Bringing transparency to environmental impacts of transport

LIPASTO transport emission database

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Introduction

• Environmental impacts of transport: changes to the environment caused by the transport system (e.g. emissions to air, soil and water, noise and natural resource depletion).
  ▫ Focus: operational use-phase energy consumption and (GHG) emissions, passenger and freight transport.

• Data on transport energy consumption and emissions are needed:
  ▫ in order to measure and quantify the environmental impacts
  ▫ for making comparisons (e.g. means and mode of transport).
• Analogous decisions are made by individuals planning their daily travel, operators managing logistics chains and authorities responsible for public transport planning or infrastructure investments.
State-of-the-art review

The setting

- Currently **no common / binding / standardized approach** for calculating and reporting transport energy consumption and emissions.
- On-going standardization work is about to change this.
  - The European Committee for Standardization (CEN/TC 320 WG10): *Methodology for calculation and declaration on energy consumptions and GHG emissions in transport services (good and passengers transport).*
- The standard (draft) emphasizes the inclusion of associated energy processes (exploitation, production and distribution of transport fuels) in addition to the operational use-phase vehicle processes.
  → Next step: environmental LCA.
State-of-the-art review
Existing methods and tools

Free-access and commercial solutions offered by companies, transport service providers, logistics operators, environmental organisations, research institutes and administrative authorities.
→ Quantity versus quality.

- Transport emission databases:
  - VTT Technical Research Centre of Finland: LIPASTO.
  - Defra, Department for Environment, Food and Rural Affairs (UK).
  - NTM, The Network for Transport and Environment (Sweden).

- Transport emission calculators:
  - EcoTransIT World (developed by Ifeu & RMCon).
State-of-the-art review

Problem areas

Differing practices compromise comparability at all levels and lead to misguided decisions. Problems deal with:

- underestimation of energy consumption and emissions
- major gaps and shortcuts: e.g. empty return journeys ignored
- allocation to (and split between) passengers, freight or both
- definition of payload (actual / theoretical, net / gross)
- the level of input data for energy use, emissions and payload (transport service, average value, common default value)
- non-transparent reporting: data sources, assumptions, etc.
The LIPASTO system

A two-part database developed and updated at VTT using the LIPASTO calculation system for transport emissions and fuel consumption.

1. Emission inventory database: total national transport emissions [t/year]
2. Unit emission database: vehicle emissions [g/km], [g/tkm], [g/pkm]

Main results available on the internet: www.lipasto.vtt.fi
LIPASTO database

1. Emission inventory database [t/year]

- The **annual total** transport energy consumption and emission figures by mode in Finland.
- A calculation system consisting of four mode-specific sub models and an additional model for working machines and off-road vehicles, each of which is updated with new activity data on an annual basis.
  - The basis for reporting transport emissions to the EU and the UN.

- Calculations are based on vehicle kilometers, vehicle characteristics, driving conditions, emission factors and forecast assumptions.
- Total national mode-specific energy consumption and the following emissions: CO, HC, NOx, PM, CH₄, N₂O, SO₂ and CO₂.
  - Results can also be segregated to regional level.
LIPASTO database

2. Unit emission database [g/km], [g/tkm], [g/pkm]

- The term ‘unit emission’ refers to the use-phase energy consumption figures and emission factors of a vehicle over one kilometre.
  - Typically expressed as grams per transport of a given transport unit over the distance of one kilometre.

- All four transport modes (passenger and freight), working machines and off-road vehicles.
- Reported: energy consumption and the following emissions: CO, HC, NOx, PM, CH₄, N₂O, SO₂, CO₂ and CO₂ equivalent.
• The goal is to present emissions of traffic situations and vehicles typical of Finland:
  ▫ vehicles, operating conditions (climate)
  ▫ recorded payloads as annual averages (actual passengers, net freight)
  ▫ return trips included.

• Much of the data is also valid internationally.

• Data sources:
  ▫ transport operators
  ▫ national and international databases
  ▫ VTT’s measurements
  ▫ transport statistics
  ▫ etc.
Examples
Unit emissions of vehicles in Finland

Freight waterborne traffic

These pages show the emissions from freight ships per transport unit and kilometre. Depending on the type of the vessel, the transport unit may refer for example to the entire ship, one tonne of freight, one container or one trailer.

The given numbers are representative of the situation in Finland (waterborne traffic to or from Finland) in terms of vessel types, amounts of cargo transported, the fuels used, geographical position etc.

How the numbers are defined is explained in Methodology. Guidance and tips for how to use the numbers correctly is given in User’s guide.

Unit emissions for passenger ships are found in Passenger waterborne traffic.

Ships

These ship types represent typical waterborne traffic in Finland. Properties of the ship types are described in section Methodology and guidance how to define unit emissions for a ship of a different size and type are found in User’s guide.

› Methodology
› User’s guide

› Container ships
› Roro and Ropax ships
› Car carriers
› Bulk carriers
› General cargo ships
› Pusher barges
› Tankers
› Chemical tankers
› All freight ships

› Frequently asked questions
› Links
Bringing transparency to environmental impacts of transport: LIPASTO transport emission database

RORO ship emissions [g/km]
- for the entire ship
- for one trailer
- for one tonne of (net) freight
+ ship characteristics

Unit emissions of Roro ships

<table>
<thead>
<tr>
<th>Roro, 18 kn, trailer capacity</th>
<th>CO [g/ship km]</th>
<th>HC [g/ship km]</th>
<th>NOx [g/ship km]</th>
<th>PM10 [g/ship km]</th>
<th>PM2.5 [g/ship km]</th>
<th>CH4 [g/ship km]</th>
<th>N2O [g/ship km]</th>
<th>SO2 [g/ship km]</th>
<th>CO2 [g/ship km]</th>
<th>CO2 eq. [g/ship km]</th>
<th>Fuel cons. [MJ]</th>
<th>Energy cons. [MJ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[g/ship km]</td>
<td>158</td>
<td>32</td>
<td>3 957</td>
<td>94</td>
<td>75</td>
<td>16</td>
<td>5</td>
<td>1 713</td>
<td>190 762</td>
<td>192 750</td>
<td>59 844</td>
<td>2 454</td>
</tr>
<tr>
<td>[g/trailer km]</td>
<td>1.3</td>
<td>0.27</td>
<td>33</td>
<td>0.78</td>
<td>0.62</td>
<td>0.13</td>
<td>0.045</td>
<td>14</td>
<td>1 590</td>
<td>1 606</td>
<td>499</td>
<td>20</td>
</tr>
<tr>
<td>[g/tkm]</td>
<td>0.11</td>
<td>0.022</td>
<td>2.8</td>
<td>0.066</td>
<td>0.052</td>
<td>0.011</td>
<td>0.0037</td>
<td>1.2</td>
<td>134</td>
<td>135</td>
<td>42</td>
<td>1.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trailer capacity [units]</th>
<th>GT [t]</th>
<th>DWT [t]</th>
<th>Main engines [kW]</th>
<th>Speed [knots]</th>
<th>Distance [km]</th>
<th>Trailers from max. [%]</th>
<th>Consumption Main [g/kWh]</th>
<th>Consumption Auxiliary [g/kWh]</th>
<th>Sulphur content HFO [m-%]</th>
<th>Sulphur content MGO [m-%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>18 000</td>
<td>10 000</td>
<td>15 000</td>
<td>18</td>
<td>1 300</td>
<td>80 %</td>
<td>190</td>
<td>210</td>
<td>1.45</td>
<td>0.1</td>
</tr>
</tbody>
</table>
The LIPASTO system
Implications and further work

Continuous improvement approach:

- involvement in the European standardization work
- co-operation with different interest groups such as transport companies, the industrial sector, authorities and developers of similar databases
- e.g. an up-coming EC funded research project COFRET (Carbon footprint of freight transport)
- e.g. database converted into the format to support the LCA software KCL-ECO.
Conclusion

- Growing demand for environmental information on products and services: freight, passengers, vehicles, transport services.

1. Lack of a common approach for calculating and reporting transport energy consumption and emissions.
2. Incomplete reporting of the background information on underlying assumptions and choices.
   → **Compromised transparency and comparability.**

- Major initiatives to address these weak points (e.g. the CEN standard).
- The LIPASTO transport emission database in the front row, aiming at transparency, compliance with up-coming standards and free-of-charge accessibility.
Thank you for your attention!

Questions?

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