Cleaner fuels to support vehicle emission reduction in Southern Africa

Stuart Rayner: National Association of Automobile Manufacturers of South Africa
Blantyre: May 2017
Presentation sections

- European CO₂ emission reductions and plans
- Vehicle CO₂ emission testing
- Vehicle technology trends to reduce emissions
- South Africa: Vehicle emission and fuel standards:
  - SA Department of Energy fuel economy labelling
  - SA National Treasury CO₂ vehicle taxation
- Summary
European new passenger car fleet standards and CO₂ legislation

- 130 gr/km average by 2015 – progressive intro from 2012.
- 95 gr/km average by 2020 – subject to review.
- Waver for sub 10,000 units pa and special arrangements for sub 300,000 units manufacturers.
- Not initially applied to light commercial vehicles – now set at 175 gr/km from 2017.
- Results in an effective 19% decrease in CO₂ emissions for all vehicles compared to current fleet.

Implications for Sub Saharan markets?
European Fuel specifications: sulphur legislation

EU Member States must make petrol and diesel having a maximum sulphur content of 10mg/kg widely available from 2005.

100% availability of such fuel mandated in 2009.
Light Vehicle Emissions Test Cell

Small vehicles only (Fully Laden < 3.5 t).

**Multi million dollar investments**

On-going calibration / correlation / maintenance requirements to maintain accuracy, precision and reliability.

Highly skilled operators required.
Emission/CO2 Testing Facilities

Slide: Ford Motor Company
Typical Light Duty Vehicle Test Facility

- Speed vs. time
- Power Absorption Unit
- Inertia Wheels
- Dilution Air
- Bag Samples
- Constant Volume Sampling (CVS) System
- Regulation ECE-83
- Measurements in g/km
New European Driving Cycle (NEDC)

- Excellent for repeatability and assessment against legislative standards.
- Recognised by both Industry and Legislators for some time as not representative of real driving.
- NEDC not only used in Europe but Mauritius / India / China / Russia / S Africa and many parts of South America.
Vehicle technology trends: Petrol Engines

- Gasoline Direct Injection
- Turbo charging
- “Downsizing & Boosting”
New Vehicle Technology Migration

**Recent/Near Term**
- Begin migration to advanced technology

**Mid Term**
- Full implementation of known technology

**Long Term**
- Volume roll-out of hybrid electric technologies and alternative energy sources

**Near Term**
- Significant number of vehicles with Stratified Injection technology
- Dual clutch and 6-speed transmissions replace 4- and 5-speeds
- Increased hybrid applications
- Increased unibody applications
- Introduction of smaller cars and CUVs
- Electric power steering
- Battery management systems
- Aero improvement

**Mid Term**
- Weight reduction
- Engine displacement reduction aligned with weight save
- Stratified injection engines available in nearly all vehicles
- Increased use of hybrids as a percentage of gas engines
- Increased diesel use as market demands
- Additional Aero improvements
- EPAS approaching 100% on light-duty vehicles
- Introduction of plug-in hybrids

**Long Term**
- Percentage of internal combustion dependant on renewable fuels
- Volume introduction of hybrids and plug-in hybrids
- Introduction of Battery Electric and fuel cell vehicles
- Clean electric / hydrogen fuels

Source: Ford Motor Company
Advanced Gas technologies and stringent emission levels will reduce the Diesel vs. Gas fuel economy and CO2 gaps.

Fuel Economy: Better

Today

Future

Diesel

Gasoline

Emissions Control impact

~10-15% fuel economy difference

Source: Ford Motor Company
Low sulphur fuel benefits: Tailpipe emission reduction technology (non CO₂)
Cross section of a Particle Filter

Exhausts from the engine

Clean exhaust gas

Images courtesy of AECC
50ppm Sulphur Diesel: Diesel Particulate Filter

Exhaust Aftertreatment System Sensors
- Lambda sensor
  - MAF/fuel injection control
- Pre-CCC Temp sensor
  - EOBD (catalyst light-off) and active CDPF regenerations
- Pre-DPF Temp sensor
  - control of active CDPF regenerations
- Differential pressure sensor
  - EOBD and CDPF functionality

CCC = Close-Coupled Catalyst
CDPF = Coated Diesel Particulate Filter
How efficient is the filtration?

- Filtration efficiency between 95-99%
- Requires sub 50 ppm diesel
- Also to be applied to petrol vehicles
Diesel sulphur level: Service Interval implications

- 3000 ppm sulphur diesel resulted in service intervals of 5000 kms in SA – unacceptable to many operators.

- 500 ppm diesel resulted in an increase to at least 10,000 km (in conjunction with lubricity specs) making diesel light vehicles more viable.

- In South Africa diesel service intervals are now typically between 15,000 and 20,000 km with widespread availability of 50 ppm diesel.

- Effect on service intervals was perhaps the most significant benefit of the sulphur reduction for SA manufacturers and importers.

- Full alignment with European intervals will require further sulphur reductions in line with EU standards.
Metal additives in petrol

 Recent issues in East Africa

ISSUE: Manganese being increasingly used at uncontrolled levels at a time when catalyst cell mesh density is increasing

EU Mn limit – 2mg/l (with warning label)

Manganese related blockages of catalytic converters: Tanzania 2016
SA Government initiatives(1)
Department of Energy

- Energy Efficiency Strategy
- Energy Efficiency Accord

- Targets to be met by 2015
- Industry and Mining – 15% final energy demand reduction
- Power Generation – 15% reduction in parasitic electrical usage
- Commercial and Public Sector Buildings – 15% final energy demand reduction
- Residential sector – 10% final energy demand reduction
- Transport sector – 9% final energy demand reduction (achieved)
South Africa: New passenger car Fuel Economy/CO$_2$ label

<table>
<thead>
<tr>
<th>FUEL CONSUMPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MORRIS MINOR 1200</td>
</tr>
</tbody>
</table>

- **Comparative fuel consumption**: 6.8 litres per 100km
- **Comparative CO$_2$ emissions**: 159 grams per km

- Carbon dioxide (CO$_2$) is the main greenhouse gas responsible for global warming.
- Actual fuel consumption and CO$_2$ emissions depend on factors such as traffic conditions, vehicle condition and how you drive.

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FORD KUGA (DM2)
1.5L PETROL 6MT

<table>
<thead>
<tr>
<th>Comparative fuel consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2 litres per 100 km</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparative CO$_2$ emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>143 grams per km</td>
</tr>
</tbody>
</table>

- Carbon dioxide (CO$_2$) is the main greenhouse gas responsible for global warming.
- Actual fuel consumption and CO$_2$ emissions depend on factors such as traffic conditions, vehicle condition and how you drive.
### COMPARATIVE PASSENGER CAR FUEL ECONOMY AND CO2 EMISSIONS DATA

Firstly, please select the MAKE of your vehicle. Then select from the next dropdown box for the TYPE of your vehicle (e.g., FORD Focus). Then click the SHOW MODELS button. Upon clicking this, your results will appear.

<table>
<thead>
<tr>
<th>Make: FORD</th>
<th>Type: FORD Fiesta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td><strong>Body shape</strong></td>
</tr>
<tr>
<td>Fiesta 1.0 EcoBoost Ambiente 5-dr MY15 Powershift</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.0 EcoBoost Ambiente 5-dr MY16</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.0 EcoBoost Titanium 5-dr MY13</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.0 EcoBoost Titanium 5-dr MY15 Powershift</td>
<td>Hatch (5-dr)</td>
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<tr>
<td>Fiesta 1.0 EcoBoost Trend 5-dr MY13 Powershift</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.0 EcoBoost Trend ESP 5-dr MY16</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.4 Ambiente 5-dr MY14</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.5 TDCi Ambiente 5-dr Dsl MY16</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.5 TDCi Trend 5-dr Dsl MY16</td>
<td>Hatch (5-dr)</td>
</tr>
<tr>
<td>Fiesta 1.6 ST 3-dr MY13</td>
<td>Hatch (3-dr)</td>
</tr>
<tr>
<td>Fiesta 1.6 TDCi Trend 5-dr Dsl MY13</td>
<td>Hatch (5-dr)</td>
</tr>
</tbody>
</table>
SA Government initiatives (2) National Treasury

- Environmental based taxation proposals: April 2006
- CO2 taxation: New passenger cars and D/Cab LCV’s.
### Table 7: Options for reforming existing environmentally-related taxes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Instrument</th>
<th>Incentive mechanism</th>
<th>Shortcomings and key technical considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>General fuel levy</td>
<td>• Increases the price of transport fuels, thereby suppressing demand;</td>
<td>• Not differentiable for time and location of infrastructure use;</td>
</tr>
<tr>
<td>(National Government)</td>
<td></td>
<td>• Discourage vehicle use;</td>
<td>• Relatively far removed from the main source of environmental externality;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Encourage the use of public transport / vehicle sharing;</td>
<td>• Complementary policies required to increase its effectiveness such as information campaigns;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Encourage the development of fuel efficient technologies; and</td>
<td>• Potentially regressive.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Could encourage the use of certain fuels over others.</td>
<td></td>
</tr>
<tr>
<td>Vehicle customs and excise duties</td>
<td>Increase the price of certain vehicles (building on the idea of a luxury tax) thereby suppressing demand for passenger and light commercial vehicles;</td>
<td>• High information requirements on vehicle types and technologies;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicle licensing fees</td>
<td>• Encourage the use of public transport / vehicle sharing;</td>
<td>• Difficult to link tax to the time and frequency of infrastructure use (if desirable);</td>
</tr>
<tr>
<td>(Provincial Government)</td>
<td></td>
<td>• Could encourage the use of selected types of vehicles / technologies through differential taxation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increase vehicle ownership costs and therefore suppress vehicle demand;</td>
<td>• The environmental incentive is likely to be small;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• By altering the fee structure to include environmental criteria, appropriate incentives could be offered to vehicle users;</td>
<td>• Must avoid over-complication of fee structure; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Could be used to increase scrapping rate of older vehicles (i.e. differentiate fees according to the age of the vehicle).</td>
<td>• Potentially regressive.</td>
</tr>
</tbody>
</table>
Final CO2 Standards and Taxation

- The rate of emissions tax on passenger vehicles is R75* per gram CO2 emissions in excess of 120 g/km based on test reports.

- The rate of emissions tax on double cabs is R100 per gram CO2 emissions in excess of 175 g/km based on test reports.

- If no test report is available the CO2 emissions will be calculated according to the following formula:
  - Passenger vehicles < 3000 cm³: 120 + (0.05 x cm³) = g/km CO2
  - Passenger vehicles > 3000 cm³: 175 + (0.05 x cm³) = g/km CO2
  - Double-cabs: 195 + (0.07 x cm³) = g/km CO2

* R100 per gram CO2 from April 2016
South Africa: Passenger car CO$_2$ emission data and trend

Weighted Average Emissions
Passenger Vehicles 2010 to 2017

Data source: Lightstone/NAAMSA
Key points

- Globally all developed markets have moved towards high fuel economy and low emission vehicle technology, utilising progressively reduced sulphur level fuels.

- In the case of Southern Africa, the benefits of enabling fuel and legislated CO2 standards and taxation was showing an approximate 1% pa CO2 improvement for passenger cars until 2016. **Further progress towards more fuel efficient technology, is subject to appropriate quality fuels becoming available.**

- Comparison of typical ‘developing market’ spec vehicles with that of the EU indicates **significant improvements in CO2/fuel economy are possible, given the appropriate fuel quality.**

- The **South African Bureau of Standards petrol and diesel specifications (SANS 1598 & SANS 342)** can be considered a practical compromise between local needs and EU standards, sufficient to support the introduction of the latest low emission vehicles into the region.
World-Wide Fuel Charter

- First established in 1998 to promote greater understanding of fuel quality needs of motor vehicle technologies and to harmonize fuel quality worldwide in accordance with vehicle needs.
- This is the go-to document for fuel quality information.
- Covers both gasoline and diesel, with four levels of each for fuel quality based on emission requirements.
- Biofuels covered by separate document.
End

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