The Global Oil Paradox

Transforming the Automotive Industry: Strategic Assessment of the Global Alternative Powertrain Market

October 2008
Who we are...

- A global growth consulting company that partners with clients to support the development of innovative growth strategies.
- For more than 45 years, we have leveraged our comprehensive market expertise to serve an extensive clientele that includes Global 1000 companies, emerging companies, and the investment community.
- We offer industry research and market strategies, provide growth consulting and corporate training, and support clients to help grow their businesses.
Top 10 Global Automotive Issues

- Fluctuation in oil prices
- Global meltdown and financial crisis
- Legislation on emission reduction
- Shift in vehicle segment
- Shift in vehicle production
- In-Car Green Technologies
- Alternate Propulsion Systems
- Low Cost Vehicle Technologies
- Green Telematics
- Congestion Charging and CO2 based taxation

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By 2015, the Oil produced in US and China will decline and the demand vs supply gap will widen.

Growing demand for Oil is expected to be compensated by supply from OPEC region.

OPEC: Organization of Petroleum Exporting Countries: Algeria, Angola, Ecuador, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, Venezuela

Source: EIA and Frost & Sullivan

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Peak Oil Scenario Imminent: 4% supply shortage may lead to 177% increase in crude oil price

U.S oil production peak: Combated by importing oil from other nations

Global production peak: Expected between 2010 – 2016

Most regions of the world are either at or past the mid-point of depletion: MidEast (and FSU and Africa) have produced <50% of their known resource

IMPLICATIONS:

Oil Demand

The construction of an average car consumes the energy equivalent of approximately 20 barrels (840 gallons) of oil. Ultimately, the construction of a car will consume an amount of fossil fuels equivalent to twice the car’s final weight.

Automobiles

Transportation

Every one dollar increase in fuel costs leads directly to 1% increase in transport costs
Increased oil prices to bring a paradigm shift in consumer acceptance of small cars

- Hybrid, Fuel Cell Vehicles productions will increase
- Decrease in Vehicle Sales
- Shift from Private to Public Modes of Transport
- VMs to offer more fuel efficient vehicles with the trend towards Smaller vehicles

- Biodiesel made from Corn would serve as an alternative to crude oil
- Hybrid and Fuel Cell vehicles would compete with Petrol and Diesel engine vehicles.
- End users to prefer car pooling and car sharing to reduce their economic burden.

- Demand vs Supply gap of oil to widen; increase the competitiveness of alternative fuels
- Natural Gas vehicles to become a feasible alternative
- Downsizing, turbo charging and direct fuel injection likely to be preferred over alternative propulsion vehicles
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Strategic Conclusions & Recommendations and Discussions

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Global Powertrain mix – Diesel and Hybrids likely to witness highest growth

Micro Hybridisation on a large scale to continue; Plug-in hybrids to account for a small share.
EVs infrastructure – public paid recharging stations to cater to both EVs and plug-in Hybrids.
Downsizing and Turbocharging – Drive towards compliance with ACEA CO2 norms; Solid SCR systems - EURO 6 application in passenger vehicles likely.

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- Strategic Conclusions & Recommendations and Discussions
Regional Snapshot of the LPG/CNG Vehicle Sales in 2006 (OE and AM)

- **Rest of the World**
  - LPG: ~ 290,000 kits
  - CNG: ~ 75,000 kits

- **EU**
  - LPG: ~ 645,000 kits
  - CNG: ~ 95,000 kits

- **Russia**
  - LPG: ~ 345,000 kits
  - CNG: ~ 5,000 kits

- **Latin America**
  - LPG: 0 kits
  - CNG: ~ 450,000 kits

- **Australia**
  - LPG: ~ 75,000 kits
  - CNG: 0 kits

- **Asia**
  - LPG: ~ 1,100 kits
  - CNG: ~ 25,000 kits

- **South East Asia**
  - LPG: ~ 300,000 kits
  - CNG: ~ 435,000 kits

- **Iran**
  - LPG: 0 kits
  - CNG: ~ 150,000 kits

- **Turkey**
  - LPG: ~ 265,000 kits
  - CNG: 0 kits

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Hybrid vehicles are increasing their share globally

- **Optimistic Scenario**: Volume OEMs such as PSA Group, Renault, GM, Ford, VW standardise Micro Hybrids across the segment line up of basic, small, low medium and upper medium segments along with Premium OEMs (BMW, Daimler Benz, Audi) for micro hybrids. European OEMs introducing mild and full hybrid vehicles.
- **F&S Scenario**: Premium OEMs standardise across their entire line-up while volume OEMs such as VW, Ford, GM introduce hybrids across selected models for micro hybrids. Honda Insight being introduced with Toyota introducing new model line up for full hybrid vehicles.
- **Conservative Scenario**: Premium and Volume OEMs to introduce micro hybrids across selected model line-ups and vehicle segments.

- North America, Japan and Europe likely to be the major adopters of hybrid technology in the coming years.
- Micro Hybrids dominant in Europe mainly driven by OEMs such as BMW, PSA Group, Daimler Benz, Renault.
- Japan and NA are likely to have higher volumes of full hybrid vehicles with estimated volumes of 400,000 and 850,000 respectively.
- Toyota is likely to drive full hybrid vehicle technology while Honda to continue its dominance in mild hybrid vehicle technology.
Scenario Analysis for Micro-Hybrid Vehicles / Stop-Start Systems – Premium OEMs likely to follow BMW; standardise Micro Hybrids for volume segments

Hybrid Volumes by key OEMs in 2012 after Microhybridisation

<table>
<thead>
<tr>
<th>OEM</th>
<th>Conservative Scenario</th>
<th>Frost &amp; Sullivan Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW</td>
<td>760,000-780,000</td>
<td>760,000-780,000</td>
</tr>
<tr>
<td>Daimler</td>
<td>720,000-740,000</td>
<td>720,000-740,000</td>
</tr>
<tr>
<td>Audi</td>
<td>500,000-520,000</td>
<td>500,000-520,000</td>
</tr>
<tr>
<td>Ford</td>
<td>280,000-290,000</td>
<td>580,000-590,000</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>270,000-300,000</td>
<td>850,000-860,000</td>
</tr>
<tr>
<td>French OEMs</td>
<td>200,000-250,000</td>
<td>2,000,000-2,300,000</td>
</tr>
<tr>
<td>Other OEMs</td>
<td>150,000-180,000</td>
<td>500,000-750,000</td>
</tr>
</tbody>
</table>

Comparison of different scenarios for Micro Hybrid Vehicles in Europe

- **Conservative Scenario**
  - Premium OEMs such as DC, Audi following BMW path and standardising small, medium and compact segment vehicles

- **Frost & Sullivan Scenario**
  - Volume OEMs to leverage Hybrids technology showcased in Premium OEMs and introduce in volume segments

- **Penetration rate ~ 30%**
- **Penetration rate ~ 11%**

Micro Hybridisation on a large scale likely to help OEMs comply with the ACEA Agreement target for 2012

Premium OEMs in a much better position to absorb Micro Hybridisation costs in comparison to volume OEMs; initial introduction of Micro Hybrids by PSA group wasn’t a great success
Frost & Sullivan expects the total market for electric vehicles to be more than 250,000 units by 2015 in Europe.

- The market currently occupied by small OEMs is likely to be 76% occupied by the big OEMs by 2015 in Europe.
- Renault-Nissan is expected to be the first big market entrant with likely volumes of 25,000 units in 2011 in Denmark.
- UK, Scandinavia, France, Italy and Spain are likely to constitute 93% of the sales in Europe.

Key Facts about Electric Vehicles

- **Technology**: Advanced lead acid, NiMH, Na-Ni-Cl, Lithium Ion
- **Advantages**: NO NOx, PM and CO2; high efficiency, low running-maintenance cost, energy security
- **OEMs**: Renault Nissan, Mitsubishi, Daimler, Think, REVA
- **Battery Suppliers**: NEC, A123Systems, Johnson-Saft, Continental, GS Yuasa, Matsushita
- **Timeframe**: Serial introduction by top OEMs beyond 2011. New business model-leasing

- EVs could offer a monthly saving potential of around €150-700 to the drivers. Cost of Powertrain development 280% more.
- OEMs and related companies to opt different financial models to tackle the cost issue- Leasing, the most popular model to account for 75% of sales by 2015 in Europe.
- The OEMs are to price the EVs between €18-25,000 under the leasing model.
**Electric Corner Module - Suppliers to drive the ECM market rather than OEMs**

- **Japan to be at the forefront in adopting ECM technology followed by NA and Europe**
- **By Wire Technologies required for implementation of ECM on all 4 wheels**
- **Design flexibility, weight reduction, fuel savings are some of the main drivers for ECM implementation**
- **Key OEMs – Toyota, Honda, General Motors and Mitsubishi**

<table>
<thead>
<tr>
<th>OEM</th>
<th>ECM Components</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honda</td>
<td>Wheel, Brake, Steering, Suspension</td>
<td>Honda’s ECM system has components such as motor, braking, steering as part of ECM system. Motor is sprung using a bar.</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>Wheel, Brake, Steering, Suspension</td>
<td>Mitsubishi system has components such as motor, braking as part of ECM system. Motor is sprung due to easier integration.</td>
</tr>
<tr>
<td>Bridgestone</td>
<td>Wheel, Brake, Steering, Suspension</td>
<td>Bridgestone concept has motor, steering, braking, suspension as part of ECM system. However the motor is sprung to avoid the extra weight of unsprung mass.</td>
</tr>
<tr>
<td>Michelin</td>
<td>Wheel, Brake, Steering, Suspension</td>
<td>Michelin concept in-wheel motor has motor unsprung with other components such as steering, suspension, braking. However, this concept has a disadvantage in terms of unsprung mass.</td>
</tr>
</tbody>
</table>

An ECM could be any combination of:
- Tire
- Wheel
- Brake
- Steering
- Suspension
- Electric Motor
- Cooling System

**Market Forecast**

- **~1,640K Units**
- **~380K Units**

<table>
<thead>
<tr>
<th>Region</th>
<th>Units 2015</th>
<th>Units 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>540,000</td>
<td>600,000</td>
</tr>
<tr>
<td>NA</td>
<td>160,000</td>
<td>490,000</td>
</tr>
<tr>
<td>Europe</td>
<td>80,000</td>
<td>2020</td>
</tr>
</tbody>
</table>

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Fuel cells and battery propulsion impact long term; source of electricity is to play a major role in the future

- Micro hybrids offer 3-4% CO2 reductions, mild hybrid upto 12% and full hybrids upto 20%.
- Plug in hybrids could offer as much as 65% CO2 reductions depending on the customer driving characteristics, is seen as a mid-term solution.
- The future of bio fuels pose a challenge with its own share of controversies regarding harvesting of crops.
- Fuel cells and pure electric propulsion technologies impact long term, both being zero emission technologies. However the source of electricity is to play a major role in the future.


- Battery Electric Vehicles
- Fuel Cell Electric Vehicles
- Plug in Hybrids
- Full, Mild and Micro Hybrids
- IC Engine and transmission improvements

<table>
<thead>
<tr>
<th>Year</th>
<th>Japan</th>
<th>Europe</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>33,000</td>
<td>32,000</td>
<td>300</td>
</tr>
<tr>
<td>2020</td>
<td>55,500</td>
<td></td>
<td>550</td>
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Strategic Conclusions & Recommendations and Discussions
Biofuel production around the World – significant growth in Eastern countries

Biofuels penetration is heavily driven by local governmental regulations and biggest differentiating factor is the source of Biofuels which varies from vegetables to fish. Clear leaders include Brazil, Thailand and India whereas Australia appears to lag behind.

*All values in Mtoe – Million tonnes of oil equivalent*
Second and Third Generation Biofuels – Processing inefficiency hindering prospects

✓ **Shelf life of Algae to determine the success of 3rd Generation Biofuel – Algae-fuel; regional climatic conditions and resources influence production / cultivation of Algae**

✓ **Sustainability of 2nd and 3rd Generation Biofuel sources and the breakeven in price achieved expected to determine success factor – large scale farming and govt. subsidies**

✓ **2nd Generation processes still inefficient; costs involved high – not likely to change for the next 10-12 years; economical feasibility only beyond 2020**

### 2nd Generation Biofuels

- **Biohydrogen** – Hydrogen produced from Biomass feedstock can be used in Fuel Cells.
- **Bio-DME** – Uses Syngas for production, can be produced from Biomethanol. Bio-DME can be used CI engines.
- **HTU Diesel** – High temperature upgrading Diesel can be mixed with fossil Diesel in any percentage.
- **Fischer-Tropsch Diesel** – uses F-T GTL technology; can be mixed with fossil Diesel in any percentage.
- **Wood Diesel** – uses wood chips; charcoal byproduct is reintroduced back into the soil as a fertiliser. Dubbed ‘carbon negative’ as it is added back to the soil.

### 3rd Generation Biofuels

- **Algae fuel** – High yield-high cost feedstocks in comparison to 2nd Generation Biofuels; no impact on freshwater resources; costs about $10 / kg – active research to reduce operating costs;

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*Breakeven Crude Price for Biofuels from different sources – a comparison*

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Breakeven Price [Billion Barrels]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol - Sugarcane [Brazil]</td>
<td>$26</td>
</tr>
<tr>
<td>Ethanol - Corn [USA]</td>
<td>$120</td>
</tr>
<tr>
<td>Biodiesel - Rapeseed [Europe]</td>
<td>$173</td>
</tr>
</tbody>
</table>

**Oil Price forecast towards 2030**

- **Conversion**
  - $30
- **Feedstock**
  - $4

**Breakeven Oil Price [Dollars / Billion Barrels]**

- **Ethanol - Sugarcane [Brazil]** $26
- **Ethanol - Corn [USA]** $91
- **Biodiesel - Rapeseed [Europe]** $147

Source: Booz & Company
Cost Benefit Analysis – uncertain future for Biofuels owing to high costs?

✓ The cost disadvantage of producing Biofuels is significantly higher than the benefits achieved with the use of them – Scenario not likely to change till 2015 even with the use of Second Generation Biofuels.

✓ Warranty issues - OEMs cannot guarantee that nothing happens in the event of using high Biofuels content owing to absence of certification and standardised vehicle testing guidelines

"We should put Biofuels on the well-to-wheel balance and see if they actually help in offsetting CO2 emissions and Biofuel compatible vehicles should get an extra discount of about 20%.”
Leading European OEM 1

“We the day the price of crude oil become more expensive than the barrel equivalent price of Biofuel, we will see a huge increase in the Biofuels output. This is not likely to happen during the next 10 years.”
Leading European Technology & Engineering Solutions provider

### Agenda for today’s presentation

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<th>Description</th>
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<td></td>
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Micro Hybrids, Down Sizing and Turbo Charging are Key Technologies to be Adopted by All Manufacturers for Short Term Emission Reduction

**OEM Fleet Average and Emission Reduction Technologies (Europe), 2008**

<table>
<thead>
<tr>
<th>OEMs</th>
<th>Current Fleet Average (2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW</td>
<td>184 g/km</td>
</tr>
<tr>
<td>Daimler</td>
<td>188 g/km</td>
</tr>
<tr>
<td>Fiat</td>
<td>144 g/km</td>
</tr>
<tr>
<td>Ford</td>
<td>162 g/km</td>
</tr>
<tr>
<td>GM</td>
<td>157 g/km</td>
</tr>
<tr>
<td>Renault</td>
<td>147 g/km</td>
</tr>
<tr>
<td>Nissan</td>
<td>168 g/km</td>
</tr>
<tr>
<td>PSA</td>
<td>142 g/km</td>
</tr>
<tr>
<td>Toyota</td>
<td>153 g/km</td>
</tr>
<tr>
<td>Honda</td>
<td>154 g/km</td>
</tr>
<tr>
<td>VW</td>
<td>166 g/km</td>
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</tbody>
</table>

Source: Frost & Sullivan

**Current Industry Fleet Average, 2006**

**Targeted OEM Fleet Average, 2012**

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European Consumers’ Attitudes & Perceptions Towards Sustainability, Environment and Alternate Powertrains

(Hybrids, Flex-Fuels, NG Vehicles)

Key Relevant Findings

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The Study Focuses on 5 Key Parameters that Define the Sustainability and Environmental Impact of Products

- A web survey was conducted using a randomly screened online consumer panel, consumers were given incentives.
- In all 2,648 interviews were conducted for this survey and F&S ensured that a solid representation of vehicle segments were captured from each country covered including France, UK, Germany, Italy and Spain.
- Respondents were recruited based on vehicle segment who were personally involved in the purchase decision of the vehicles.
- A good representation of different age groups (younger than 17 were screened out) & gender to ensure a good representation of consumers.

<table>
<thead>
<tr>
<th></th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Spain</th>
<th>Sweden</th>
<th>UK</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;B</td>
<td>150</td>
<td>24.7%</td>
<td>152</td>
<td>25.0%</td>
<td>77</td>
<td>24.3%</td>
<td>76</td>
</tr>
<tr>
<td>C</td>
<td>151</td>
<td>24.9%</td>
<td>150</td>
<td>24.6%</td>
<td>77</td>
<td>24.3%</td>
<td>75</td>
</tr>
<tr>
<td>D&amp;E</td>
<td>149</td>
<td>24.5%</td>
<td>150</td>
<td>24.6%</td>
<td>77</td>
<td>24.3%</td>
<td>76</td>
</tr>
<tr>
<td>MPV</td>
<td>81</td>
<td>13.3%</td>
<td>75</td>
<td>12.3%</td>
<td>48</td>
<td>15.1%</td>
<td>38</td>
</tr>
<tr>
<td>SUV-Large</td>
<td>61</td>
<td>10.0%</td>
<td>56</td>
<td>9.2%</td>
<td>22</td>
<td>6.9%</td>
<td>23</td>
</tr>
<tr>
<td>SUV-Small</td>
<td>15</td>
<td>2.5%</td>
<td>26</td>
<td>4.3%</td>
<td>16</td>
<td>5.0%</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>607</td>
<td>100%</td>
<td>609</td>
<td>100%</td>
<td>317</td>
<td>100%</td>
<td>300</td>
</tr>
</tbody>
</table>

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While CO2 is seen as the most harmful vehicle emission in Europe the UK sees carbon monoxide as most harmful while in Italy particulate matter is seen as most harmful vehicle emission.

**Total European Response**

- Carbon Dioxide (CO2): 36%
- Carbon Monoxide (CO): 28%
- Hydrocarbons (HC): 11%
- Oxides of Nitrogen (NOx): 10%
- Particulate Matter (PM): 15%

**Country-wise Breakdown**

- **CO2**
  - **UK**: 41%
  - **Ger**: 39%
  - **Ita**: 14%
  - **Spa**: 43%
  - **Swe**: 46%
  - **UK**: 36%

- **CO**
  - **UK**: 26%
  - **Ger**: 23%
  - **Ita**: 28%
  - **Spa**: 31%
  - **Swe**: 13%
  - **UK**: 38%

- **NOx**
  - **UK**: 9%
  - **Ger**: 9%
  - **Ita**: 7%
  - **Spa**: 12%
  - **Swe**: 18%
  - **UK**: 5%

- **HC**
  - **UK**: 12%
  - **Ger**: 10%
  - **Ita**: 11%
  - **Spa**: 6%
  - **Swe**: 5%
  - **UK**: 14%

- **PM**
  - **UK**: 12%
  - **Ger**: 19%
  - **Ita**: 41%
  - **Spa**: 10%
  - **Swe**: 12%
  - **UK**: 3%

Base: 2008 n=2,648, Fr n=607, Ger n=609, Ita n=317, Spa n=300, Swe n=211, UK n=604

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Swedish Consumers Show the Greatest Awareness of ‘Eco-Driving’ and ‘Eco-Driving’ Seen as Improving Emissions & Fuel by Changing Drive Style

8 in 10 consumers in Sweden aware of the term eco-driving. Just over half of consumers in France and Spain said they had heard of it.

Q8 Are you aware of the term ‘Eco-driving’?

<table>
<thead>
<tr>
<th>Country</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>79%</td>
<td>21%</td>
</tr>
<tr>
<td>France</td>
<td>61%</td>
<td>39%</td>
</tr>
<tr>
<td>Spain</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>Germany</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>Italy</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>Total</td>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>

1 in 2 consumers understand eco-driving to be improving drive style to save fuel and emissions, checking tyre pressure, lowering acceleration and using emission filters on vehicles.

Q9 What does ‘eco-driving’ mean to you? Please select all that apply

- Improving my driving style due to a feedback / suggestion system - save fuel: 56%
- Checking tyre pressure - better tyre pressure improved fuel consumption: 55%
- Low acceleration - less acceleration means less fuel used: 52%
- Using emission filters on your vehicle - to lower CO2 or other gasses: 51%
- Controlling and minimising the use of in car features such as air conditioning and...: 47%
- Using low resistance tyres - less resistance means less fuel used: 34%
- Small down sized engines - smaller engines that have turbo or other techs: 33%
- Gear shift digital meter or ‘Gear Shift Indicator’ - this shows on a screen when...: 31%
- Optimised driving with the help of real time route guidance (navigation) system: 31%
- Others: 6%
7 in 10 consumers say that tax incentives for hybrid vehicles and adopting ‘green’ technologies will benefit the environment most. When data is compared to Q11, data suggests that incentives for purchasing hybrids are more favorably perceived than 'green' vehicle taxation initiatives.

<table>
<thead>
<tr>
<th>Q12 How much do you think the following ‘green tax’ initiatives for cars will benefit the environment?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tax incentives for purchasing Hybrid Vehicles</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>5%</td>
</tr>
<tr>
<td><strong>Tax incentives for having &quot;green&quot; technologies which are implemented in the car well before government regulations require them.</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>6%</td>
</tr>
<tr>
<td><strong>CO2 vehicle emission based taxation policy - you are taxed more or less depending on your vehicles emissions</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>9%</td>
</tr>
<tr>
<td><strong>Pay as you drive insurance schemes</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>16%</td>
</tr>
<tr>
<td><strong>Road pricing schemes - you are charged based on distance travelled</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>22%</td>
</tr>
<tr>
<td><strong>Fuel surcharges - additional fuel surcharges</strong></td>
</tr>
<tr>
<td>No benefit at all</td>
</tr>
<tr>
<td>28%</td>
</tr>
</tbody>
</table>
1 in 2 consumers likely to resist Biofuel vehicles because of concern about land to grow food and other resources

While consumers are open to alternative fuels biofuel adoption may continue to be a sensitive issue until it can be proven that these fuels do not impact food or other resources.

7 in 10 consumers agree that they are much more willing to consider a vehicle that runs on electricity or alternative fuels than in the past and demonstrates the greater awareness and heightened concerns about the environment and increasing fuel costs.

Q3 Please state whether you agree or disagree with the following statements...

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am much more willing to consider a vehicle that runs on electricity or alternative fuels now than I was in the past</td>
<td>14%</td>
<td>22%</td>
<td>64%</td>
</tr>
<tr>
<td>I use less petrol or diesel now than I previously did and I drive with the environment in mind</td>
<td>18%</td>
<td>24%</td>
<td>58%</td>
</tr>
<tr>
<td>I would be very interested in purchasing a car that is made of recyclable parts</td>
<td>11%</td>
<td>32%</td>
<td>58%</td>
</tr>
<tr>
<td>I like having good performance from my car so would prefer buy extra technologies that help save fuel but I want to have high performance</td>
<td>23%</td>
<td>27%</td>
<td>50%</td>
</tr>
<tr>
<td>I feel my vehicles impact on the environmental sustainability is not an issue, there are far more important environmental considerations to worry about</td>
<td>39%</td>
<td>25%</td>
<td>36%</td>
</tr>
<tr>
<td>I am willing to pay for and take driving lessons to teach me how to drive more eco friendly</td>
<td>45%</td>
<td>29%</td>
<td>26%</td>
</tr>
<tr>
<td>I do not understand what a ‘carbon footprint’ really is</td>
<td>56%</td>
<td>23%</td>
<td>22%</td>
</tr>
<tr>
<td>I am not concerned that the impact of using bio-fuels will mean there is less land to grow food and other resources</td>
<td>54%</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td>My government is doing more than they need to in order to help the environment</td>
<td>63%</td>
<td>23%</td>
<td>14%</td>
</tr>
</tbody>
</table>

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Agenda for today’s presentation

Global Alternative Powertrain – How is the market shaping up?

The Oil Scenario Outline

Global Powertrain Mix – Breakdown of Propulsion technologies towards 2015


Global Biofuels – Potential of 2nd Generation Biofuels and strategic analysis

OEM Preferences on ‘Green Technologies’ – Overview of selected OEMs

European Consumers’ Attitudes & Perceptions Towards Sustainability, Environment and Alternate Powertrains

Strategic Conclusions & Recommendations and Discussions

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Strategic Outlook towards 2020 and Beyond – To be prepared for the ‘unknown’

✓ Demand from countries like China and India likely to play a critical part in the price and output of crude oil – Oil exploration rate, cost of processing and quality of oil to be deciding factors
✓ Local governments providing strategic support to Biofuels need to ensure that short term detrimental effects are minimise while providing subsidies and benefits to Biofuels
✓ Oil companies forecasting price for crude oil to be about $55 - $60 by 2030; huge potential for Biofuels to contribute considering agricultural growth
✓ 2nd Generation Biofuels to be commercially successful only if price of extracting Biofuels is lesser than or equal to price of producing fossil fuels

2030 Scenario 1 – considering historical agricultural supply growth
Total supply of 110 MBPD

Non-OPEC Supply 56%
Biofuels Volume 44%

2030 Scenario 2 – considering half of historical agricultural supply growth
Total supply of 85 MBPD

Non-OPEC Supply 70%
Biofuels Volume 30%

Source: Booz & Company
Increased oil prices to bring a paradigm shift in consumer acceptance of small cars

Current & past oil price trend

### High Oil Price Scenario

- **Years**
- **Oil Price ($/Barrel)**
  - Gasoline: 40-42%
  - LPG / CNG: 16-18%
  - EV / Fuel Cells: 5-8%
  - Hybrids: 7-9%
  - Diesel: 25-28%

### Reference Oil Price Scenario

- **Years**
- **Oil Price ($/Barrel)**
  - Gasoline: 17-19%
  - LPG / CNG: 23-25%
  - EV / Fuel Cells: 11-13%
  - Hybrids: 18-20%
  - Diesel: 25-28%

### Low Oil Price Scenario

- **Years**
- **Oil Price ($/Barrel)**
  - Gasoline: 11-13%
  - LPG / CNG: 25-27%
  - EV / Fuel Cells: 12-14%
  - Hybrids: 19-20%
  - Diesel: 24-26%

Current & past oil price trend

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Strategic Conclusions and Recommendations

- OEMs, oil producers and suppliers can gain considerable advantage is in logistics and shipping costs. Cost savings on running a related business to support biofuels processing likely to be a critical success factor.

- More than 1 in 2 consumers feel that choice of available models is what they most dislike about hybrids and alternative fuelled vehicles.

- The biofuel issue can be linked to farming subsidies and in Europe currently if you are a farmer it is commercially more attractive to grow fuel crops than food crops.

- Oil majors not willing to have their share of oil replaced with Biofuel content as it directly impacts their revenues.

- 7 in 10 rate fuel economy as most influential in choice of next vehicle. 1 in 10 consumers with conventional will consider alternative fuelled vehicles.

- Consumers will likely leapfrog diesel in search of cheaper to run vehicles

- Limited choice of available models holding back adoption of hybrid & alternative fuelled vehicles

- Historical growth rates for India and China do not do justice to the actual expected demand by 2015 / 2020. High consumption of fossil fuels likely to hamper Biofuels output at the global level.

- More than 1 in 2 consumers feel that choice of available models is what they most dislike about hybrids and alternative fuelled vehicles.

- Being prepared for the Unknown – Demand from countries like China & India likely to influence global oil output

- Costs involved in 2nd Generation Biofuels to be very high in comparison to benefits achieved even towards 2020

- Separate Business Activities to leverage existing stronghold in Europe – increasing profitability and margins

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