



PwC Automotive Institute
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Analyst Briefing

Gasoline Engine Downsizing

EngineExpo 2006 – Open Technology Forum
Stuttgart, 10 May2006

Agenda

Introduction

Downsizing in action

Overview of market drivers

Conclusion and recommendations

Introduction

The CO₂ reduction imperative

Worldwide mission to reduce greenhouse gases

- CO₂ is main constituent accounting for around 56%

Slow global warming

- Potentially devastating to the environment
 - The Blomstrandbreen glacier retreat

Gasoline downsizing is powertrain Act III

- After diesel and transmission development

Blomstrandbreen, Norway 1928



Blomstrandbreen, Norway 2002



Introduction

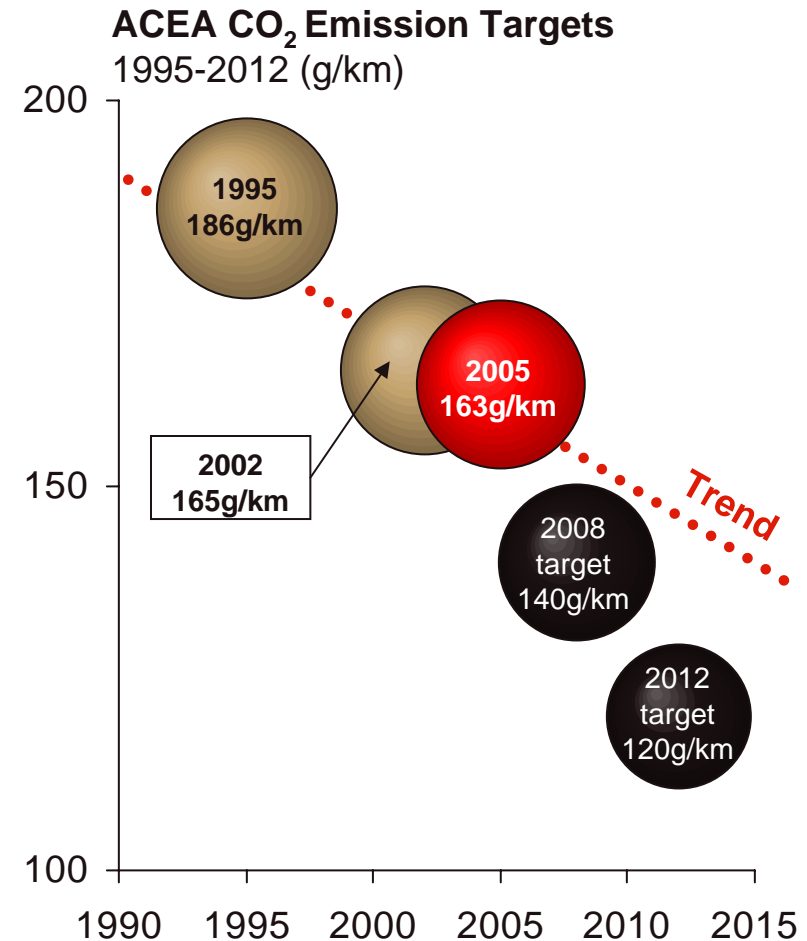
The CO₂ reduction imperative

ACEA set in place a voluntary agreement in 1998

- 140g/km CO₂ for new vehicle fleets by 2008
- 120g/km CO₂ tentatively set for 2012
- A pre-emptive move to avoid EC mandate

Current rate of progress is not sufficient

- Even with escalating diesel market share



Market developments and regulations are running counter to CO₂ reduction and compounding the target deficit.

Introduction

A silk purse from a sow's ear

Regulations

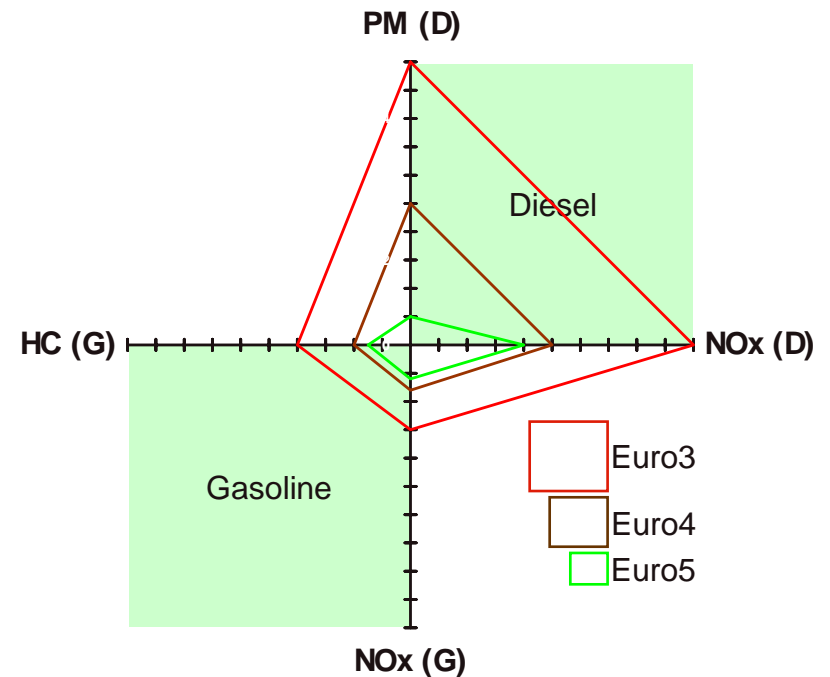
- Vehicle weight
- Pedestrian safety
- EC's End-of-Life Vehicles directive
- Emission regulations

Market trends

- Generational increases
- SUVs
- Premium vehicle market growth
- Increasing specifications

European Vehicle Emission Standards

Euro3/4/5 2000/2005/2010*



* Euro5 draft proposals

Even with the rise of diesel, CO₂ reduction is missing the target. The need now is to look at the gasoline side of the equation.

Downsizing in Action

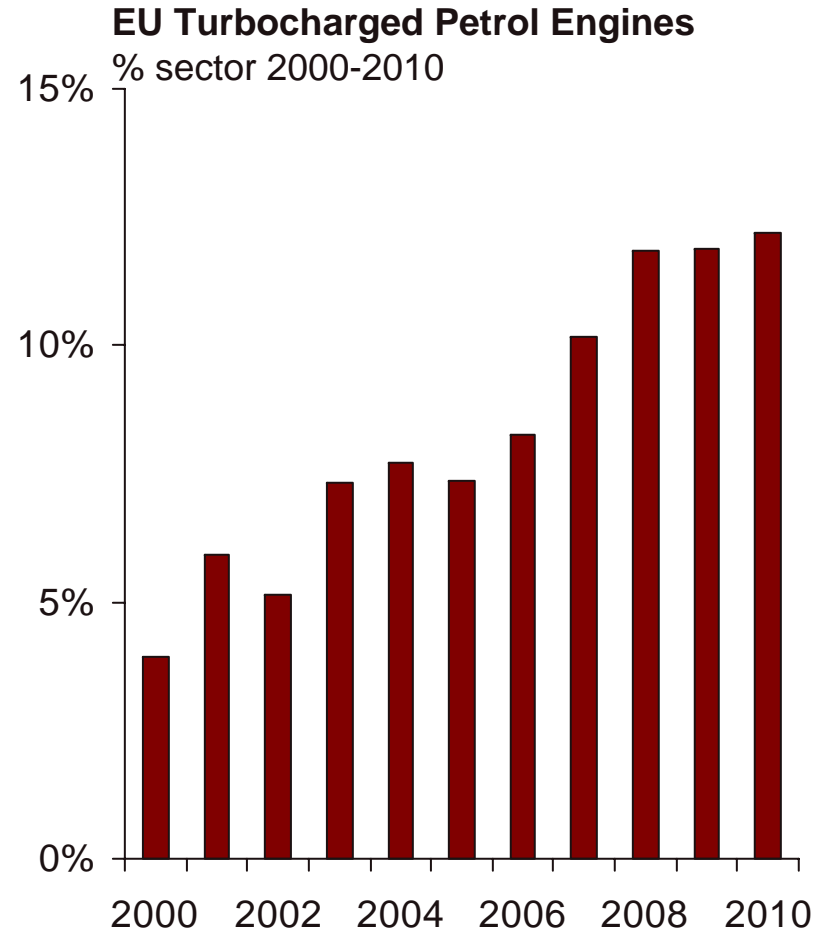
Turbocharger business to be boosted?

Engine downsizing

- Less fuel, less pumping losses
- Forced induction required

Turbocharger suppliers optimistic over market prospects

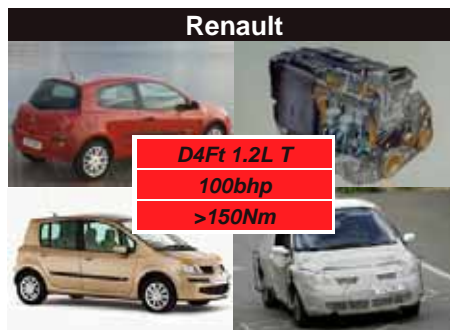
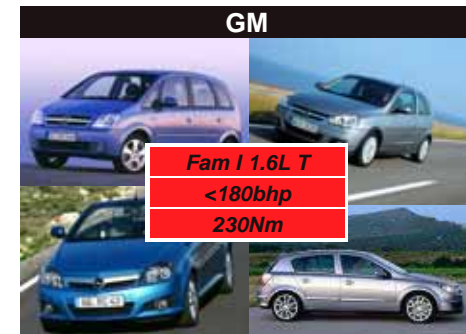
- Honeywell: current levels more than doubled
- BorgWarner: 25% of gas engines by 2010



In light of known programs this seems optimistic and flows through to our prognosis for displacement trends in the market

Downsizing in action

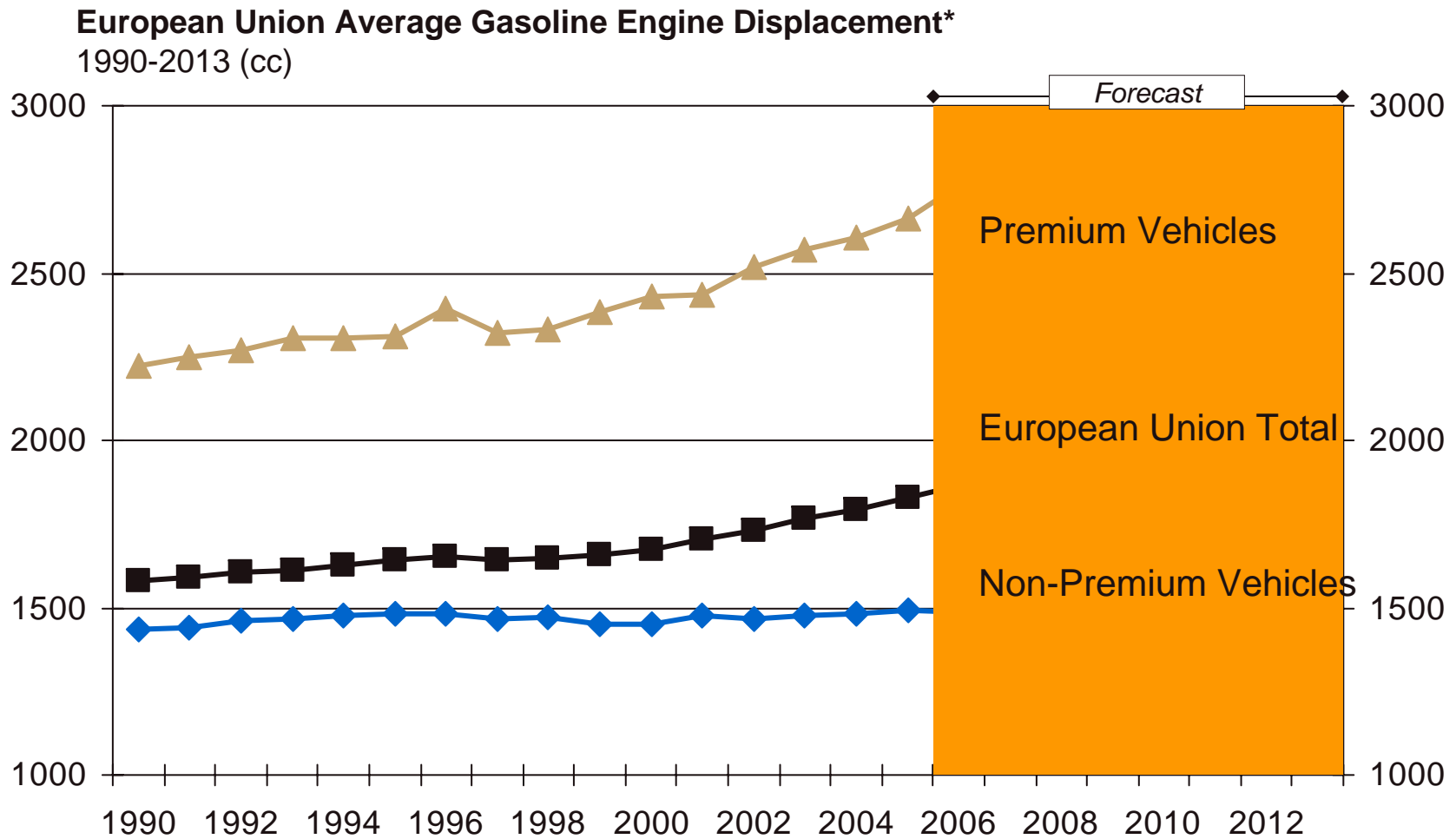
Present and future downsizing programs



Despite the forecast raft of new models, none so far will be real volume sellers within the vehicle ranges. Part of the issue is the number of engine variants on offer in European vehicle ranges, makes it difficult to see the value proposition.

Downsizing in action

The bottom line



*Average displacement weighted to consumption history/forecast

Downsizing in action

The market is skewed against downsizing

Principle problem for the volume manufacturers

- Majority of their petrol output already emitting on or under 140g/km
- Above 1.5L as rule of thumb

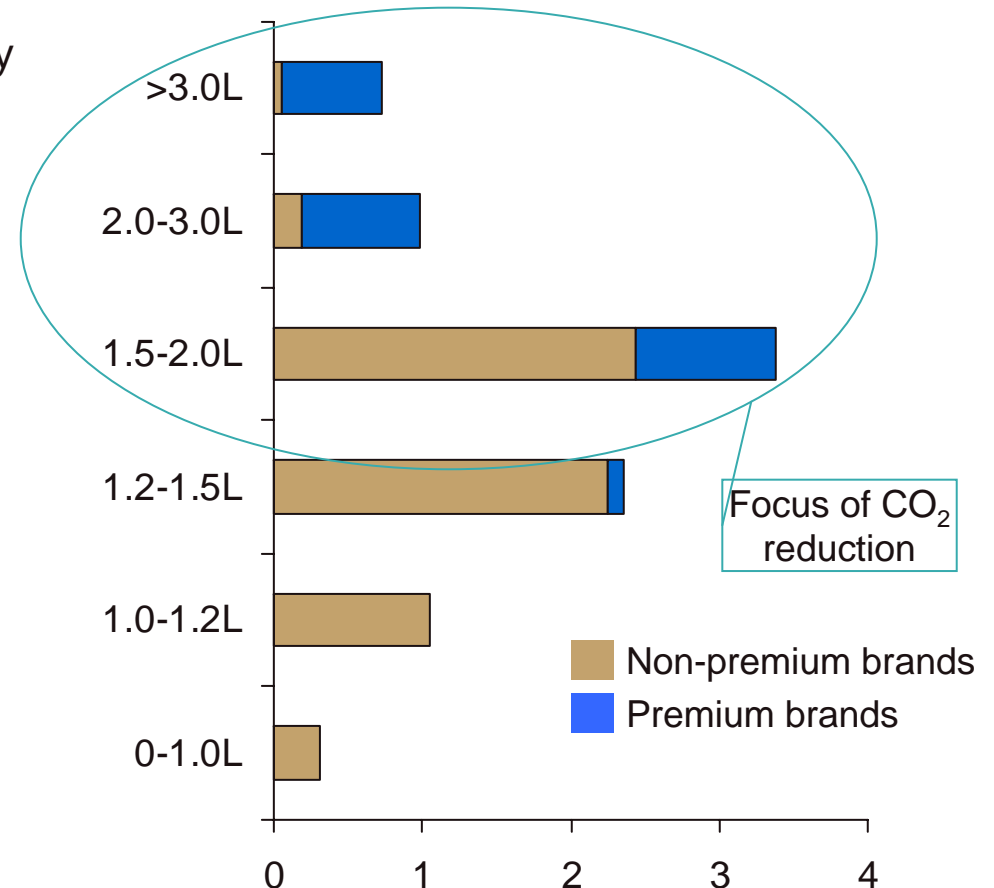
Area of attack is too small to make significant difference

- Displacement trends largely unaffected by downsizing programs in place
- New vehicle fleet emissions will struggle

Issue more vexing for premium brands

- Vast majority of petrol-engined output exceeds 1.5L displacement
- How to entice those customers out of their cars?

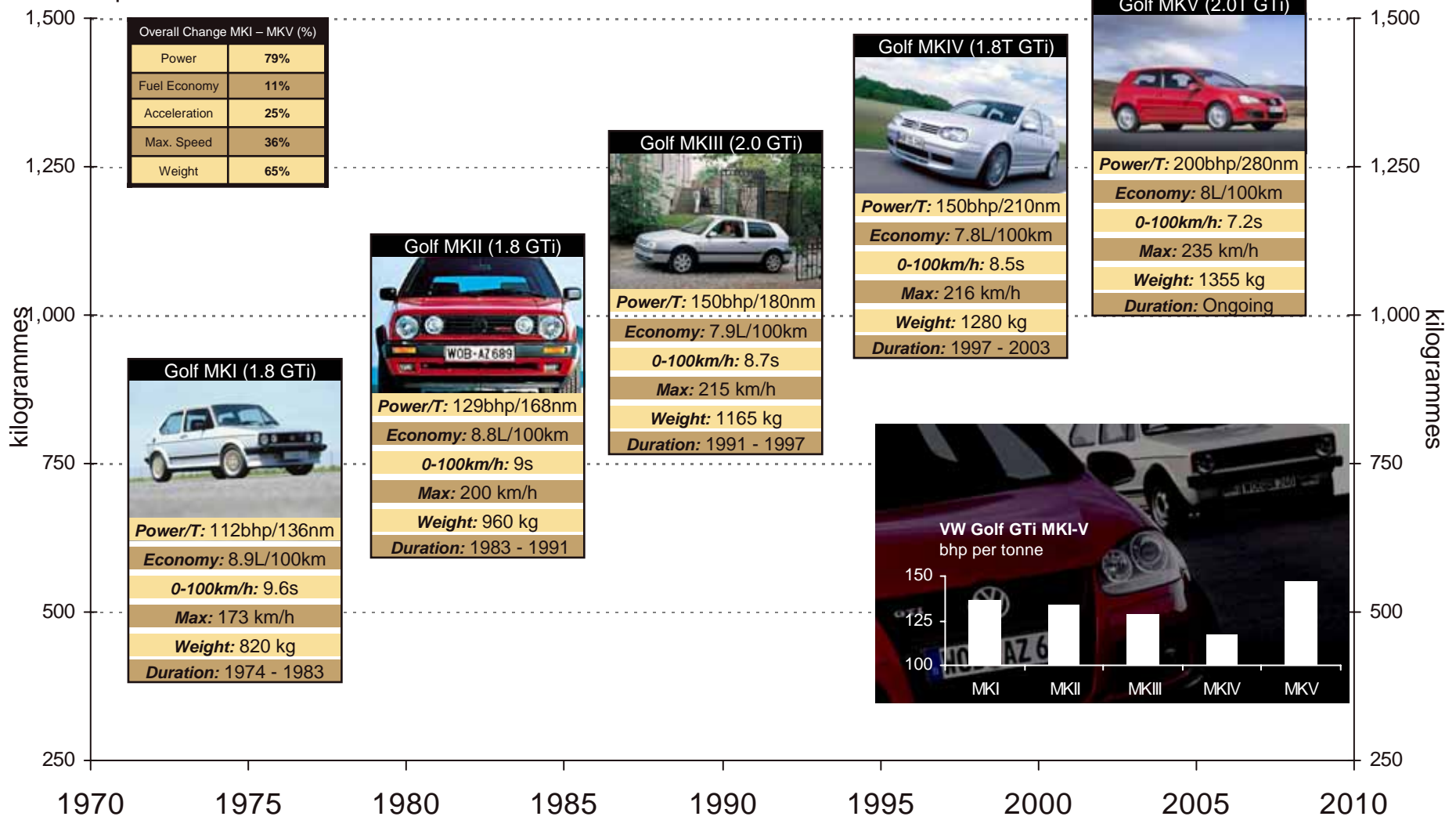
EU Gas Engine Consumption by cc band 2005



Downsizing in action

The Golf GTi runs to keep still

Volkswagen Golf GTi MKI-V Specifications



Overview of market drivers

Summary



OEM desire and risk reduction	ACEA resolve for CO ₂ reduction. Hedge against competitive advantage.
Market trends add pressure	Weight gains: safety; ELV; SUV/MPV growth; equipment
OEM synergies	Scale possibilities. Optimise engine and tune with turbo (cf. M271)



Consumer perception	Counter to culture and wealth effects
Vehicle weight	Negating efficiency gains of smaller engines...
Diesel focus	Development focussed on diesel; now part of the consumer mindset.
Costs	Forced induction high-cost options or marketed as high-end options.
No "quantum leap"	170bhp TSI demonstrates possibilities, but no option in volume heartland

Conclusion and recommendation

Conclusion

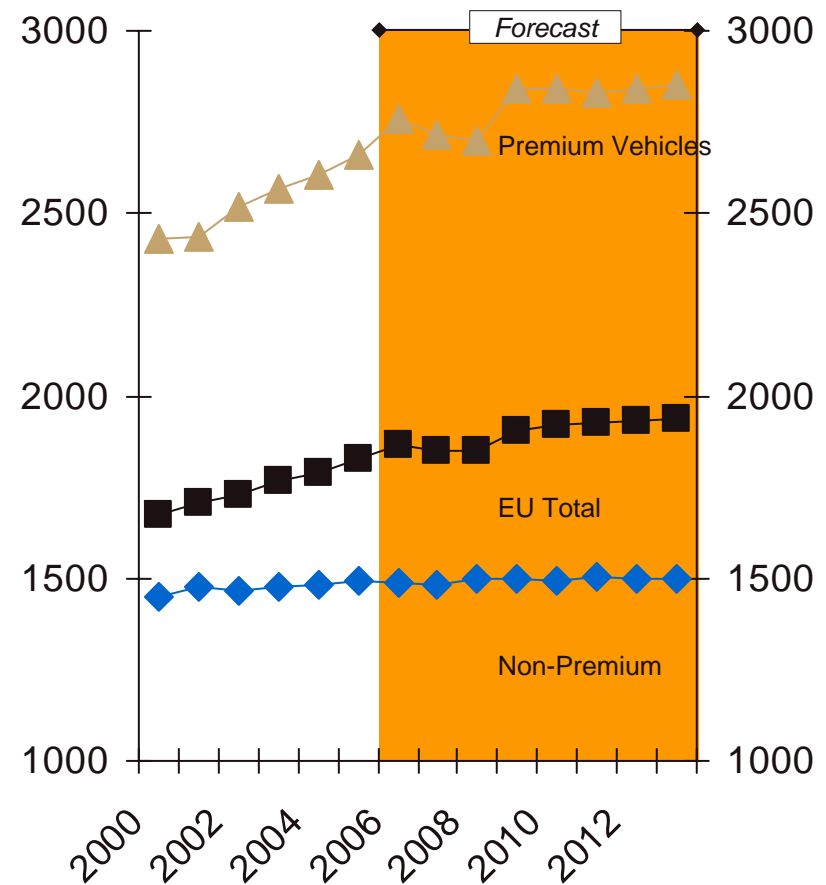
Ceteris paribus it is difficult to see much change beyond the base forecast

- CO₂ commitment is **voluntary** so not mandated

Demand for downsizing dependent on:

- Attractiveness versus substitute goods
 - **Efficiency**
 - **Performance and appeal**
 - **Costs**
- Beneficial legislation:
 - **Fiscal**
 - **Emissions**

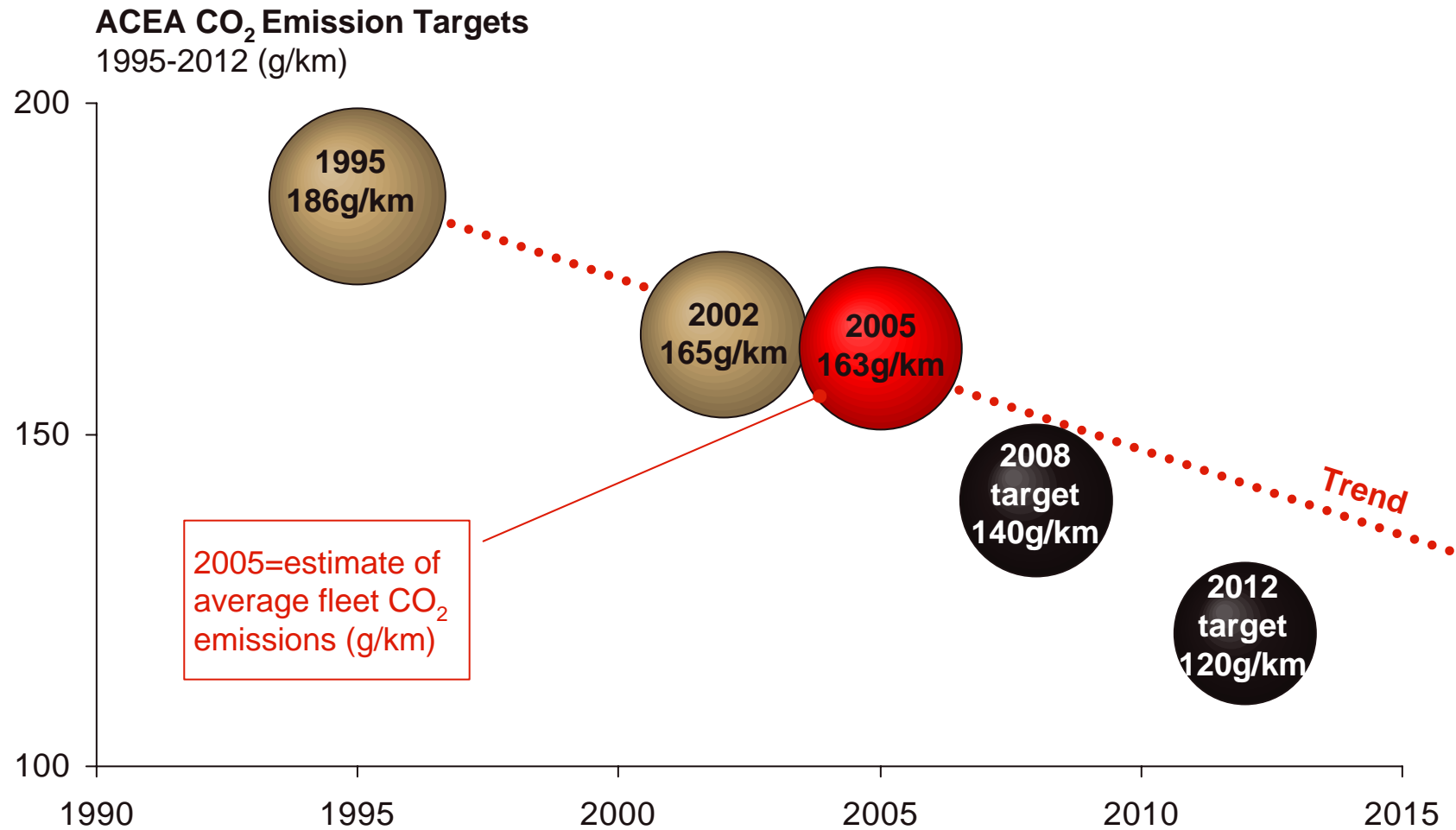
EU Average Gasoline Engine Displacement*
2000-2013 (cc)



*Average displacement weighted to consumption history/forecast

Conclusion and recommendations

The conclusion that really matters...



Conclusion and recommendations

Recommendations

Stop making it a one-way street on CO₂

- Holistic planning required
- CO₂ reduction tacked onto the bottom of a laundry list

Fiscal harmonisation

- cm³ taxes, minus impunities
- Incentivize consumers

Supply-side changes

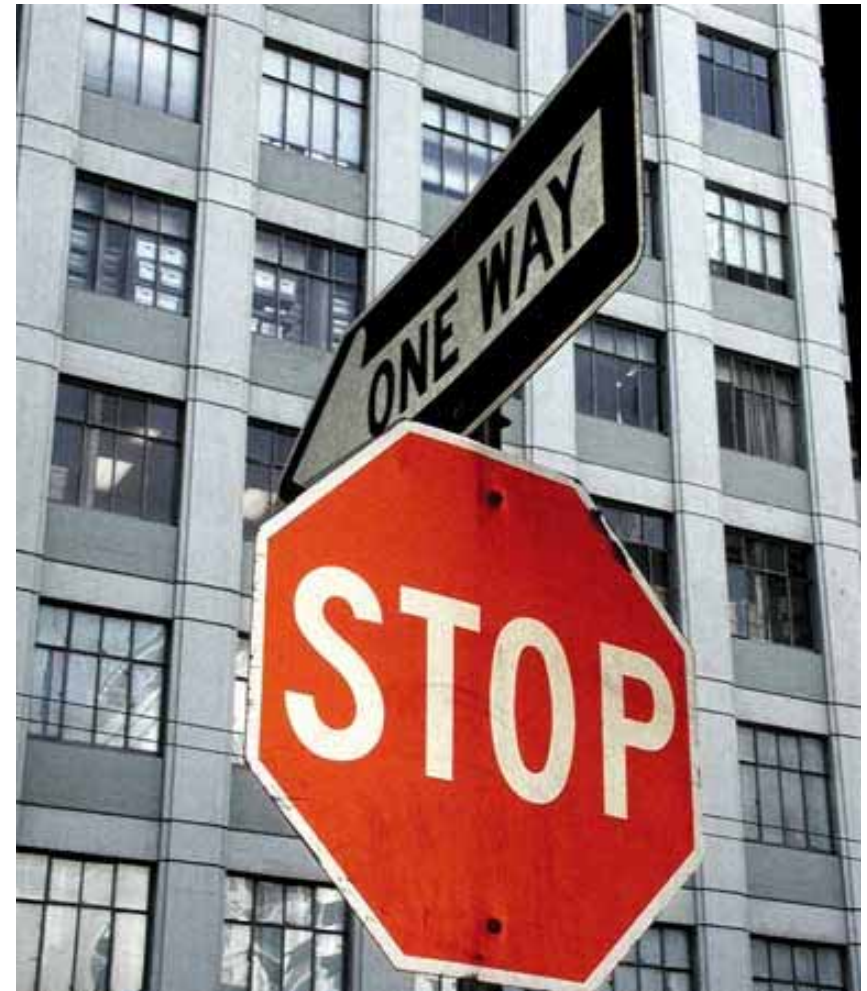
- Fix segmentations; offer fiscal incentives to vehicles fitting bounds that aid CO₂ reduction
- Similar to Kei-car segment in Japan

Change emphasis of vehicle safety

- Move towards active safety

Educate consumers

- Consequence of their actions



Without supply-side mandates, or demand-side incentives, the market currently lacks the impetus to downsize.



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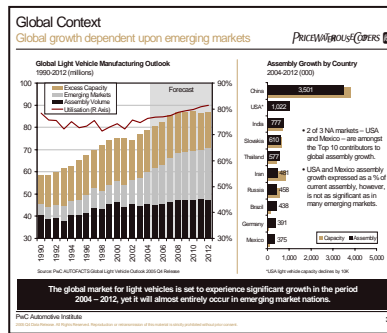


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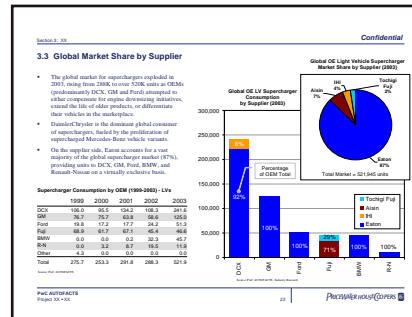


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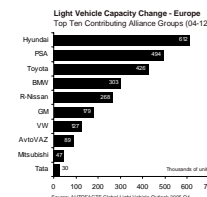
Analyst Note October 28, 2005

European Light Vehicle Capacity
Production Base Shifting East

Long-term growth opportunities and a favourable investment climate characterized by relatively low labour costs, infrastructure improvements and direct incentives among Central and Eastern European countries are reshaping the light vehicle manufacturing landscape within Europe.

Going forward, the top three European countries for automotive investment will be the Czech Republic, Slovakia, and Russia, with a combined increase in light vehicle manufacturing capacity of 1.9 million units.

On the other side of this equation, Spain, Italy, the Netherlands and the United Kingdom each are expected to decline by at least 100,000 units in their respective capacity totals.



- Light vehicle manufacturing capacity across Europe is expected to increase on a net-net basis by 1.3 million units between 2004 and 2012.
- Although individual automaker capacity investments remain large in European Union (EU) countries, notable declines expected for Fiat, DaimlerChrysler and Ford will moderate the EU's contribution to capacity growth across the whole of Europe.
- Top contributors to capacity growth in EE include Renault-Nissan, GM and AvtoVAZ. Hyundai, PSA, and BMW pace capacity growth within the EU.
- Toyota and VW are expected to make significant investments in both regions.
- As local Central European auto markets remain sluggish, growth in the CE light vehicle capacity base will target more mature EU markets.

- Capacity expansions in Central Europe (read: EU accession countries) and Eastern Europe are focused on "greenfield" investments. Meanwhile, Western EU capacity growth largely reflects efforts to better utilize existing facilities.
- The majority of capacity growth within the EU is focused on the CE countries of the Czech Republic (+720k units) and Slovakia (+690k units).
- In total, CE countries add 1.9 million units of capacity while western EU countries combine for a 1.2 million unit decrease in capacity.
- Within EE, Russian capacity is expected to expand by a third, from 1.8 million units in 2004 to over 2.3 million units by 2012 as Renault-Nissan, Toyota and VW (among others) look to establish a domestic foothold in this emerging market.

Chris Benko | Global Director | +1 313 394 8806 | christopher.benko@us.pwc.com | www.pwc.com/auto/institute
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Contact:

Calum MacRae

Manager

+44 (0)1603 883240

calum.j.macrae@uk.pwc.com

www.pwc.com/auto/institute



www.pwc.com/auto/institute

Calum MacRae +44 (0)1603 883240 calum.j.macrae@uk.pwc.com

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