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Direction Economie Circulaire et Déchets
Service Produits et Efficacité Matières
Olivier Réthoré
Telephone : 01.47.65.24.44
E-mail : olivier.rethore@ademe.fr

BASE IMPACTS® DATA DOCUMENTATION

CATEGORY: TRANSPORT

3 levels of documentation are available for the datasets in Base Impacts®:

- A **general documentation** explaining general information on the datasets and data general requirements
- A **sectorial documentation:** one document per sector describing the available datasets and their characteristics (technological representativeness, geographical representativeness), and providing the information on the datasets in a common layout. Information comes from the consultation specifications, the dataset commissioner technical proposal and the metadata
- The **datasets metadata** can be viewed directly in the datasets sheets. They include more detailed information (flow diagrams, Etc.)

This document is the category documentation for transport.

CONTENTS

A. PRESENTATION OF THE DATASETS

1. List of available datasets

The following datasets are available:

Technological representativity			Geographical representativity	Dataset type
Truck transport, Transport at room temperature	Average fleet	Use rate : 20%	Continental (6 continents), European countries (25 countries)	LCI Result
		100%	Continental (6 continents), European countries (25 countries)	LCI Result
	7,5t (3t)	20%	France	LCI Result
		50%	France	LCI Result
		100%	France	LCI Result
	14-20t (10t)	20%	France	LCI Result
		50%	France	LCI Result
		100%	France	LCI Result
	34-40t (25t)	20%	France	LCI Result
		50%	France	LCI Result
		100%	France	LCI Result
Truck transport, refrigerated truck	Fresh-food	20%	France	LCI Result
		100%	France	LCI Result
	Frozen-food	20%	France	LCI Result
		100%	France	LCI Result
Road infrastructure			*Europe*	*Not publicly available in Base Impacts ®*
Piece of truck	*7,5t (3t)* *14-20t (10t)* *34-40t (25t)*		*Europe*	*Not publicly available in Base Impacts ®*

Technological representativity		Geographical representativity	Dataset type
Railway transportation	Average fleet	Continental (6 continents), European countries (25 countries)	LCI Result
Railway infrastructure		*Europe*	*Not publicly available in Base Impacts ®*
Maritime transportation	Ocean ferry transport	Global	LCI Result
	Ocean container transport	Global	LCI Result
	Ocean bulk transport	Global	LCI Result
Maritime infrastructure		*Europe*	*Not publicly available in Base Impacts ®*
Ocean bulk ship *Ocean container ship* *Ocean ferry ship*		*Europe*	*Not publicly available in Base Impacts ®*
Fluvial transportation	Inland motorboat transport	Europe	LCI Result
	Inland towboat transport	Europe	LCI Result
Inland waterways infrastructure		*Europe*	*Not publicly available in Base Impacts ®*
Inland ship		*Europe*	*Not publicly available in Base Impacts ®*
Air transportation	Short distance	Global	LCI Result
	Medium distance	Global	LCI Result
	Long distance	Global	LCI Result
Airport		*Europe*	*Not publicly available in Base Impacts ®*
Aircraft		*Europe*	*Not publicly available in Base Impacts ®*

Table 1 : Available datasets

2. Advice for use of available datasets

2.1. Scope for aggregation

The data available in the Base IMPACTS® result from aggregated inventories, and can therefore be used separately.

2.2. Modeling of specific payload and empty return rate for road transport

The datasets for road transportation are provided with 20% and 100% use rate, which allows the user to model a specific payload and empty return rate.

If payload and empty return rates are generic parameters (for all transportation steps), one of the generic datasets should be used. Datasets will be made available with the use rate requested in sectorial category rules.

If payload and empty return rate are semi-specific parameters (for final distribution), you can calculate the appropriate transport impact by combining the 20% and 100% use rate datasets provided in Base Impacts ®:

An empty trip has to be modelled with the 20% payload truck

A full trip has to be modelled with 100% payload truck

For all other values between 20% and 100% the following formula has to be used.

$$C_P = P^* \frac{C100 - C20}{80\%} + \{C100 - \left(\frac{1}{80\%}\right) * (C100 - C20)\}$$

Explanation:

The energy/fuel consumption of the truck (and therefore the environmental impacts as first assumption) is linear between a payload of 20% and 100%.

C = P*R+Z

ONLY VALID FOR A PAYLOAD BETWEEN 20% AND 100%

C: consumption (but also all environmental impacts)

P: Payload including return (in %)

R: linear relation between Payload and consumption

Z: fictive consumption of the truck for an empty trip if the consumption was linear up to 0% payload

$$R = \frac{C100 - C20}{80\%}$$

C100 = Consumption for a 100% Payload

C20 = Consumption for a 20% Payload

80% = Difference between 20% and 100% payload

$$Z = C100 - 100\% * (\frac{C100 - C20}{80\%})$$

B. SCOPE OF THE DATASETS

1. Reference flow, functional unit

The processes are provided for 1 t*km, which represents a cargo of 1t transported over 1km.

Example: Therefore, the environmental impact of 10t transported over 500km will be modeled by using a dataset with a quantity of 10 x 500 and will be similar to the impact of 500t transported over 10 km.

2. System boundaries

2.1. General foreground system boundaries

Cut-off for each unit process:

The datasets cover at least 95% of mass and energy of the input and output flows, and 98% of the environmental relevance (according to expert judgment).

Infrastructures

Infrastructure of transportation system is included in the datasets.

2.2. Dataset-specific foreground system boundaries

2.2.1. Road transport

The data set should be used for LCI/LCA studies where bulk or packaged goods have to be transported via road (motorway) over a longer distance. The datasets are provided with 20% and 100% utilization rates, which allows the user to model a specific payload and empty return rate (see explanations in paragraph A.2).

The provided datasets are fleet average datasets per continent or per country. The information on the composition of the fleet (type of truck) can be found in the online metadata.

This datasets cover road infrastructure, truck as well as operation of truck:

- **Road Infrastructure**
  - The data set contains the material demand for the construction of road infrastructure including bridges and tunnels. Transport of materials and EoL is included, energy and auxiliary consumption during construction of the road infrastructure is excluded. Operational life time of the bridges and tunnels is assumed to be 50 years. For the roads, annual material demand as given in MaRess (2011) has been used (varying life times have been assumed for the different layers of the road for the different road types).
  - The data set is based on material demand for total road infrastructure in Germany and has been scaled to EU-27 based on the amount of each infrastructure type (i.e. motorways, highways, state roads, other roads, concrete bridges, composite bridges, steel bridges and tunnels).
  - The infrastructure amount is allocated to freight based on an economic allocation for the freight/passenger usage of road infrastructure. It is finally scaled to one tkm freight transported, i.e. the LCI of the entire road infrastructure is divided by the life time and annual tkm freight transported in EU-27.
  - Annual operation data (usage of de-icer) has also been included.

- **Truck:**
  The data set includes the truck manufacturing and disposal based on publically available information[1]. e.g. Volvo EPD. Where publically available information was not available, data gaps have been closed by PE Internationals expertise. The assumed lifetime per truck class can be found in the online metadata.

- **Fleet:**
  - For French datasets, the fleet distribution is based on Coppert 4 information
  - For continental datasets, the fleet distribution is based information on truck distribution published in "lastauto omnibus Kataloge"

[1] WARNING – Written by mistake « not included » in some metadata

Distribution of weight categories per continent		
Continent	**Percentage [%]**	**Total weight**
North America	36,2%	up to 6,0 t total weight
	25,7%	6,0 to 15,9 t total weight
	38,0%	more than 16,0 t
South America	17,6%	up to 6,0 t total weight
	56,5%	6,0 to 15,9 t total weight
	25,9%	more than 16,0 t
Africa	62,5%	up to 6,0 t total weight
	24,6%	6,0 to 15,9 t total weight
	12,9%	more than 16,0 t
Australia/Oceania	71,2%	up to 6,0 t total weight
	11,4%	6,0 to 15,9 t total weight
	17,3%	more than 16,0 t
Asia	56,1%	up to 6,0 t total weight
	19,2%	6,0 to 15,9 t total weight
	24,6%	more than 16,0 t
source:	lastauto omnibus Kataloge: 2007-2011;2013	

- **Operation:**
  The operation of the different truck is based on COPPERT 4 information as well as information provided by ADEME on GHG related emissions.
  Regional specific adjusted parameters are: payload, utilisation ratio, distance, sulphur content of fuel, driving share urban/interurban/motorway and driving speed: the information per country and continent can be found in the online metadata.
  - Inputs: cargo.
  - For refrigerated trucks: cooling utility vehicle: 2 kg/h Diesel start up time for 2 hours, 40 km/h average speed for cooling truck, cooling at -18 to -23°C[2].Outputs: cargo and combustion emissions (ammonia, benzene, carbon dioxide, carbon monoxide, methane, nitrogen monoxide, nitrogen dioxide, nitrous oxide, NMVOC, particulate PM 2.5, sulphur dioxide). NMVOC emissions of the truck result from imperfect combustion and evaporation losses via diffusion through the tank.
  - The fuel supply chain (emissions of exploration, refinery, transportation etc.) is included in a regional fitted way. [3]

Data sources:

- GaBi databases 2006
- TREMOVE 2.7 / EMISSIONS, 2007
- Spezifischer Energieeinsatz im Verkehr, Ermittlung und Vergl. der spezifischen Energieverbräuche
- Umweltlexikon: Betankungsverlust, 2006
- Emissionen und Minderungspotential von HFKW, FKW und SF6 in Deutschland Im Auftrag des UBA(29841256)
- Statistische Mitteilungen, Reihe 2: Kraftfahrzeuge, 2003
- Emission functions for Heavy Duty Vehicles Update Handbook Emission Factors for Road Traffic
- EUROPA - Environment - Auto-Oil II Programme, 2000
- Richtlinie 2003/17/EG: Änderung der R 98/70/EG über die Qualität von Otto- und Dieselkraftstoffen
- BGL - Daten und Fakten, 2006
- Basisdaten für ökol. Bilanzierungen,Einsatz v. Nutzfahrzeugen in Transport,Landwirtschaft u. Bergbau
- Modell zur Simulierung umweltrelevanter Auswirkungen von Transportprozessen

[2] WARNING – Written by mistake « 4°C » in metadata
[3] WARNING – Written by mistake « not included » in some metadata

- Handbuch Emissionsfaktoren des Straßenverkehrs, Version 3.1, 2010
- Lastauto Omnibus Katalog 2007 to 2013
- Biodiesel Supply and Consumption in the Short-Term Energy Outlook
- Status of Fuel Quality and Vehicle Emission Standards: Sub Saharan Africa
- Status of Fuel Quality and Vehicle Emission Standards in Asia-Pacific
- Status of Fuel Quality and Vehicle Emission Standards: East Europe, the Caucasus, Central Asia
- Status of Fuel Quality and Vehicle Emission Standards: Latin America and the Caribbean
- Middle East, North Africa & West Asia Diesel Sulphur Matrix
- COPERT 4
- Sibyl
- MaRess 2011
- EU transport figures, 2012
- Progtrans 2007
- EPD - Volvo FH12 and volvo FM12

2.2.2. Rail freight

The dataset represents standard transport of bulk or volume goods in an average train with gross tonne weight of 1000t and payload capacity of 726t.

This data set covers railway[4] infrastructure, train as well as operation of train[5].

- **Railway Infrastructure:**
  The data set contains the material demand for the construction of rail infrastructure including bridges and tunnels. Transport of materials and EoL is included, energy and auxiliary consumption during construction of the rail infrastructure is excluded. Maintenance of infrastructure is included based on the annual material demand as given in MaRess (2011).
  The data set is based on material demand for total rail infrastructure in Germany and has been scaled to EU-27 based on the total length of railway
  It is allocated to freight based on an economic allocation for the freight/passenger usage of rail infrastructure.
  It is scaled to one tkm freight transported, i.e. the LCI of the entire infrastructure is divided by the life time and annual tkm freight transported by rail in EU-27. The inventory is based on literature data.

- **Train:**
  The data set includes the train (locomotive and carriages) manufacturing and disposal based on publically available information. e.g. Bombardier EPD of diesel and electric locomotive. Where publically available information was not available, data gaps have been closed by PE Internationals expertise. The assumed lifetime per train is assumed to be 30 years / 150,000 km per year.

- **Operation:**
  The electricity consumption electric train and GHG relevant emissions of diesel train are based on information provided by ADEME. Regional specific adjusted parameters are: sulphur content of fuel, share of biobased diesel, share electric / diesel powered train. The detail of the share of electric / diesel powered train for each country or continent is provided in the related online metadata.

Data sources:

- GaBi databases 2006
- Energieverbrauch u. Schadstoffemiss. des motorisierten Verkehrs in Deutschland 1960-2030(TREMOD, v5)
- EcoTransIT World, Ecolog.Transport Information Tool for Worldwide Transports: Methodology and Data
- Railway Handbook 2012 Energy Consumption and CO2 Emissions
- Electric locomotive market primed for growth
- Rail Diesel Study WP1 Final Report Status and future development of the diesel fleet
- Estimating Emissions from Railway Traffic
- Railways: Looking for Traffic
- Collection 2010-2011
- The data set represents country specific settings of parameters such as ppm_sulfur, share_CO2_bio, type of drive share (Diesel or electric), country specific energy provision.
- specific information provided by ADEME.

[4] WARNING – Written by mistake « road » in metadata
[5] WARNING – Written by mistake « truck » in metadata

2.2.3. Sea freight and inland waterway transportation

Provision of a standard cargo transport service according to the applied technology.

This data set covers:

- waterway infrastructure,
  for harbours, the data set is based on material demand for 6 ports in Germany and has been scaled to EU-27 based on total tonnage transported. It is allocated to freight based on an assumption that the ports mainly are used for freight transport (100% allocation to freight, 0% to passengers). Finally, an average impact per 1 tkm has been calculated based on the total tkm freight transported by sea with origin in EU in 2009.
  For inland waterways, the infrastructure data is modelled on basis of total material demand for inland waterways in Germany. It is scaled to EU-27 based on total length of the infrastructure in EU-27 and hereafter allocated to freight based on an assumption that the waterways mainly are used for freight transport (100% allocation to freight, 0% to passengers). Finally, an average impact per 1 tkm has been calculated based on the total tkm freight transported by inland waterways in EU-27 in 2010.
- ship assembly and end of life, with ship-specific capacity (DWT), empty weight (LDT), yearly distance and lifetime
- use: ship-specific fuel type and consumption

The following data was used to calculate the impact in t*km:

Transportation type	**Fuel consumption** (per vehicle*km)	**Deadweight tons** (thousand t)	Loading ratio	Empty return rate	**Average utilisation** = loading ratio x (1 – empty return rate)	**Fuel consumption** (per kg*km) = fuel cons. / (deadweight x utilisation)
Inland motorboat	**7,3 L**	**0,6 - 1**	80%	31%	**55%**	**13 L**
Inland towboat	**14,4 L**	**2,3**	80%	31%	**55%**	**11 L**
Ocean ferry	**115 kg**	**1,2-10**	27%	0%	**27%**	**42 kg**
Ocean container	**104 kg**	**27,5**	61%	0%	**61%**	**6,2 kg**
Ocean bulk	**49 kg**	**100-200**	90%	51%	**44%**	**0,56 kg**

Data sources:

- GaBi databases 2006
- Technische und wirtschaftliche Konzepte für flußangepaßte Binnenschiffe
- Binnenschifffahrt in Zahlen 1994, 1994
- Verkehrswirtschaftlicher und ökologischer Vergleich der Verkehrsträger Straße, Bahn und Wasserstraße
- Oil Tanker Phase Out andthe Ship Scrapping Industry - A study on the implications of the accelerated
- MaRess 2011
- EU transport figures, 2012

- UNCTAD maritime transport 2012
- How Efficient Are Ferries In Providing Public Transport Services? The Case Of Norway
- Base Carbone, data coming from study “Etude de l’efficacité énergétique et environnementale du transport maritime 430, réalisée pour l'ADEME et le Ministère de l’écologie, de l’énergie, du développement durable et de l’aménagement du territoire par les sociétés MLTC et TECNITAS" (final report April 2009).

2.2.4. Air transport

Provision of a standard cargo transport service according to the applied technology.

The following datasets should be used:

- Short distance for distances 0 to 1000 km;
- Medium distance for distances 3000 to 4000 km;
- Long distance for distances 8000 to 9000 km.

This data set covers infrastructure, plane manufacturing and end of life as well as operation.

- **Air transport infrastructure:**
  - The data set contains the material demand for the construction of airports including runways, terminals and parking spaces. Transport of materials and EoL is included, energy and auxiliary consumption during construction of the infrastructure is excluded. Varying operational life times are assumed for the different layers of the runways/movement areas (20-50 years). Terminals and parking house are assumed to have a life time of 40 years.
  - Annual operational data (such as electricity consumption and usage of de-icer) has also been included based on an average of 4 European airports (Hamburg, Frankfurt, Paris and Zurich).
  - The infrastructure data is modelled on basis of total material demand for Hamburg airport. It is scaled to EU-27 based on the amount of passengers in EU-27 and hereafter allocated to freight based on a mass allocation between freight/passengers (1 passenger = 100 kg) for the freight/passenger usage of airport infrastructure. Finally, an average impact per 1 tkm has been calculated based on the total freight tkm in EU-27 in 2011.

- **Plane manufacturing:**
  - Planes are modeled based on public information on material composition, e.g. LCA of A330, weight information published by Airbus and completed by internal knowledge on manufacturing.
  - Short and medium distances are represented by A310 (empty weight 79t) while long distance assumed to be equivalent to A330 (empty weight 109t). Estimated lifetime: 24 years; Flights per month: 51

- **Operation:**
  - Plane for cargo set to 1tkm. Inputs: Kerosene and cargo. Outputs: Cargo and combustion emissions (carbon dioxide, carbon monoxide, methane, nitrogen oxides, NMVOC, sulphur dioxide, dust).
  - Fuel consumption and emissions are modeled specific to climb/ cruise/ descent. Operation is modeled based on information provided by ADEME and public source, e.g. Joint EMEP/CORINAIR. Fuel consumption were adapted with data provided by ADEME:
    - 0,45 kg/tkm for short distance,
    - 0,36 kg/tkm for medium distance
    - 0,33 kg/tkm for long distance

Data sources:

- Balance. Das Wichtigste zum Thema Nachhaltigkeit
- Modellsystem zur routinemäßigen Ermittlung umweltoptimierter Flugstrecken
- Joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook, Third Edition
- EU air transport 2008
- EU transport figures, 2012

- Paris airport sustainability data 2011
- Zurich airport Facts and Figures 2011
- Zurich airport data 2011
- Eurostat airport data 2011
- A330-200F - Specifications

2.3. Background system boundaries

Background system boundaries follow the rules defined by PE International.

C. DATA SOURCES AND QUALITY

1. Data quality requirements

Quality requirements for Base Impacts® datasets are detailed in the general Base Impacts® documentation.

No specific quality requirements were set for the transport datasets.

2. Types and sources of data

The data sources for the complete product system are sufficiently consistent: primary data from industry was supplemented and validated with different literature data (see technology description for references).

3. Data quality

3.1. Technological representativeness

3.2. Time-related coverage

Reference year: 2011 for truck and railway transportation, 2012 for maritime, fluvial and air transportation

Annual average

3.3. Geographical coverage

Datasets were provided for France and/or European countries and/or continental average

3.4. Precision

3.5. Completeness

All relevant flows quantified

3.6. Consistency

4. Multi-functionality and allocation procedure

4.1. Foreground system allocation procedure

Transport infrastructure have been allocated between passenger and freight transportation/ The allocation details are explained in chapter 2.2.

4.2. Background system allocation procedure

Background system allocation procedure follows the rules defined by PE International.

D. CRITICAL REVIEW

All Base Impacts® datasets follow the ILCD Entry Level requirements, which require a review either internal with public report or external.

The leather datasets were reviewed by internal review:

- Raw data: Validation of data sources, Sample tests on calculations, Cross-check with other source, Expert judgement
- Unit process(es), single operation, black box: Energy balance, Element balance, Cross-check with other source, Cross-check with other data set, Expert judgement, Mass balance, Compliance with ISO 14040 to 14044
- LCI results or Partly terminated system: Energy balance, Element balance, Cross-check with other source, Cross-check with other data set, Expert judgement, Mass balance, Compliance with ISO 14040 to 14044
- LCIA results : Cross-check with other source, Cross-check with other data set, Expert judgement, Compliance with ISO 14040 to 14044
- Documentation: Expert judgement, Compliance with ISO 14040 to 14044, Documentation
- Life cycle inventory methods : Compliance with ISO 14040 to 14044
- LCIA results calculation : Expert judgement, Compliance with ISO 14040 to 14044
- Goal and scope definition: Expert judgement, Compliance with ISO 14040 to 14044

E. REPORTS FOR MORE INFORMATION

The following documents should be used for more information:

- Gabi Modelling Principles 2013
- General Base Impacts® documentation
- Review report, available in the metadata of each dataset

F. ADMINISTRATIVE INFORMATION

1. Commissioner

PE International.

2. Dataset modeler

PE International.

APPENDIX: DATA NEED AND DATA SELECTION

A Technical Committee on transport datasets specifications was held on 10 June 2011 to identify the transport datasets required for environmental labeling.

The conclusions of this Technical Committee were a synthesis of data need for transport.

The datasets identified by the Technical Committee are provided in Base Impacts®, with the following modifications:

Consultation specification	Implementation in Base Impacts®	Justification
• Datasets with 0% and 100% payload	• Datasets with 20% and 100% payload	The relationship between load and impact is linear between 20% and 100% payload. 20% payload can be considered as an empty truck