vehicle technology, DaimlerChrysler and GM said Wednesday.

**Bloomberg.com**

**BMW Joins GM, DaimlerChrysler to Develop Gas-Electric Engines**



DC-GM-BMW MoU, 9/12/2005

# DC/GM/BMW Hybrid - Common Basis for Cooperation



## Targets

- 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

## Strategy

- 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

## Steps

- Bring GM, MCG, CG - RWD HEVs into the market
- Develop collectively FWD HEV system



**Proprietary Information not Shown**

# Alternative Fuels



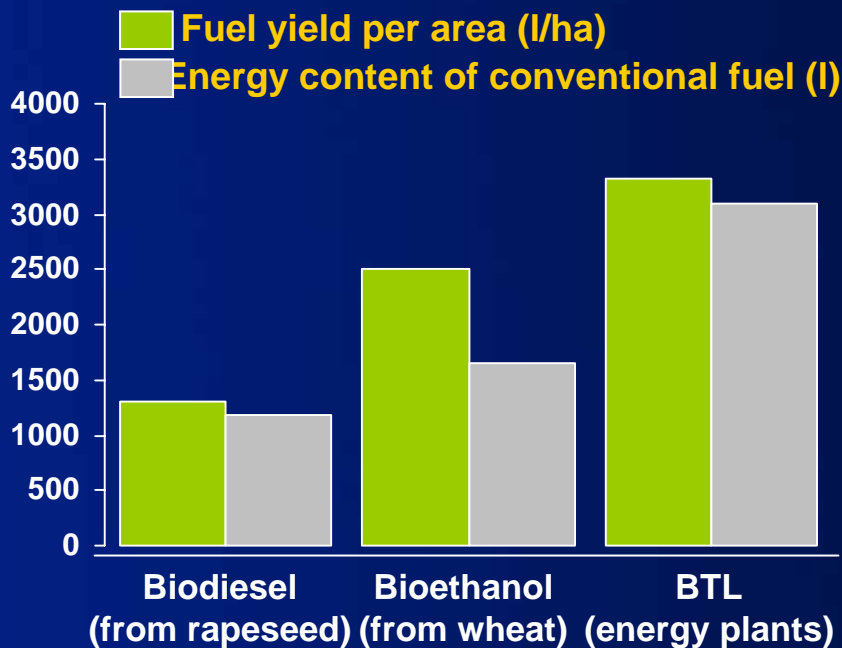
- Biodiesel
- Bioethanol
- SunDiesel



# Alternative Fuels



Yield per unit area for BTL higher:



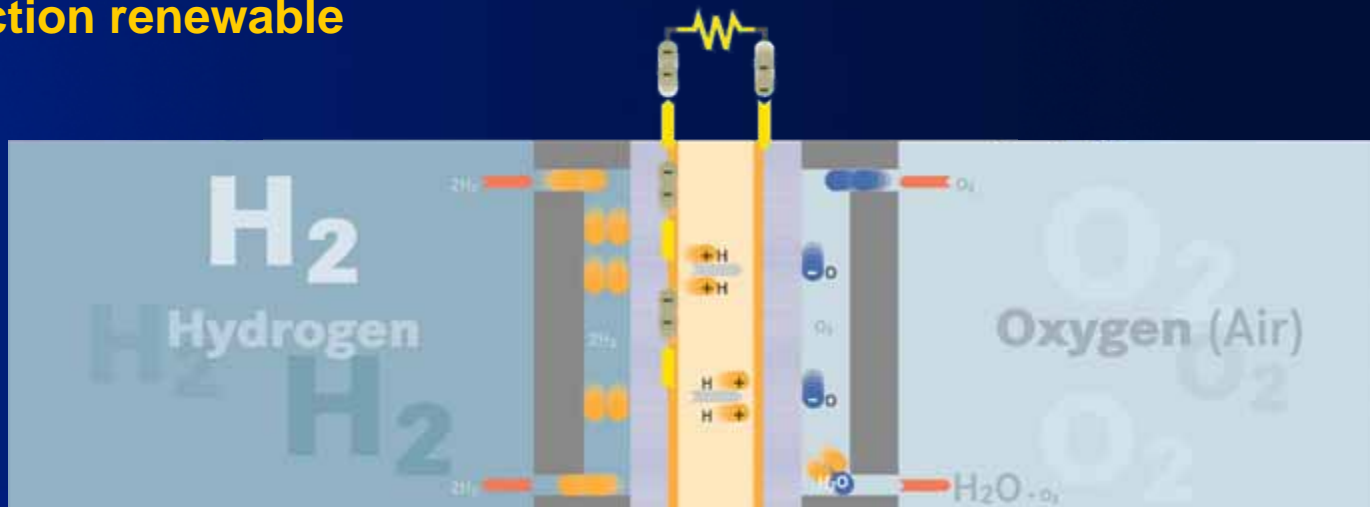
- DaimlerChrysler started a cooperation with Choren Industries in 2001 for research on BTL-diesel
- Volkswagen and lately Shell joined the cooperation
- To date, tests conducted have totaled more than 30,000 km
- For 2006 an annual production of 15,000 t SunDiesel is planned, next step will be to build 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



# 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

# 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<sup>®</sup> 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