



Widening
Prospects



February 2011

“Powertrain Study: Driven by Change”
Identifying changes to survive in the engine
market

Extract

„Driven by Change“ – Challenges

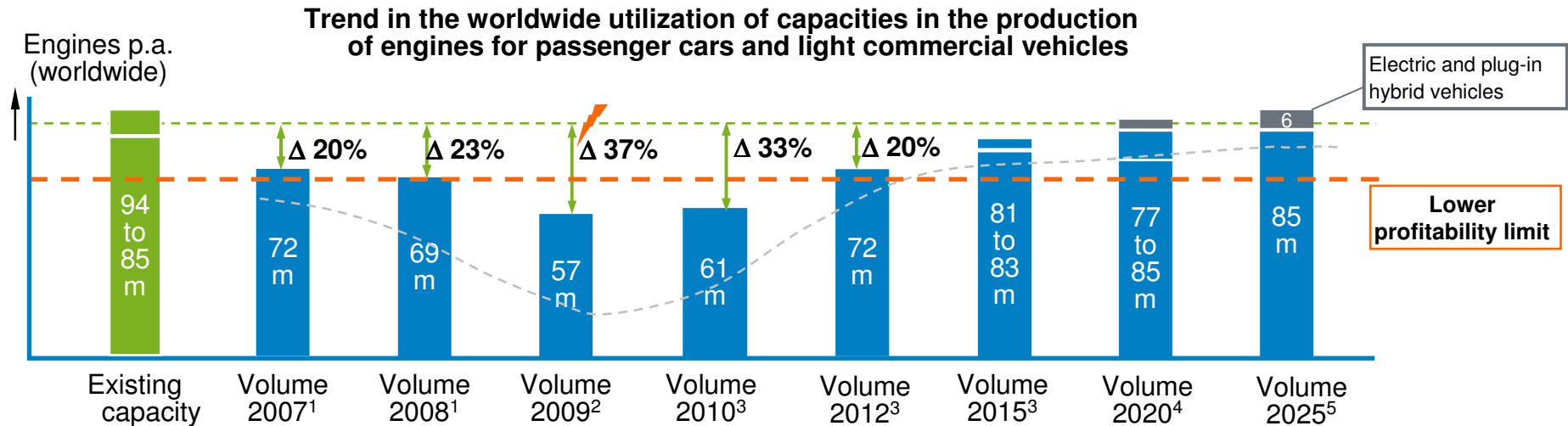
The Study „Driven by Change“ explores the challenges for automobile products triggered by the financial crises and changes within the global markets.



Challenges

- The market slump 2008/09 entailed a capacity utilization of merely 63 % in Europe and the USA.
- In the growth markets, demand for small and economic petrol engines with low consumption, performance and emissions is rising constantly by 25 %.
- In Europe, the diesel engine has high potential for CO₂ reduction. At the same time, its position is threatened by rising costs and further efficiency increases in the Otto technology.
- The diverse requirements in the global markets force both OEMs and their suppliers to rethink their current products.

A recovery in the markets will not be able to reduce the surplus capacities that exist worldwide in the production of internal combustion engines for CVs and LCVs



- Developing and manufacturing ICEs is an OEM core competency accounting for an average share of 22% in value added
- The market for internal combustion engines will only show marginal growth rates from 2015 onward
- Higher levels of electrification from 2020 will put additional pressure on the volumes of ICEs sold
- Greater technological diversification will see OEMs lose shares in the value they add.

¹ Source: VDA 2009

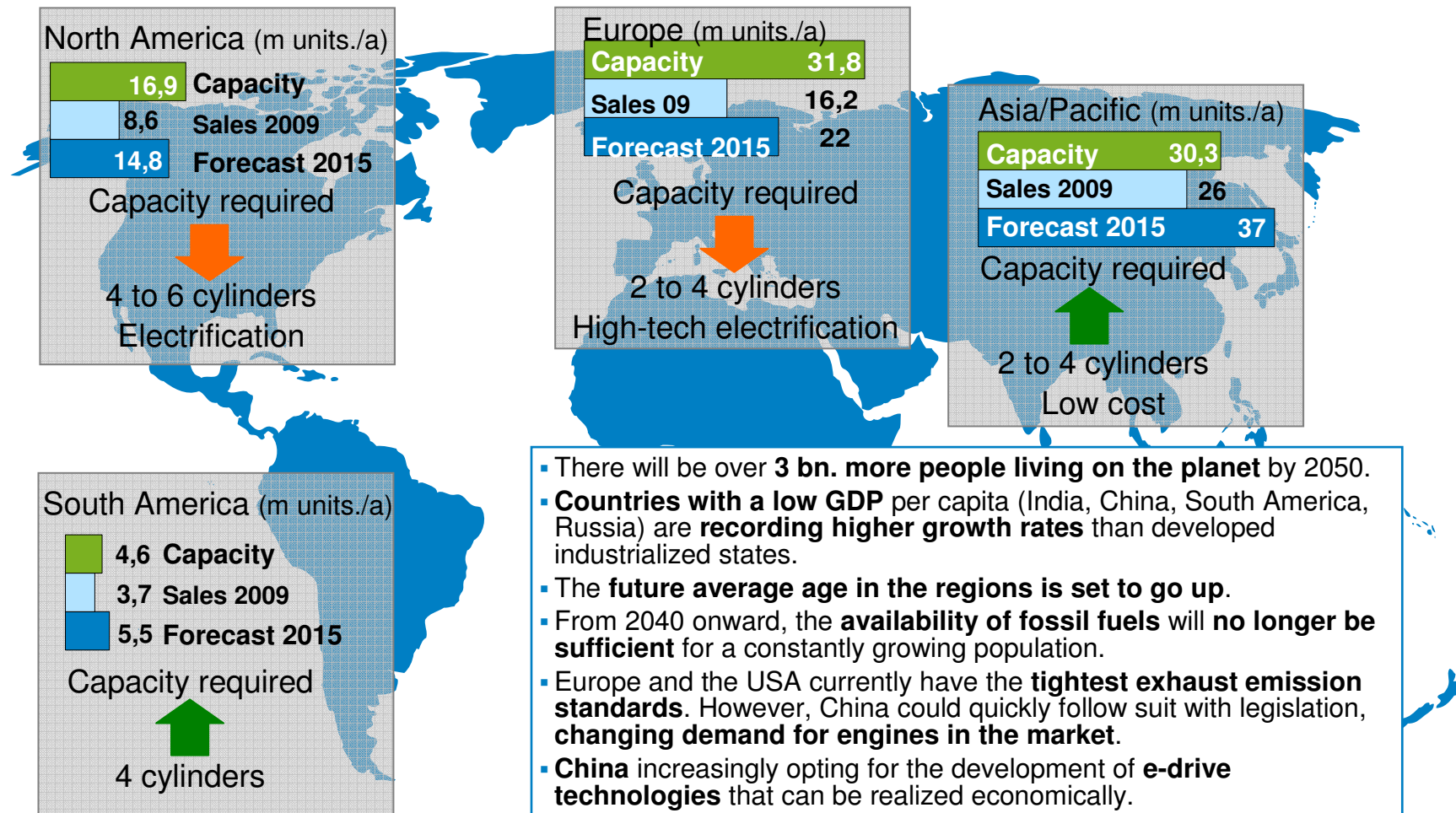
^{2,3} Source: CSM Worldwide

⁴ Source: McKinsey

⁵ Source: Oliver Wayman Electromobility 2025

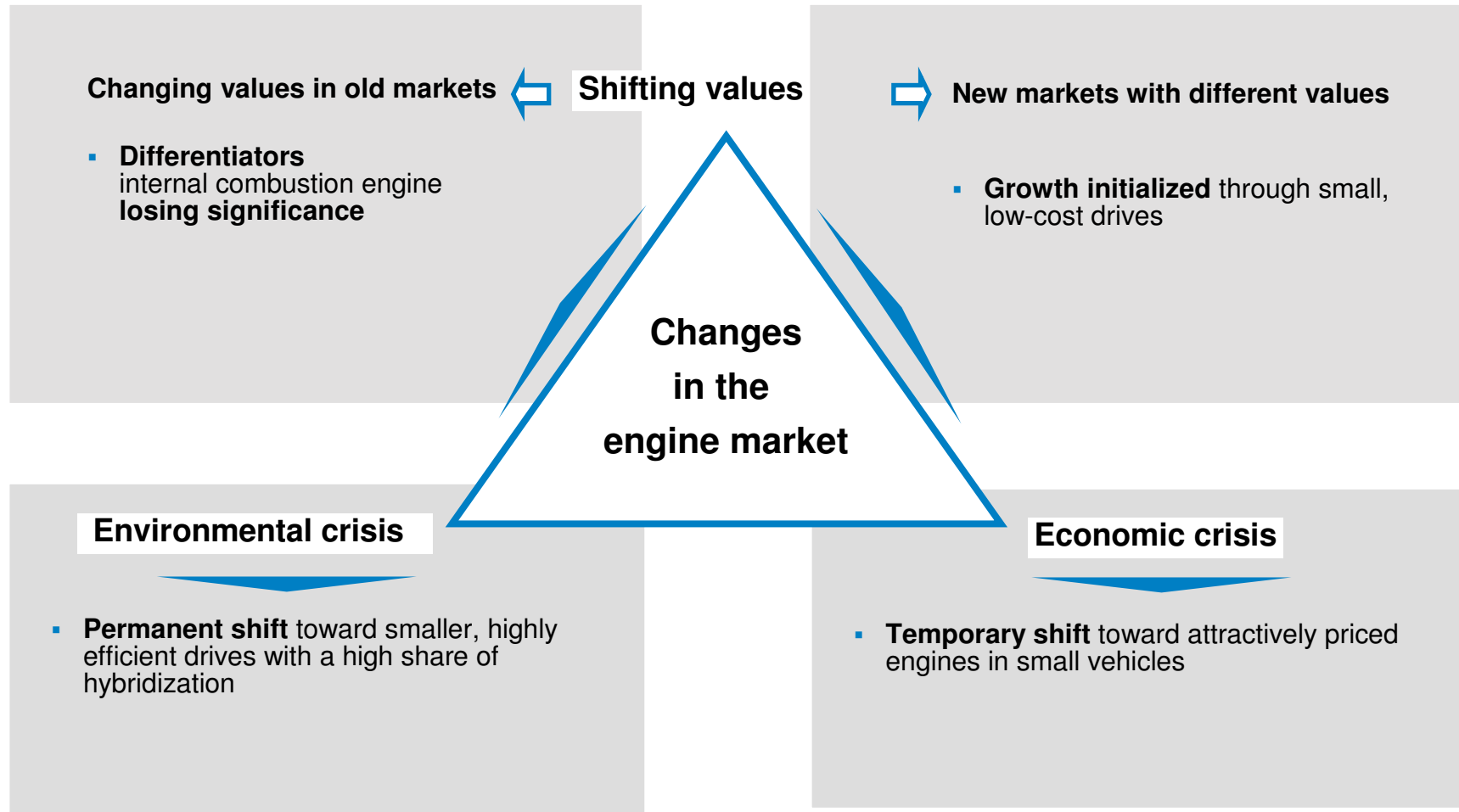
Future Growth Drivers

Social changes are producing a shift in the main sales markets and the technological focus



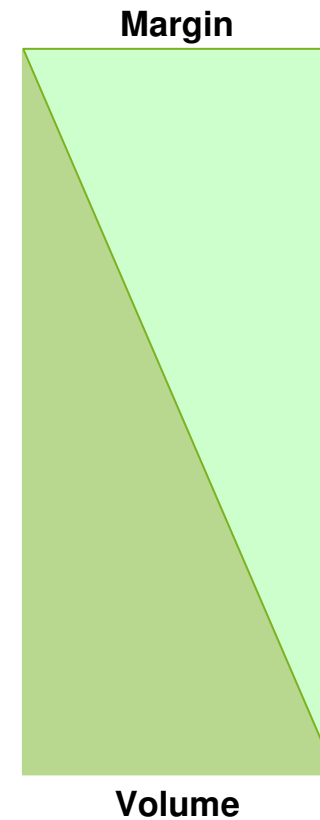
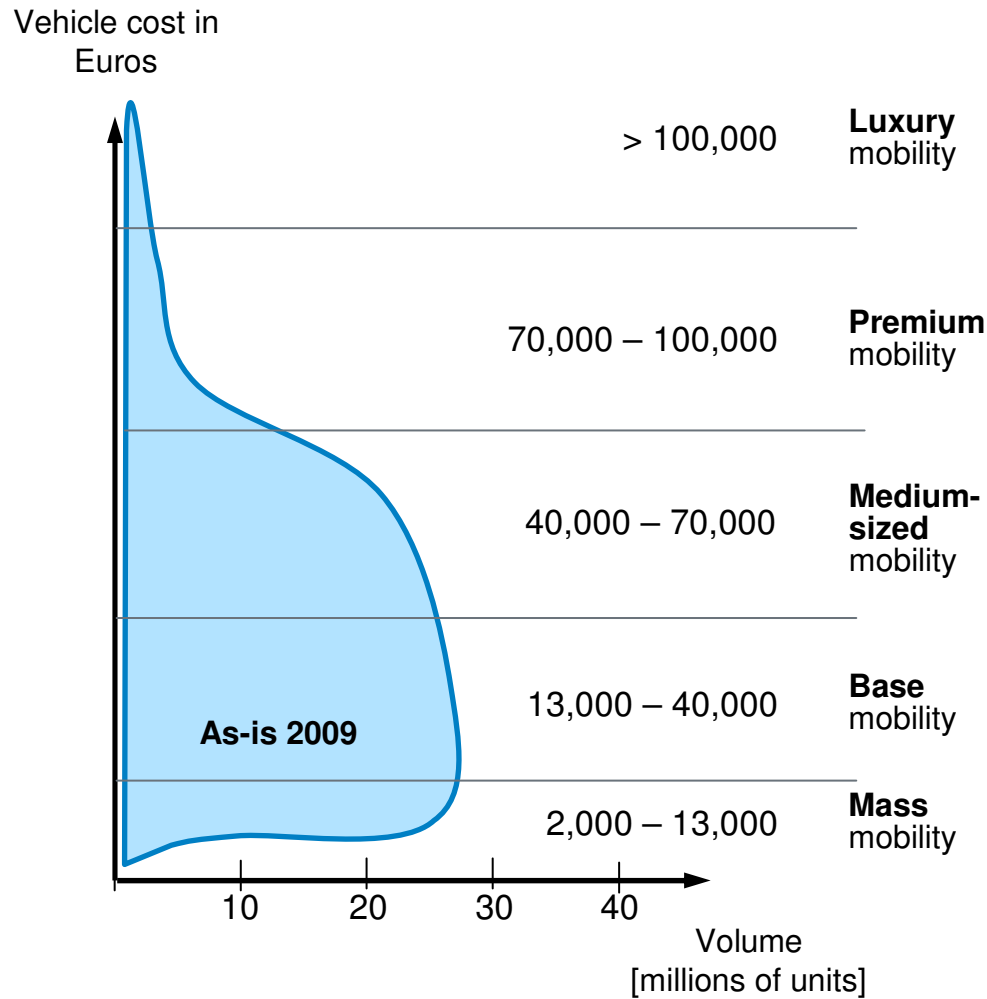
Mega trends are driving change

Shifts in the engine market are due to three main causes, the effect of which must be evaluated on a differentiated basis.



Volume vs. Margin

High production capacity utilization can be seen in the field of mass mobility resulting from high quantities, yet, at the expense of margins and high tech innovations.



Premises within the „Driven by Change“ scenario descriptions

Two scenarios of the development in worldwide engine sales in relation to the critical parameters of worldwide exhaust-emission legislation and fuel costs.

Premises: Scenario1-Max. Volume

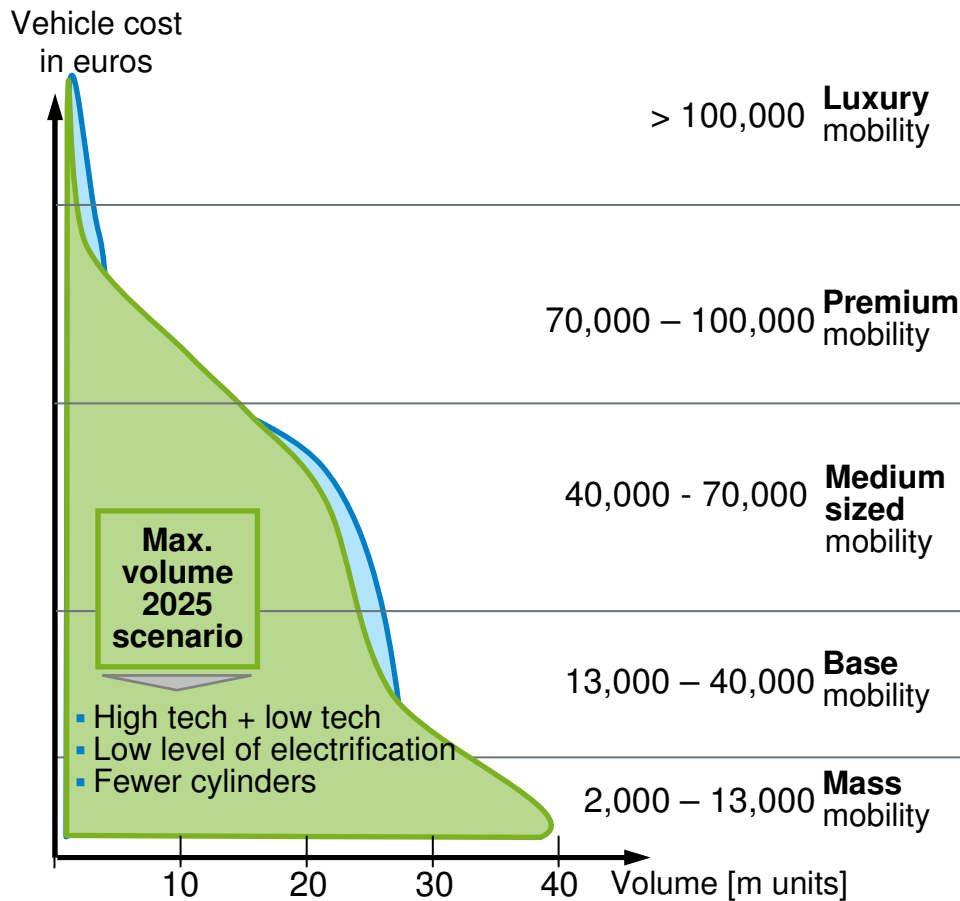
- Until 2025 the stringent regulation of CO2 limit values will be restricted to TRIAD, inc. Western Europe and USA
- Fuel costs will undergo a moderate increase by 2025 in relation to purchasing power in the regions
- Endeavors to activate markets for alternative forms of propulsion in Western countries at a low level
- No major technological leap forward will take place in the mobile storage of electric power.

Premises: Scenario2-Min. Volume

- Stringent regulation of CO2 limit values: TRIAD (emerging countries soon to follow)
- Fuel costs will increase at a disproportionate rate by 2025 as raw-material resources become scarcer and world population rises, substitution with alternative raw materials will not be possible
- Endeavors to activate markets for alternative forms of propulsion in Western countries at a very high level
- A major technological leap forward will take place in the mobile storage of electric power.

The 'max. volume 2025' scenario is considered realistic and will lead to strong growth in the mass-mobility segment

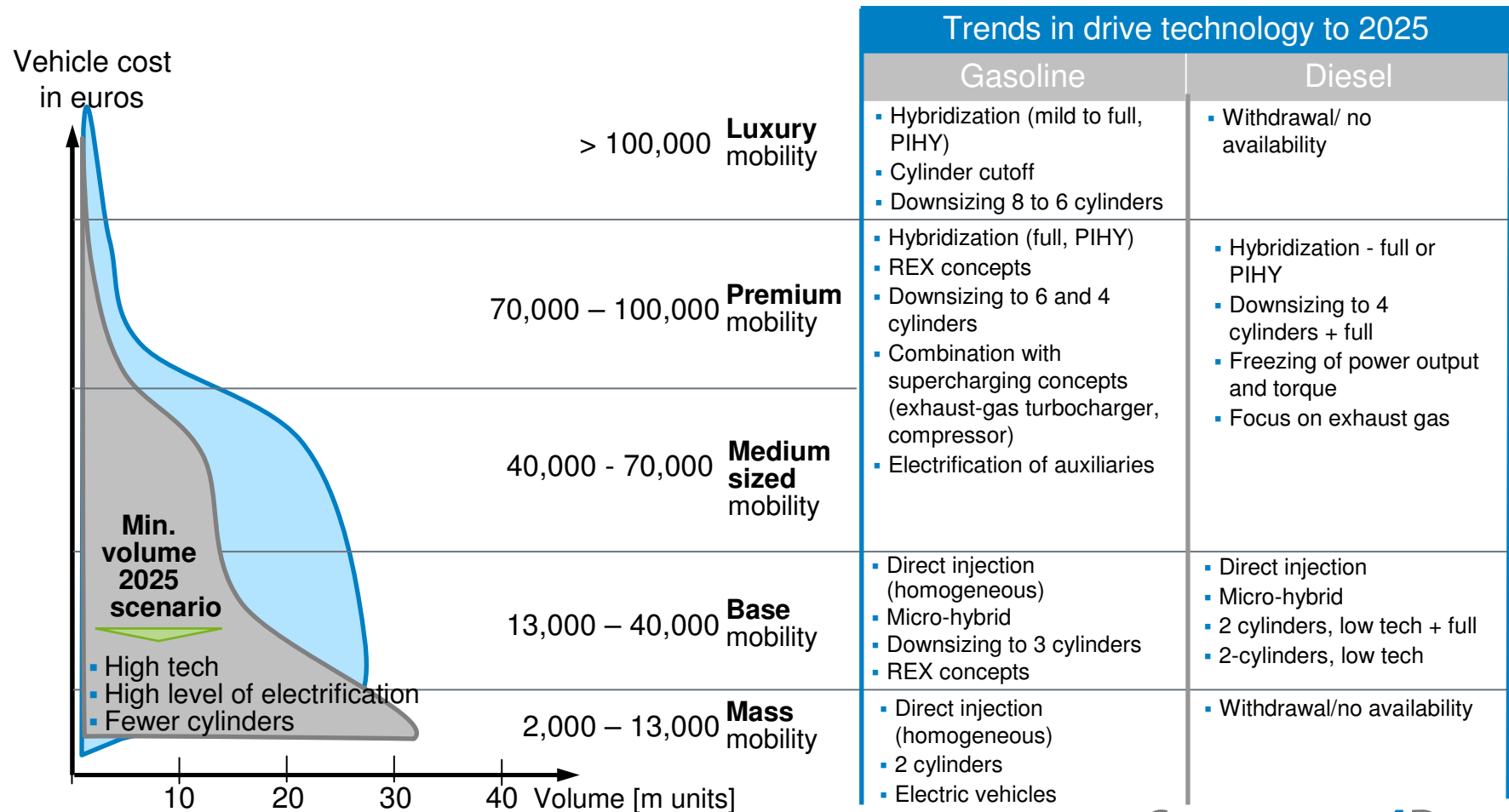
Growth drivers in this scenario are the emerging markets; vehicles can be produced for well under € 6,000 as a result of lower demands on consumption and exhaust emissions coupled with less powerful engines.



Trends in drive technology to 2025	
Gasoline	Diesel
<ul style="list-style-type: none"> Hybridization (mild to full, PIHY) Cylinder cutoff Downsizing 8 to 6 cylinders 	<ul style="list-style-type: none"> Not available
<ul style="list-style-type: none"> Hybridization (micro to full, PIHY) Downsizing to 6 and 4 cylinders Combination with supercharging concepts (exhaust-gas turbocharger, compressor) Electrification of auxiliaries 	<ul style="list-style-type: none"> Hybridization - full or PIHY Downsizing to 4 cylinders Freezing of power output and torque
<ul style="list-style-type: none"> Direct and manifold injection Micro hybrid + electric 3 to 4 cylinders 	<ul style="list-style-type: none"> Direct injection Micro-hybrid 4 cylinders 2 cylinders, low tech + full
<ul style="list-style-type: none"> Manifold injection Direct injection 2 cylinders Electric 	<ul style="list-style-type: none"> 2 cylinders, low-tech diesel

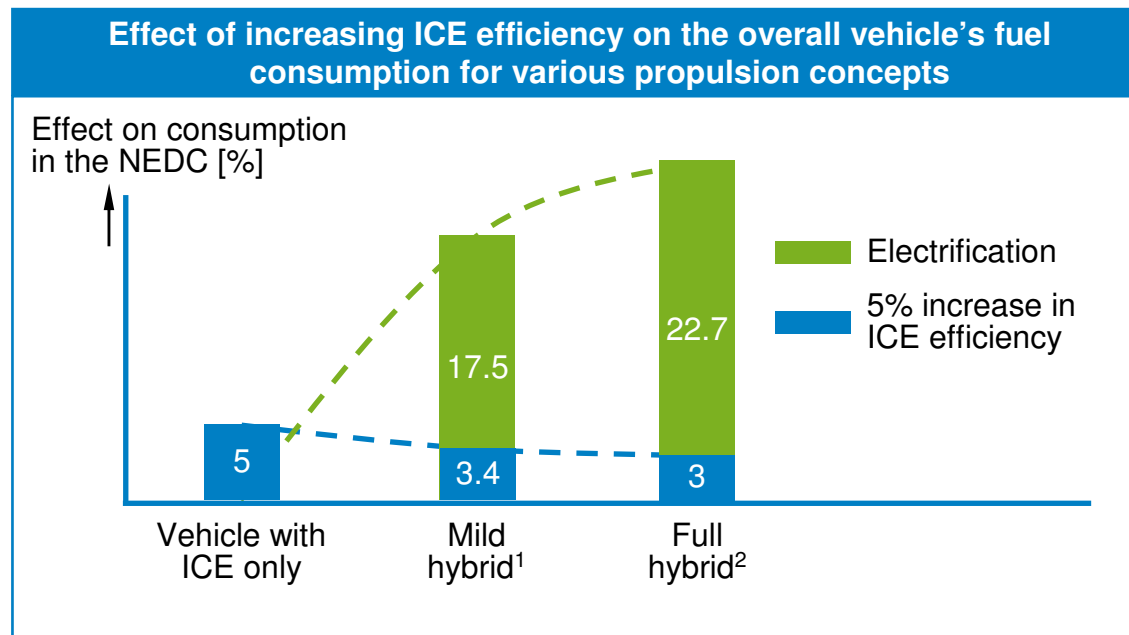
The 'min. volume 2025' scenario significantly limits the cost-reducing potential and intensifies growth in the mass-mobility segment

Sales drivers are small vehicles with a significantly lower power output to achieve CO₂ consumption goals.



Significance of the “ICE optimization” lever decreases in the overall vehicle as powertrain electrification increases

The trend toward electrifying drives opens up the opportunity to “downgrade” the internal combustion engine with little effect on the vehicle’s overall efficiency.



Opportunity to downgrade combustion engines

- Electrification allows for ICE „downgrading“
- The degree of electrification reduces ICEs to their basic technologies
- A simple e-drive integration comes to the fore
- In growth markets, costs are the dominant selling proposition

- Simple ICEs and the OEM’s brand value open up new sales models in growth markets

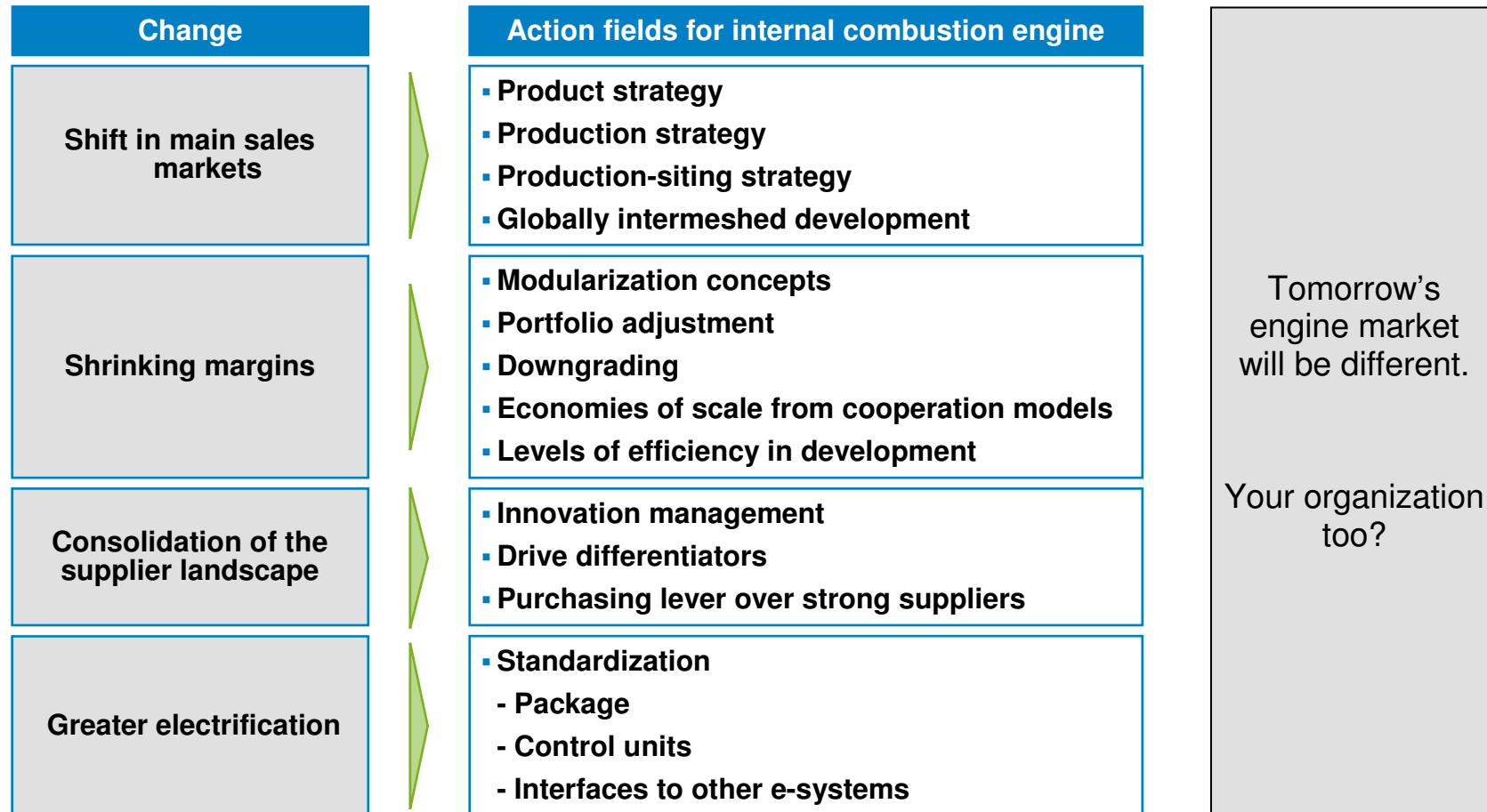
¹ Basis: BMW 7 Active Hybrid

² Basis: BMW X6 Active Hybrid

Lasting changes on the engine market demand sustained action

→ turning risks into opportunities

Looking at the changes ahead, it is necessary to scrutinize established ways of thinking as well as place product and organization on a future-proof footing



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