Future Fuels for Commercial Vehicles

Rolf Willkrans
Director Environmental Affairs
Volvo Group Headquarters
Göteborg, Sweden
## Business Areas

<table>
<thead>
<tr>
<th>Business Areas</th>
<th>Mack Trucks</th>
<th>Renault Trucks</th>
<th>Volvo Trucks</th>
<th>Buses</th>
<th>Construction Equipment</th>
<th>Volvo Penta</th>
<th>Volvo Aero</th>
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Business Areas, 2004

Total Sales: EUR 22,0 bn

- Trucks 68%
- Buses 6%
- Construction Equipment 14%
- Volvo Penta 5%
- Volvo Aero 3%
- Others 4%
Sales and Employees Worldwide 2004

- **NORTH AMERICA**
  - Sales 26%
  - 14,620 employees
  - 18%

- **SOUTH AMERICA**
  - Sales 3%
  - 3,110 employees
  - 4%

- **EUROPE**
  - Sales 56%
  - 57,460 employees
  - 71%

- **ASIA**
  - Sales 11%
  - 4,130 employees
  - 5%

- **OTHERS**
  - Sales 5%
  - 1,760 employees
  - 2%
Volvo Corporate Values

Quality

Safety

Environment
Drivers

- Climate change - fossil greenhouse gas emissions
- Availability of energy resources and projected increasing demand
  - Crude oil is a finite resource. Global crude oil production will peak within a decade
  - 97% of the energy used for transport comes from crude oil
- Security of supply
  - The majority of known crude oil reserves are located in the Middle East
- Emissions, regulated and unregulated
Climate change – fossil greenhouse gas emissions

- “Climate issues will present the automotive industry with its greatest challenge in the future”
  - Leif Johansson, CEO and President of AB Volvo.
- Reduction of fossil greenhouse gas emissions is addressed in national and international strategies and programmes.
  - The transport sector is a focused area.
- Will be a strong driver for low or neutral CO$_2$ fuels and vehicles.
Production of Oil and Gas

Source: CJ Campbell, 2004

Trend +1.6% per year (IEA 2004)
North Sea

- The North Sea peaked in 2001
- Production decreased by 7% during 2004 compared to 2003
- The production will be approximately 40% of the 2000 level in 2015

![Production and Discoveries North Sea](image)

Source: CJ Campbell, 2005
Emissions, regulated and unregulated

- Truck and bus diesel emission standards 2010
  - NOx and PM levels will be 100 times lower than for uncontrolled engines.
  - Regulated emissions from diesel vehicles will approach sustainable levels.
- Exhaust emissions will not be a main driver for changes to alternative fuels
  - But, urban areas will require even lower emissions.
- Fuels which can reach desired emission levels with low driveline cost will be favoured.
Scenario conclusions

- Climate change must be addressed
  - Well-to-wheel CO2 emissions
- Current use of oil is not sustainable in the long run
  - Availability
  - Security
  - Oil price
- Energy efficiency must be focused, regardless if the energy is finite or renewable
  - Well-to-wheel energy efficiency
Gross list of energy carriers of interest

- Ethanol, (EtOH)
- Methanol, (MeOH)
- Diesel (crude oil and synthetic = Fischer-Tropsch)
- Rape seed Methyl Ester (RME)
- Dimethylether (DME)
- Methane, Natural Gas and Biogas
- Hydrogen
Well to wheel analysis
Volvo study

- Diesel (crude oil) hybrid
- Diesel (natural gas) hybrid
- MeOH (natural gas) hybrid
- DME (natural gas) hybrid
- CNG (natural gas) hybrid
- Hydrogen (crude oil) hybrid
- Hydrogen (natural gas) hybrid
- DME (electr. EU mix) hybrid
- MeOH (electr. wind) hybrid
- DME (wood, black liquor) hybrid
- MeOH (wood, black liquor) hybrid
- Biogas (sewage) hybrid
- DME (wood)
- MeOH (wood)
- DME (rapeseed)
- RME (rapeseed)
- Ethanol (wood)
- Ethanol (wheat)

Energy efficiency, %
CO2-equivalents, g/kWh
Fuel consumption development
Volvo FH12, 40 tonnes, long-haul traffic situation

![Graph showing fuel consumption development over time](image)
Energy efficiency
Well-to-wheel

Fossil alternatives

Index

0 10 20 30 40 50 60 70 80 90 100

Diesel (crude oil)  DME (natural gas)  MeOH (natural gas)  CNG (natural gas)  Synthetic diesel (natural gas)  Hydrogen (electr. EU mix)
Energy efficiency
Well-to-wheel

Index

Renewable alternatives

0 10 20 30 40 50 60 70 80 90 100

Diesel (crude oil)  DME (wood, black liquor)  Biogas (sewage)  DME (wood)  Synthetic diesel (wood)  RME (rape seed)  Ethanol (wood)  Ethanol (wheat)
### Why DME

- **Best “well to wheel” energy efficiency from bio source and from non crude oil fossil source**
- **Multi source and multi purpose features**
  - produced through gasification of an organic source
  - can be used for diesel engines; fuel cells; power gas turbines
  - as domestic fuel and as chemical feedstock
- **Energy dense and liquid at low pressure – handles like LPG**
- **Non-toxic, biodegradable and harmless to the atmosphere**
- **A genuine compression ignition fuel, with potential for ultra low exhaust emissions**
Volvo’s Position on Future Fuels

- Conventional diesel fuel will remain the dominant fuel for at least two decades.
- Natural gas and biogas will be used regionally.
- DME is a strong candidate for a more long-term future fuel:
  - Best well-to-wheel energy efficiency from bio source.
  - Close to CO2 neutral if produced from biomass.
Recent DME activities at Volvo

- DME truck developed in the EU funded project AFFORHD.
  - Presented May 18 in Stockholm.
- 9-litre diesel engine adapted to DME.
- Exhaust emissions below Euro V level.
Printed material

Available on www.volvo.com