Measures to reduce CO2 Emissions in the German Freight Sector

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Overview:

Transport Performance and CO₂ Emissions

- CO₂ emissions from passenger transport are still dominating
- Freight transport in Germany is still increasing (+36 % from 1991 to 2004)
- CO₂ emissions have not risen as much as performance did (1991 to 2004: +11%)

Transport performance

<table>
<thead>
<tr>
<th>Year</th>
<th>PT [bn personkm / year]</th>
<th>FT [bn tonkm / year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>600</td>
<td>200</td>
</tr>
<tr>
<td>1986</td>
<td>700</td>
<td>250</td>
</tr>
<tr>
<td>1991</td>
<td>800</td>
<td>300</td>
</tr>
<tr>
<td>1996</td>
<td>900</td>
<td>350</td>
</tr>
<tr>
<td>2002</td>
<td>1000</td>
<td>400</td>
</tr>
<tr>
<td>2004</td>
<td>1100</td>
<td>450</td>
</tr>
</tbody>
</table>

CO₂ emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>PT [million t / year]</th>
<th>FT [million t / year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>1986</td>
<td>120</td>
<td>25</td>
</tr>
<tr>
<td>1991</td>
<td>140</td>
<td>30</td>
</tr>
<tr>
<td>1996</td>
<td>160</td>
<td>35</td>
</tr>
<tr>
<td>2002</td>
<td>180</td>
<td>40</td>
</tr>
<tr>
<td>2004</td>
<td>200</td>
<td>45</td>
</tr>
</tbody>
</table>
Road Overview:
**CO\textsubscript{2} emissions of road freight transport**

**Light Duty Trucks < 3.5 t GVW**

- According to their strongly increased mileage CO\textsubscript{2} emissions of light duty trucks have doubled from 1991 to 2004
- Data about performance (tkm) of LD trucks are not available

**Heavy Duty Trucks**

- HD trucks: performance (tkm) increased by 55% from 1991 to 2004, emissions by 10%
Overview:

Influencing CO2 emissions in freight transport

- consumption of traditional engine
  - Reduction of fuel consumption
  - Substitution of CO2 producing fuels by alternative fuels

- choice of the engine system
  - Use of alternative engines

- choice of infrastructures and transport modes
  - Shift of transportation to carriers with lower CO2 emissions

- transport organization
  - Reduction of road performance
  - Logistics concepts
Road:

**Fuel consumption**

- use of biofuels
  - obligation to add biofuels to conventional fuels
  - Tax privilege for biofuels

- reduction of fuel consumption (support program within ERP program for environment and energy saving)
  - support of purchase of new emission reduced commercial vehicles > 3.5 t total weight and refitting of vehicles
  - support of purchase of biogas- or CNG-powered vehicles and installation of gas filling pumps
  - development of logistics centres in conjunction with emission reduced and low-emission commercial vehicles
  - location of firms within a logistics centre in conjunction with reduced-emission and low-emission commercial vehicles
Road:

Obligation to add biofuels

- law concerning proportion of biofuels in total fuels (BioKraftQuG, 1.1.2007) based on EU legislation
- obligation to increase proportion of biofuels continuously until 2015; quota is calculated of the energy content (not by energy mass)

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzin</td>
<td>1,2%</td>
<td>2,0%</td>
<td>2,8%</td>
<td>3,6%</td>
<td>3,6%</td>
</tr>
<tr>
<td>Diesel</td>
<td>4,4%</td>
<td>4,4%</td>
<td>4,4%</td>
<td>4,4%</td>
<td>4,4%</td>
</tr>
<tr>
<td>total</td>
<td>-</td>
<td>-</td>
<td>6,25%</td>
<td>6,75%</td>
<td>8,0%</td>
</tr>
</tbody>
</table>

- suggestion of EU-Commission (01.2007) to achieve a quota of 10% until 2020
Road:

**Tax privilege for biofuels**

- tax privilege for the 2nd generation of biofuels („Advanced Bio-fuels“) e.g. BTL (bio-mass-to-liquid) and alcohol based of lignite cellulose, reduced until 2015 to zero

- lowering of the tax privilege for bio-diesel since 2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2006</td>
<td>9 ct/l</td>
</tr>
<tr>
<td>1.2008</td>
<td>15 ct/l</td>
</tr>
<tr>
<td>1.2009</td>
<td>21 ct/l</td>
</tr>
</tbody>
</table>

- the more expensive production costs of bio-diesel are increasingly absorbed by the tax privilege
Road:

Engine Systems in Road Freight Transport

- Diesel engine is standard engine in road freight transport
- Vehicles with CNG engine are used in the group of light commercial vehicles
  - Decreasing efficiency by rising total weight of the vehicle
  - As HDV only used as Low-Emission-Vehicle in sensitive exhaust city-zones

- New registrations of commercial vehicles 2005 in Germany

<table>
<thead>
<tr>
<th>2005</th>
<th>&lt; 1 t payload</th>
<th>1 - &lt; 2 t payload</th>
<th>2 t payload and more</th>
<th>tractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>90.356</td>
<td>77.079</td>
<td>47.375</td>
<td>32.426</td>
</tr>
<tr>
<td>gasoline</td>
<td>4.936</td>
<td>355</td>
<td>76</td>
<td>15</td>
</tr>
<tr>
<td>gas</td>
<td>2.078</td>
<td>492</td>
<td>83</td>
<td>5</td>
</tr>
<tr>
<td>electric</td>
<td>17</td>
<td>3</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>hybrid</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: KBA, VDA
Road:

**Support program for commercial vehicles** (01.2007-12.2008)

- no explicit reference to CO2 emissions
  - but: technical progress in the past reduced the fuel consumption
  - but: NOx-reduction versus CO2-reduction (e.g. Euro 4-Transporter)
- purchase of new emission reduced commercial vehicles > 3,5 t total weight and refitting
- volume: 100 Mio € p.a.
- standard: Euro 5 or European emission standard EEV (Enhanced Environmentally Friendly Vehicle)
- credits in the amount of 50 % of the additional investment costs compared to common vehicles (Regional- and KMU-additional fee)
- additional costs of EEV or Euro 5: approx. 8500 €/vehicle
Road:

New registrations of HGV > 3,5 t total weight and tractions by emissions class, 2000-2006

SKL = „Schadstoffklassen“ or „pollutant categories“
Road:

**Maut system**

- diversification of toll
  - involvement of vehicles 3,5 - 12 t total weight until 2012 (EU-target)
  - temporal differentiation and zone pricing (included in “Masterplan Logistik” of BMVBS, German Ministry for Transport)
- increase in toll charges
  - increase in charges by 1,1 ct (12,4 ct to 13,5 ct per km) on average
  - but: Intended measures should be implemented not before facilitation of German HGV is defined (e.g. reducing motor-vehicle-tax)
- current toll for vehicles >12 t total weight:

<table>
<thead>
<tr>
<th>Emission category</th>
<th>&lt; 3 axes</th>
<th>&gt; 4 axes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A (Euro 5, EEV)</td>
<td>0,09 €</td>
<td>0,10 €</td>
</tr>
<tr>
<td>Category B (Euro 3, Euro 4)</td>
<td>0,11 €</td>
<td>0,12 €</td>
</tr>
<tr>
<td>Category C (Euro 1, Euro 2)</td>
<td>0,13 €</td>
<td>0,14 €</td>
</tr>
</tbody>
</table>
Road:

**Impact of toll**

- Toll is without reference to CO2 emission (but with reference to pollutant categories)
- Toll = promoter of efficient transport organisation?

Rate of loaded distance of German HDV (Mio km), 2000-2006

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unloaded distance [km]</strong></td>
<td>7.045</td>
<td>6.777</td>
<td>6.289</td>
<td>6.060</td>
<td>5.931</td>
<td>5.628</td>
<td>6.017</td>
</tr>
<tr>
<td><strong>Rate of loaded km [%]</strong></td>
<td>75,3</td>
<td>76,4</td>
<td>77,3</td>
<td>78,1</td>
<td>79,2</td>
<td>80,3</td>
<td>80,1</td>
</tr>
</tbody>
</table>

Source: Stat. Mitteilungen des BAG und des KBA, Reihe 8

introduction of Maut system
Road:

Support programm logistics centres & vehicles

- Funding of „development and extension or initial construction of logistic centres including the use of low emission (air and noise) vehicles
  - Logistics centre (GVZ = Güterverkehrszenrum), e.g. investments for buildings or technical infrastructures in the buildings
  - Location on the GVZ area, e.g. investments in the construction of buildings, technical infrastructures
  - Purchase of low emission vehicles (air and noise) > 3,5 t
  - Construction of gas station infrastructure for natural gas / bio-methane fuels

- Objective: achieve a higher level of environmental protection than requested by EU legislation
  - European norm on emissions EEV (Enhanced Environmentally Friendly Vehicle) or Euro 5-Norm
  - Additional investment costs compared to conventional vehicles
  - Funding of up to 50 % of additional investment costs (with extensions by regions and size of firm)
  - Additional funding on credit costs up to 1 % of credit costs p.a.
Rail Overview:

Freight Transport by Rail

Transport performance

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>[bn tkm/year]</td>
<td></td>
<td></td>
<td></td>
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CO₂ emissions

<table>
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<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>[million t/year]</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Increasing transport performance since the middle of the 1990s
- CO₂ is declining due to higher efficiency in general and less shunting
- Amount of CO₂ emissions is determined mainly by energy production
Rail Overview:

Measures in Rail Freight Transport

- Environmental program 2004-2008 / Climate program 2020 of DB AG
  - CO2 emissions of DB AG should be reduced by 15% until 2020

- Emission trading for power exchange by power stations (01.2005)

- Support for “combined traffic”
  - Special business conditions as compensation of competitive disadvantage
  - Program to support new traffic on rail and waterways (05.2005)
  - Program to support handling equipment (04.2006)

- Support for private rail sidings
  - Program to support the building, development and reactivation of private rail sidings (01.2005)
Rail: Environmental Program 2004-2008 / Climate Program 2020 of DB AG

- 25 % reduction of specific CO2 emissions of traction between 1990-2002
- further 15 % reduction of CO2 emissions until 2020
  - energy efficient vehicles and power stations
    - 90 % electric-, 10 % diesel locomotives
  - upgrading of infrastructure
  - increase of quota of regenerative energy
    - 10 % of power produced by water, wind and solar plants
    - bio diesel for diesel locomotives
  - Increase of load per train
  - Energy saving by driving characteristics
  - Driver training (TEMA-Box – “Traktionsenergie-Messung und Abrechnung”: Measuring energy use for traction and energy billing), based on experiences made in passenger transport: reduction of 140,000 t CO2 emission between 2002-2006
Rail:

**Emission Trading (01.2005)**

- being transport operators, railway companies cannot participate independently in emission trade
- other competitors of rail are not concerned by the emission trading
Rail:

**Special Business Conditions in Combined Traffic ("Kombinierter Verkehr" = KV)**

- special business conditions as compensation of competitive disadvantage
  - Reduction of motor vehicle tax for vehicles of the combined traffic
  - Higher total weight of 44 t allowed for vehicles of KV
  - Exception from no-driving rule on Sundays, official holidays and public / religious holidays
Rail:

Support program new traffic on rail and waterway by combined traffic (05.2005-2008)

- 15 Mio. Euro p.a., waterways / road and rail / road funding with no re-funding or as proportional funding
  - max. 30 % of (investment) costs within the first three years
  - “start up” support
    - reduction of economic risks linked to the introduction of new services
    - costs for intermodal loading units, railway vehicles, inland water and coastal ships
    - costs for infrastructure or operation
  - support of investments
    - procurement of specific equipment
      - transshipment technologies
      - waterway vehicles
      - innovative systems of information processing
Rail:

**Support program for transshipment terminals (04.2006)**

- support for transshipment terminals of combined transport (04.2006) in its new version
  - replacement of support for former rules to support combined transport (11.2002)
  - construction and extension of transshipment infrastructure for combined transport (bimodal and trimodal)
- support of projects
- max. 85 % of costs as non-repayable
Rail:

Support Program of Private Sidings (01.2005-2010)

- support of new building, development and reactivation of private sidings
  - 50 % financing of the costs
  - amount: new building 8 € / t / a 32 € / 1000 tkm / a
    development 4 € / t / a 16 € / 1000 tkm / a
    reactivation 4 € / t / a 16 € / 1000 tkm / a
- track construction, switch, contact line
- infrastructure for loading and unloading the goods

- transport mass of 3,1 Mio. t p.a. until 2006 are supported
  (equivalent to approx. 100.000 HDV-tours)
- program is not yet well accepted (until now only 15,5 Mio € are allocated)
Rail:

Trend of Private Sidings in Germany, 1965-2002

Source: Martin, Ullrich: Braucht die moderne Bahn noch Anschlussbahnen? in:
Inland Water Transport:

**CO2 Emissions in Inland Water Transport**

- ratio of transport performance (tkm) of inland water transport should increase to 14% until 2015 (now 11%)
  (“Sustainability Strategy” of the Federal Government)
- age structure of vessels

<table>
<thead>
<tr>
<th></th>
<th>Average age in years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1992</td>
</tr>
<tr>
<td>Freight motor boat</td>
<td>ca. 47</td>
</tr>
<tr>
<td>Tank motor boat</td>
<td>ca. 26</td>
</tr>
<tr>
<td>Pulling tug</td>
<td>unknown</td>
</tr>
</tbody>
</table>

source: (BTD 14/9872)

- lifecycle of motorboats
  - long lifetime of approx. 65 years
  - two general overhaul and change of the engine
- emission standards of vessels since 2002 (RheinSchUO)
  - 01.2002 Standard I, 07.2007 Standard II
Inland Water Transport:

Support program for low emission engines (-12.2008)

- support of low emission engines
- support of construction and operation of “river friendly” infrastructures
  - purchase of new vessels
  - credits up to 50 % of additional investment costs
  - additional support of credit costs up to 1 % p.a.

- definition of low emission engines by emission by sulfur and CO
  - EU rule 2004/26 EG – (5,0 g CO/kWh) or chap. 8a of “Central Commission for ship transport on the Rhine” (3,5-5,5 g CO/kWh)

- incentives for purchase of low emission engines
Conclusions

- There is a large bundle of measures having influence on CO2 emissions.
- Explicit political measures to address the reduction of CO2-emissions do not exist for the German freight sector.
- A majority of measures leads to a CO2 reduction only indirectly as other targets are primarily addressed.
- The most effective CO2 reductions occur by increases in efficiency, in particular by the reduction of fuel consumption.
- Figures about the effects of CO2 emission reduction by the measures listed above do not exist.