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BASE IMPACTS® DATA DOCUMENTATION

CATEGORY: HEAT

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 heat.

CONTENTS

A.	PRESENTATION OF THE HEAT DATASETS	3
1.	List of available datasets	3
2.	Scope for aggregation	3
B.	SCOPE OF THE DATASETS	4
1.	Reference flow, functional unit	4
2.	System boundaries.....	4
2.1.	General foreground system boundaries.....	4
2.2.	Dataset-specific foreground system boundaries.....	5
2.3.	Background system boundaries.....	9
C.	DATA SOURCES AND QUALITY	10
1.	Data quality requirements.....	10
2.	Types and sources of data	10
3.	Data quality	11
3.1.	Technological representativeness	11
3.2.	Time-related coverage	11
3.3.	Geographical coverage.....	11
3.4.	Precision.....	11
3.5.	Completeness	11
3.6.	Consistency	11
4.	Multi-functionality and allocation procedure.....	11
4.1.	Foreground system allocation procedure.....	11
4.2.	Background system allocation procedure	11
D.	CRITICAL REVIEW	12
E.	REPORTS FOR MORE INFORMATION.....	12
F.	ADMINISTRATIVE INFORMATION.....	13
1.	Commissioner.....	13
2.	Dataset modeler	13
	APPENDIX: DATA NEED AND DATA SELECTION	14

A. PRESENTATION OF THE HEAT DATASETS

1. List of available datasets

The following datasets are available:

Technological representativity		Geographical representativity	Dataset type	
Average mix for steam		<ul style="list-style-type: none"> France, 2 continents: Europe, Asia 	LCI Result	
Steam per energy carrier	From biomass	<ul style="list-style-type: none"> Power of steam plant : < 10 MW, > 10 MW Unspecified 	<ul style="list-style-type: none"> 2 continents: Europe, Asia 	LCI Result
	From hard coal	<ul style="list-style-type: none"> Power of steam plant : > 50 MW 	<ul style="list-style-type: none"> 8 countries: Belgium, Germany, Spain, United Kingdom, Italy, Netherlands, Russia, United States 2 continents: Europe, Asia 	LCI Result
	From light fuel oil	<ul style="list-style-type: none"> Sulfur content: 0,1% or 0,2% Power of steam plant: < 10 MW or > 10 MW Technology for NOx emissions reduction: « low Nox » burner, selective catalytic reduction or uncontrolled flue gas cleaning Unspecified 	<ul style="list-style-type: none"> 2 continents: Europe, Asia 	LCI Result
	From heavy fuel oil	<ul style="list-style-type: none"> Power of steam plant: < 10 MW or > 10 MW Sulfur content : 1% (for Europe and Asia) or 3,5% (Asia only) Technology for NOx emissions reduction: electrostatic precipitator, low NOx burner, flue gas desulphurization, and/or selective catalytic reduction, or uncontrolled flue gas cleaning. Unspecified 	<ul style="list-style-type: none"> 2 continents: Europe, Asia 	LCI Result
	From natural gas	<ul style="list-style-type: none"> Power of steam plant : < 10 MW, > 10 MW Unspecified 	<ul style="list-style-type: none"> 10 countries: Belgium, Switzerland, China, Germany, Spain, United Kingdom, Italy, Netherlands, Russia, United States 2 continents: Europe, Asia 	LCI Result

Table 1 : Available datasets

2. Scope for aggregation

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

B. SCOPE OF THE DATASETS

1. Reference flow, functional unit

The processes are provided for 1 MJ of useful heat produced as steam.

2. System boundaries

2.1. General foreground system boundaries

The datasets represent the average national or region specific steam production, per energy carrier. Main technologies for firing, flue gas cleaning and steam generation are considered according to the national or region specific situation.

The steam plant models combine emission data from literature with calculated values for non-measured emissions e.g. organics or heavy metals. For the emissions CO₂, SO₂, NO_x, CO, CH₄, N₂O, NMVOC and particulate matter (PM) measured/calculated data are used, taken from national inventory reports, emission inventory data bases, utility companies and other sources. The calculation of other emissions within the models are based on energy carrier properties, transfer coefficients and power plant thermodynamics representing the applied flue gas treatment technologies and standards (flue gas desulphurisation, dust filter etc.).

Cut-off rules for each unit process: Coverage of at least 95% of mass and energy of the input and output flows, and 98% of their environmental relevance (according to expert judgment).

Infrastructure of power plant is included.

2.2. Dataset-specific foreground system boundaries

2.2.1. Average mix for steam

The average mixes for steam¹ has been calculated based on French statistics from SNCU (Syndicat National de Chauffage Urbain et de la Climatisation Urbaine) in 2012. The mix was recalculated to exclude steam from waste, as these mix datasets are used to account for the benefits from energy recovery from incineration of municipal solid waste.

The mix is the following:

Energy carrier	Share in the steam mix (France, Europe and Asia)
Natural gas	56%
Hard coal	12%
Heavy fuel oil	10%
Other (excluding steam from waste)	22%

Steam from other sources has been linearly allocated to steam from natural gas, heavy fuel oil and hard coal.

The emission factors for steam production in the mix are given in the following tables:

Emission factors - Steam mix France			
[kg/TJ fuel input]	Natural gas	Heavy fuel oil	Hard coal
CO ₂	57.000	77.110	95.000
CO	14	15	19
SO ₂	0,3	412	292
NOx	57	157	170
Dust	2	20	17

Emission factors - Steam mix Europe			
[kg/TJ fuel input]	Natural gas	Heavy fuel oil	Hard coal
CO ₂	56.850	77.400	94.206
CO	11	15	19
SO ₂	0	300	245
NOx	40	134	175
Dust	1	12	14

Emission factors - Steam mix Asia			
[kg/TJ fuel input]	Natural gas	Heavy fuel oil	Hard coal
CO ₂	56.100	77.400	94.600
CO	39	15	49
SO ₂	0	920	311
NOx	89	246	346
Dust	1	23	109

Warning : in all individual Steam dataset (biomass, natural gas...etc) it is indicated by mistake : « The data set can be used for all LCA/CF studies where **medium voltage electricity from hard coal** is needed. Combination with individual unit processes using this commodity enables the generation of user-specific (product) LCAs.”

¹ WARNING : these data have been created in order to model the credit related to incineration with energy recovery. They should't be used as energy sources. Use individual steam dataset.

2.2.2. Steam from biomass

The steam is produced in a biomass specific steam plant with an efficiency of 86%.

Considered are national and regional specific technology standards of the steam plants in regard to efficiency and emission control, with the following emission factors:

Emission factors - Steam from biomass						
[kg/TJ fuel input]		CO ₂	CO	SO ₂	NOx	Dust
< 10MW	Europe	101.000	300	46	150	70
	Asia	100.900	300	69	150	70
> 10MW	Europe	101.000	244	46	93	8
	Asia	100.900	244	69	93	8

The biomass supply considers the whole supply chain of the energy carrier from exploration, production, processing and transport of the fuels to the power plants. The country / region-specific biomass supply (by import and / or domestic supply) including the country / region-specific energy carrier properties (e.g. element and energy contents) is accounted for.

2.2.3. Steam from hard coal

The steam is produced in a hard coal specific steam plant with an efficiency of 88%.

Considered are national and regional specific technology standards of the steam plants in regard to efficiency and emission control, with the following emission factors:

Emission factors - Steam from hard coal					
[kg/TJ fuel input]	CO ₂	CO	SO ₂	NOx	Dust
Belgium	92.700	15	250	183	14
China	90.567	106	329	580	146
Germany	94.000	9	70	70	64
Spain	101.000	19	567	335	35
Italy	97.621	19	157	87	4
Netherlands	96.230	9	70	64	3
Russia	96.067	33	967	478	99
Great Britain	90.450	25	259	262	9
United States	92.492	29	403	141	6
Asia	94.600	49	311	346	109
Europe	94.206	19	245	175	14

The hard coal supply considers the whole supply chain of the energy carrier from exploration, production, processing and transport of the fuels to the power plants. The country / region-specific hard coal supply (by import and / or domestic supply) including the country / region-specific energy carrier properties (e.g. element and energy contents) is accounted for.

2.2.4. Steam from light fuel oil

The steam is produced in a light fuel oil (LFO) specific steam plant with an efficiency of 92%.

Considered are national and regional specific technology standards of the steam plants in regard to efficiency and emission control, with the following differentiation for emission factors:

- The steam plant has no air pollution control
- The steam plant is equipped with low NOx burner.
- The steam plant is equipped with selective catalytic reduction for NOx removal.

Emission factors - Light fuel oil						
	[kg/TJ fuel input]	CO ₂	CO	SO ₂	NOx	Dust
Europe (0.1% Sulphur)	uncontrolled	74.100	15	46,7	150	7
	Low Nox burner (< 10MW)	74.100	15	46,7	97,5	7
	SCR (> 10 MW)	74.100	15	46,7	30	7
Europe (0.2% Sulphur)	uncontrolled	74.100	15	93,4	150	7
	Low Nox burner (< 10MW)	74.100	15	93,4	97,5	7
	SCR (> 10 MW)	74.100	15	93,4	30	7
Asia (0.1% Sulphur)	uncontrolled	74.100	15	46,7	150	7
	Low Nox burner (< 10MW)	74.100	15	46,7	97,5	7
	SCR (> 10 MW)	74.100	15	46,7	30	7
Asia (0.2% Sulphur)	uncontrolled	74.100	15	93,4	150	7
	Low Nox burner (< 10MW)	74.100	15	93,4	97,5	7
	SCR (> 10 MW)	74.100	15	93,4	30	7

The light fuel oil supply considers the whole supply chain of the energy carrier from exploration, production, processing and transport of the fuels to the power plants.

2.2.5. Steam from heavy fuel oil

The steam is produced in a heavy fuel oil (HFO) specific steam plant with an efficiency of 92%.

Considered are national and regional specific technology standards of the steam plants in regard to efficiency and emission control, with the following differentiation for emission factors:

- The steam plant has no air pollution control
- The emission control of the steam plant includes an electrostatic precipitator and a low NO_x burner.
- The emission control of the steam plant includes an electrostatic precipitator (ESP), flue gas desulphurisation (FGD) and low NO_x burner.
- The emission control of the steam plant includes a cyclone for dedusting.
- The emission control of the steam plant includes an electrostatic precipitator (ESP) and selective catalytic reduction (SCR) for NO_x removal.
- The emission control of the steam plant includes an electrostatic precipitator (ESP), flue gas desulphurisation (FGD) and selective catalytic reduction (SCR) for NO_x removal.

Emission factors - Heavy fuel oil							
[kg/TJ fuel input]		CO ₂	CO	SO ₂	NO _x	Dust	
Europe (1.0% Sulphur)	< 10 MW	uncontrolled	77.400	15	494	300	35
		ESP, low NO _x burner	77.400	15	494	195	3
		ESP, FGD, low NO _x burner	77.400	15	75	195	3
	> 10 MW	Cyclone	77.400	15	494	300	17
		ESP, SCR	77.400	15	494	60	3
		ESP, SCR, FGD	77.400	15	75	60	3
Asia (1.0% Sulphur)	< 10 MW	uncontrolled	77.400	15	494	300	35
		ESP, low NO _x burner	77.400	15	494	195	3
		ESP, FGD, low NO _x burner	77.400	15	75	195	3
	> 10 MW	Cyclone	77.400	15	494	300	17
		ESP, SCR	77.400	15	494	60	3
		ESP, SCR, FGD	77.400	15	75	60	3
Asia (3.5% Sulphur)	< 10 MW	uncontrolled	77.400	15	1740	300	53
		ESP, low NO _x burner	77.400	15	1740	195	5
		ESP, FGD, low NO _x burner	77.400	15	261	195	5
	> 10 MW	Cyclone	77.400	15	1740	300	26
		ESP, SCR	77.400	15	1740	60	5
		ESP, SCR, FGD	77.400	15	261	60	5

The heavy fuel oil supply considers the whole supply chain of the energy carrier from exploration, production, processing and transport of the fuels to the power plants.

2.2.6. Steam from natural gas

The steam is produced in a natural gas specific steam plant with an efficiency of 94%.

Considered are national and regional specific technology standards of the steam plants in regard to efficiency and emission control, with the following emission factors:

Emission factors - Steam from natural gas						
[kg/TJ fuel input]		CO ₂	CO	SO ₂	NOx	Dust
< 10MW	Belgium	55.920	41	0,3	70	0,5
	Switzerland	55.000	20	0,5	70	0,5
	China	56.100	20	0,2	70	0,5
	Germany	56.000	5	0,4	42	0,3
	Spain	56.388	20	0,1	70	0,5
	Italy	57.201	25	0,4	50	0,2
	Netherlands	56.700	20	0,4	70	0,5
	Russia	55.257	20	0,4	70	0,5
	Great Britain	57.880	20	0,4	70	0,5
	United States	55.822	20	0,4	23	0,8
	Asia	56.100	20	0,2	70	0,5
	Europe	56.850	20	0,3	70	0,5
> 10 MW	Belgium	55.920	20	0,3	47	0,3
	Switzerland	55.000	20	0,5	19	0,3
	China	56.100	46	0,2	69	1,7
	Germany	56.000	2	0,4	45	0,3
	Spain	56.388	14	0,1	23	1,3
	Italy	57.201	14	0,4	38	0,7
	Netherlands	56.700	2	0,4	47	0,3
	Russia	55.257	19	0,4	150	1,7
	Great Britain	57.880	9	0,4	36	1,1
	United States	55.822	4	0,4	33	0,8
	Asia	56.100	39	0,2	89	0,9
	Europe	56.850	11	0,3	40	0,9

The natural gas supply considers the whole supply chain of the energy carrier from exploration, production, processing and transport of the fuels to the power plants. The country / region-specific natural gas supply (by import and / or domestic supply) including the country / region-specific energy carrier properties (e.g. element and energy contents) is accounted for.

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 heat datasets.

2. Types and sources of data

The inventory is mainly based on industry data and is completed, where necessary, by secondary literature data.

Detailed power/steam plant models were used, which combine measured (e.g. NOx) with calculated emission values (e.g. heavy metals). The inventory is partly based on primary industry data, partly on secondary literature data.

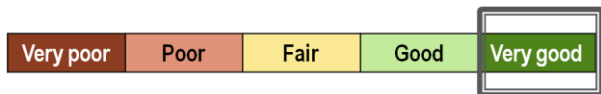
The datasets were created with the use of the following elements and references:

wood

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- 13. Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes
- EMEP/EEA air pollutant emission inventory guidebook - 2009
- Brennstoffe und Verbrennungsrechnung, 2. Auflage
- GHG Inventories 2008 - Common Reporting Format (CRF)
- Erarbeitung der Grundlagen für das BVT - Merkblatt Großfeuerungsanlagen
- The European Pollutant Release and Transfer Register
- Telefonische Recherche - Preis Kraftwerksnebenprodukte
- Plant-by-Plant emissions of SO₂, NO_x and dust and energy input to large combustion plants covered...
- Integrated Pollution Prevention and Control (IPPC) - Ref. Doc. on the BAT for Large Combustion Plant
- Compilation of Air Pollutant EF, V. 1: Stationary Point and Area Sources, AP 42, Fifth Edition
- Dampferzeugung
- Kraftwerkstechnik
- Die Brennstoff-Frage - Energieversorgungslösungen für Industrie und Kommunen

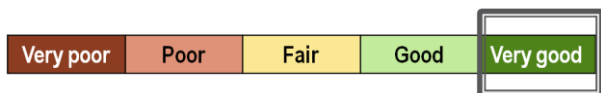
3. Data quality

3.1. Technological representativeness



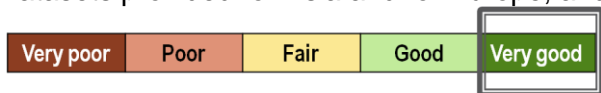
3.2. Time-related coverage

Data collection period: 2010-2012, reference year 2008, annual average

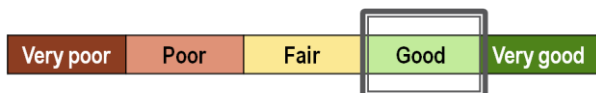


3.3. Geographical coverage

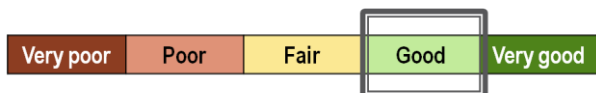
Datasets provided for Asia and for Europe, and for main countries



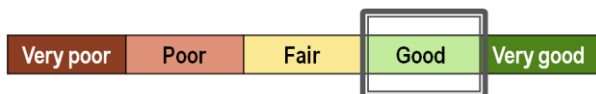
3.4. Precision



3.5. Completeness



3.6. Consistency



4. Multi-functionality and allocation procedure

4.1. Foreground system allocation procedure

Steam and power plant by-products, i.e. gypsum, boiler ash and fly ash are allocated by market value due to no common physical properties.

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 datasets were reviewed by internal critical review:

- **Raw data:** Validation of data sources, Sample tests on calculations, Cross-check with other source, Expert judgement
- **Unit process(es), single operation :** Validation of data sources, Sample tests on calculations, 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
- **Unit process(es), black box:** Validation of data sources, Sample tests on calculations, 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 aggregated system:** Validation of data sources, Sample tests on calculations, 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
- **Documentation :** Expert judgement, Compliance with ISO 14040 to 14044
- **Life cycle inventory methods:** 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 glass datasets specifications was held on 25 March 2011 to identify the heat datasets required for environmental labeling.

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

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

Consultation specification	Implementation in Base Impacts®	Justification
Datasets should be provided for different Nox reduction technologies and power of steam plant	Data provided also for different fuel composition (sulfur content) for light fuel oil and heavy fuel oil	Data available