Examples on vehicle performance:
Fuel consumption and emissions

NVF Fordon och Transporter Helsingfors 3.2.2010
Kimmo Erkkilä
VTT Technical Research Centre of Finland
Research on heavy-duty vehicles

- HDENERGY 2003 – 2005
- New project “HDENIQ” 2009 – 2011 within the TransEco programme
Information is available in English!

Heavy-duty Vehicles: Safety, Environmental Impacts and New Technology: "RASTU"

A research project for 2006-2008

In the years 2003-2005, VTT conducted a comprehensive project on energy savings for heavy-duty vehicles. The project, called "Motiva", aimed to identify and develop new technologies to reduce fuel consumption and improve safety. The research was carried out in close collaboration with industry partners, including manufacturers of heavy-duty vehicles.

The research work continues within the new "RASTU" research project. The project aims to further develop and validate new technologies, as well as to disseminate the results to the wider community.

The objectives of the new project can be summarised as follows:

- To improve the performance of new types of vehicles
- To develop new technologies that reduce fuel consumption
- To improve the safety of heavy-duty vehicles
- To develop new strategies for reducing fuel consumption and improving safety
- To disseminate the results of the research to the wider community

www.rastu.fi
Background

- Emission certification for heavy-duty vehicles is carried out using stand-alone engines
  - testing does not reflect the properties of the vehicle
  - fuel consumption is not reported (will be introduced for Euro VI)

- The ETC test cycle differs significantly from the actual load patterns for, e.g., city buses
  - discrepancy between emission certification classes and real-life emissions performance in the case of buses
  - better correlation for heavy-duty trucks

Questions to be answered:
- From the fleet operators’ view:
  - Which vehicles provide best fuel economy?
- From the view of decision makers and service procurement:
  - Which vehicles actually deliver low emissions (regulated, CO$_2$)?
Background

- In 2002 VTT (Technical Research Centre of Finland) commissioned a new emission laboratory for heavy-duty vehicles

- At the end of 2009 VTT had tested more than 200 vehicles
  - more than 100 buses and some 100 trucks
  - vehicles with Euro I to EEV emission certification, diesel and NG
  - a comprehensive data base on emission factors and fuel consumption has been generated

- Types of activities
  - development of measurement methodology
  - determination of real-life emission characteristics
  - determination of fuel efficiency
  - research on fuel savings
  - research on new biofuels (next generation)
Why test complete HD vehicles?

- There is a clear need for a test method to determine emissions and fuel consumption that takes into account the properties of the complete vehicle
  - "real-life" emission and fuel consumption figures (g/km based)
  - effects of payload and driving cycle
  - vehicle-to-vehicle comparisons, checking of in-use vehicles

- Chassis dynamometer testing can meet all these needs
  - accuracy for fuel consumption measurements ± 1 %
  - accuracy for emission measurements ± 15 %
Development of test methodology - trucks

- For trucks the speed and road gradient profiles were recorded from actual routes served by Transpoint (a major truck operator in Finland).

- Varying speed and taking into account the road gradient creates highly transient loading.

- Three cycles were developed: freeway, highway and delivery.
Example: Bus NOx and PM emissions
Example: Truck fuel consumption
2007 results

Fuel consumption on highway and freeway cycles.
Full trailers (max. 60t)

- Euro 3 Average
- Brand A Euro 4 EGR
- Brand C Euro 4 EGR + DPF
- Brand G Euro 4 SCR
- Brand B Euro 4 SCR
- Brand F Euro 4 SCR

Highway Freeway

Fuel consumption l/100 km

0-Load 1/2-Load 2/2-Load 0-Load 1/2-Load 2/2-Load
Example: Truck NOx and PM emissions

2007 results

Full trailers (max. 60t)

PM- and NOx-emissions on highway and motorway cycles

PM-emission (g/kWh at driven wheel)

NOx-emission (g/kWh at driven wheel)

- Euro 3 Average
- Brand A Euro 4 EGR
- Brand C Euro 4 EGR + DPF
- Brand G Euro 4 SCR
- Brand B Euro 4 SCR
- Brand F Euro 4 SCR
- Freeway
- Highway
Summary

- VTT has developed methodology to measure HD vehicle fuel consumption (1% accuracy) and exhaust emissions (accuracy 15%)
  - transient chassis dynamometer testing including simulation of road gradient

- Continuous activities on HD vehicle emissions and fuel efficiency since 2002
  - large projects attracting a lot of attention
  - good cooperation between authorities, transport companies and research institutes
  - more than 200 HD vehicles measured
Summary

- Buses:
  - very large variations in actual emission performance
  - some vehicles provide “real” EEV performance

- Trucks:
  - fuel consumption reduced from Euro III to Euro IV and V
  - initially SCR vehicles delivered better fuel economy than EGR vehicles
  - now the gap between SCR and EGR has narrowed, especially for combined cost of fuel and urea
  - good emission results for both EGR and SCR under high load

- VTT can provide fleet operators with vehicle type specific performance data
  - e.g. Transpoint is using VTT data when procuring new vehicles
VTT creates business from technology