Life Cycle Inventories of solid fossil fuels

Updates for electricity generation from hard coal, lignite and peat

Version 3.0

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SUMMARY

The power sector, and especially coal power generation, is of high importance for Life Cycle Assessment (LCA) studies due to its high contributions across a wide range of environmental impact categories. Up to this update, the underlying Life Cycle Inventory (LCI) data of the supply chain for electricity generation from solid fossil fuels in the UVEK:2018 database was largely based on raw data from the year 2007 and older. Since then, environmental regulation in most countries has become substantially more strict and novel technologies have been introduced to abate emissions, while technological advances have improved on the efficiencies of the coal power generation.

This comprehensive update of the LCI models for the complete solid fossil fuel supply chain in the UVEK database includes the actualisation of a total of 87 LCI datasets, the introduction of 35 new heat datasets as well as structural changes due to new and obsolete LCI datasets. The update of the solid fossil fuel supply chain for the UVEK database focuses on coal mining, hard coal supply mixes, solid fossil fuel combustion in power plants and electricity generation. Furnaces fired by solid fossil fuels as well as related infrastructure like coal mine storage facilities as well as power plant infrastructure are not updated and remain unchanged as described in Röder et al. (2007). The full report of Röder et al. (2007) in German is attached as annex to this report.

The update of LCI models for the solid fossil fuel supply chain in the UVEK database is a collaborative effort of Zürich University of Applied Sciences (ZHAW) and the Swiss Federal Institute of Technology (ETH) and was carried out in accordance with the data quality guideline of ecoinvent v2.0 (Datenqualitätsrichtlinie ecoinvent Daten V2.0, DQRv2) according to Frischknecht et al. (2007).

Electricity generation from solid fossil fuels is among the technologies with the highest environmental impacts per kWh of electricity generated. The greenhouse gas emissions caused by the generation of 1 kWh of electricity from hard coal ranges from 0.861 to 1.32 kg CO_2-eq with generation in the Czech Republic causing the highest greenhouse gas emissions with 1.32 kg CO_2-eq followed by Russia and India with 1.15 and 1.23 kg CO_2-eq, respectively. The greenhouse gas emissions caused by the generation of 1 kWh of electricity from lignite ranges from 1.0 to 1.35 kg CO_2-eq with generation in the Bosnia Herzegovina causing the highest greenhouse gas emissions with 1.35 kg CO_2-eq followed by Greece and Slovakia with 1.33 and 1.28 kg CO_2-eq, respectively.

The primary energy demand caused by the generation of 1 kWh of electricity from hard coal ranges from 9.53 to 14.7 MJ oil-eq with generation in the Czech Republic causing the highest primary energy with 14.7 MJ oil-eq followed by India and Russia with 14.2 and 13.5 MJ oil-eq, respectively. The primary energy

demand caused by the generation of 1 kWh of electricity from lignite ranges from 9.34 to 22.9 MJ oil-eq with generation in the Greece causing the highest primary energy with 22.9 MJ oil-eq followed by North Macedonia and the Serbia with 15.3 and 14.9 MJ oil-eq, respectively.

The total environmental impacts caused by the generation of 1 kWh of electricity from hard coal ranges from 1’010 to 1’830 eco-points with generation in the India causing the highest total environmental impacts with 1’830 eco-points followed by Czech Republic and the Russia with 1’600 and 1’570 eco-points, respectively. The total environmental impacts caused by the generation of 1 kWh of electricity from lignite ranges from 1’150 to 1’910 eco-points with generation in the North Macedonia causing the highest total environmental impacts with 1’910 eco-points followed by Bosnia Herzegovina and the Serbia with 1’690 and 1’670 eco-points, respectively.

Most relevant processes in supply chain for electricity generation from solid fossil fuels are the combustion process, the conversion efficiencies in the power plants and coal mining. The conversion efficiency is not reflected in the contribution analysis and only influences the overall magnitude of results. The detailed contribution analysis for electricity from hard coal generated in Germany revealed, that most important contributor for greenhouse gas emissions with more than 84 % are the direct emissions from combustion of hard coal, followed by the coal supply with 15 %. The contribution of flue gas treatment and power plants only have a minor contribution to the total greenhouse gas emissions of 0.5 and 0.2 %, respectively.

Most important contributor for primary energy demand with more than 98 % is the hard coal supply. The contribution of flue gas treatment and power plants only have a minor contribution to the primary energy demand of 0.7 and 0.2 %, respectively. Most important contributor for total environmental impacts with more than 73 % are the direct emissions from combustion of hard coal, followed by the coal supply with 25 %. The contribution of flue gas treatment and power plants only have a minor contribution to the total environmental impacts of 1.4 and 0.3 %, respectively.

This update of the LCI models for the solid fossil fuel supply chain in general leads to lower environmental impact assessment results caused by the electricity generation from solid fossil fuels mainly due to (1) the update of the power plants efficiencies, (2) the update of the emission profiles of the solid fossil fuel combustion datasets (3) the update of the methane emissions from the coal mining processes and (4) the update of the hard coal supply mixes (sorted in descending order according to importance).

The highest changes occur for the total environmental impacts assessed with the Ecological Scarcity Method 2021. The changes in total environmental impacts ranges from +8 % to -42 % per kWh of electricity generated from solid fossil fuels. This reduction is mainly due to the updated key emissions, methane in case of coal mining, CO_2 and priority air pollutants like, NO_x, SO_2, PM as well as trace elements (heavy metals, volatile organic compounds) in case of the solid fossil fuel combustion. The changes for the greenhouse gas emissions according to IPCC 2021 per kWh of electricity generated range from +19 % to -24 % and can mainly be attributed to the change in power plant conversion efficiencies. The changes in primary energy demand per kWh of electricity generated range from +14 % to -20 % and result exclusively from the change in power plant conversion efficiencies, since the heating values and coal input into the combustion process has not been changed compared to the last version of the UVEK database.

In general, the update leads to a harmonisation of inventory models and differences in the impact assessment results from different electricity generation datasets were reduced. However, with greenhouse gas emissions of 0.861 kg CO_2-eq. – 1.35 kg CO_2-eq. per kWh electricity from hard coal, lignite and peat power generation solid fossil fuels remains among the technologies with the highest contribution to the global climate crisis.

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ABBREVIATIONS

Ar	Argon
AT	Austria
AU	Australia
BA	Bosnia and Herzegovina
BE	Belgium
BIT	Bituminous coal
BKB	Brown coal briquettes
CAS	Centre for Atmospheric Sciences
CEC	China Electricity Council
CEDS	Community Emissions Data System
CENTREL	Central European Electricity Network
CH_4	Chemical formula for methane
CN	China
CO_2	Chemical formula for carbon dioxide
CPA	Centrally Planned Asia
CZ	Czech Republic
DE	Germany
DETEC	Federal Department of the Environment, Transport, Energy and Communications
DFFE	Department of Forestry, Fisheries and the Environment
EDGAR	Emissions Database for Global Atmospheric Research
EEA	European Environment Agency
EEU	Region Eastern Europe
EIA	US Energy Information Administration
EMEP	European Monitoring and Evaluation Programme
ENTSOE-E	European Network of Transmission System Operators
EPA	Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
ES	Spain
ETH	Swiss Federal Institute of Technology, Eidgenössische Technische Hochschule
FOEN	Federal Office for the Environment
FR	France
FRCC	Florida Reliability Coordinating Council
GR	Greece
HU	Hungary
IEA	International Energy Agency
IITD	Indian Institute of Technology Delhi
IN	India
IPCC	Intergovernmental Panel on Climate Change
IT	Italy
kWh	Kilowatt hour
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LHV	Lower heating value
LIG	Lignite
MK	North Macedonia

MRO	Midwest Reliability Organization
N_2	Nitrogen
NERC	North American Electric Reliability Corporation
NL	Netherland
NMVOC	Non-methane volatile organic compound
NORDEL	Electricity transmission grid operators of Iceland, Norway, Sweden and Finland
NO_x	Chemical formula for nitrogen oxides
NPCC	Northeast Power Coordinating Council
O_2	Oxygen
OECD	Organisation for Economic Co-operation and Development (OECD)
PL	Poland
PM	Particulate matter
$PM_{>10}$	Particulate matter with a diameter of more than 10 micrometres
$PM_{10-2.5}$	Particulate matter with a diameter between 2.5 and 10 micrometres
$PM_{2.5}$	Particulate matter with a diameter below 2.5 micrometres
PT	Portugal
RC	Refined coal
RER	Region Europe
RFC	Reliability First Corporation
RLA	Region Latin America
RNA	Region North America
RS	Serbia
RU	Russia
S&P	Standard and Poor's
SCR	Selective catalytic reduction
SERC	SERC Reliability Corporation
SI	Slovenia
SK	Slovakia
SO_2	Chemical formula for sulphur dioxide
SPP	Southwest Power Pool
SUB	Sub-bituminous coal
TNO	The Netherlands Organization for Applied Scientific Research
UCTE	Union for the Coordination of Transmission of Electricity
US	United States
UVEK	Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation
WC	Waste coal
WECC	Western Electricity Coordinating Council
WEU	Region Western Europe
ZA	South Africa
ZHAW	Zurich University of Applied Sciences

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1 INTRODUCTION

The power sector, and especially coal power generation, is of high importance for Life Cycle Assessment (LCA) studies due to its high contributions across a wide range of environmental impact categories. Up to this update, the underlying Life Cycle Inventory (LCI) data of the supply chain for electricity generation from solid fossil fuels in the UVEK:2018 database (UVEK DQRv2, 2018) was largely based on raw data from the year 2007 and older), described in ecoinvent reports No. 5 (Dones et al., 2004) and No. 6 (Dones et al., 2007). Thus, for example, the data on the coal supply mixes for power plants are based on statistical data from the year 2000. Similarly, the average European coal-based electricity generation inventory is based on an outdated country share breakdown from the year 2000. Plant efficiencies are based on 2007 data. In addition, some of the combustion-related pollutant emissions are based on data or models from the 1990s. Moreover, the technical performances of the power plants are based on 15 years old data. Finally, additional inventories of coal-fired power generation for Russia (Bauer et al., 2012) and India (Stucki, 2011) have been added to the database following a different structural approach in comparison to existing inventories.

The situation described above influence the environmental impact assessment results of electricity generation from solid fossil fuels, among other things because:

- The supply mix determines the impact from mining, including methane emissions from coal extraction;
- The emission profiles of the coal combustion process (mass of pollutants that can be emitted during combustion) and therefore the emissions per kWh of electricity produced strongly affect the impact assessment results;
- The efficiency of power plants and correspondingly the quantity of fuel burned to produce 1 kWh and thus its emissions changed over time.

Since the development of inventories in 2007, environmental regulation in most countries has become substantially more strict and novel technologies have been introduced to abate emissions, while technological advances have improved on the efficiencies of coal power generation. The life cycle inventory models for solid fossil fuel power generation therefore needed to be updated to reflect technical and market developments.

The Federal Office for the Environment (FOEN) commissioned an update of the inventory data for the generation of electricity from coal, peat and lignite and their process chains in the UVEK:2023 database. This update provides the upcoming version of the UVEK:2023 database with updated inventories for these types of electricity productions. Solid fossil fuel power generation is modelled for more than 20 different countries and regions. The update of Life Cycle Inventory (LCI) models was a collaborative effort of the Zurich University of Applied Sciences (ZHAW) and the Swiss Federal Institute of Technology (ETH). The researchers from the Ecological Systems Design Group at ETH are responsible for the update of the key LCI parameters on power plant level (emissions factors, pollutants, and efficiencies). They have in-depth knowledge of the global coal supply chains (Oberschelp et al., 2019). The researchers from the Life Cycle Assessment research group at ZHAW are responsible for the compilation of LCI models according to the recommendations for data quality guidelines according to Frischknecht et al. (2007) as well as the update of methane emissions from coal mining and the hard coal supply mixes.

Other emissions and inputs like the coal power plant construction, auxiliary materials for the operation of the power plants, the mining activities and others remain unchanged as described in Röder et al. (2007). The full report of Röder et al. (2007) in German is attached as annex to this report.

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2 GOAL AND SCOPE

This comprehensive update of the LCI models for the complete solid fossil fuels supply chain in the UVEK database includes the actualisation of a total 87 LCI datasets, the introduction of 35 new heat datasets as well as structural changes due to new and obsolete datasets. All updated datasets as well as the obsolete datasets and mappings to new datasets are described in the section 2.1. The system boundaries of the updated LCI models are described in section 2.2 and other general technical descriptions in the section 2.3. Furthermore, there is a list of the obsolete datasets in the Annex "List of obsolete datasets", that can be removed after the update as well as a replacement file in the Annex "Replacement file" that describes which datasets have to replaced including their corresponding replacements.

2.1 Updated and new datasets

This section provides an overview of all LCI datasets updated within this actualisation. Section 2.1.1 list all the updated LCI datasets for coal, lignite and peat mining activities. Section 2.1.2 lists all the updated LCI dataset for hard coal supply mixes. Section 2.1.3 and 2.1.4 list all the updated LCI datasets for hard coal, lignite and peat combustion. And finally, section 2.1.5 and 2.1.6 list all the LCI data for electricity generation from the solid fossil fuels hard coal, lignite and peat. A comprehensive list of replacement and obsolete datasets is also shown in Tab. 5.17 and Tab. 5.18 in the annex. Furthermore, there is a digital version of these tables in the excel file "ecoinvent-names-v2.0-ZHAW-v1.xlsx" in the tab "replacements".

2.1.1 Hard coal, lignite and peat mining

The update for the mining of solid fossil fuels includes a total of 11 hard coal, lignite and peat mining datasets as shown in Tab. 2.1. The dataset "hard coal, at mine/kg/WEU" is obsolete since there is no more relevant hard coal mining in Western Europe and is not linked to the hard coal supply mixes of the respective countries.

Tab. 2.1: List of the updated hard coal, lignite and peat mine datasets including mapping of the UVEK:2018 against UVEK:2023 datasets; obsolete datasets in light grey.

UVEK:2018 datasets	UVEK:2023 datasets
hard coal, at mine/kg/AU	hard coal, at mine/kg/AU
hard coal, at mine/kg/CN	hard coal, at mine/kg/CN
hard coal, at mine/kg/CPA	hard coal, at mine/kg/CPA
hard coal, at mine/kg/EEU	hard coal, at mine/kg/EEU
hard coal, at mine/kg/RLA	hard coal, at mine/kg/RLA
hard coal, at mine/kg/RNA	hard coal, at mine/kg/RNA
hard coal, at mine/kg/RU	hard coal, at mine/kg/RU
hard coal, at mine/kg/ZA	hard coal, at mine/kg/ZA
hard coal, at mine/kg/WEU	obsolete
hard coal, at mine/kg/IN	hard coal, at mine/kg/IN
lignite, at mine/kg/RER	lignite, at mine/kg/RER
peat, at mine/kg/NORDEL	peat, at mine/kg/NORDEL

2.1.2 Hard coal supply mix

The update for the hard coal supply mixes includes a total of 16 hard coal supply datasets as shown in Tab. 2.2. The hard coal mix for UCTE has also been updated although this dataset is mainly used in the steel supply chain of the UVEK database.

Tab. 2.2: List of the updated hard coal supply datasets including mapping of the UVEK:2018 against UVEK:2023 datasets.

UVEK:2018 datasets	UVEK:2023 datasets
Hard coal supply mix, at regional storage/US U	Hard coal supply mix, at regional storage/US U
Hard coal supply mix/AT U	Hard coal supply mix/AT U
Hard coal supply mix/BE U	Hard coal supply mix/BE U
Hard coal supply mix/CN U	Hard coal supply mix/CN U
Hard coal supply mix/CZ U	Hard coal supply mix/CZ U
Hard coal supply mix/DE U	Hard coal supply mix/DE U
Hard coal supply mix/FR U	Hard coal supply mix/FR U
Hard coal supply mix/ES U	Hard coal supply mix/ES U
Hard coal supply mix/HR U	Hard coal supply mix/HR U
Hard coal supply mix/IT U	Hard coal supply mix/IT U
Hard coal supply mix/NL U	Hard coal supply mix/NL U
Hard coal supply mix/PL U	Hard coal supply mix/PL U
Hard coal supply mix/PT U	Hard coal supply mix/PT U
Hard coal supply mix/SK U	Hard coal supply mix/SK U
Hard coal supply mix/IN U	Hard coal supply mix/IN U
Hard coal, at regional storage/RU U	Hard coal, at regional storage/RU U
Hard coal mix, at regional storage/UCTE U	Hard coal mix, at regional storage/UCTE U

2.1.3 Hard coal combustion ("burned in power plant")

The update for the hard coal combustion ("burned in power plant") datasets includes a total of 16 hard coal combustion datasets as shown in Tab. 2.3. The dataset "Hard coal, burned in coal mine power plant/CN U" has been merged with the dataset "Hard coal, burned in power plant/CN U" and is now obsolete. The regionalised datasets for the different US grid operators (ERCOT, FRCC, MRO, NPCC, RFC, SERC, SPP and WECC) have been merged to one dataset "Hard coal, burned in power plant/US U". Basis for the merger before the update of the emission profile was the former WECC dataset. The power plant dataset for the "Hard coal, burned in power plant/US U" dataset has been harmonised with the European combustion datasets. All regionalised datasets for the different US grid operators (ERCOT, FRCC, MRO, NPCC, RFC, SERC, SPP and WECC) are considered as obsolete. All datasets with an input of US grid operators (ERCOT, FRCC, MRO, NPCC, RFC, SERC, SPP and WECC) need to be relinked to WECC/US power plant dataset.

Tab. 2.3: List of the updated hard coal combustion datasets including mapping of the UVEK:2018 against UVEK:2023 datasets; obsolete and merged datasets in light grey.

UVEK:2018 datasets	UVEK:2023 datasets
Hard coal, burned in power plant/AT U	Hard coal, burned in power plant/AT U
Hard coal, burned in power plant/BE U	Hard coal, burned in power plant/BE U
Hard coal, burned in power plant/CN U	Hard coal, burned in power plant/CN U
Hard coal, burned in coal mine power plant/CN U	
Hard coal, burned in power plant/CZ U	Hard coal, burned in power plant/CZ U
Hard coal, burned in power plant/DE U	Hard coal, burned in power plant/DE U
Hard coal, burned in power plant/ES U	Hard coal, burned in power plant/ES U
Hard coal, burned in power plant/FR U	Hard coal, burned in power plant/FR U
Hard coal, burned in power plant/HR U	Hard coal, burned in power plant/HR U
Hard coal, burned in power plant/IT U	Hard coal, burned in power plant/IT U
Hard coal, burned in power plant/NL U	Hard coal, burned in power plant/NL U
Hard coal, burned in power plant/PL U	Hard coal, burned in power plant/PL U
Hard coal, burned in power plant/PT U	Hard coal, burned in power plant/PT U
Hard coal, burned in power plant/SK U	Hard coal, burned in power plant/SK U
Hard coal, burned in power plant/ERCOT U	Hard coal, burned in power plant/US U
Hard coal, burned in power plant/FRCC U	
Hard coal, burned in power plant/MRO U	
Hard coal, burned in power plant/NPCC U	
Hard coal, burned in power plant/RFC U	
Hard coal, burned in power plant/SERC U	
Hard coal, burned in power plant/SPP U	
Hard coal, burned in power plant/WECC U	
Hard coal, burned in power plant/RU U	Hard coal, burned in power plant/RU U
Hard coal, burned in power plant/IN U	Hard coal, burned in power plant/IN U

2.1.4 Lignite and peat combustion ("burned in power plant")

The update for the lignite and peat combustion ("burned in") datasets includes a total of 11 lignite and peat combustion datasets as shown in Tab. 2.4. The datasets "Lignite, burned in power plant/AT U", "Lignite, burned in power plant/ES U" and "Lignite, burned in power plant/FR U" are obsolete since there is no more relevant lignite power plants in these countries. The dataset "Lignite, burned in power plant/CS U" was replaced with the dataset "Lignite, burned in power plant/RS U". An individual dataset for lignite combustion in Montenegro was not compiled.

Tab. 2.4: List of the updated lignite and peat combustion datasets including mapping of the UVEK:2018 against UVEK:2023 datasets; obsolete and merged datasets in light grey.

UVEK:2018 datasets	UVEK:2023 datasets
Lignite, burned in power plant/AT U	obsolete
Lignite, burned in power plant/BA U	Lignite, burned in power plant/BA U
Lignite, burned in power plant/CS U	Lignite, burned in power plant/RS U
Lignite, burned in power plant/CZ U	Lignite, burned in power plant/CZ U
Lignite, burned in power plant/DE U	Lignite, burned in power plant/DE U
Lignite, burned in power plant/ES U	obsolete
Lignite, burned in power plant/FR U	obsolete
Lignite, burned in power plant/GR U	Lignite, burned in power plant/GR U
Lignite, burned in power plant/HU U	Lignite, burned in power plant/HU U
Lignite, burned in power plant/MK U	Lignite, burned in power plant/MK U
Lignite, burned in power plant/PL U	Lignite, burned in power plant/PL U
Lignite, burned in power plant/SI U	Lignite, burned in power plant/SI U
Lignite, burned in power plant/SK U	Lignite, burned in power plant/SK U
Peat, burned in power plant/NORDEL U	Peat, burned in power plant/ENTSO-E U

2.1.5 Electricity and heat generation from hard coal

The update for the electricity generation datasets from hard coal includes a total of 19 electricity generation datasets as shown in Tab. 2.5. The dataset “Electricity, hard coal, at coal mine power plant/CN U” was merged with the dataset “Electricity, hard coal, at power plant/CN U” and is now obsolete. The regionalised datasets for the different US grid operators (ERCOT, FRCC, MRO, NPCC, RFC, SERC, SPP and WECC) have been merged to one dataset “Electricity, hard coal, at power plant/US U” and are obsolete. The datasets “Electricity, hard coal, at power plant/CENTREL U”, “Electricity, hard coal, at power plant/NORDEL U” and “Electricity, hard coal, at power plant/UCTE U” are replaced with “Electricity, hard coal, at power plant/ENTSO-E U” and are obsolete.

In addition, there are 14 new datasets for heat from hard coal generated by cogeneration in power plants with allocation according to exergy as shown in Tab. 2.6.

Tab. 2.5: List of the updated electricity datasets for generation from hard coal including mapping of the UVEK:2018 against UVEK:2023 datasets; obsolete and merged datasets in light grey.

UVEK:2018 datasets	UVEK:2023 datasets
Electricity, hard coal, at power plant/AT U	Electricity, hard coal, at power plant/AT U
Electricity, hard coal, at power plant/BE U	Electricity, hard coal, at power plant/BE U
Electricity, hard coal, at power plant/CN U	Electricity, hard coal, at power plant/CN U
Electricity, hard coal, at coal mine power plant/CN U	
Electricity, hard coal, at power plant/CZ U	Electricity, hard coal, at power plant/CZ U
Electricity, hard coal, at power plant/DE U	Electricity, hard coal, at power plant/DE U
Electricity, hard coal, at power plant/ES U	Electricity, hard coal, at power plant/ES U
Electricity, hard coal, at power plant/FR U	Electricity, hard coal, at power plant/FR U
Electricity, hard coal, at power plant/HR U	Electricity, hard coal, at power plant/HR U
Electricity, hard coal, at power plant/IT U	Electricity, hard coal, at power plant/IT U
Electricity, hard coal, at power plant/NL U	Electricity, hard coal, at power plant/NL U
Electricity, hard coal, at power plant/PL U	Electricity, hard coal, at power plant/PL U
Electricity, hard coal, at power plant/PT U	Electricity, hard coal, at power plant/PT U
Electricity, hard coal, at power plant/SK U	Electricity, hard coal, at power plant/SK U
Electricity, hard coal, at power plant/ERCOT U	Electricity, hard coal, at power plant/US U
Electricity, hard coal, at power plant/FRCC U	
Electricity, hard coal, at power plant/MRO U	
Electricity, hard coal, at power plant/NPCC U	
Electricity, hard coal, at power plant/RFC U	
Electricity, hard coal, at power plant/SERC U	
Electricity, hard coal, at power plant/SPP U	
Electricity, hard coal, at power plant/WECC U	
Electricity, hard coal, at power plant/RU U	Electricity, hard coal, at power plant/RU U
Electricity, hard coal, at power plant/IN U	Electricity, hard coal, at power plant/IN U
Electricity, hard coal, at power plant/CENTREL U	Electricity, hard coal, at power plant/ENTSO-E U
Electricity, hard coal, at power plant/NORDEL U	
Electricity, hard coal, at power plant/UCTE U	

Tab. 2.6: List of the new heat datasets for cogeneration from hard coal; allocation according to exergy

UVEK:2018 datasets	UVEK:2023 datasets
None	heat, hard coal, at cogen, allocation exergy/AT U
None	heat, hard coal, at cogen, allocation exergy/BE U
None	heat, hard coal, at cogen, allocation exergy/CN U
None	heat, hard coal, at cogen, allocation exergy/CZ U
None	heat, hard coal, at cogen, allocation exergy/DE U
None	heat, hard coal, at cogen, allocation exergy/ES U
None	heat, hard coal, at cogen, allocation exergy/FR U
None	heat, hard coal, at cogen, allocation exergy/IT U
None	heat, hard coal, at cogen, allocation exergy/NL U
None	heat, hard coal, at cogen, allocation exergy/PL U
None	heat, hard coal, at cogen, allocation exergy/RU U
None	heat, hard coal, at cogen, allocation exergy/SK U
None	heat, hard coal, at cogen, allocation exergy/US U
None	heat, hard coal, at cogen, allocation exergy/ENTSO-E U

2.1.6 Electricity and heat generation lignite and peat

The update for the electricity generation datasets from lignite and peat includes a total of 14 electricity generation datasets as shown in Tab. 2.7. The datasets “Electricity, lignite, at power plant/AT U”, “Electricity, lignite, at power plant/ES U” and “Electricity, lignite, at power plant/FR U” are obsolete. The datasets “Electricity, lignite, at power plant/CENTREL U” and “Electricity, lignite, at power plant/UCTE U” are replaced by “Electricity, lignite, at power plant/ENTSO-E U” and are obsolete. The dataset “Electricity, peat, at power plant/NORDEL U” is replaced by the dataset “Electricity, peat, at power plant/ENTSO-E U” and is obsolete.

In addition, there are 11 new datasets for heat from lignite and peat generated by cogeneration in power plants with allocation according to exergy as shown in Tab. 2.8.

Tab. 2.7: List of the updated electricity datasets for generation from lignite and peat including mapping of the UVEK:2018 against UVEK:2023 datasets; obsolete and merged datasets in light grey.

UVEK:2018 datasets	UVEK:2023 datasets
Electricity, lignite, at power plant/AT U	obsolete
Electricity, lignite, at power plant/BA U	Electricity, lignite, at power plant/BA U
Electricity, lignite, at power plant/CS U	Electricity, lignite, at power plant/RS U
Electricity, lignite, at power plant/CZ U	Electricity, lignite, at power plant/CZ U
Electricity, lignite, at power plant/DE U	Electricity, lignite, at power plant/DE U
Electricity, lignite, at power plant/ES U	obsolete
Electricity, lignite, at power plant/FR U	obsolete
Electricity, lignite, at power plant/GR U	Electricity, lignite, at power plant/GR U
Electricity, lignite, at power plant/HU U	Electricity, lignite, at power plant/HU U
Electricity, lignite, at power plant/MK U	Electricity, lignite, at power plant/MK U
Electricity, lignite, at power plant/PL U	Electricity, lignite, at power plant/PL U
Electricity, lignite, at power plant/SI U	Electricity, lignite, at power plant/SI U
Electricity, lignite, at power plant/SK U	Electricity, lignite, at power plant/SK U
Electricity, lignite, at power plant/CENTREL U	Electricity, lignite, at power plant/ENTSO-E U
Electricity, lignite, at power plant/UCTE U	
Electricity, peat, at power plant/NORDEL U	Electricity, peat, at power plant/ENTSO-E U

Tab. 2.8: List of the new heat datasets for cogeneration from lignite and peat; allocation according to exergy

UVEK:2018 datasets	UVEK:2023 datasets
None	heat, lignite, at cogen, allocation exergy/BA U
None	heat, lignite, at cogen, allocation exergy/CZ U
None	heat, lignite, at cogen, allocation exergy/DE U
None	heat, lignite, at cogen, allocation exergy/GR U
None	heat, lignite, at cogen, allocation exergy/HU U
None	heat, lignite, at cogen, allocation exergy/PL U
None	heat, lignite, at cogen, allocation exergy/RS U
None	heat, lignite, at cogen, allocation exergy/SI U
None	heat, lignite, at cogen, allocation exergy/SK U
None	heat, peat, at cogen, allocation exergy/ENTSO-E U
None	heat, lignite, at cogen, allocation exergy/ENTSO-E U

2.2 System Boundaries

The update of solid fossil fuel supply chains for the UVEK database focuses on coal mining, hard coal supply mixes, solid fossil fuel combustion in power plants, and electricity generation. Furnaces fired by solid fossil fuels as well as related infrastructure like mines storage facilities as well as power plants, transports and logistics are not updated. Section 2.2.1 gives an overview over the main processes of the solid fossil fuel supply chain, section 2.2.2 gives a more detailed overview of the lignite supply chain and section 2.2.3 a more detailed overview of the hard coal supply chain.

2.2.1 Main processes coal supply chain

The main processes of the coal supply chain in the UVEK database are mining, refining, transport, power plants and furnaces as depicted in Fig. 2.1. This update only focuses on solid fossil fuel mining, hard coal supply mixes including transports and power plant operation. Processes related to refining and furnaces are not updated. Furthermore, the update of the mining processes is limited to methane emissions, because methane emissions are most important contributors for GHG emissions and total environmental impacts from coal mining. The update of transport and storage is limited to the hard coal supply mixes and their corresponding transports.

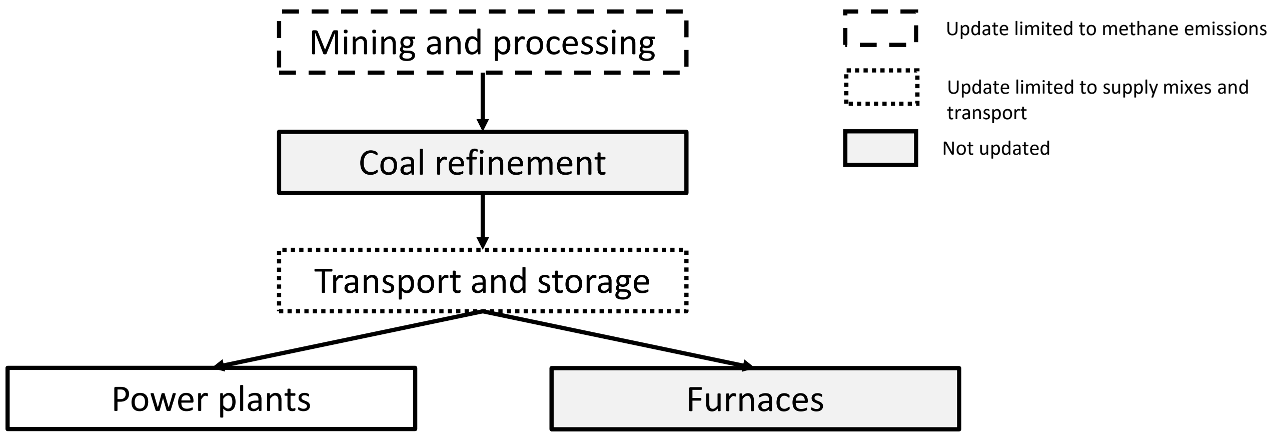

Fig. 2.1: Main processes in the coal supply chain as modelled in this project; main processes with grey shade are not updated; Mining and processing update is limited to methane emissions from coal mining

2.2.2 Lignite supply chain

An overview of the lignite supply chain in the UVEK database is depicted in Fig. 2.2. This update focuses on the parts of the lignite supply chain that are relevant for electricity generation. LCI datasets for lignite furnaces, as well as mining or power plant infrastructure are not updated.

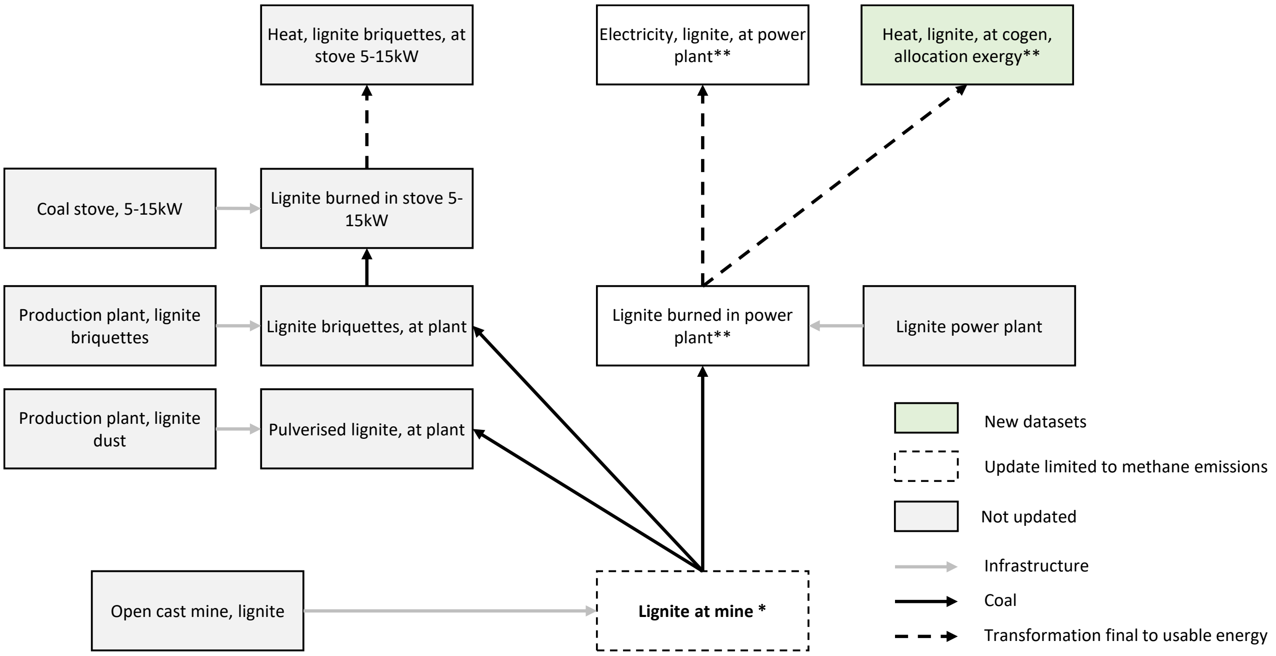

Fig. 2.2: Simplified process chain for the lignite system as modelled in this project. Only processes that are explicitly modelled are shown. Main processes in grey are not updated; Mining and processing update is limited to methane emissions

*** Modelled for European supply mix**

**** datasets listed in Tab. 2.4, Tab. 2.7 and Tab. 2.8**

2.2.3 Hard coal supply chain

An overview of the hard coal supply chain in the UVEK database is depicted in Fig. 2.3. This update focuses on the parts of the hard coal supply chain that are relevant for electricity generation. LCI datasets for hard coal furnaces, hard coal refining and transport are not updated. Furthermore, the LCI dataset for related infrastructure like hard coal mines, storage facilities and power plants are not updated.

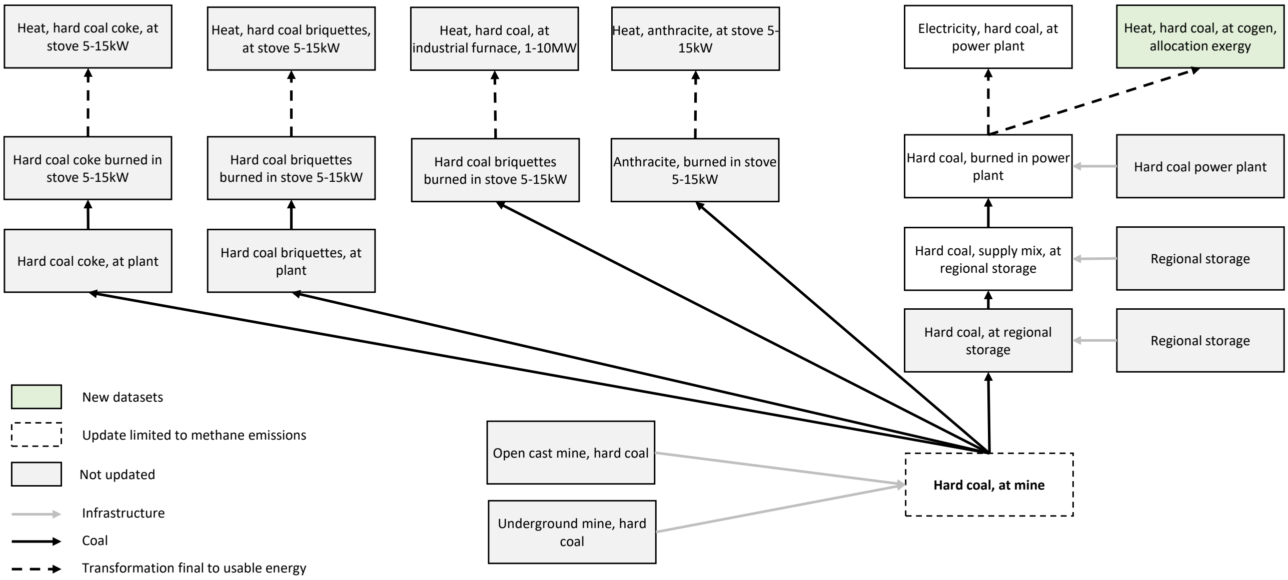

Fig. 2.3: Simplified process chain for the hard coal system as modelled in this project. Only processes that are explicitly modelled are shown. Processes in grey shade are not updated; Mining and processing update is limited to methane emissions from hard coal mining

2.3 Technical Description of the System

This section provides additional information on technical aspects relevant for the solid fossil fuel chains. Section 2.3.1 describes the used classification for coal types and section 2.3.2 the regional grouping and coverage.

2.3.1 Classification of coal types

The grouping of coal types around the world is not harmonized, as different national standards have been developed and still exist for historical reasons. Data collection efforts of the OECD and data compilations of the International Energy Agency (IEA) have led to some alignment. Since this update makes use of IEA data, their basic classification of coal is followed (International Energy Agency (IEA), 2019), while the terms “hard coal” and “lignite” have a different meaning as defined for UVEK:2018 and predecessors. The most relevant difference between UVEK and IEA classification is that “Sub-bituminous coal” is considered a type of “Lignite” by UVEK, while the IEA (and the majority of other data sources) consider this type of coal a “hard coal”. The mapping of IEA fuel types against UVEK fuel groups is shown in Tab. 2.9. Data of inputs and outputs generally includes both "main activity producers" (plants that supply energy to third parties) and "autoproducers" (plants that supply energy in whole or in part for own use) in the same way.

Tab. 2.9: Mapping of IEA fuel types against updated UVEK:2023 fuel groups.

IEA fuel type	UVEK:2023 fuel group
Anthracite	Hard coal
Coal tar	
Coke oven coke	
Coking coal	
Hard coal (if no detail)	
Other bituminous coal	
Sub-bituminous coal	
Brown coal briquettes (BKB)	Lignite
Brown coal (if no detail)	
Lignite	
Patent fuel	
Peat	Peat
Peat products	

In addition to data from the IEA, we also used data from the US Energy Information Administration (EIA) (2022). This data uses its own coal type classification system that is mapped to UVEK coal fuel groups as shown in Tab. 2.10.

Tab. 2.10: Mapping of EIA fuel types against updated UVEK:2023 fuel groups.

EIA fuel type	Abbreviation	UVEK:2023 fuel group
Bituminous coal	BIT	Hard coal
Refined coal	RC	
Sub-bituminous coal	SUB	
Waste coal	WC	
Lignite	LIG	Lignite

For Chinese coal types, another classification exists, but the statistical information used for this update groups all types of coal together. Thus, all Chinese coal types are classified as “Coal” for the use of the UVEK database, following the IEA approach of grouping all Chinese thermal coal as “Other bituminous coal” (Tab. 2.9).

2.3.2 Regional grouping and regional coverage

The regions covered with individual coal power generation datasets by the UVEK:2018 are largely European countries and countries of particular global importance. In addition, the US in the UVEK:2018 database is distinguished on a sub-national level (North American Electric Reliability Corporation (NERC) regions), and on a super-national level for the distinct European electricity grids. Several changes are made to this grouping in order to account for regional developments and priorities. In particular, the electricity grids in Europe have been integrated and synchronized with the operation of the new grid now being organized under the ENTSO-E. Thus, CENTREL, NORDEL and UCTE datasets are merged into one ENTSO-E dataset each (as listed in Tab. 2.11). In addition, the US NERC regions datasets are merged into one US dataset (as shown in Tab. 2.11).

Tab. 2.11: Merging of UVEK:2023 regions.

Region UVEK:2018	Region UVEK:2023
CENTREL	ENTSO-E
NORDEL	
UCTE	
ERCOT	US
FRCC	
MRO	
NPCC	
RFC	
SERC	
SPP	
WECC	

The former dataset for Serbia and Montenegro (“CS”) dataset is replaced by a Serbian (“RS”) dataset and an additional specific dataset for Montenegro (ME) was not added to the UVEK database. The Chinese coal mine power plant dataset “Electricity, hard coal, at coal mine power plant/CN U” is considered obsolete and is replaced by the general Chinese coal power dataset “Electricity, hard coal, at power plant/CN U”. These changes are all listed in Tab. 2.3 and Tab. 2.4 and apply likewise to fuel combustion datasets in Tab. 2.5 and Tab. 2.7.

3 LIFE CYCLE INVENTORIES

This chapter provides a detailed description of the adjustments in the LCI models of the process chains for electricity generation from solid fossil fuels in this update. Section 3.1 describes the update of methane emissions in the LCI of the coal mining activities. Section 3.2 describes the update of the hard coal supply mixes for all countries covered by the UVEK database. Section 3.3 describes the update of solid fossil fuel combustion datasets with the adjustments in the air pollutants. And finally, section 3.4 described the update of the LCI datasets for electricity generation from solid fossil fuels.

3.1 Methane emissions from coal mining

Methane (CH_4) emissions related to fuel extraction at the mine have a significant contribution to the impacts of electricity (Whitaker et al., 2012). At mining level of hard coal, the UVEK:2018 database considers nine supply regions: China (CN), East Asia (CPA), North America (RNA), South Africa (ZA), Australia (AU), Russia (RU), Western Europe (WEU), Central and Eastern Europe (EEU) and South America (RLA). For all regions, methane emissions related to fuel extraction were updated, as previous data were largely based on estimates. Only exception was the supply region of Western Europe, for which no update was carried out since coal mining is no longer relevant for this region. In addition to hard coal mining, methane emissions within the inventories of lignite extraction in Europe (RER) and peat extraction in Northern Europe (NORDEL) were updated.

UVEK:2018 and UVEK:2023 values for methane emissions related to fuel extraction are compared in Tab. 3.1. The corresponding methodologies used to derive updated methane emissions are described in section 3.1.1.

Other exchanges than the methane emissions remain unchanged as in the original coal mining datasets described in Chapter 6 *Förderung und Aufbereitung* of Röder et al. (2007). The full report of Röder et al. (2007) is attached as annex at the end of this report. The full detailed LCI datasets including adjustments and unchanged exchanges as well as the meta information are shown in Tab. 5.1 and Tab. 5.2 in the Annex.

Tab. 3.1: Compilation of methane emissions from coal mining, comparing values in UVEK:2018 datasets and updated UVEK:2023 datasets according EPA'19/IEA (2020/2018p) based on coal production for the year 2018 (IEA, 2019) and methane emissions for the year 2018 for Australia, United States and Russia based on (UNFCCC, 2023), for China based on (UNFCCC, 2018), for South Africa based on (DFFE, 2022), for India based on (GHGPI, 2018) and other countries based on (US Environmental Protection Agency (EPA), 2019).

Product		Methane emissions to air, UVEK:2018 datasets	Methane emissions to air, UVEK:2023 datasets	Ratio UVEK 2023 / UVEK 2018
		kg CH_4	kg CH_4	
hard coal, at mine/AU	1 t	2.7	2.35	0.87
hard coal, at mine/CN	1 t	16.9	5.92	0.35
hard coal, at mine/CPA	1 t	3	5.82	1.94
hard coal, at mine/EEU	1 t	8.2	11.2	1.37
hard coal, at mine/RLA	1 t	0.16	8.38	52.38
hard coal, at mine/RNA	1 t	3	3.46	1.15
hard coal, at mine/RU	1 t	9.2	7.9	0.86
hard coal, at mine/ZA	1 t	3.5	0.533	0.15
hard coal, at mine/IN	1 t	2.92	1.27	0.43
lignite, at mine/RER	1 t	0.23	0.804	3.50
peat, at mine/NORDEL	1 t	0.23	0.804	3.50

3.1.1 Methodology to derive methane emissions from coal mining

The updated UVEK:2023 values for methane emissions from hard coal mining were derived following the methodology suggested by Oberschelp et al. (2019). As database, predicted emission data for 2020 published by the United States Environmental Protection Agency (US Environmental Protection Agency (EPA), 2019) and coal production data for 2018 published by the International Energy Agency (International Energy Agency (IEA), 2019) were used.

Total methane emissions from coal mining were retrieved on individual country level for the year 2018 for Australia, United States and Russia based on (UNFCCC, 2023), for China based on (UNFCCC, 2018), for South Africa based on (DFFE, 2022), for India based on (GHGPI, 2018) and other countries based on (US Environmental Protection Agency (EPA), 2019). These methane emissions were given by EPA in kg CO_2-eq per year and referred to the mining of all types of coal. The derivation of the updated relative methane emissions from hard coal mining for each supply region included following steps:

Total yearly methane emissions expressed in kg CO_2-eq were transformed into values expressed in kg CH_4. This was done applying the characterization factor for methane regarding GWP as used by EPA: 24 kg CO_2-eq / kg CH_4 (US Environmental Protection Agency (EPA), 2019).

Yearly methane emissions from hard coal mining on country level were derived, expressed in kg CH_4. For this purpose, methane emissions from lignite mining were estimated based on IEA production data and then subtracted from the methane emissions as given by EPA, which corresponded to all types of coal. As most current available data, national production data for 2018 from IEA were used (International Energy Agency (IEA), 2019), which were expressed in tonnes.

Lignite is exclusively produced in surface mines, with the exception of Turkey (Walker, 2000). Consequently, the average IPCC emission factor for surface mining (1.2 m^3 CH_4/t produced coal) was used to quantify the total methane emissions from lignite mining (Intergovernmental Panel on Climate Change (IPCC), 2006). In addition, the IPCC conversion factor of 0.67 kg CH_4/ m^3 CH_4 was applied to convert volume of methane into mass of methane (Intergovernmental Panel on Climate Change (IPCC), 2006). Emissions from peat mining were assumed to be the equal to the ones of lignite mining.

Specific methane emission factors from hard coal mining on country level, expressed in kg CH_4/kg coal, were derived by dividing yearly methane emissions from hard coal mining by yearly hard coal production volumes. Yearly production volumes of hard coal were derived based on IEA production data (International Energy Agency (IEA), 2019). Again, IEA production data for 2018 were used. The IEA reported coal production data for three coal categories: lignite, steam coal and coking coal. Both steam coal and coking coal production data were summed and assigned to hard coal production for each country.

Methane emission factors from hard coal mining of individual countries were aggregated according to supply regions used in the UVEK database. Tab. 3.2 summarizes the individual countries which were included in each supply region. The supply regions AU, CN, RU, ZA and IN consist of one country each and therefore did not require any aggregation. Regarding the supply regions CPA, RLA and RNA, the aggregation was done by calculating the weighted mean according to the total hard coal production volumes of the individual countries. Tab. 3.3 shows the compilation of methane emissions from coal mining for updated UVEK:2023 datasets according EPA'19/IEA (2020/2018p) based on 2018 (US Environmental Protection Agency (EPA), 2019) and (IEA, 2019).

Tab. 3.2: Summary of countries included in each production region and corresponding countries considered for updated methane emissions from hard coal production. Country names written in grey indicate countries which formed part of a specific production region but which were not considered for updated methane emissions as they did not produce hard coal

Supply region	Included countries
Australia (AU)	Australia
China (CN)	China
Centrally Planned Asia (CPA)	China, South Korea, Mongolia
Central and Eastern Europe (EEU)	Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Macedonia, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom
Latin America & the Caribbean (RLA)	Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, British Indian Ocean territory, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands (Malvinas), French Guiana, Greenland, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Pierre and Miquelon, Saint Vincent and The Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela, Virgin Islands (British), Virgin Islands (U.S.)
North America (RNA)	American Samoa, Canada, Guam, Puerto Rico, United States Minor Outlying Islands, United States of America
Russia (RU)	Russia
South Africa (ZA)	South Africa
India (IN)	India

Tab. 3.3: Compilation of methane emissions from coal mining for updated UVEK:2023 datasets according EPA'19/IEA (2020/2018p) based on coal production for the year 2018 (IEA, 2019) and methane emissions for the year 2018 for Australia, United States and Russia based on (UNFCCC, 2023), for China based on (UNFCCC, 2018), for South Africa based on (DFFE, 2022), for India based on (GHGPI, 2018) and other countries based on (US Environmental Protection Agency (EPA), 2019).

Ecoinvent regions		Country names ecoinvent	CH_4 emissions from coal mining (total) USEPA 2020, UNFCC 2023, UNFCCC 2018, DFFE 2022, GHGPI 2018 2020 [1000t CH_4]	CH_4 emissions from lignite mining derived from IEA+IPCC 2018p [1000t]	CH_4 emissions from hard coal mining USEPA data minus lignite mining emissions derived from IEA+IPCC [1000t]	hard coal production from IEA 2018p [1000t]	CH_4 emissions, hard coal per country kg CH_4 / kg coal	weighted mean per region kg CH_4 / kg coal
AU	Australia	Australia	1060	36.9	1030	437000	0.00235	0.00235
CN	China	China	21000		21000	3550000	0.00592	0.00592
CPA	Centrally Planned Asia and China				21100	3620000	0.00582	0.00582
		China	27500		21000	3550000	0.00592	
		Korea, Democratic People's Republic Of KP	25		25	31100	0.000805	
		Mongolia	16.7	5.59	11.1	38000	0.000291	
IN	India	India	957	36.5	920	726000	0.00127	0.00127
RU	Russian Federation	Russian Federation	2740	65.4	2670	338000	0.0079	0.0079
ZA	South Africa	South Africa	138		138	259000	0.000533	0.000533
EEU/RER	Central and Eastern Europe				826	73700	0.0112	0.0112
		Bulgaria	33.3	24.3	9	334	0.027	
		Czech Republic	142	31.7	110	4590	0.024	
		Norway	4.17		4.17	150	0.0278	
		Poland	725	47.1	678	63900	0.0106	
		Spain	4.17		4.17	2160	0.00193	
		United Kingdom	20.8		20.8	2580	0.00807	
RNA	North America				2360	681000	0.00346	0.00346
		Canada	45.8	6.22	39.6	46900	0.000845	
		United States of America	2360	41.6	2320	634000	0.00366	
RLA	Latin America & the Caribbean				853	102000	0.00838	0.00838
		Argentina	4.17		4.17	23	0.181	
		Brazil	58.3	1.16	57.2	3570	0.016	
		Chile	12.5		12.5	2300	0.00545	
		Colombia	358		358	83000	0.00432	
		Mexico	417	0.351	416	11800	0.0353	
		Peru	4.17		4.17	217	0.0192	

3.1.2 Plausibility analysis

The plausibility of the updated methane emissions from hard coal mining was evaluated by comparing the results with methane emissions which were derived based on alternative data sources and for different reference years. As alternative source for methane emissions, an earlier EPA report on non-CO_2 anthropogenic greenhouse gas emissions was used (US Environmental Protection Agency (EPA), 2012), which also contained predicted emissions for the year 2020. In addition, four sets of values for methane emissions were used which had been derived by Saunois et al. (2020) based on four different sources: the EDGAR v4.3.2 global atlas of greenhouse gas emissions (Janssens-Maenhout et al., 2019), anthropogenic emissions from the Community Emissions Data System (CEDS) by Hoesly et al. (2018), global anthropogenic methane emissions derived with the GAINS model framework (Höglund-Isaksson, 2012), and the above mentioned earlier report by EPA (US Environmental Protection Agency (EPA), 2012). The alternative data sources and reference years are summarized in Tab. 3.4, while the comparison of derived methane emissions is illustrated in Fig. 3.1.

Tab. 3.4: Data sources and references years used for methane emissions and coal production volumes within the plausibility analysis of updated values for methane emissions from hard coal mining.

Label	Reference year and data source for methane emissions from coal mining	Reference year and data source for coal production volumes
EPA’19/IEA (2015/2017)	2018 (US Environmental Protection Agency (EPA), 2019)	2017 (IEA, 2019)
EPA’19/IEA (2020/2018p)	2018 (US Environmental Protection Agency (EPA), 2019)	2018 (IEA, 2019)
EPA’12/IEA (2020/2018p)	2020 (EPA, 2012)	2018 (IEA, 2019)
Saunois/IEA (CEDS/2018p)	2017 (Hoesly et al., 2018; Saunois et al., 2020)	2018 (IEA, 2019)
Saunois/IEA (EDGAR/2018p)	2017 (Janssens-Maenhout et al., 2019; Saunois et al., 2020)	2018 (IEA, 2019)
Saunois/IEA (GAINS/2018p)	2017 (Höglund-Isaksson, 2012; Saunois et al., 2020)	2018 (IEA, 2019)
Saunois/IEA (EPA’12/2018p)	2017 (Saunois et al., 2020; US Environmental Protection Agency (EPA), 2012)	2018 (IEA, 2019)

For the supply regions Australia, Central and Eastern Europe, North America, and Russia, updated methane emissions are in the range of the values in the UVEK:2018 database and also in the range of values derived based on alternative data sources.

For China, the updated methane emissions are significantly lower than UVEK:2018 value. The lower value is considered plausible, as it is supported by the results based on alternative data sources. In addition, emissions used in the UVEK:2018 database appear to be very high.

For Centrally Planned Asia as well as for Latin America & the Caribbean, updated methane emissions are significantly higher than UVEK:2018 values. Again, the updated values are supported by results based on alternative data sources. The updated emissions for the supply regions China and Centrally Planned Asia are almost identical, as the latter is dominated by the results for China due to its high production volume.

South Africa does not produce any lignite, but only hard coal (International Energy Agency (IEA), 2019), according to the designation used in this report which counts both coking coal and steam coal as hard coal. More than 60% of the coal in South Africa is produced in surface mining (DFFE, 2022), which is connected to significant lower release of methane than underground mining (Intergovernmental Panel on Climate Change (IPCC), 2006). Furthermore, country-specific emission factors reported for South Africa are well below average IPCC default emission factors: The South African national GHG inventory is based on an emission factor of 0.77 m^3 CH_4/t coal from underground mines (DFFE, 2022), instead of 17 m^3 CH_4/t coal as given by IPCC. This justifies the comparable low methane emission for hard coal production in South Africa.

The country-specific emissions factors for South Africa are based on a national study carried out from 2001 to 2004, during which methane emissions from several South African underground coal mines were measured (Lloyd & Cook, 2005). Based on the measurement results, the authors estimated an annual average total release of 72’000 t CH_4 from South African coal mines, including surface and underground mines. Referred to the annual coal production volumes of South Africa for 2000 and for 2005 (International Energy Agency (IEA), 2019), this is equivalent to relative methane emissions between 0.321 and 0.294 kg CH_4/t coal produced, which confirms the UVEK:2023 value based on EPA emission data for 2020 and IEA production data for 2018.

The updated methane emissions for hard coal mining in South Africa were derived from the National Greenhouse Gas Inventory for 2020 (DFFE, 2022) in combination with the IEA production statistics for hard coal for 2018 (International Energy Agency (IEA), 2019). With 0.53 kg CH_4/t coal produced, this updated value is 85% lower than the value previously used in the UVEK:2018 database.

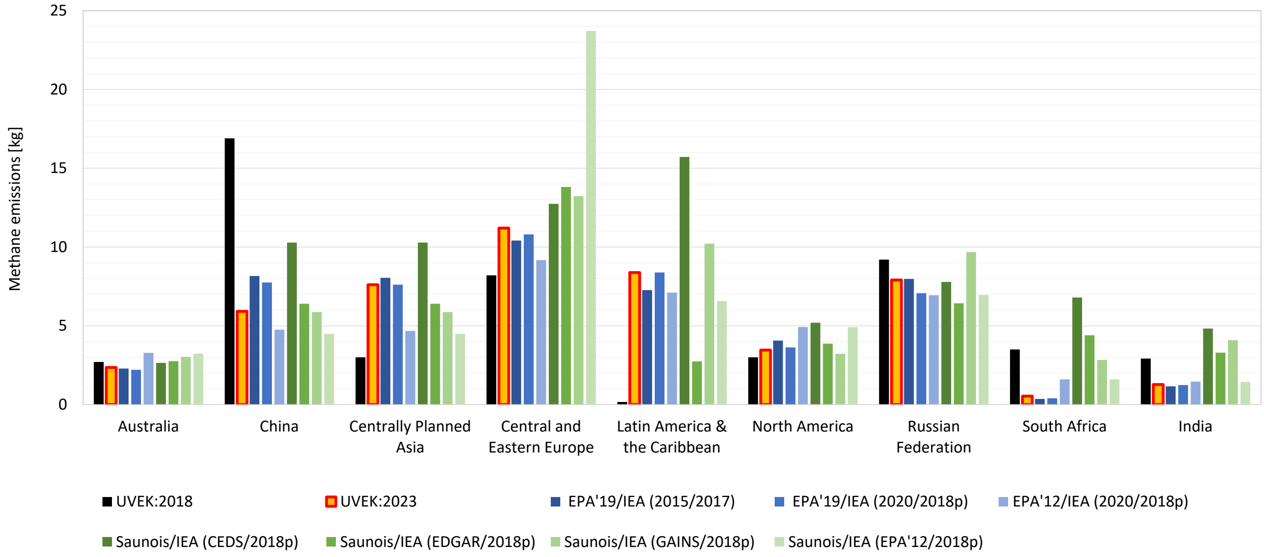

Fig. 3.1: **Comparison of methane emissions from hard coal mining based on different data sources and reference years; methane emissions used in the UVEK:2018 datasets are shown in blue, the updated UVEK:2023 values are highlighted with a red frame (EPA'19/IEA, 2020/2018p).**

3.2 Hard Coal Supply Mixes and Transports

3.2.1 Hard Coal supply mixes

The coal supply mixes for the European countries (Austria AT, Belgium BE, Czech Republic CZ, Germany DE, Spain ES, France FR, Hungary HR, Italy IT, Netherlands NL, Poland PL, Portugal PT and Slovakia SK), the United States (US), China (CN) and India (IN) have been updated. The coal production statistics of the IEA (OECD, 2020b) was used to quantify the domestic consumption calculated as the domestic production minus changes in stocks minus the exported coal. For the imported coal, trade statistics of the IEA (OECD, 2020a) have been used to determine the origin of the imported coal for the individual countries and regions. For India and China, the trade statistics were not available from the above-mentioned data sources. Therefore, the origins of the imports were taken from Alvarez at al. (2020). Similarly, the import shares for the European region as a whole were also taken from Alvarez at al. (2020) because the trade statistics of the IEA (OECD, 2020a) for OECD Europe as region also included countries within Europe as origin for imports to Europe. Based on the domestic net production as well as the imported coal the supply mixes as shown in Tab. 3.5 have been calculated.

The use of the IEA production (OECD, 2020b) and IEA trade (OECD, 2020a) statistics as well as Alvarez at al. (2020) allows for a more detailed resolution on country level compared to world region approach that is currently used for the Life Cycle Inventory models in the UVEK database. The LCI models of the supply mixes use this higher resolution on country level and the corresponding world regions have been used to approximate the country of origin. Coal exporting countries that are currently missing in the UVEK database are Venezuela, Colombia, Indonesia and Kazakhstan. However, these countries do not make up for major shares in the supply mixes in the UVEK database. Accordingly, Venezuela and Colombia were approximated with the region Latin America, Indonesia was approximated with India and Kazakhstan was approximated with Russia. For the next update of the coal mining LCI it is recommended to also generate individual datasets for coal mining in these countries.

Tab. 3.5: Coal supply from domestic net production and imports in 1'000 tonnes for European countries, India, China and the United States according to coal production (OECD, 2020b) and coal trade (OECD, 2020a) statistics of the International Energy Agency statistics for the year 2020

	in 1000 tonnes	UCTE	US	AT	BE	CN	CZ	DE	ES
Domestic	Net Supply	133'000	370'151	1'037	1'586	3'244'633	2'108	19'750	3'607
	Net production	40'205	365'921	0	0	3'002'863	779	0	0
Import	Total	92'794	4'228	1'037	1'586	241'770	1'329	19'750	3'607
	Australia	0	0	0	112	53'489	0	0	153
	Bolivarian Republic of Venezuela	0	0	0	0	0	0	0	220
	Colombia	23'605	3'316	0	13	0	0	1'854	461
	Czech Republic	0	0	21	0	0	0	3	0
	Indonesia	0	546	0	0	159'397	0	0	0
	Kazakhstan	0	0	0	0	0	0	159	259
	Poland	0	0	596	0	0	982	172	0
	Russian Federation	60'235	253	342	1'169	28'884	320	13'349	2'126
	South Africa	2'442	0	0	102	0	0	417	0
	United States	6'512	0	0	7	0	0	2'089	54
	Other	0	113	78	184	0	27	1'706	334

	in 1000 tonnes	FR	HR	IT	IN	NL	PL	PT	SK
Domestic	Net Supply	3'997	98	5'549	821'073	2'414	51'204	5	590
	Net production	0	0	0	673'239	0	40'194	0	0
Import	Total	3'997	98	5'549	147'835	2'414	11'010	5	590
	Australia	490	0	0	3'249	28	80	0	0
	Bolivarian Republic of Venezuela	0	0	0	0	0	0	0	0
	Colombia	501	0	584	0	251	902	0	6
	Czech Republic	0	0	0	0	0	39	0	69
	Indonesia	0	0	67	97'474	54	0	0	0
	Kazakhstan	13	0	304	0	0	844	0	0
	Poland	0	77	0	0	0	0	0	96
	Russian Federation	1'974	10	4'009	5'686	1'409	9'056	0	351
	South Africa	746	11	0	35'740	59	0	0	0
	United States	197	0	369	5'686	558	76	0	0
	Other	77	0	215	0	56	13	5	68

Other exchanges than the supply mix composition and corresponding transport services remain unchanged as in the original hard coal supply datasets described Chapter 6 *"Förderung und Aufbereitung"* of Röder et al. (2007). The full detailed LCI datasets including adjustments and unchanged exchanges as well as the meta information are shown in Tab. 5.3 and Tab. 5.4 in the Annex.

3.2.2 Transports

The transport distances in the hard coal supply mix datasets have been adjusted to the new composition of the countries of origin. The hard coal mix for UCTE has also been updated although this dataset is mainly used in the steel supply chain of the UVEK database.

For the transport model the following transportation steps are considered: (1) Transport from coal mine to port by train, (2) transport from port in country of origin to port of destination by oceanic freight ship and (3) transport in the country of destination by train and lorry.

The transport distances for (1) and (2) are shown in Tab. 3.6 and are largely based on Röder et al. (2007). For Russia and Kazakhstan, the mining operations were assumed to take place in the Kuzbass and Ekibastuz regions, since these are the currently dominant mining regions in the respective countries. This leads to significantly higher transport distances by train for these two countries of origin of about 5'000 km.

Tab. 3.6: Transport distances for export from country of origin to Northern and Southern Europe by ship and train

Transport distance for export in km		Ship OCE						Train
		Northern Europe			Southern Europe			
		Full	Empty	Total	Full	Empty	Total	
Australia	AU	23'000	8'000	31'000	19'500	8'000	27'500	200
Bolivarian Republic of Venezuela	VE	8'500	8'500	17'000	9'000	9'000	18'000	200
Colombia	CO	8'500	8'500	17'000	9'000	9'000	18'000	200
Indonesia	ID	21'000	8'000	29'000	17'500	8'000	25'500	200
Kazakhstan	KZ	-	-	-	-	-	-	5'000
Russian Federation	RU	-	-	-	-	-	-	5'000
South Africa	ZA	13'500	13'500	27'000	11'000	11'000	22'000	600
United States	US	7'500	7'500	15'000	9'500	9'500	19'000	800
China	CN	26'000	10'000	36'000	26'000	10'000	36'000	600
United Kingdom	UK	1'283	1'283	2'567	1'283	1'283	2'567	100

The transport distances for oceanic freight ship and train for export from country of origin to the United States, China, India and Europe (UCTE) are shown in Tab. 3.7, Tab. 3.8, Tab. 3.9 and Tab. 3.10.

Tab. 3.7: Transport distances for export from country of origin to the United States by ship and train

Import to the United States	Hard coal in kt	Transport distances in km	
		Freight ship, oceanic	Train export
Colombia	3'316	5'986	200
Indonesia	546	44'955	200
Russian Federation	253	18'042	2'000
People's Republic of China	98	21'142	600
Canada	14	-	800
United Kingdom	1	15'000	100

Tab. 3.8: Transport distances for export from country of origin to China by ship and train

Import to China	Hard coal in kt	Transport distances in km	
		Freight ship, oceanic	Train export
Indonesia	159'397	9'345	200
Australia	53'489	15'672	200
Russian Federation	28'884	-	5'000

Tab. 3.9: Transport distances for export from country of origin to India by ship and train

Import to India	Hard coal in kt	Transport distances in km	
		Freight ship, oceanic	Train export
Indonesia	97'474	10'030	200
South Africa	35'740	14'109	600
United States	5'686	42'555	800
Russian Federation	5'686	16'457	2'000
Australia	3'249	22'902	200

Tab. 3.10: Transport distances for export from country of origin to Europe by ship and train

Import to the Europe	Hard coal in kt	Transport distances in km	
		Freight ship, oceanic	Train export
Russian Federation	60'235	-	5'000
Colombia	23'605	17'000	200
South Africa	2'442	27'000	600
United States	6'512	15'000	800

For transport in the country of destination (3) 400 km by train and 40 km by lorry were assumed for the United States, China and India as well as 200 km by train and 40 km by lorry for the remaining European countries.

Other exchanges than the supply mix composition and corresponding transport distances remain unchanged as in the original hard coal supply datasets described Chapter 6 *"Förderung und Aufbereitung"* of Röder et al. (2007). The full detailed LCI datasets including adjustments and unchanged exchanges as well as the meta information are shown in Tab. 5.3 and Tab. 5.4 in the Annex.

3.3 Coal combustion and emission profiles ("burned in" datasets)

The update of the coal combustion and emission profiles ("burned in" datasets) is limited to key air pollutants and trace elements as well as flue gas treatment. Other exchanges remain unchanged as in the original coal mining datasets described in Chapter 9 *"Kraftwerke"* of Röder et al. (2007).

With this update, the subcompartments for air emissions of the hard coal combustion datasets have been harmonised to "high population density". Before the update the air emissions of the European hard coal combustion LCI datasets used "emission to air, low population density" and the US and Indian datasets used "emission to air, high population density". The subcompartments for air emissions of the lignite and peat combustion datasets remain unchanged as "emission to air, low population density".

The full detailed LCI datasets for the combustion of hard coal, lignite and peat including adjustments and unchanged exchanges as well as the meta information are shown in Tab. 5.5, Tab. 5.6, Tab. 5.7 and Tab. 5.8 in the Annex.

3.3.1 Airborne emissions

The update of airborne emission followed a tiered approach in order to account for the amount of available data in the different regions of the world and for different substances. In addition, the list of pollutants was adjusted for all of the countries to allow for a fair comparison. The main priority in the update were the emissions of CO_2, SO_2, NO_x, $PM_{>10}$, $PM_{10-2.5}$, $PM_{2.5}$ and mercury, which typically dominate environmental impacts of coal power generation, while further trace elements (other heavy metals, volatile organic compounds) were covered with a simplified approach. The emissions of CO_2 were generally calculated using IPCC emission factors (Intergovernmental Panel on Climate Change (IPCC), 2006) and the specific fuel types in each coal group according to IEA data (International Energy Agency (IEA), 2021). Likewise, methane (CH_4) and carbon monoxide (CO) emission intensities were updated from IPCC data (Intergovernmental Panel on Climate Change (IPCC), 2006) following the identical approach. Trace emissions including NMVOCs (non-methane volatile organic compounds) were taken for the specific coal fuel groups from data provided by the European Energy Agency (EMEP/EEA, 2019). No specific adjustments to NMVOCs based on other pollutant emissions were made. For the other emissions, the following general cases could be distinguished.

The US has plant specific emission reporting for SO_2, NO_x, $PM_{2.5}$ and mercury available. SO_2, NO_x and $PM_{2.5}$ data was used directly, while $PM_{>10}$ and $PM_{10-2.5}$ were extrapolated as described below.

Members of the European Union report SO_2, NO_x, and total particulate matter (PM) emissions per plant (European Environment Agency (EEA), 2022a). This data was directly used with total PM emissions being disaggregated to $PM_{>10}$, $PM_{10-2.5}$ and $PM_{2.5}$ as described further below. Measured mercury emissions were taken from the same report. German and Slovakian data for 2019 was not yet available so the latest available data for 2017 was used instead and coal power plants, that had been shut down between 2017 and 2019, were excluded from the analysis.

Eastern European members of the Energy Community Treaty report their SO_2, NO_x, and total PM emissions per plant in a format similar to European Environment Agency reports (European Environment Agency (EEA), 2022a, 2022b) and thus the same approach as for the EU was applied in these cases.

China reported plant-specific emissions for SO_2, NO_x and total PM (China Electricity Council (CEC), 2015a, 2015b, 2016). This data was reported as flue gas concentration und standard conditions. These concentrations have been converted to flue gas emissions per fuel input as described below. Plant-specific mercury emissions were not reported so the current Chinese emission limit of 0.03 mg/m^3 (IEA International Centre for Sustainable Carbon, 2020) was used to approximate the Chinese coal power mercury emission factor. Total PM was also disaggregated as described below.

India has fragmented digital reporting of SO_2, NO_x and PM flue gas concentrations for some coal power plants, but due to the number of different online portals, lack of systematic data access options and the only partial share that is publicly available, such data cannot easily be used for recurring updates. However, a recent report has been published that contains tables of SO_2, NO_x and PM flue gas concentrations for different coal power plants (Centre for Atmospheric Sciences (CAS), Indian Institute of Technology Delhi (IITD), 2022). This data is available for more than 200 Indian coal power generating units and has been extracted manually to calculate mean emission intensities for SO_2, NO_x, $PM_{>10}$, $PM_{10-2.5}$ and $PM_{2.5}$. Mean Indian mercury emission intensities have been obtained from scientific literature (Agarwalla et al., 2021) with lignite-related data not being included as this coal type is not covered in the UVEK database for India.

No reliable public reporting of SO_2, NO_x, $PM_{>10}$, $PM_{10-2.5}$, $PM_{2.5}$ and mercury emissions for coal power plants in Russia was found. The calculation of emissions based on satellite measurements was explored but found too unreliable in comparison to individual ground-level measurements. However, there is reporting of emissions directly to the respective government and reporting of compliance or non-compliance with the emission limits. Assuming that the Russian coal power plants thus roughly follow the legal limits, the respective emission limits for each of the Russian power plants have been used (IEA International Centre for

Sustainable Carbon, 2020), by considering the plant-specific fuel type, size, age and technology. Thus, the emission intensity per plant, and finally the capacity-weighted emission intensity has been calculated with the basic power plant data provided by S&P Global (2022) and used as the indicative emission intensity. For

validation purposes, this data has been compared against emission intensities in Eastern Europe (technologically and legally similar conditions) and few available unrepresentative emission data points. Generally, the approach yields sufficiently accurate results. The uncertainty for the Russian case has been adjusted to the lowest value of 5 across all tiers.

Emissions that were not updated were taken over from the previous version of each dataset. Minor inconsistencies may be the result of that. Furthermore, some double counting of emissions may exist as intended according to the data quality guidelines (e.g. certain heavy metals are being accounted for individually, but are also part of particulate matter (Frischknecht, Jungbluth, Althaus, Doka, et al., 2007)).

Flue gas treatment for SO_2 and NO_x is updated by adjusting the inputs of "SO_x retained, in hard coal flue gas desulphurisation/RER U" and "NO_x retained, in SCR/GLO U" for each combustion dataset. The respective amount is calculated as difference of generic unabated emissions (as reported by (EMEP/EEA, 2019), e.g. 209 g/GJ in case of NOx and 820 g/GJ in case of SO2 for hard coal) and the region and fuel-specific emission factor, unless the actual emissions exceed the unabated averages, in which case the flue gas treatment is set to zero (see Tab. 3.11).

Tab. 3.11: Overview showing emission intensities of SO_2 and NO_x per country and fuel in relation to SO_2 and NO_x retainment as implemented in the UVEK datasets.

Fuel type	Region	Emission intensity SO_2 [kg/MJ]	Emission intensity NO_x [kg/MJ]	SO_2 retained [kg/MJ]	NO_x retained [kg/MJ]
Hard coal	Austria	1.68E-05	0.00005	0.000803	0.000159
Hard coal	Belgium	9.47E-05	0.000094	0.000725	0.000115
Hard coal	China	0.000016	1.91E-05	0.000804	0.00019
Hard coal	Czech Republic	0.000186	0.000125	0.000634	8.41E-05
Hard coal	Germany	3.46E-05	5.43E-05	0.000785	0.000155
Hard coal	Spain	0.000122	9.44E-05	0.000698	0.000115
Hard coal	France	0.000141	0.000115	0.000679	9.42E-05
Hard coal	Croatia	3.77E-05	4.22E-05	0.000782	0.000167
Hard coal	Italy	3.25E-05	3.92E-05	0.000788	0.00017
Hard coal	Netherlands	1.16E-05	2.11E-05	0.000808	0.000188
Hard coal	Poland	0.000088	0.00008	0.000732	0.000129
Hard coal	Portugal	4.94E-05	5.19E-05	0.000771	0.000157
Hard coal	Slovakia	6.14E-05	3.89E-05	0.000759	0.00017
Hard coal	United States	7.81E-05	5.67E-05	0.000742	0.000152
Hard coal	Russia	0.000721	0.000172	9.95E-05	3.67E-05
Hard coal	India	6.36E-05	6.68E-05	0.000756	0.000142
Lignite	Bosnia and Herzegovina	0.000484	0.000111	0.001196	0.000136
Lignite	Serbia	0.001213	0.000134	0.000467	0.000114
Lignite	Czech Republic	8.86E-05	8.08E-05	0.001591	0.000166
Lignite	Germany	4.38E-05	7.64E-05	0.001636	0.000171
Lignite	Greece	0.000159	7.55E-05	0.001521	0.000172
Lignite	Hungary	8.12E-05	0.000106	0.001599	0.000141
Lignite	North Macedonia	0.002823	0.000147	0	0.0001
Lignite	Poland	9.47E-05	9.03E-05	0.001585	0.000157
Lignite	Slovenia	3.14E-05	0.000064	0.001649	0.000183
Lignite	Slovakia	0.00015	7.86E-05	0.00153	0.000168
Peat	ENTSO-E	2.61E-05	8.21E-05	0.001654	0.000165

3.3.2 Conversion of pollutant concentrations into emission intensities

Several countries such as China, India or Russia report emissions or emission limits as flue gas concentrations instead of per fuel input or electricity output. At the same time, the documentation of the flue gas reference conditions under which the concentrations are reported, are not entirely clear. In this UVEK database update, it is assumed that the conditions of any reported concentrations match those of the national legal concentration limits, which are known for India and Russia from (IEA International Centre for Sustainable Carbon, 2020). Normal conditions (0°C, 101.3 kPa) and corrected to 6 % oxygen in the waste gas on a dry basis is most common for legal limits around the world, so this has also been assumed for the Chinese case, where more specific information was missing. Data on these conditions was then used to convert emission concentration data into emission intensities per fuel input by also assuming that the flue gas is an ideal gas and with the data on coal CO_2 emission intensities from the IPCC (Intergovernmental Panel on Climate Change (IPCC), 2006). The equation to calculate the emission factors EF for the substance i was as follows:

$$EF_i = c_i \cdot \frac{EF_{CO2}}{M_{CO2} \cdot \varsigma_{CO2-O2} \cdot x_{O2}} \cdot k \cdot R \cdot T \cdot p$$

With:

EF: Emission factor [kg/TJ]

i: substances such as SO_2, NO_x, or PM

c: concentration [mg/Nm3]

M_{CO2}: Molar mass of CO_2 (44 g/mol)

ς_{CO2-O2}: Molar conversion of oxygen to CO_2 (1 mol/mol)

x_{O2}: Oxygen molar fraction in air (0.21 mol/mol)

k: Adjustment factor from 0% oxygen in flue gas to 6% oxygen ((21%-0%)/(21%-6%))

R: Ideal gas constant (8.314 kJ/kmol/K)

T: Temperature at normal conditions (273 K)

p: Pressure at normal conditions (0.1013 MPa)

Any components of the flue gas other than CO_2, O_2, N_2 and Ar were implicitly neglected.

3.3.3 Disaggregation and extrapolation of PM emissions

The rationale for disaggregation and extrapolation of PM emissions is that large particles are typically easier to abate than small particles. Thus, in case of high total PM emissions, the share of small particles is smaller than in case of low total PM emissions. The basic data for hard coal, lignite and peat at different emission levels is obtained from The Netherlands Organization for Applied Scientific Research (TNO) (2022). Interpolations and extrapolations for different emission intensities are made linearly as shown for the example of lignite in Fig. 3.2.

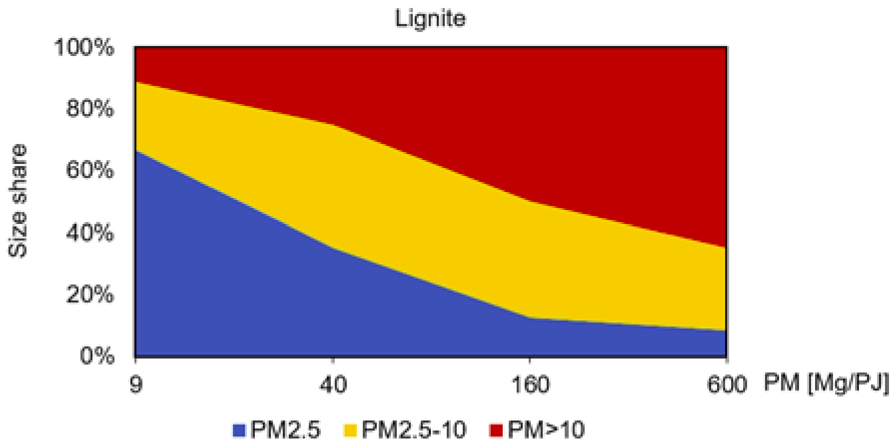

Fig. 3.2: Linear interpolation/extrapolation data for different size classes of PM.

For the case of lignite, the distribution of PM size classes was known at overall emission intensities of 9, 40, 160 and 600 Mg/PJ. The corresponding values were 6, 35, 140 and 510 Mg/PJ for hard coal, and 9 and 120 Mg/PJ for peat. No emission intensities had to be calculated above the respective maximum emission intensities, but for emission intensities below the minimum reported value, a linear extrapolation was assumed. Any disaggregation step to PM size classes was performed *before* aggregation or averaging (e.g. over a number of power plants) in order to avoid the obvious aggregation errors.

3.3.4 Comparison of emission intensities

Generally, the emission intensities for greenhouse gases per fuel type differ only slightly due to the approach of using emission factors by the IPCC (Intergovernmental Panel on Climate Change (IPCC), 2006) in the background. The emission factors for different specific fuel types in the fuel groups (Tab. 2.9 and Tab. 2.10) differ only to a small extent and it is typically bituminous coal that dominates hard coal emission factors and lignite that dominates lignite emission factors. All CO_2 emission factors of hard coal, for example, are thus close to 95 kg/GJ and for lignite close to 101 kg/GJ (based on lower heating values (LHVs)). In the case of peat, there is only one CO_2 emission factor that is relevant, which is at 106 kg/GJ. Hence, the greenhouse gas emission intensities per amount of electricity produced in each of the fuel groups are largely caused by the fuel input requirements instead of the emission factors, which are due to the electrical efficiencies as well as the allocation to co-produced heat.

More differentiated emission intensity patterns are visible for the priority air pollutants SO_2, NO_x and PM (see Fig. 3.3 to Fig. 3.6). In the case of SO_2 specifically, largely unabated emissions in combination with high sulphur contents in the coal lead to exceptionally high emission intensities (e.g. BA, RS, MK), while countries with stringent regulation and widespread deployment of end-of-pipe desulphurization lead to substantially lower SO_2 emission intensities (e.g. CN, DE, NL).

In case of NO_x emissions, especially countries with modern coal power plants possess low emission intensities due to a combination of low NO_x burners in the boilers and post-combustion abatement such as selective catalytic reduction (SCR). Examples for such cases are also hard coal power plants in CN and NL, while for example DE possesses a mix of older and newer plants, that may all have recent end-of-pipe NO_x abatement but are limited in the primary reduction of NO_x during combustion due to the difficulties of retrofitting primary NO_x abatement measure to older power plants. Other countries with even higher shares of old boilers (such as IN) show even higher NO_x concentrations.

In case of $PM_{2.5}$, modern post-combustion flue gas treatment is applied at most Western power plants as well as the Chinese plants. As a result, the emission intensities vary less than for SO_2 and NO_x among these regions, while still some differences can be observed. Much larger are the $PM_{2.5}$ emission intensities in RU, IN, BA, RS and MK, where still a substantial share of coal power plants is reported to operate with outdated and less efficiently operating PM flue gas treatment. This is well in line with patterns observed elsewhere in independent scientific literature (Tong et al., 2018).

For mercury emissions, only about half of the combinations of countries and coal fuel types have measured emission data available that can be used for calculation of country-specific emission intensities (Fig. 3.6). The rest is filled with typical average emission intensities reported in literature (EMEP/EEA, 2019). While the measurement-based emission intensities for some countries like NL and PT (in case of hard coal) are lower than the average emission intensities, it is especially a few countries like PL (hard coal and lignite), IN (hard coal) and CZ (lignite) that are two times as high as the typical averages or more. With this large of a variation, it would seem beneficial to have more measurement data available in the future, but current reporting limits of power plants do not yet allow for that. As all the measured lignite emission intensities exceed the typical averages, it would furthermore be relevant to know whether there is a systematic deviation, for example for European lignite power plants, or whether this is a pure coincidence. Without additional data, however, this will remain unknown.

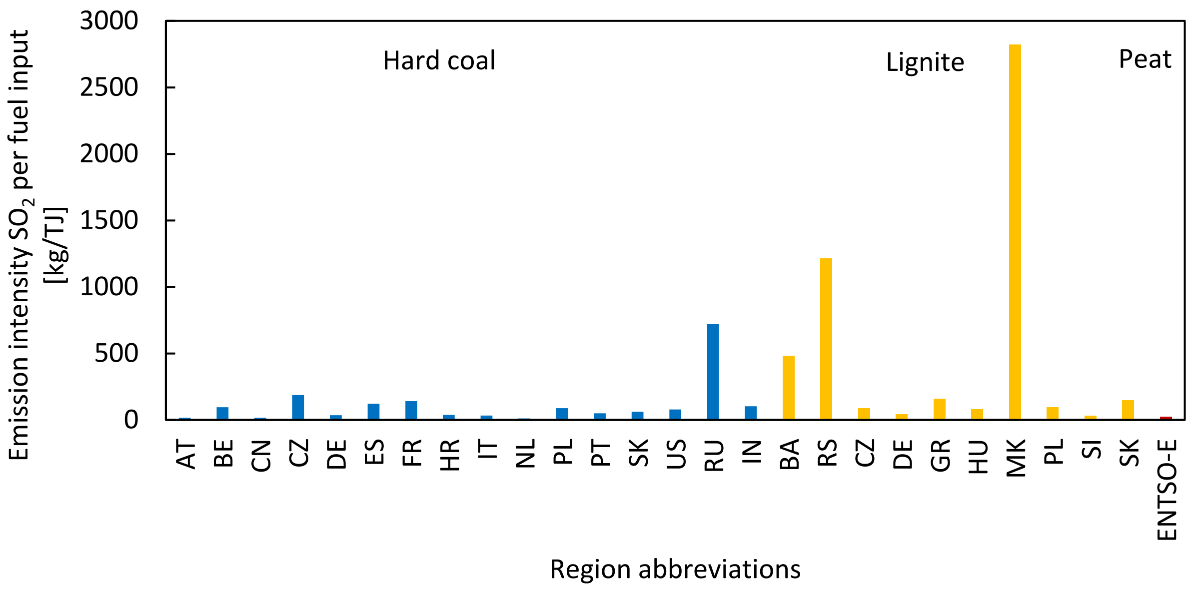

Fig. 3.3: **Emission intensities for SO_2 by fuel type (hard coal in blue, lignite in yellow and peat in red) and region. The peat data covers all peat power plants within the European ENTSO-E electricity grid, while other data is calculated on a national resolution.**

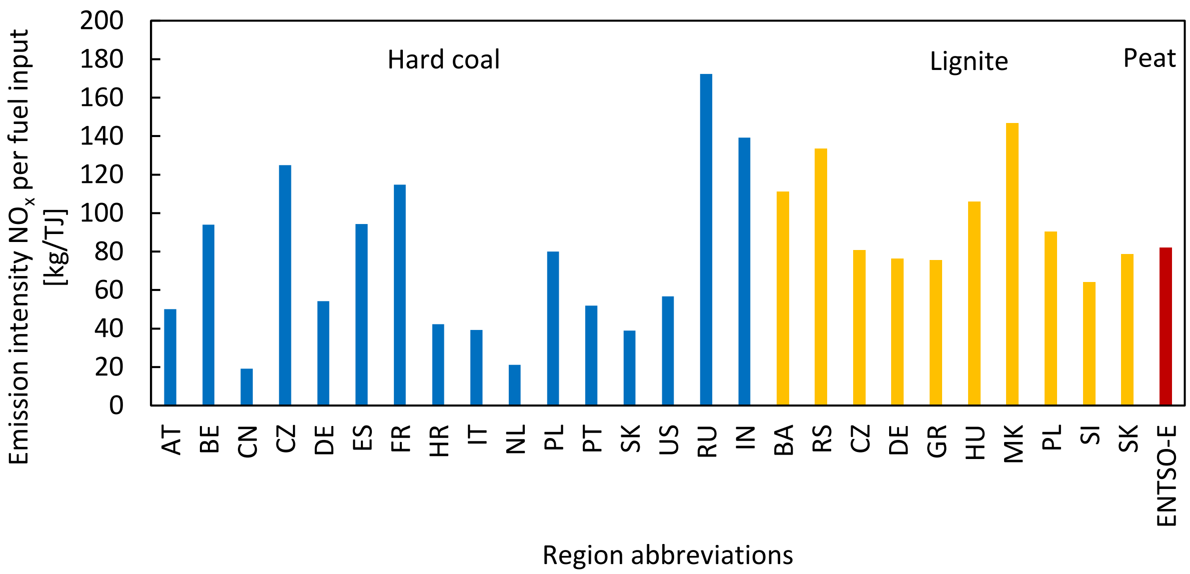

Fig. 3.4: **Emission intensities for NO_x by fuel type and region.**

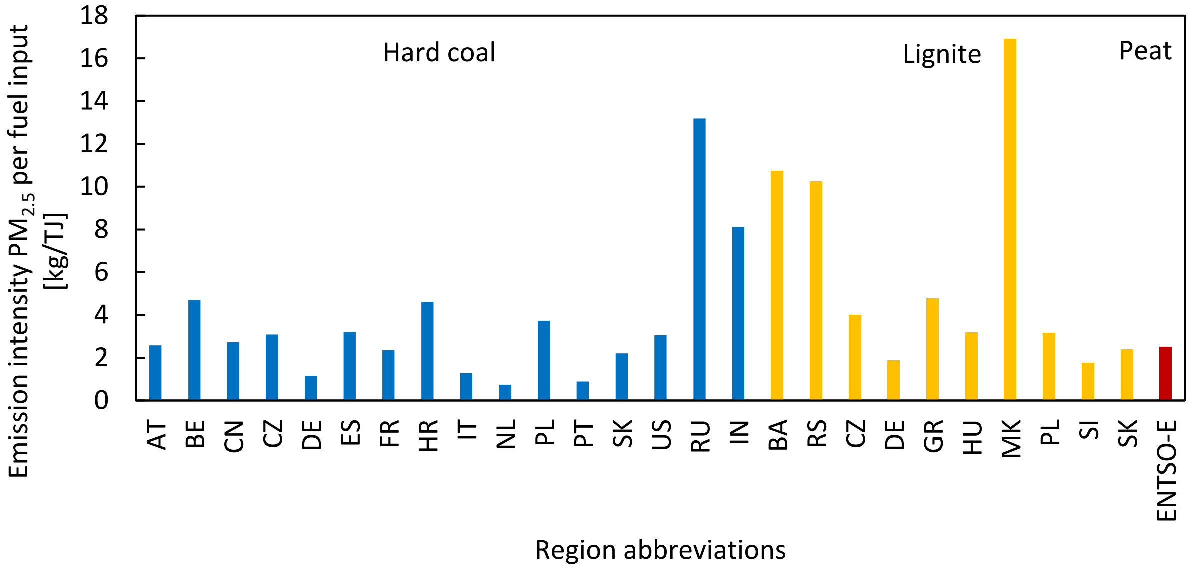

Fig. 3.5: **Emission intensities for $PM_{2.5}$ by fuel type and region.**

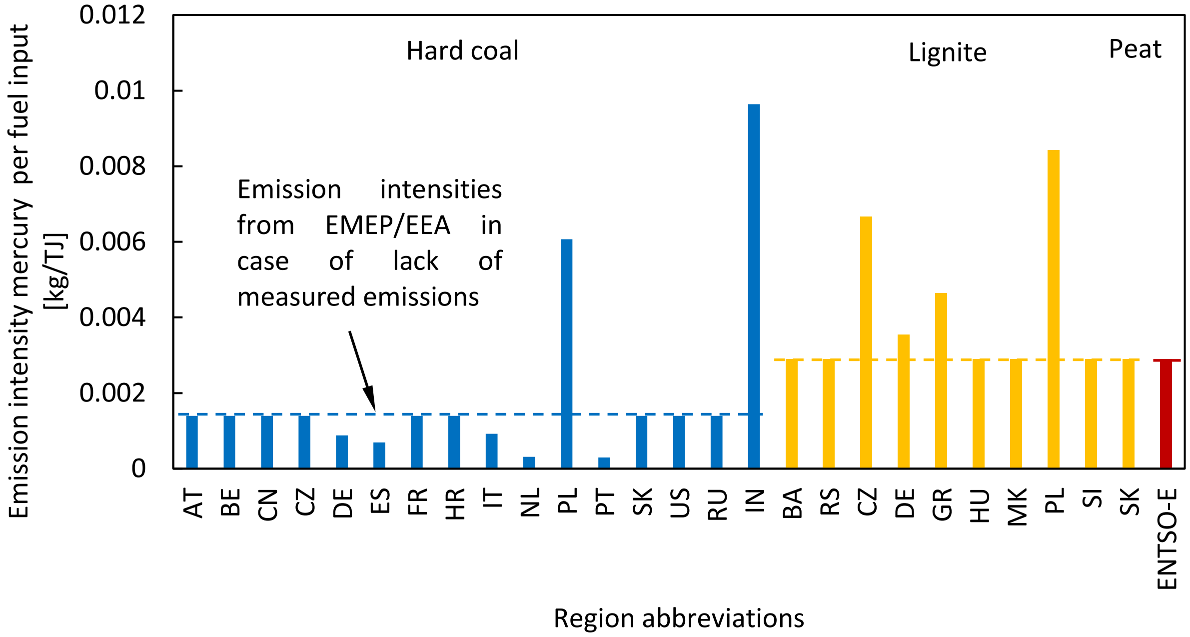

Fig. 3.6: **Emission intensities for mercury by fuel type and region.**

3.3.5 Adjustment of trace element emission coverage list and approach

The relevance of the trace element list and methodology adjustment has been tested with the German coal power generation datasets and the Ecological Scarcity LCIA method. The single score LCIA results (EEA trace element emission data vs. original UVEK:2018 data) differ less than 3% as shown in Fig. 3.7. Hence this approach is justifiable.

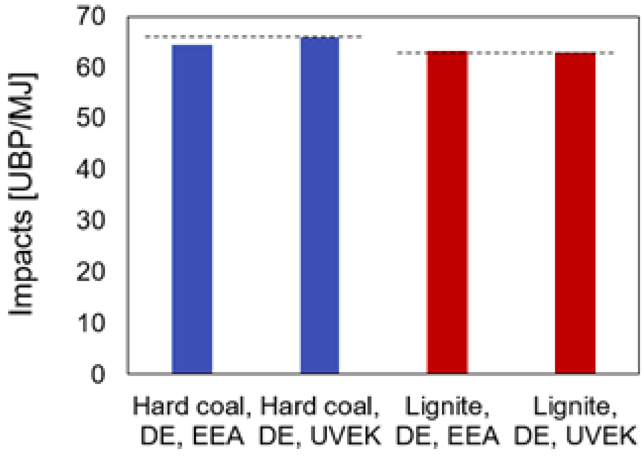

Fig. 3.7: Comparison of LCIA single scores in terms of eco-points according to Ecological Scarcity 2013 for EEA and UVEK:2018 trace element emission data.

3.4 Electricity Generation: Fuel demands and efficiency

The amount of fuel consumption per net electricity output are the central element of the datasets named "Electricity, […] at power plant" for the different regions. For all datasets, the annual fuel input and electricity output per fuel is obtained from the IEA, with the target year of the update being 2019 as this is the last year with complete data (International Energy Agency (IEA), 2021). The fuel consumption per electricity output is obtained by dividing the one by the other and directly implemented in the datasets. All types of fuel inputs are based on LHVs. Conversion of gross to net electricity generation is performed with the corresponding national ratios reported for combustible fuels in the dataset IEA OECD - Electricity and heat generation (International Energy Agency (IEA), 2022), while for non-OECD countries, the weighted mean value is applied. Uncertainties are directly taken over from the original UVEK:2018 datasets as the general methodology behind the data has not changed substantially (except for the case of Belgian hard coal combustion as explained further below). One change is introduced for co-generation power plants, though, as co-generation has not been considered in the original UVEK:2018. datasets, while a parallel development in the ecoinvent database has resulted in a methodology to account for this (Heck, 2007). Thus, co-generation data is included by allocating the fuel inputs required by heat supply and electricity supply and taking only the electricity part into account for the calculation of the total fuel demands per region. The underlying calculation is:

$$f_{specific} = \frac{m_{fuel,non-cogen} + m_{fuel,cogen,allocated}}{e_{non-cogen} + e_{cogen,allocated}}$$

With:

$f_{specific}$: Specific fuel demand based on LHV [MJ/kWh]

$m_{fuel,non-cogen}$: Fuel input as LHV (non-cogeneration plants) [MJ/a]

$m_{fuel,cogen,allocated}$: Fuel input as LHV (cogeneration plants, allocated) [MJ/a]

$e_{non-cogen}$: Net electricity generation (non-cogeneration plants) [kWh/a]

$e_{cogen,allocated}$: Net electricity generation (cogeneration plants, allocated) [kWh/a]

The allocation procedure is based on exergy as described in detail in (Heck, 2007) and assumes an exergy content of 35% for the co-generated heat, which roughly corresponds to exported low pressure steam at around 170-180°C. This temperature level represents a compromise between exported heat for domestic heating purposes (frequently in the temperature range of 80-130°C, but in some countries like Russia also much higher) and industrial steam requirements (typically 150-400°C). This compromise is necessary as more specific exported heat data is not available. Allocation is applied at the most disaggregated data (e.g. per sub-fuel for either autoproducers or main activity producers) and only aggregated afterwards.

Because of the allocation approach, the combustion emissions per amount of fuel consumption continue to represent the physically correct relationships (mass balance) between inputs and outputs. Thus, they could for example also be used to approximate hard coal, lignite or peat combustion for purposes other than electricity generation, e.g. for the use in industrial boilers for pure heat supply. The allocation procedure is instead applied at the level of electricity generation, which means that the fuel inputs per amount of electricity generated represent the respective shares of fuel inputs that are attributed to electricity generation, not the part attributed to heat supply. The part attributed to co-generation heat supply is covered by separate new datasets called "heat, at CHP power plant" for the corresponding regions and fuel types.

In case of Belgian hard coal combustion, the amount of fuel consumption per electricity output is not plausible as the approach above yields a specific fuel demand of 4.17 MJ hard coal input per kWh electricity output. Such a value would indicate an electrical efficiency above 80% while the most modern hard coal power plants may actually reach electrical efficiencies around 50% to 55%. The cause for the deviations is unknown and might be a systematic data collection or processing issue in the raw data from the International Energy Agency as the same issue exists for other years. The ENTSO-E average efficiency of 40.2% for 2019 has been used as proxy instead, which - after unit conversion - results in a specific fuel demand of 8.96 MJ/kWh for the case of the dataset “Electricity, hard coal, at power plant/BE U”. The uncertainty score, given as standard deviation (SD95), has been increased from the default value of 1.1 used in the datasets to 1.2.

Furthermore, due to the lack of Belgium-specific data, the Belgian CHP power plant heat output is excluded from the ENTSO-E hard coal heat mix.

The allocation shares to electricity and heat per fuel type and region are presented in Tab. 3.12, while an overview of the resulting fuel consumption intensities per amount of electricity production is shown in Fig. 3.8. The full detailed LCI datasets for electricity generation from hard coal, lignite and peat including adjustments and unchanged exchanges as well as the meta information are shown in Tab. 5.9, Tab. 5.10, Tab. 5.11 and Tab. 5.12 in the Annex.

Tab. 3.12: Share of fuel consumption allocated to electricity and heat per fuel type and region.

Fuel type	Region	Energy output as net electricity [%]	Energy output as heat [%]	Allocation to net electricity [%]	Allocation to heat [%]
Hard coal	Austria	56.8	43.2	79	21
Hard coal	Belgium	75.1	24.9	89.6	10.4
Hard coal	China	79.5	20.5	91.7	8.3
Hard coal	Czech Republic	31.8	68.2	57.1	42.9
Hard coal	Germany	74.9	25.1	89.5	10.5
Hard coal	Spain	100	0	100	0
Hard coal	France	89.1	10.9	95.9	4.1
Hard coal	Croatia	100	0	100	0
Hard coal	Italy	97.5	2.5	99.1	0.9
Hard coal	Netherlands	96.9	3.1	98.9	1.1
Hard coal	Poland	68.4	31.6	86.1	13.9
Hard coal	Portugal	100	0	100	0
Hard coal	Slovakia	54.4	45.6	77.3	22.7
Hard coal	United States	99.1	0.9	99.7	0.3
Hard coal	Russia	56.8	43.2	79	21
Hard coal	India	100	0	100	0
Lignite	Bosnia and Herzegovina	96.1	3.9	98.6	1.4
Lignite	Serbia	96.4	3.6	98.7	1.3
Lignite	Czech Republic	72.5	27.5	88.3	11.7
Lignite	Germany	95	5	98.2	1.8
Lignite	Greece	94.5	5.5	98	2
Lignite	Hungary	96.1	3.9	98.6	1.4
Lignite	North Macedonia	100	0	100	0
Lignite	Poland	97.7	2.3	99.2	0.8
Lignite	Slovenia	90.9	9.1	96.6	3.4
Lignite	Slovakia	47.4	52.6	72	28
Peat	ENTSO-E	50.7	49.3	74.6	25.4

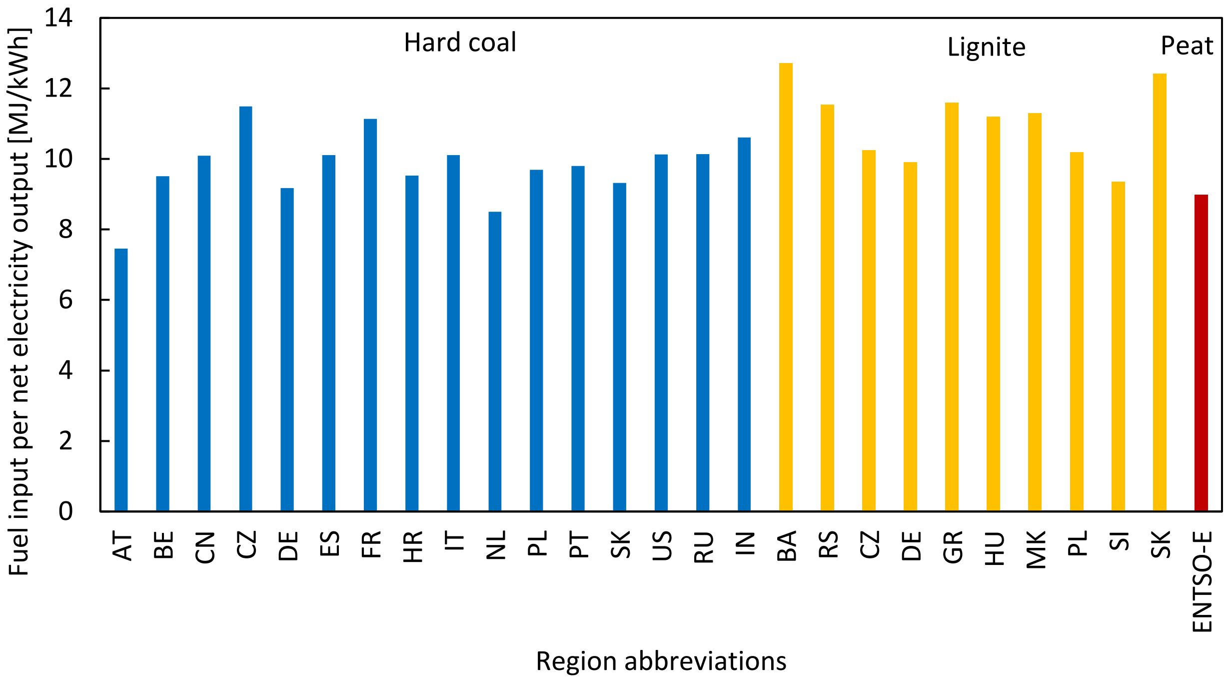

Fig. 3.8: Fuel inputs per net electricity output for different regions and fuel types due to electrical efficiencies adjusted for co-generated heat.

A plausibility check of the coal UVEK datasets is performed by comparing the cumulative CO_2 emissions of these datasets for 2019 with the cumulative CO_2 emissions reported for public electricity and heat production across all fuels by the UNFCCC (UNFCCC, 2023). Supply chain emissions are not included in either case as these are compared elsewhere in this report. Most countries have 2019 emission data available while the latest Chinese data submission was in 2014 (UNFCCC, 2018) and the latest available Indian data for 2018 was obtained from an alternative data source (GHGPI, 2018). The emission ratios are presented in Tab. 3.13. Results generally seem plausible. For countries with high share of coal power in the national electricity mix, coal power dominates overall CO_2 emissions of the solid fossil fuel combustion in the sector and cumulative emissions are similar in both approaches (e.g. Germany, Poland, Czech Republic). The Indian and Chinese data is difficult to compare due to the difference in temporal scope and partly also methodology, but nevertheless seem to show plausible results. Countries with lower share of coal power in national electricity mixes and higher shares of other CO_2 emitting solid fuels show stronger deviations in CO_2 emissions (e.g. Belgium, France). Reasons may on the one hand be relative contributions due to the solid fossil fuel contributions by other fuel types (e.g. incineration of fossil wastes), but additional influences may come from the combustion of coal with technology types that are not covered by the UVEK coal power update. Such a case is probably Russia, where the use of heat plants for district heating and industrial purposes with coal as fuel is common, but not covered by UVEK. Overall, the CO_2 emission comparison against reported benchmarking data yields plausible results.

Tab. 3.13: Comparison of total annual UVEK coal power CO_2 emissions and national public power and heat supply CO_2 emissions across all types of solid fossil fuels reported to the UNFCCC (UNFCCC, 2023). Indian and Chinese data is from alternative data sources (GHGPI, 2018; UNFCCC, 2018).

	Ratio UVEK coal CO_2 emissions vs. reported reference CO_2 emissions	Year of energy sector CO_2 emissions data	Sector coverage of reference data
Austria	1.16	2019	Solid fossil fuels
Belgium	0.02	2019	Solid fossil fuels
China	1.17	2014	Fossil fuels energy industry
Czech Republic	1.04	2019	Solid fossil fuels
France	0.5	2019	Solid fossil fuels
Germany	0.95	2019	Solid fossil fuels
Greece	0.78	2019	Solid fossil fuels
Hungary	0.74	2019	Solid fossil fuels
India	0.84	2018	Public electricity and captive power plants
Italy	1.00	2019	Solid fossil fuels
Netherlands	0.74	2019	Solid fossil fuels
Poland	0.84	2019	Solid fossil fuels
Russia	0.51	2019	Solid fossil fuels
United States	1.07	2019	Solid fossil fuels

4 LIFE CYCLE IMPACT ASSESSMENT RESULTS

Chapter 4 describes the Life Cycle Impact Assessment (LCIA) results for electricity generation from solid fossil fuels (hard coal, lignite and peat) for the full supply chain including mining activities, supply mixes, combustion and electricity generation. Furthermore, it includes the comparison of the LCIA results from the updated inventory models with those from the UVEK:2018 database. A summary of the LCIA results for electricity generation from solid fossil fuels is described in section 4.1. The results for greenhouse gas emissions according to IPCC (2021), primary energy demand (cumulative energy demand) according to Frischknecht et al. (2007) and total environmental impacts according to Ecological Scarcity Method 2021 (FOEN, 2021) including a comparison to the UVEK:2018 database are described in section 4.2, 4.3 and 4.4, respectively.

4.1 Summary LCIA results

Electricity generation from solid fossil fuels is among the technologies with the highest environmental impacts per kWh of electricity generated. A summary of the LCIA results per kWh of electricity generated is shown in Tab. 4.1. This table shows LCIA results of electricity for all the different types of solid fuels fossils (hard coal, lignite and peat) and countries covered by the updated UVEK:2023 database.

The greenhouse gas emissions caused by the generation of 1 kWh of electricity from hard coal ranges from 0.861 to 1.32 kg CO_2-eq with generation in the Czech Republic causing the highest greenhouse gas emissions with 1.32 kg CO_2-eq followed by France and India with 1.25 and 1.23 kg CO_2-eq, respectively. The greenhouse gas emissions caused by the generation of 1 kWh of electricity from lignite ranges from 1 to 1.35 kg CO_2-eq with generation in the Bosnia Herzegovina causing the highest greenhouse gas emissions with 1.35 kg CO_2-eq followed by Greece and Slovakia with 1.33 and 1.28 kg CO_2-eq, respectively.

The primary energy demand caused by the generation of 1 kWh of electricity from hard coal ranges from 9.53 to 14.7 MJ oil-eq with generation in the Czech Republic causing the highest primary energy with 14.7 MJ oil-eq followed by India and the France with 14.2 and 13.5 MJ oil-eq, respectively. The primary energy demand caused by the generation of 1 kWh of electricity from lignite ranges from 9.34 to 22.9 MJ oil-eq with generation in the Greece causing the highest primary energy with 22.9 MJ oil-eq followed by North Macedonia and the Serbia with 15.3 and 14.9 MJ oil-eq, respectively.

The total environmental impacts caused by the generation of 1 kWh of electricity from hard coal ranges from 1’010 to 1’830 eco-points with generation in the India causing the highest total environmental impacts with 1’830 eco-points followed by Czech Republic and Russia with 1’600 and 1’570 eco-points, respectively. The total environmental impacts caused by the generation of 1 kWh of electricity from lignite ranges from 1’150 to 1’910 eco-points with generation in the North Macedonia causing the highest total environmental impacts with 1’910 eco-points followed by Bosnia Herzegovina and the Serbia with 1’690 and 1’670 eco-points, respectively.

Tab. 4.1: Summary of LCIA results for the generation of 1 kWh of electricity from solid fossil fuels (hard coal, lignite and peat) including greenhouse gas emissions in kg CO_2-eq according to IPCC (2021), primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) and total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) in the UVEK:2023 database.

			Greenhouse gas emissions	Primary energy demand, total	Primary energy demand, non-renewable	Primary energy demand, renewable	Total environmental impacts
			kg CO_2-eq	MJ oil-eq	MJ oil-eq	MJ oil-eq	eco-points
Electricity, at power plant	Hard coal	India (IN)	1.23	14.2	14.1	0.116	1830
		Czech Republic (CZ)	1.32	14.7	14.5	0.178	1600
		France (FR)	1.13	13	12.8	0.131	1510
		Russia (RU)	1.25	13.5	13.4	0.17	1570
		Spain (ES)	1.16	12.2	12.0	0.2	1440
		Poland (PL)	1.13	11.6	11.4	0.124	1320
		Belgium (BE)	1.11	11.8	11.6	0.13	1280
		Europe (ENTSO-E)	1.07	13.4	13.3	0.0739	1300
		Italy (IT)	1.11	11.5	11.4	0.123	1300
		Hungary (HU)	1.12	12.4	12.3	0.15	1380
		China (CN)	1.09	11.5	11.3	0.2	1340
		Slovakia (SK)	1.09	11.7	11.5	0.152	1320
		United States (US)	1.09	12.3	12.1	0.144	1310
		Portugal (PT)	1.09	12	11.8	0.185	1310
		Germany (DE)	1.04	10.8	10.7	0.16	1250
		Netherland (NL)	0.969	10.4	10.3	0.145	1160
		Austria (AT)	0.861	9.53	9.4	0.127	1010
	Lignite	North Macedonia (MK)	1.2	15.3	15.2	0.0299	1910
		Bosnia and Herzgovina (BA)	1.35	12.6	12.6	0.0304	1690
		Serbia (RS)	1.23	14.9	14.9	0.0329	1670
		Greece (GR)	1.33	12.5	12.5	0.0312	1540
		Slovakia (SK)	1.28	22.9	22.8	0.0512	1600
		Europe (ENTSO-E)	1.24	13.2	13.2	0.0	1540
		Hungary (HU)	1.2	13.2	13.2	0.032	1420
		Poland (PL)	1.1	12.5	12.4	0.0299	1330
		Czech Republic (CZ)	1.09	9.34	9.31	0.0238	1280
		Germany (DE)	1.06	11.6	11.6	0.0282	1240
		Slovenia (SI)	1	9.65	9.62	0.024	1150
	Peat	Europe (ENTSO-E)	1.01	9.52	9.49	0.0254	1080

Heat generated from solid fossil fuels is among the technologies with the highest environmental impacts per kWh of heat generated. A summary of the LCIA results per kWh of heat generated is shown in Tab. 4.2. This table shows LCIA results of heat for all the different types of solid fuels fossils (hard coal, lignite and peat) and countries covered by the updated UVEK:2023 database.

The greenhouse gas emissions caused by the generation of 1 kWh of heat from hard coal ranges from 0.3 to 0.439 kg CO_2-eq with generation in the Czech Republic causing the highest greenhouse gas emissions with 0.439 kg CO_2-eq followed by France and Russia with 0.39 and 0.389 kg CO_2-eq, respectively. The greenhouse gas emissions caused by the generation of 1 kWh of heat from lignite ranges from 0.3 to 0.46 kg CO_2-eq with generation in Slovenia causing the highest greenhouse gas emissions with 0.46 kg CO_2-eq followed by Slovakia and Greece with 0.42 and 0.41 kg CO_2-eq, respectively.

The primary energy demand caused by the generation of 1 kWh of heat from hard coal ranges from 3.23 to 4.88 MJ oil-eq with generation in the Czech Republic causing the highest primary energy with 4.88 MJ oil-eq followed by the United States and the Russia with 4.58 and 4.46 MJ oil-eq, respectively. The primary energy demand caused by the generation of 1 kWh of heat from lignite ranges from 3.12 to 7.39 MJ oil-eq with generation in the Greece causing the highest primary energy with 7.39 MJ oil-eq followed by Serbia and Hungary with 4.79 and 4.43 MJ oil-eq, respectively.

The total environmental impacts caused by the generation of 1 kWh of heat from hard coal ranges from 357 to 529 eco-points with generation in the Czech Republic causing the highest total environmental impacts with 529 eco-points followed by Russia and France with 516 and 491 eco-points, respectively. The total environmental impacts caused by the generation of 1 kWh of heat from lignite ranges from 352 to 535 eco-points with generation in Serbia causing the highest total environmental impacts with 535 eco-points followed by Slovenia and Greece with 525 and 518 eco-points, respectively.

Tab. 4.2: Summary of LCIA results for the generation of 1 kWh of heat from solid fossil fuels (hard coal, lignite and peat) including greenhouse gas emissions in kg CO_2-eq according to IPCC (2021), primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) and total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) in the UVEK:2023 database.

			Greenhouse gas emissions	Primary energy demand, total	Primary energy demand, non-renewable	Primary energy demand, renewable	Total environmental impacts
			kg CO_2-eq	MJ oil-eq	MJ oil-eq	MJ oil-eq	eco-points
Heat, at cogeneration, allocation exergy	Hard coal	Czech Republic (CZ)	0.439	4.88	4.82	0.059	530
		Russia (RU)	0.389	4.46	4.42	0.0453	521
		France (FR)	0.39	4.24	4.19	0.0533	493
		Slovakia (SK)	0.38	4.21	4.15	0.0651	460
		China (CN)	0.38	3.94	3.9	0.0421	447
		Poland (PL)	0.36	3.96	3.92	0.048	442
		United States (US)	0.37	4.58	4.55	0.0252	443
		Austria (AT)	0.37	4.05	3.99	0.0539	430
		Europe (ENTSO-E)	0.35	3.81	3.76	0.0492	428
		Spain (ES)	0.34	3.59	3.54	0.0519	425
		Belgium (BE)	0.34	3.61	3.55	0.0591	422
		Italy (IT)	0.34	3.46	3.42	0.0371	395
		Germany (DE)	0.32	3.28	3.23	0.0484	378
		Netherland (NL)	0.30	3.23	3.18	0.0448	359
	Lignite	Serbia (RS)	0.40	4.79	4.78	0.0106	535
		Slovenia (SI)	0.46	4.42	4.4	0.011	525
		Greece (GR)	0.41	7.39	7.37	0.0166	518
		Slovakia (SK)	0.42	4	3.99	0.00996	492
		Hungary (HU)	0.40	4.43	4.42	0.0107	476
		Bosnia and Herzgovina (BA)	0.36	3.32	3.31	0.00801	444
		Czech Republic (CZ)	0.36	3.12	3.11	0.00796	429
		Poland (PL)	0.35	3.96	3.95	0.00951	424
		Europe (ENTSO-E)	0.36	3.47	3.46	0.00857	422
		Germany (DE)	0.30	3.29	3.28	0.008	352
	Peat	Europe (ENTSO-E)	0.31	2.94	2.93	0.00784	334

Most relevant processes in supply chain for electricity generation from solid fossil fuels are the combustion process, the conversion efficiencies in the power plants and coal mining. Fig. 4.1 shows the contribution analysis for combustion and coal supply for electricity generation from hard coal in Germany for greenhouse gas emissions, primary energy demand and total environmental impacts. The conversion efficiency is not reflected in the contribution analysis and only influences the overall magnitude of results.

Most important contributor for greenhouse gas emissions with more than 85 % are the direct emissions from combustion of hard coal, followed by the coal supply with 12 %. The contribution of flue gas treatment and power plants only have a minor contribution to the total greenhouse gas emissions of 0.5 and 0.2 %, respectively.

Most important contributor for primary energy demand with more than 98 % is the hard coal supply. The contribution of flue gas treatment and power plants only have a minor contribution to the primary energy demand of 0.7 and 0.2 %, respectively.

Most important contributor for total environmental impacts with more than 75 % are the direct emissions from combustion of hard coal, followed by the coal supply with 20 %. The contribution of flue gas treatment and power plants only have a minor contribution to the total environmental impacts of 1.4 and 0.3 %, respectively.

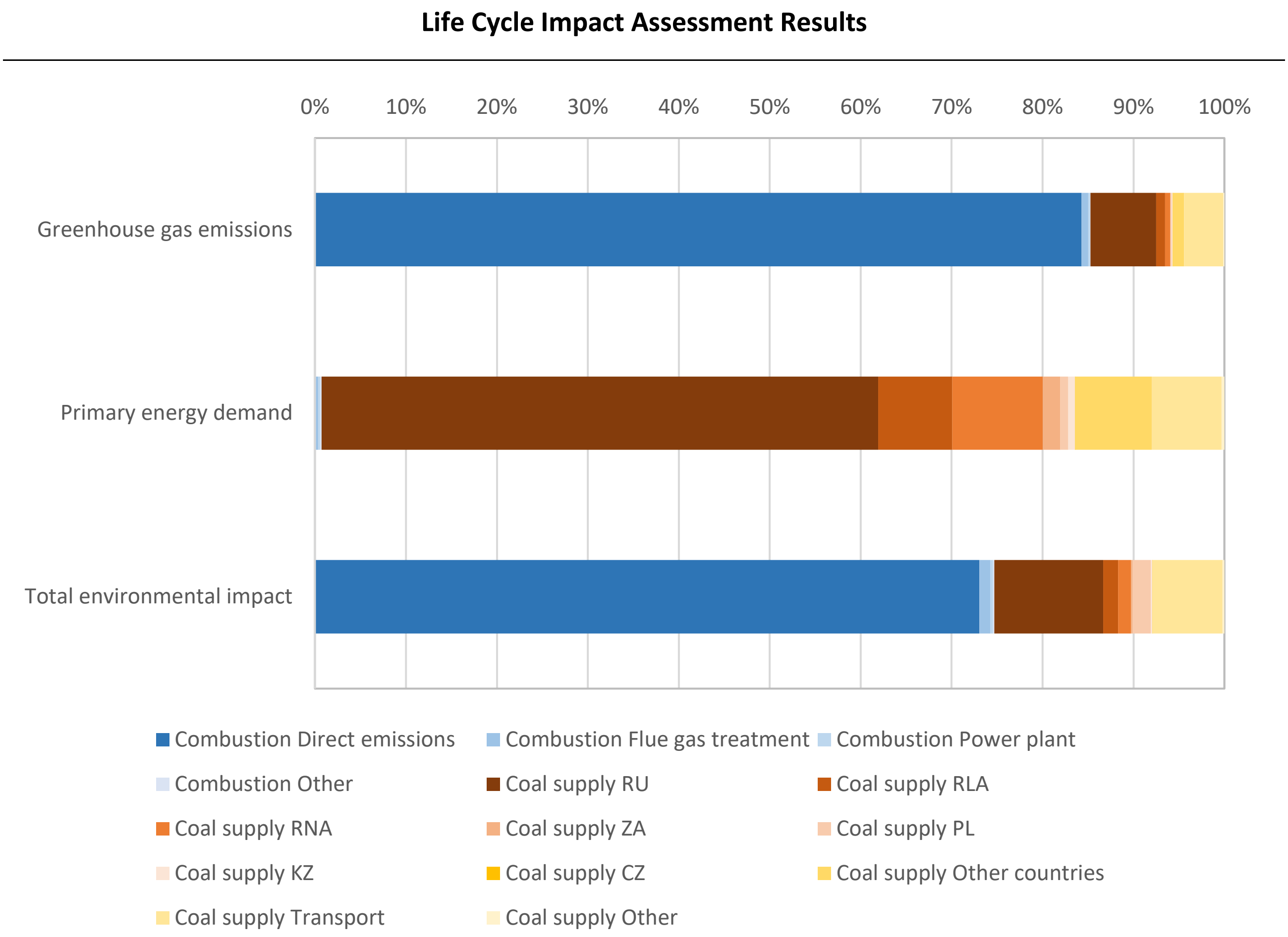

Fig. 4.1: Contribution analysis for greenhouse gas emissions according to IPCC (2021), primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) and total environmental impacts according to Ecological Scarcity Method 2021 (FOEN, 2021) per kWh of electricity generated in Germany with individual contributions from combustion and coal supply

4.2 Greenhouse Gas Emissions

This section describes the LCIA results for greenhouse gas emissions according to IPCC (2021) for the individual stages of the solid fossil fuel supply chain that have been updated with this actualisation. The greenhouse gas emissions caused by mining activities, hard coal supply mixes, solid fossil fuel combustion and electricity generation are described in the sections 4.2.1, 4.2.2, 4.2.3 and 4.2.4, respectively.

4.2.1 Coal mining

Fig. 4.2 shows the comparison of greenhouse gas emissions according to IPCC (2021) per kg hard coal, lignite and peat mined in the different countries covered by the UVEK database before and after the update.

Due to the updated methane emissions the greenhouse gas emissions per kg of mined hard coal, lignite and peat change significantly. The most significant increases in greenhouse gas emissions with +785 % occur for the region Latin America, followed by Centrally Planned Asia with +72 %. The methane emissions from coal mining in Latin America were very low in UVEK:2018 (see Fig. 3.1) due to the update the methane emissions for coal mining in Latin America are now more in line with other world regions like China, Europe and Russia. There is also an increase of +90 % for greenhouse gas emissions caused by lignite and peat mining. For all other mining LCI datasets the greenhouse gas emissions per kg of solid fossil fuel are reduced. The highest reduction is China with -75 % followed by South Africa with -67 %. The reduction for South Africa is caused the use of data from South African measurement campaigns for methane emissions from coal mining. The reduction for China is caused by the removal of direct emissions from coal fires that have been included in UVEK:2018.

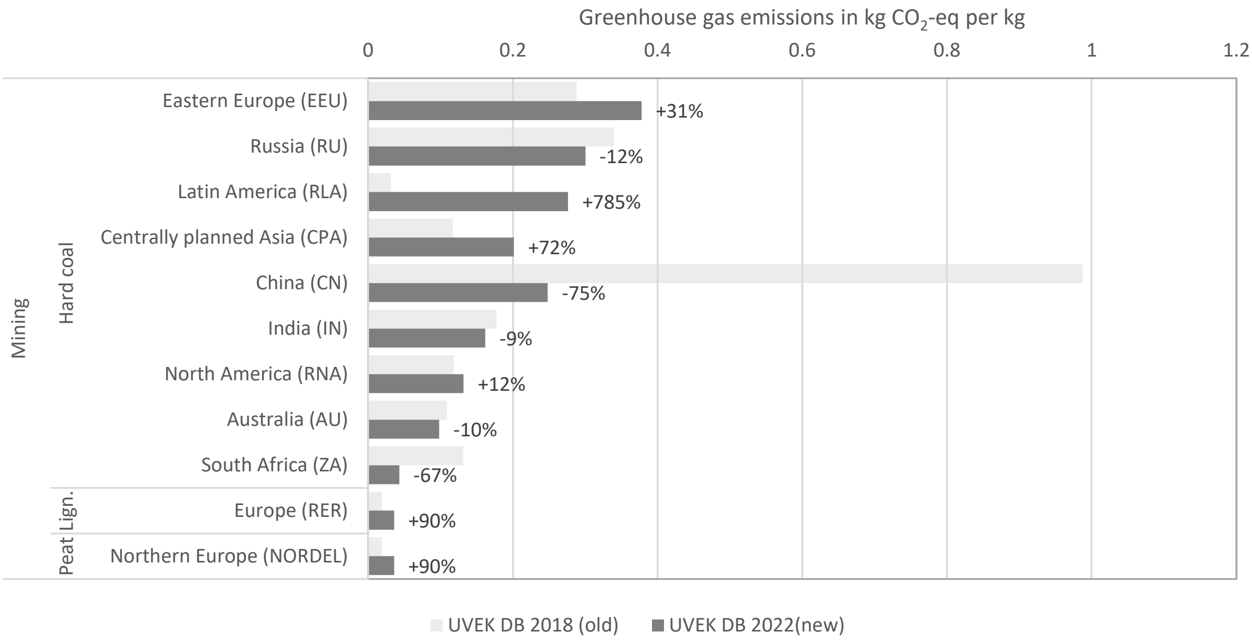

Fig. 4.2: **Comparison of greenhouse gas emissions in kg CO_2-eq according to IPCC (2021) per kg hard coal, lignite and peat mined in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.2.2 Hard coal supply mix

The hard coal supply mixes of the different European Countries, China, India and the United States have been updated based on the coal production and trade statistics of the year 2020 as described in section 3.1. Fig. 4.3 shows the comparison of greenhouse gas emissions in kg CO_2-eq according to IPCC (2021) per kg hard coal supplied in the different countries covered by the UVEK database. Portugal sees the highest changes in the greenhouse gas emissions per kg of supplied hard coal after the update with an increase of +139%.

According to the trade and production statistics of the year 2020, the coal supply in Portugal is coming from stock changes and imports from Spain. This is a major difference compared to the Portuguese supply mix in the UVEK:2018 database, which mainly consists of imports from Latin America, North America and South Africa with very low greenhouse gas emissions in UVEK:2018.

After the update, the greenhouse gas emissions for the hard coal supply mix in China, India and Russia are 73 %, 13 % and 11 % lower, respectively. This mainly due to the reduced greenhouse gas emissions caused by coal mining activities (see Fig. 4.2). The differences between the hard coal supply mixes for the European countries decrease because all European countries mainly import coal from Poland and Russia. Due to the similar supply mix of the European countries, there are only minor differences in the greenhouse gas emissions per kg supplied coal in these countries. The reduction for China is caused by the removal of direct emissions from coal fires that have been included in UVEK:2018.

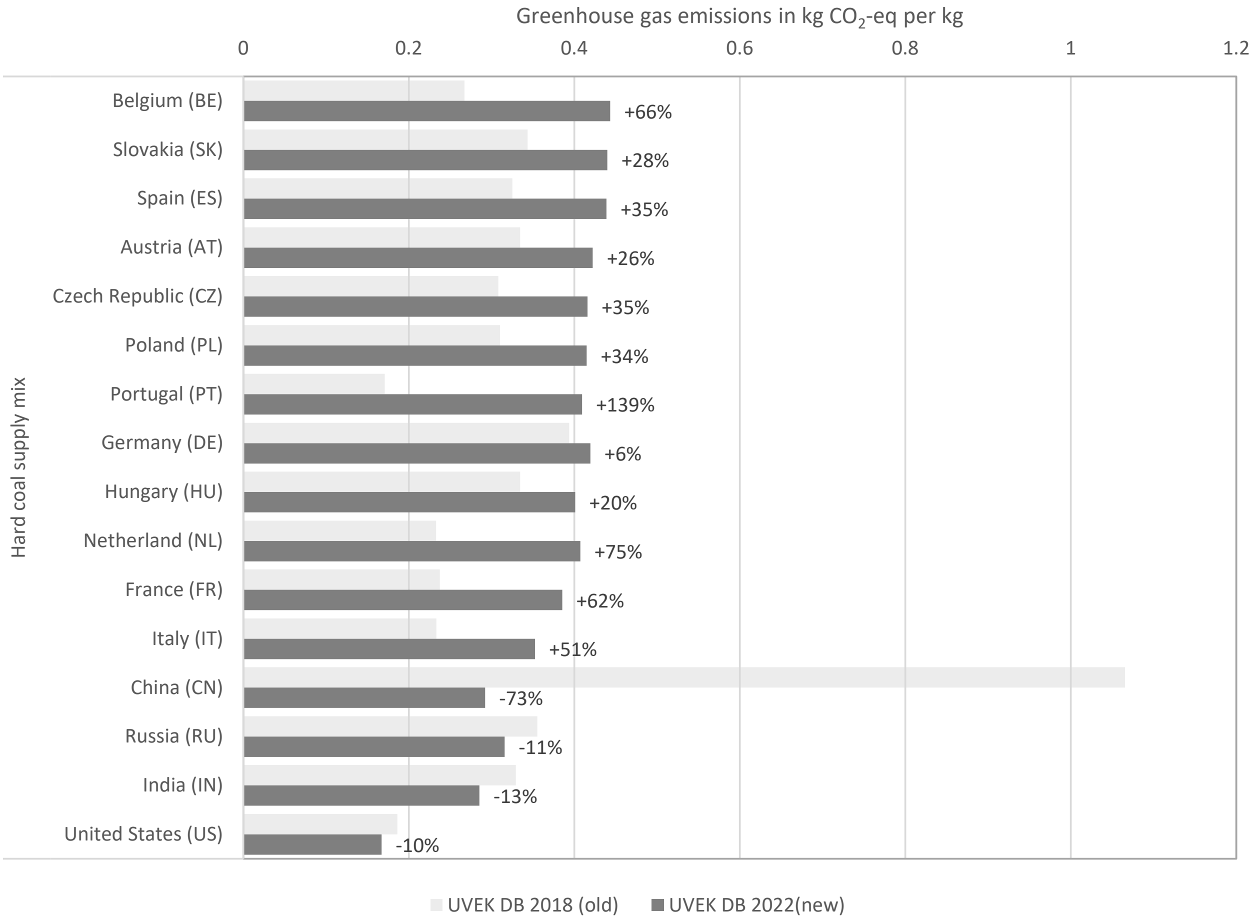

Fig. 4.3: **Comparison of greenhouse gas emissions in kg CO_2-eq according to IPCC (2021) per kg hard coal supplied in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.2.3 Coal, lignite and peat combustion

With regard to the greenhouse gas emissions per MJ of coal, lignite and peat combustion there are only minor differences after the update except for China and Greece with reduction of -24 % and -13 %, respectively (see Fig. 4.4). In addition, there are increases in greenhouse gas emissions per MJ of burned hard coal in Portugal +12 %. However, this is not caused by changes in the emission profiles but rather due to the higher greenhouse gas emissions caused by Portuguese hard coal supply (see Fig. 4.3). Overall, the greenhouse gas emissions per MJ of coal, lignite and peat burned in power plants are more harmonised across the different datasets. This in agreement with the more harmonised coal supply mixes (see Fig. 4.3).

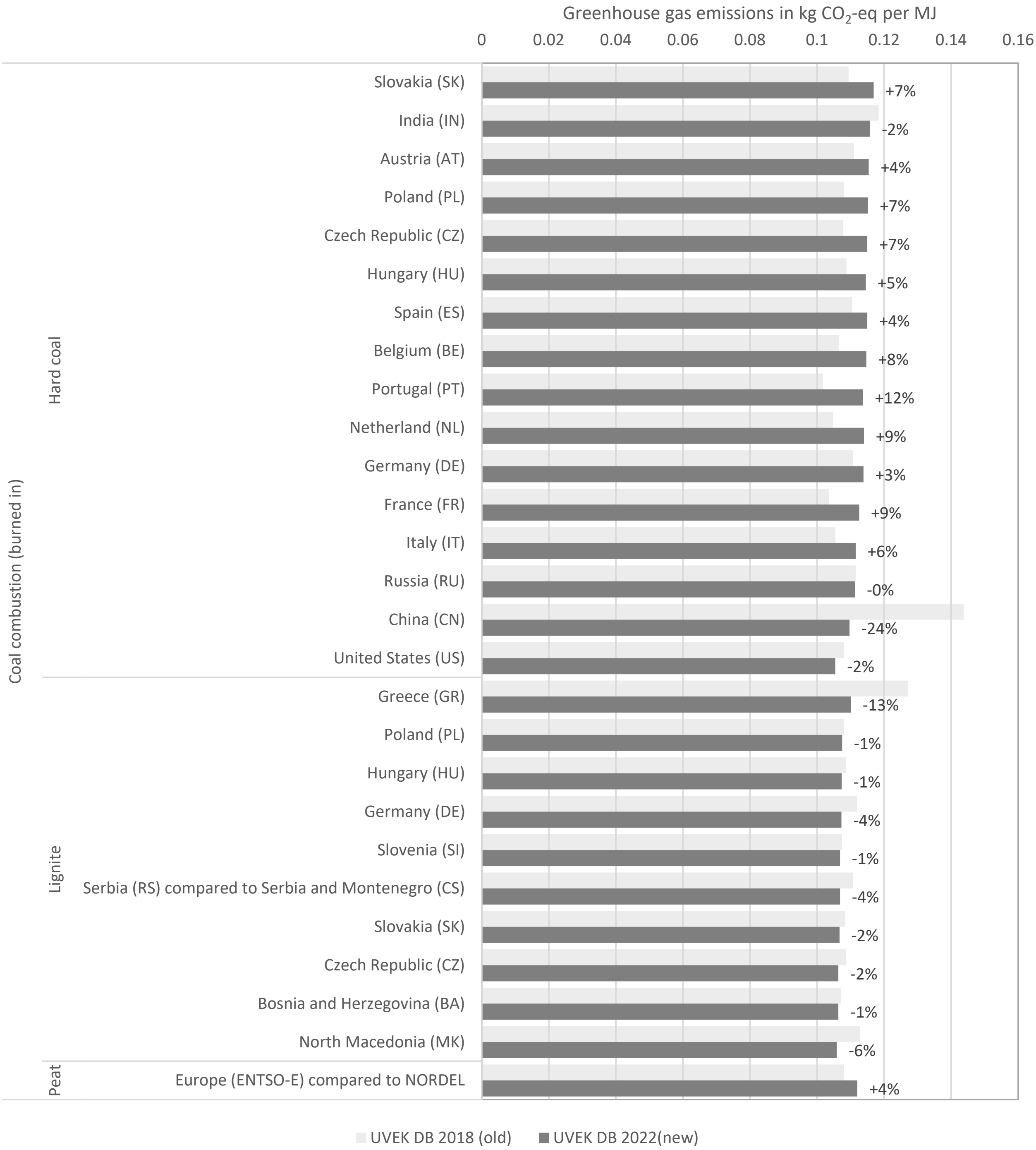

Fig. 4.4: **Comparison of greenhouse gas emissions in kg CO_2-eq according to IPCC (2021) per MJ of hard coal, lignite and peat burned in the power plant in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.2.4 Electricity generation from coal, lignite and peat

The greenhouse gas emissions per kWh of electricity produced from hard coal, lignite and peat show the highest changes for the UVEK:2023 update compared to UVEK:2018 (see Fig. 4.5). The changes are mainly due to the adjusted electricity conversion efficiencies as well as the adjusted allocation for co-generation as described in section 3.4. The highest reduction in the greenhouse gas emissions per kWh of electricity generated from hard coal occur for China and Austria with -24 % and -13 % followed by the Netherlands and United States both with -11 % and -9 %.

The highest increase in greenhouse gas emissions per kWh of electricity generated from hard coal occurs for France with +19 % followed by Portugal with +14 % and Italy with +11 %. This is consistent with the increases in the hard coal supply mixes shown in Fig. 4.3 as well as the increases for the combustion process shown in Fig. 4.4.

For electricity generation from lignite and peat the greenhouse gas emissions decrease for all datasets in the UVEK database. Slovakia, Slovenia, Hungary and Germany have the highest decrease with -22 %, -16 %, -14 % and -20 %, respectively. In general, the differences in the greenhouse gas emissions for electricity generation from hard coal and lignite are less pronounced after the update of the LCI datasets.

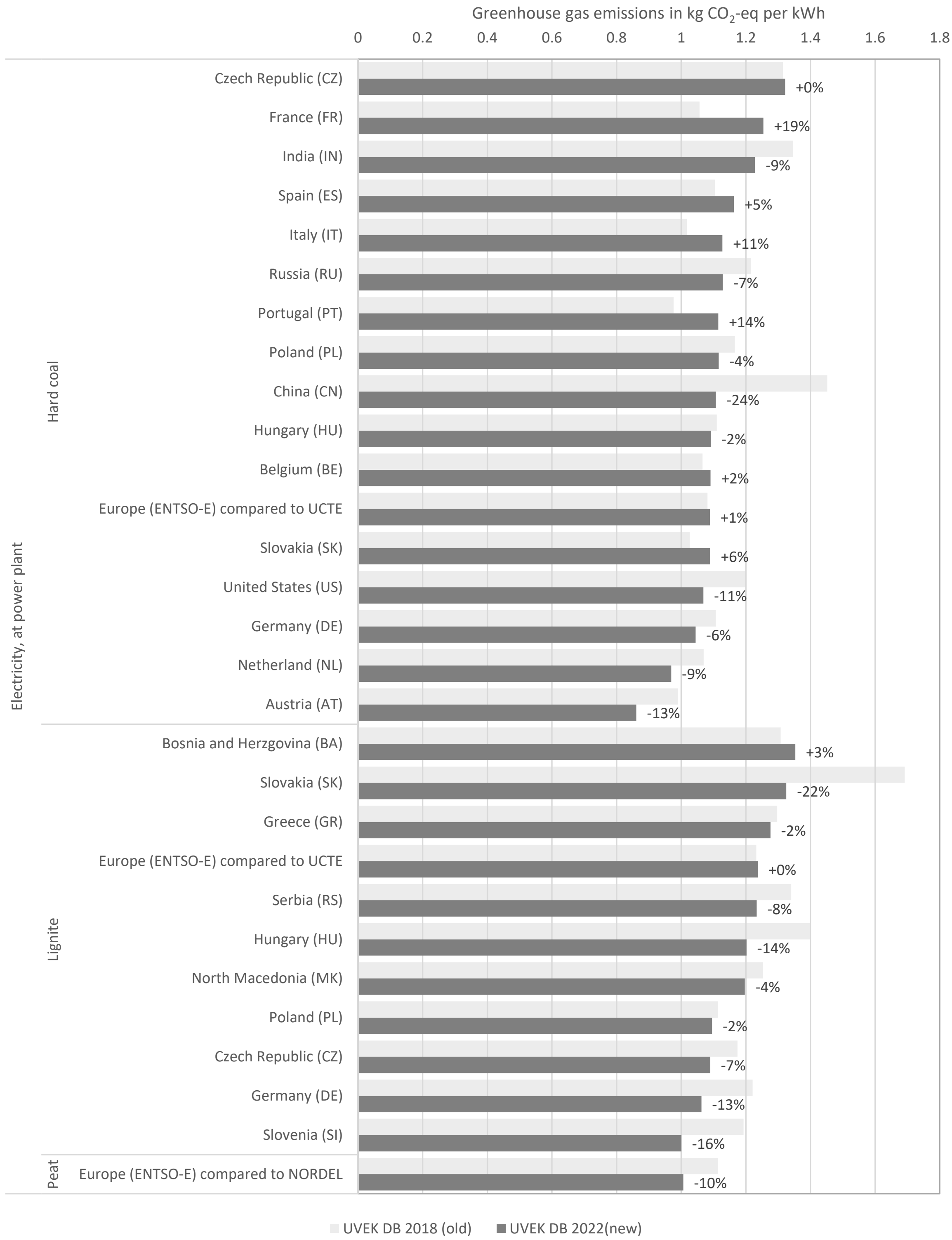

Fig. 4.5: **Comparison of greenhouse gas emissions in kg CO_2-eq according to IPCC (2021) per kWh of generated electricity from hard coal, lignite and peat the power plants in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.3 Primary Energy Demand

This section describes the LCIA results for the primary energy demand according to Frischknecht et al. (2007) for the individual stages of the solid fossil fuel supply chain that have been updated with this actualisation. The primary energy demand caused by mining activities, hard coal supply mixes, solid fossil fuel combustion and electricity generation are described in the sections 4.3.1, 4.3.2, 4.3.3 and 4.3.4, respectively.

4.3.1 Coal mining

The coal mining datasets show no difference before and after the updates because only the methane emissions have been updated in the coal mining datasets, which cause no change in primary energy demand (see Fig. 4.6). There are slight changes in the primary energy demand for Indian and Chinese coal mining because electricity generated from Indian coal is used for coal mining and Chinese coal mine power plant has been replaced. However, this change is only a reduction of about -1 % and -3 %, respectively.

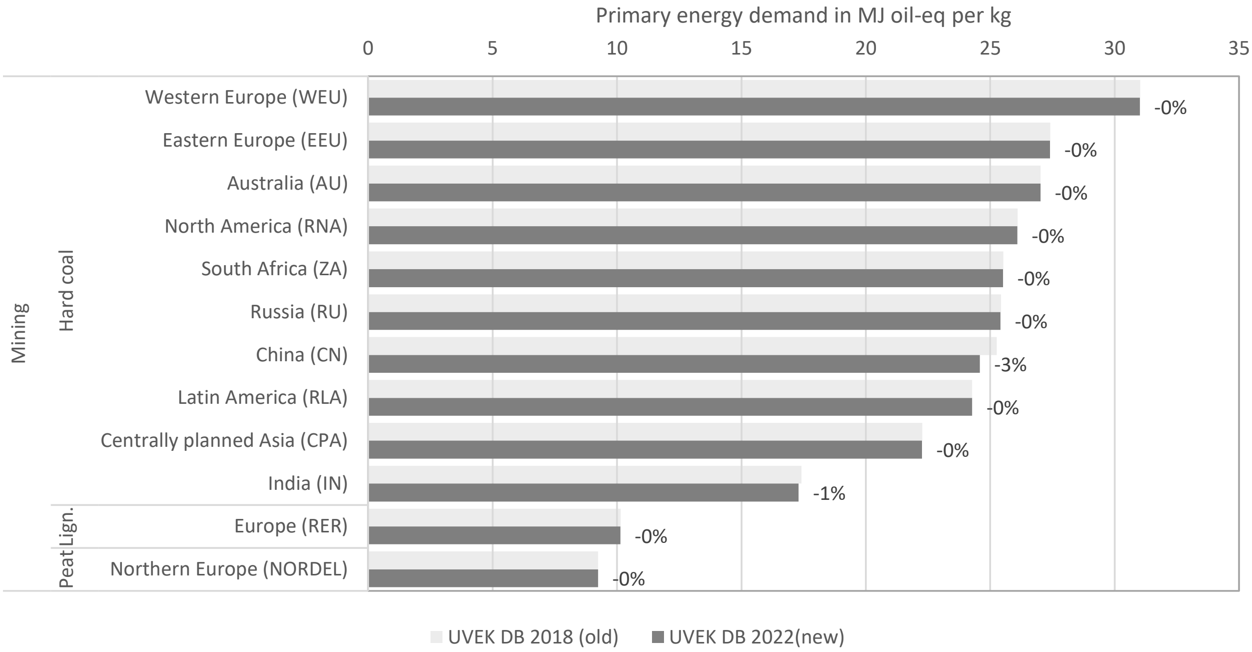

Fig. 4.6: **Comparison of primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) per kg coal, lignite and peat mined in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.3.2 Hard coal supply mix

Due to the updated hard coal supply mixes there are changes in the primary energy demand per kg of hard coal supplied in the European countries (see Fig. 4.7). The highest reduction in primary energy demand per kg of hard coal occur in Germany and China with -7 % and -6 %, respectively. The highest increase in primary energy demand per kg of hard coal occurs in Portugal with +5 %. For all other countries the changes are below +/-5 %.

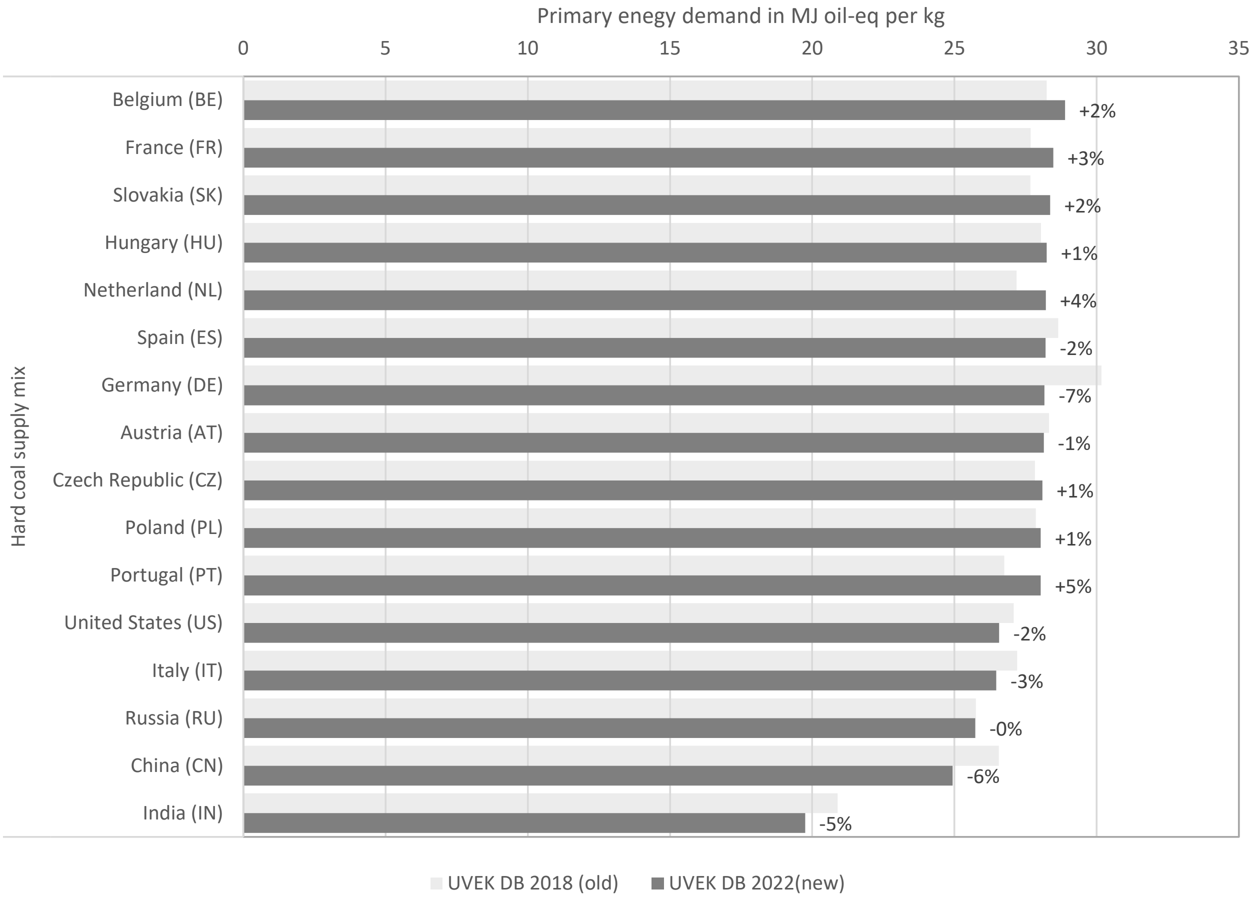

Fig. 4.7: **Comparison of primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) per kg hard coal supplied in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

4.3.3 Coal, lignite and peat combustion

The primary energy demand for the combustion of hard coal as (see Fig. 4.8) shows the same changes as for the hard coal supply mixes (see Fig. 4.7). The primary energy demand for the combustion of lignite and peat shows no changes since the lignite supply remains unchanged.

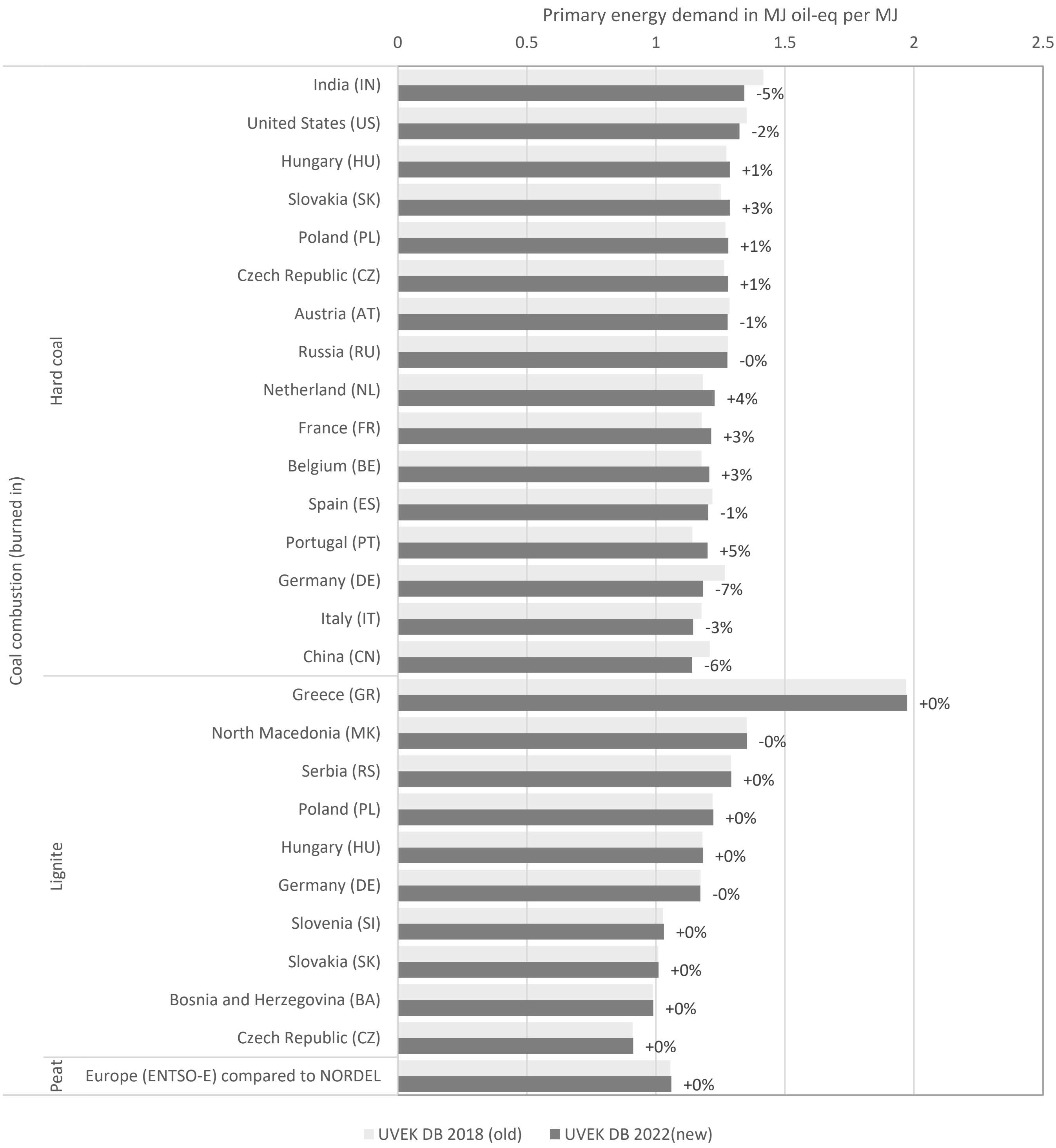

Fig. 4.8: Comparison of primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) per MJ of hard coal, lignite and peat burned in the power plant in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.

4.3.4 Electricity generation from coal, lignite and peat

The primary energy demand per kWh of electricity produced from hard coal, lignite and peat show the highest changes for the UVEK:2023 update compared to UVEK:2018 (see Fig. 4.9). The changes are mainly due to the adjusted electricity conversion efficiencies as well as the adjusted allocation for co-generation as described in section 3.4. The highest reductions in the primary energy demand per kWh of electricity generated from hard coal occur for Austria, Germany and the Netherlands with -17 % and -14 %, respectively, followed by India with -12 % as well as Poland with a reduction of -10 %.

The highest increase in primary energy demand per kWh of electricity generated from hard coal occurs for France with +13 % followed by Portugal with +7 %. This is consistent with the increases in the hard coal supply mixes shown in Fig. 4.7 as well as the increases for the combustion process shown in Fig. 4.8.

For electricity generation from lignite and peat the primary energy demand decreases for all datasets in the UVEK database except for Greece, Bosnia Herzegovina and North Macedonia. Slovakia, Slovenia and Hungary have the highest decrease with -20 %, -15 %, -and -13 %, respectively. In general, the differences in the primary energy demand for electricity generation from coal and lignite are similar after the update of the LCI datasets.

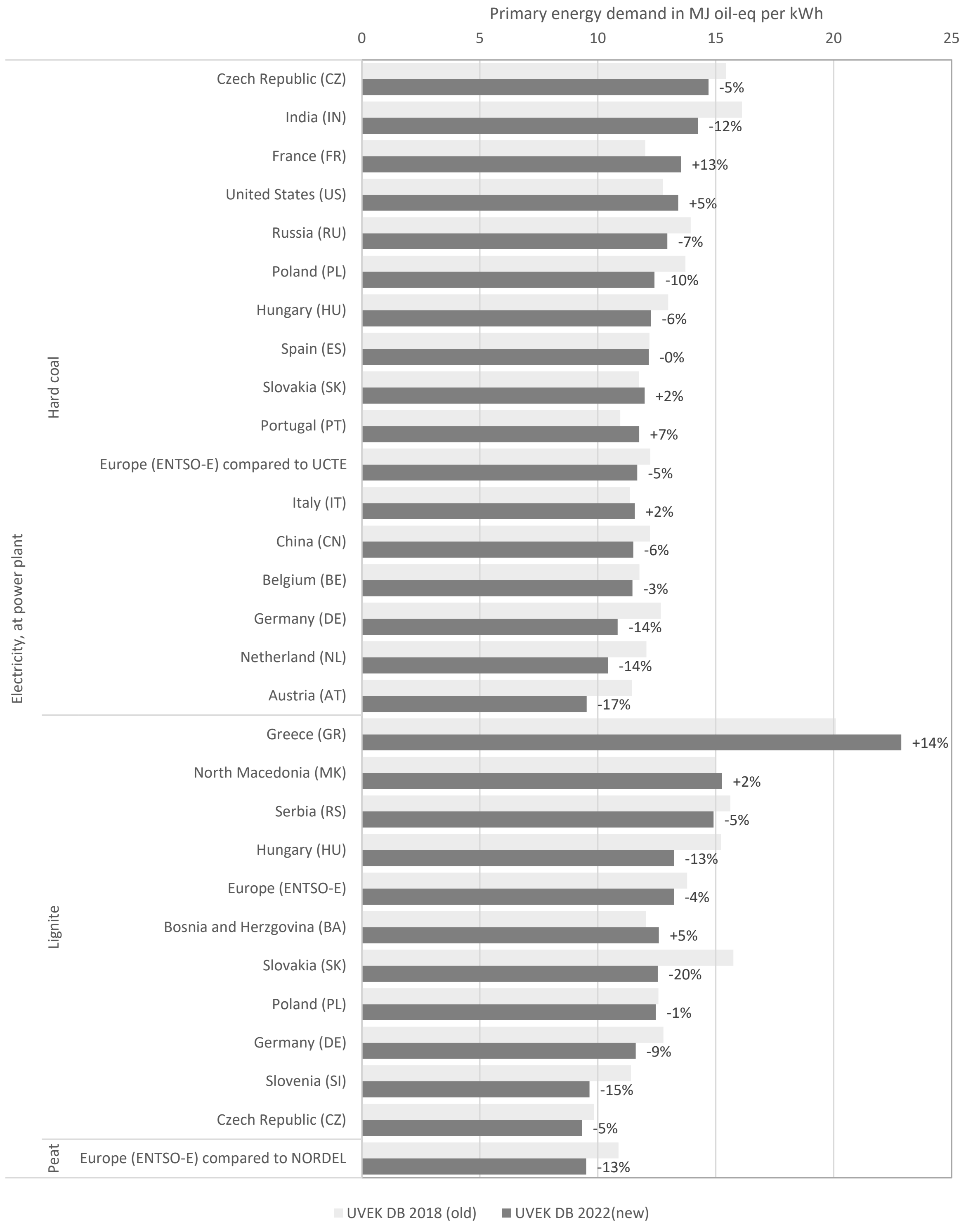

Fig. 4.9: Comparison of primary energy demand in MJ oil-eq according to Frischknecht et al. (2007) per kWh of generated electricity from coal, lignite and peat the power plants in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.

4.4 Total environmental impacts

This section describes the LCIA results for the total environmental impacts according to the Ecological Scarcity Method 2021 (FOEN, 2021) for the individual stages of the solid fossil fuel supply chain that have been updated with this actualisation. The total environmental impacts caused by mining activities, hard coal supply mixes, solid fossil fuel combustion and electricity generation are described in the sections 4.4.1, 4.4.2, 4.4.3 and 4.4.4, respectively.

4.4.1 Coal mining

Fig. 4.10 and Fig. 4.11 show the comparison of total environmental in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg coal, lignite and peat mined in the different countries covered by the UVEK database before and after the update.

The most significant increases in total environmental impacts with +81 % occur for the region Latin America, followed by Centrally Planned Asia with +26 %. The methane emissions from coal mining in Latin America were very low in UVEK:2018 (see Fig. 3.1) due to the update the methane emissions for coal mining in Latin America are now more in line with other world regions like China, Europe and Russia. There is also an increase of +15 % and +59 % for total environmental impacts caused by lignite and peat mining. For all other mining LCI datasets, the total environmental impacts per kg of solid fossil fuel are reduced. The highest reduction has China with -66 %, followed by South Africa with -23 %. The reduction for China is caused by the removal of direct emissions (CO_2 and SO_2) from coal fires that have been included in UVEK:2018.

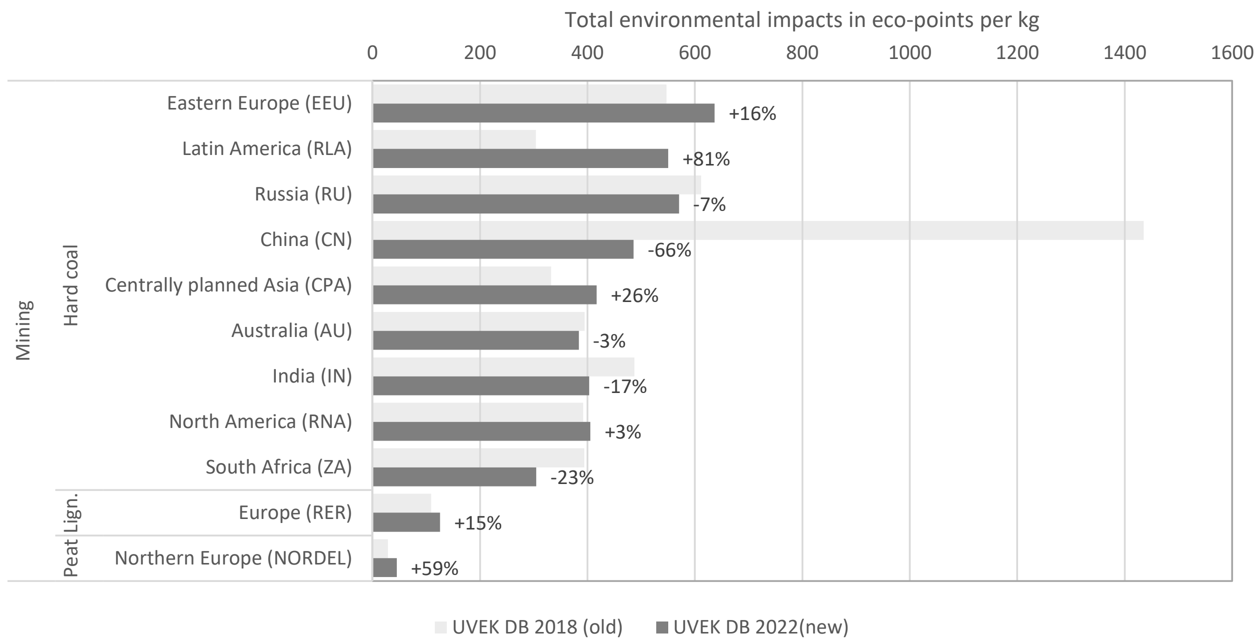

Fig. 4.10: Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg coal, lignite and peat mined in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.

With regard to the contribution of most important impact categories, there are only changes in the contribution of greenhouse gas emissions since only the methane emissions have been updated (see Fig. 4.11). There are some exceptions for China and India which saw a high decrease in emissions due to the removal of coal fire emissions in the case of China and the drastic improvement of the electricity from Indian hard coal, that is used to mine Indian coal.

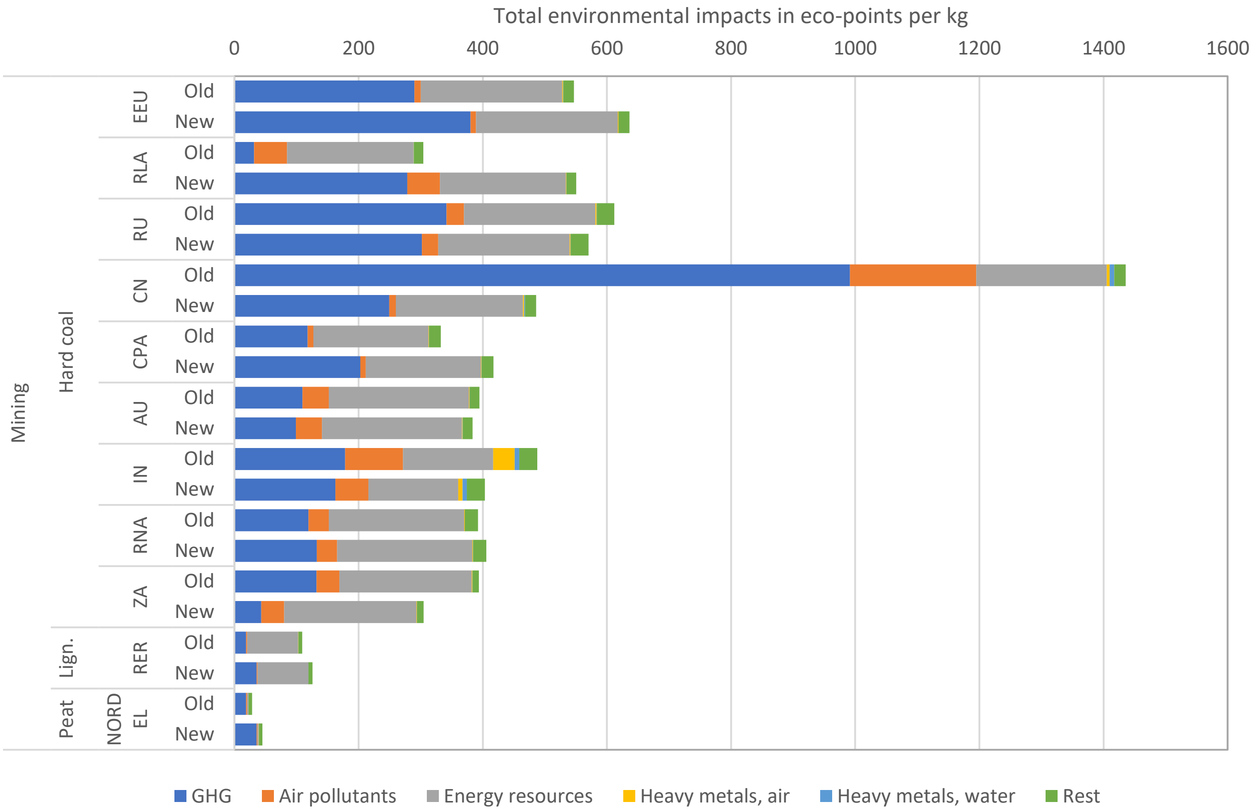

Fig. 4.11: **Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg coal, lignite and peat mined in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey showing the contribution of the most important impact categories.**

4.4.2 Hard coal supply mix

The hard coal supply mixes of the different European Countries, China, India and the United States have been updated based on the coal production and trade statistics of the year 2020 as described in section 3.1. Fig. 4.12 and Fig. 4.13 show the comparison total environmental in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg hard coal supplied in the different countries covered by the UVEK database. The Netherlands see the highest changes in total environmental impacts per kg of supplied hard coal after the update with an increase of +35 %.

After the update, the greenhouse gas emissions for the hard coal supply mix in China, India and the United States are 63 %, 20 % and 10 % lower, respectively. This mainly due to the reduced greenhouse gas emissions caused by coal mining activities (see Fig. 4.11 and Fig. 4.13).

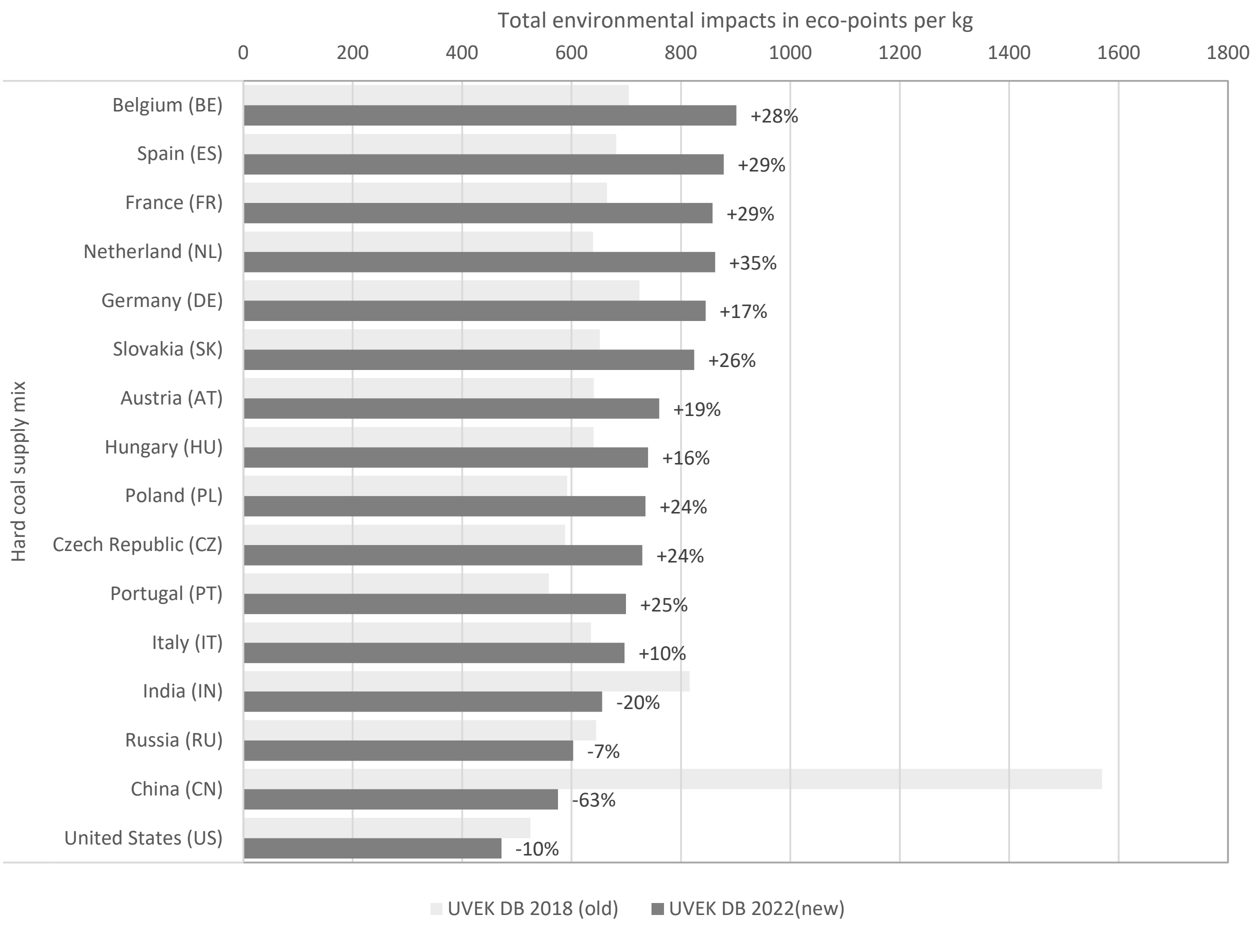

Fig. 4.12: **Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg hard coal supplied in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

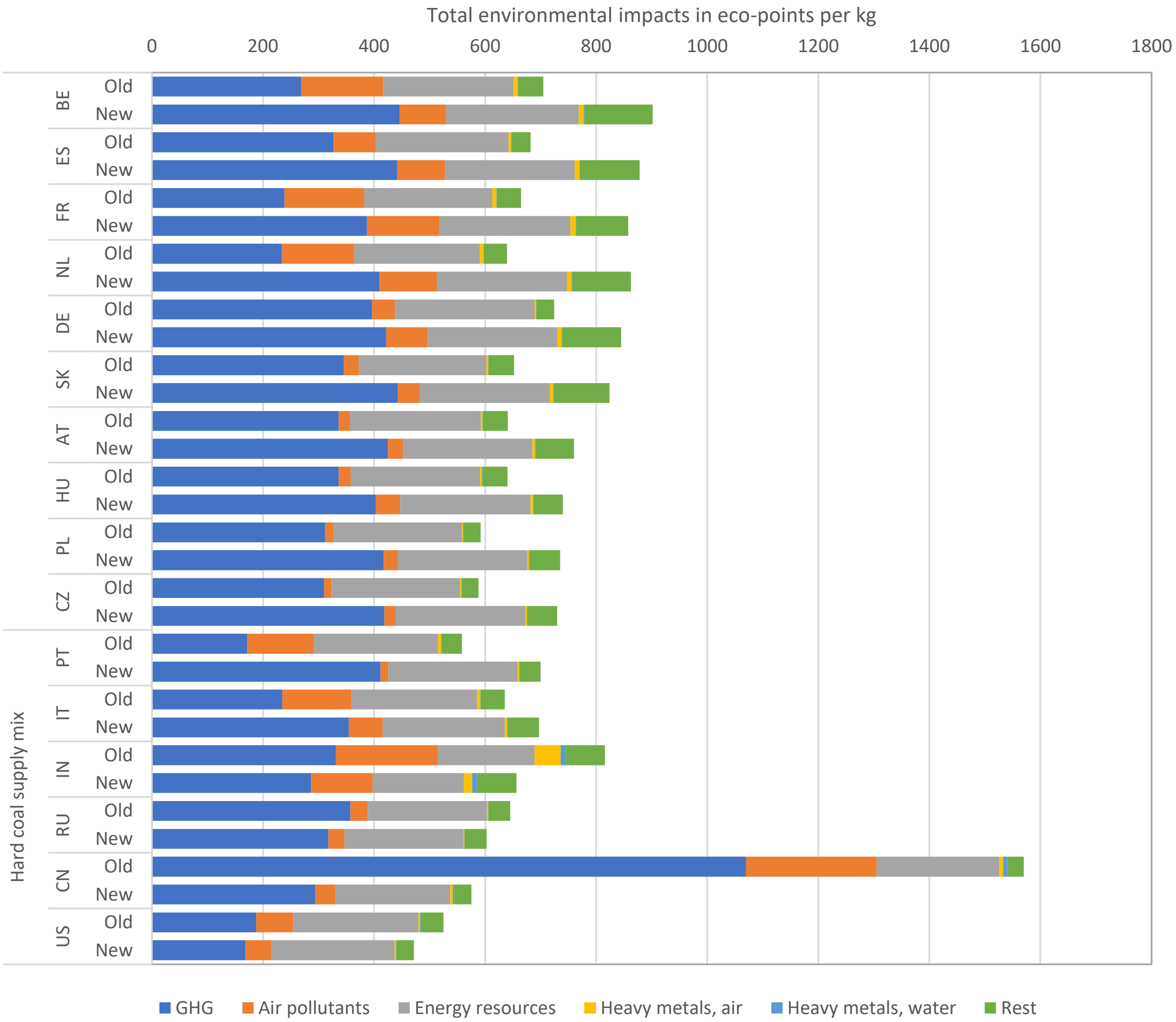

Fig. 4.13: Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg hard coal supplied in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey showing the contribution of the most important impact categories.

4.4.3 Hard coal, lignite and peat combustion

With regard to the total environmental impacts per MJ of hard coal, lignite and peat combustion, there are significant differences after the update due to adjusted emissions of air pollutants and trace elements as described in section 3.3 (see Fig. 4.14 and Fig. 4.15). Overall, the total environmental impacts of most combustion LCI datasets decrease due to the reduced emission of air pollutants and trace emissions. Exceptions are the Czech Republic, the Netherlands and Austria, which show an increase of +7%, +6 % and

+4 %, respectively. The reduction in total environmental impacts from combustion of hard coal is the highest for India with -38 %, followed by China with -37 %, Slovakia with -20%, Russia with -17 % and Spain with - 12 %.

The reduction in total environmental impacts from combustion of lignite is the highest for Slovenia, Greece and Bosnia-Herzegovina all with -23 %.

After the update the contribution of the impact category of greenhouse gas emissions dominates the results for all datasets for the combustion of solid fossil fuels in the UVEK database (see Fig. 4.15).

In general, the differences in the total environmental impacts for the combustion of coal and lignite are less pronounced after the update of the LCI datasets and the emission profiles across the different LCI datasets are more harmonised after the update.

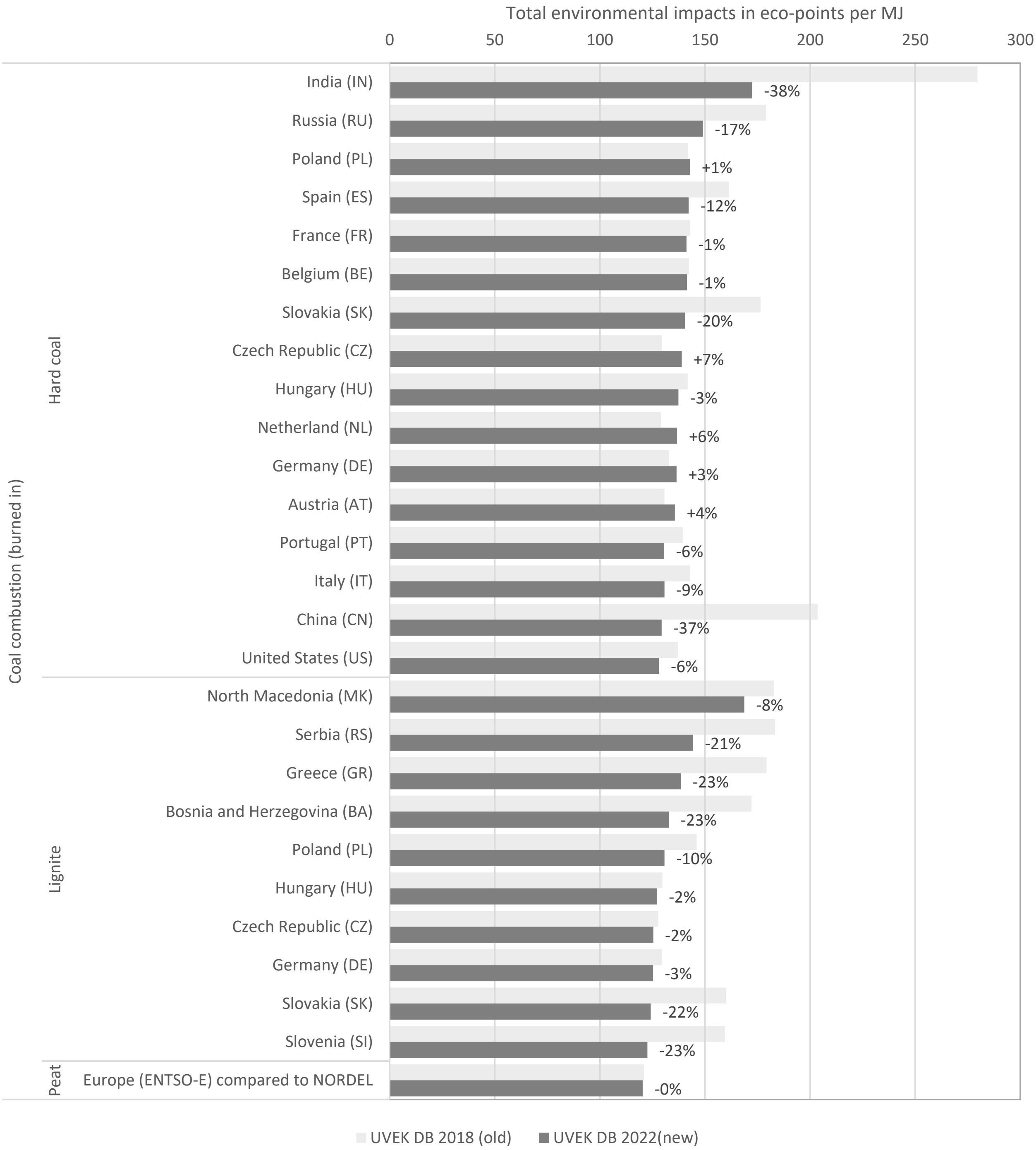

Fig. 4.14: **Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per MJ of hard coal, lignite and peat burned in the power plant in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.**

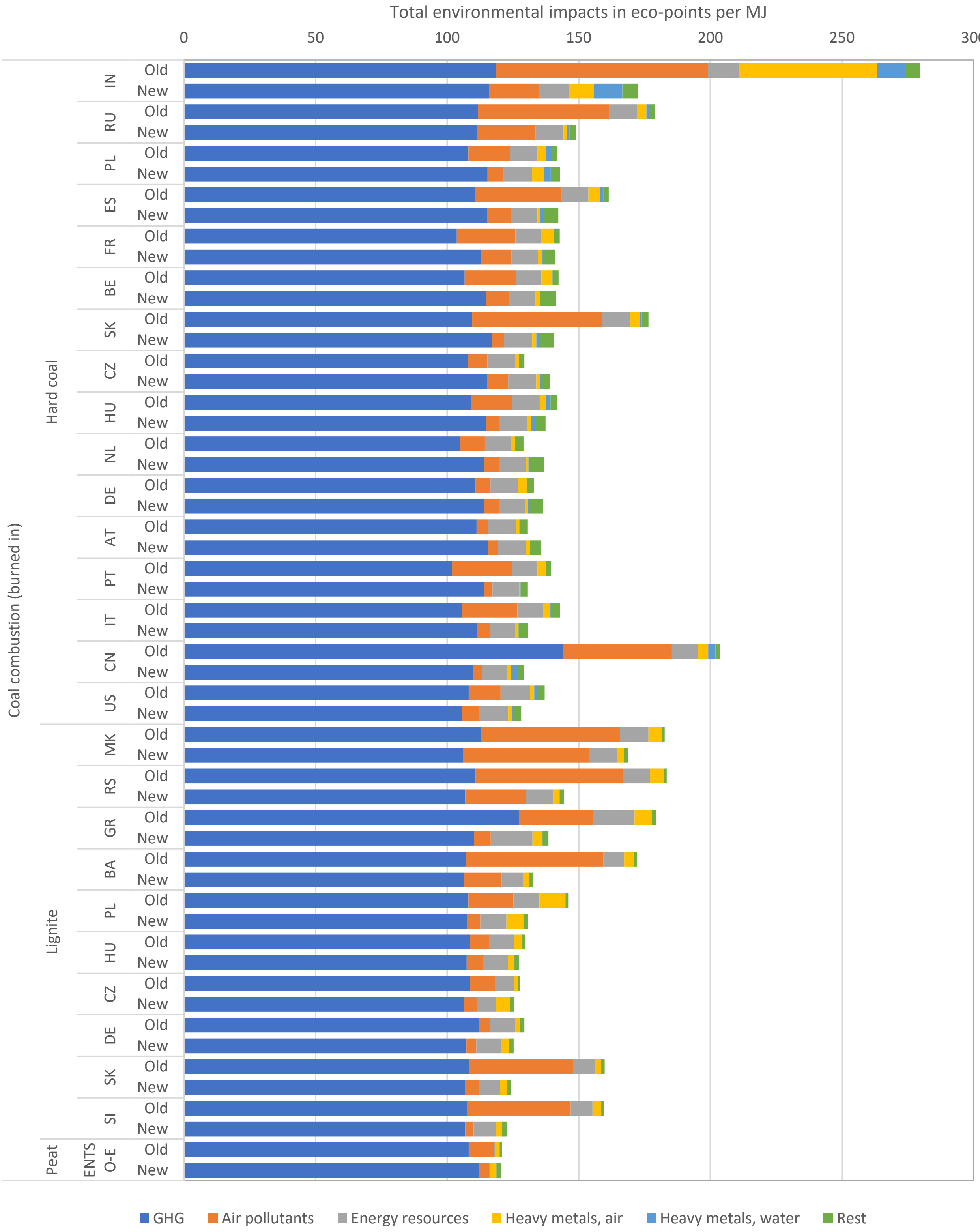

Fig. 4.15: **Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per MJ of hard coal, lignite and peat burned in the power plant in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update showing the contribution of the most important impact categories.**

4.4.4 Electricity generation from coal, lignite and peat

The total environmental impacts per kWh of electricity produced from coal, lignite and peat show the highest changes for the UVEK:2023 update compared to UVEK:2018 with a significant decrease in total environmental impacts for all electricity generation LCI datasets in the UVEK database (see Fig. 4.16 and Fig. 4.17). The changes are mainly due to the adjusted emissions of air pollutants and trace elements as described in section 3.3 and adjusted electricity conversion efficiencies as well as the adjusted allocation for co-generation as described in section 3.4. Especially regions and fuel types with high heat outputs in comparison to electricity outputs such as co-generation from peat combustion can be strongly affected by the allocation procedure between the two process outputs heat and electricity. The highest reduction in the total environmental impacts per kWh of electricity generated from hard coal occurs for India with -42 % followed by China with -37 % and Russia with a reduction of -23 %.

For electricity generation from lignite and peat the greenhouse gas emissions decrease for all datasets in the UVEK database. Slovenia, Slovakia, Serbia, and Bosnia-Herzegovina have the highest decreased with -38 %, -35 %, -25 % and -20 %, respectively.

In general, the differences in the total environmental impacts for electricity generation from coal and lignite are less pronounced after the update of the LCI datasets.

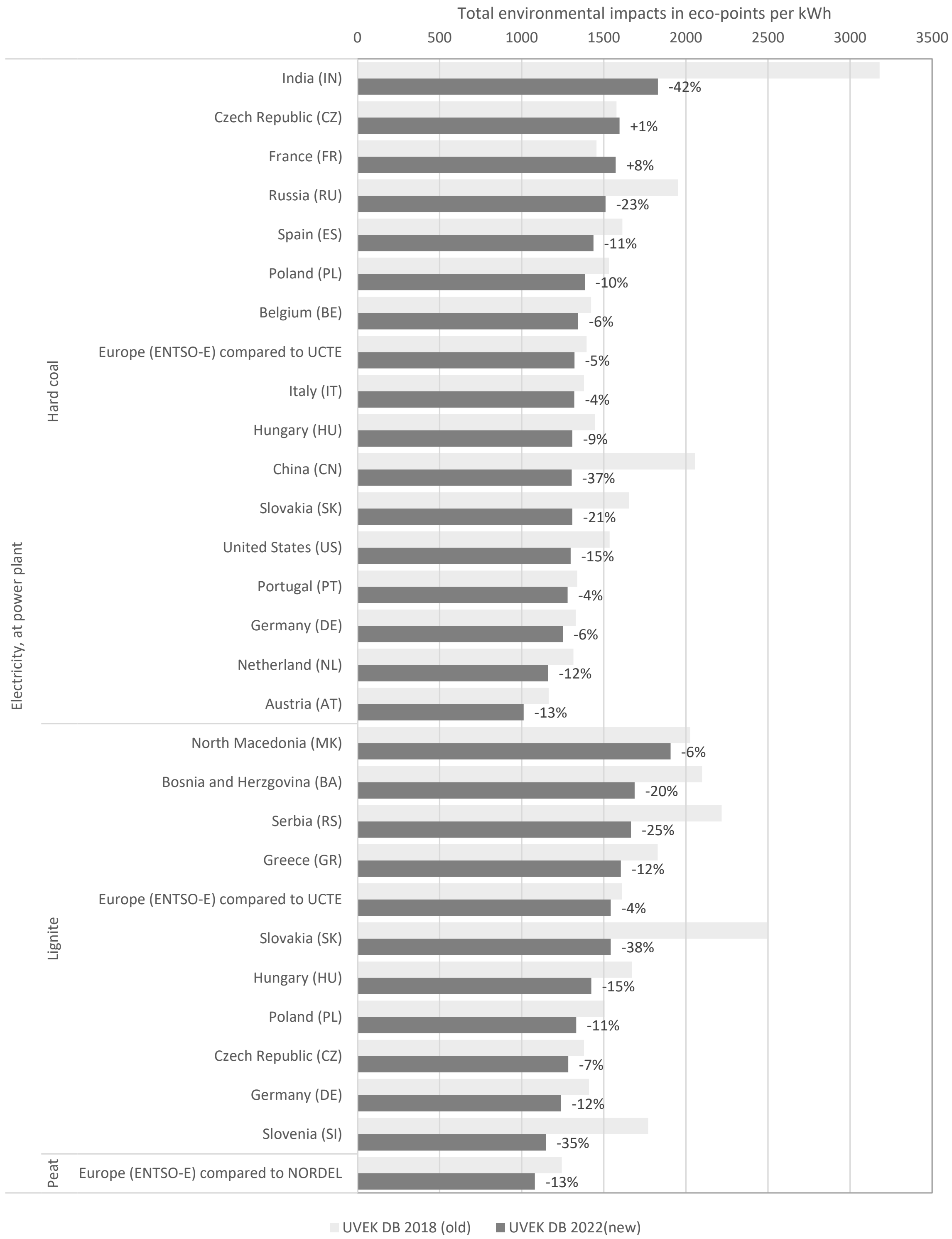

Fig. 4.16: Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kWh of generated electricity from hard coal, lignite and peat the power plants in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update; current UVEK value in light grey; updated UVEK value in dark grey; relative change compared to before the update indicated as percentage.

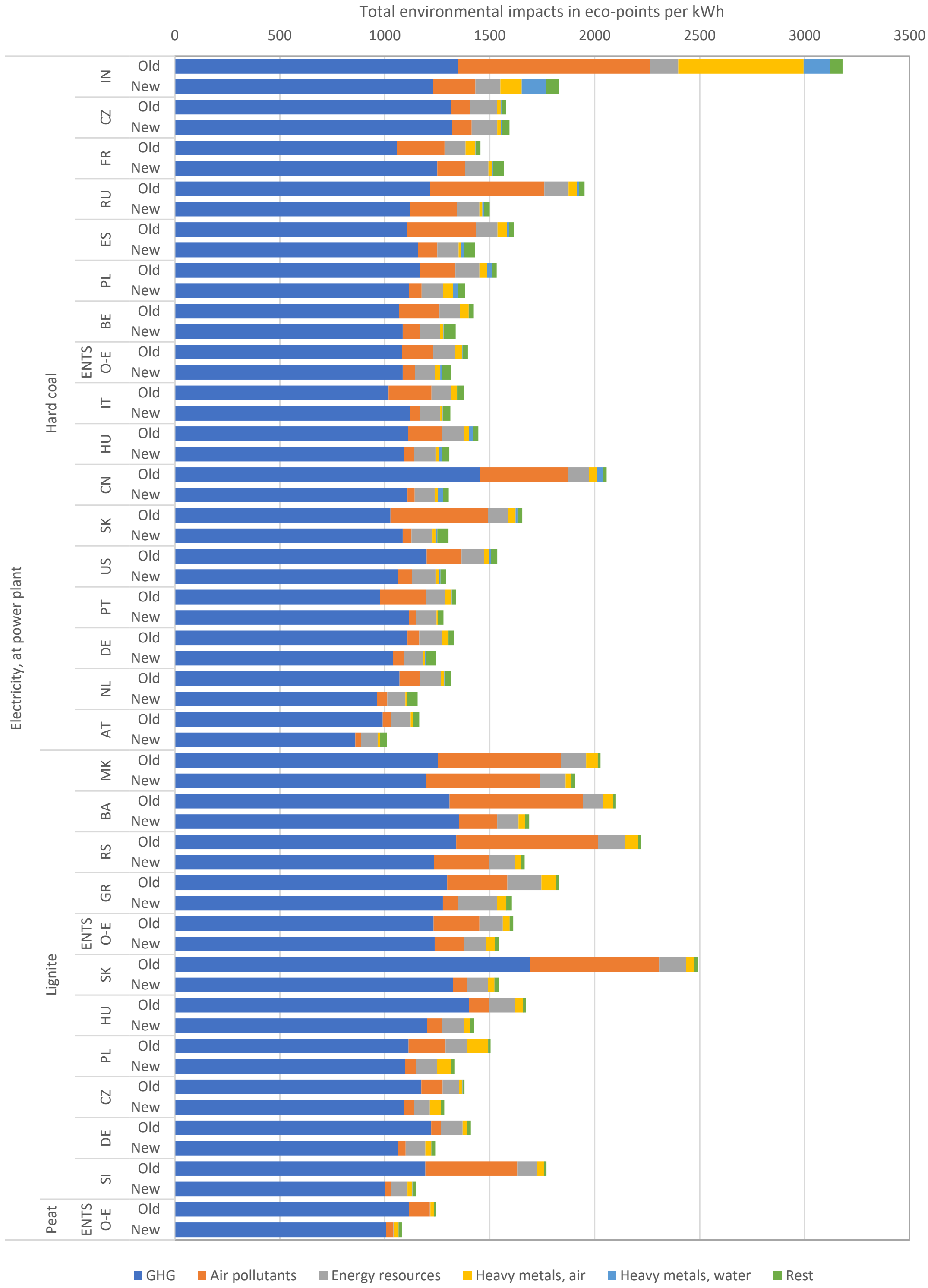

Fig. 4.17: **Comparison of total environmental impacts in eco-points according to Ecological Scarcity Method 2021 (FOEN, 2021) per kWh of generated electricity from hard coal, lignite and peat the power plants in the different countries covered by the UVEK database sorted in descending order from highest to lowest after the update showing the contribution of the most important impact categories.**

5 Discussion and Outlook

This report describes a comprehensive update of the complete coal supply chain in the UVEK database from coal mining to electricity generation. The update for the coal mining datasets as well as solid fossil fuel combustion datasets are limited to key emissions, methane in case of coal mining, CO_2 and priority air pollutants like NO_x, SO_2, PM as well as trace pollutants (heavy metals and some organic compounds) in case of the solid fossil fuel combustion. With these adjustments, the most relevant LCI parameters along the full supply chain are covered.

This update in general leads to lower environmental impact assessment results caused by the electricity generation from solid fossil fuels mainly due to (1) the update of the power plants efficiencies including the introduction of allocation between the co-products electricity and heat as described in section 3.4, (2) the update of the emission profiles of the solid fossil fuel combustion dataset as described in section 3.3, (3) the update of the methane emissions from the coal mining processes described in section 3.1 and (4) the update of the hard coal supply mixes as described in section 3.2 (sorted in descending order according to importance).

The highest changes occur for the total environmental impacts according to the Ecological Scarcity Method 2021. The reduction in total environmental impacts ranges from +8 % to -42 % per kWh of electricity generated from solid fossil fuels. This is mainly due to the updated emission profiles for the solid fossil fuel combustion LCI datasets. The changes for the greenhouse gas emissions according to IPCC 2021 per kWh of electricity generated ranged from +14 % to -24 % and can mainly be attributed to the change in power plant conversion efficiencies. The changes in primary energy demand per kWh of electricity generated range from +14 % to -20 %.

In general, the differences in total environmental impacts, greenhouse gas emissions and primary energy demand between the different LCI datasets for the electricity generation from solid fossil fuels are less pronounced and the emission profiles across the different LCI datasets are more harmonised after the update of the LCI datasets.

5.1 Quality and comprehensiveness

The key emissions, methane for the coal mining datasets as well as CO_2 and priority air pollutants like NO_x, SO_2, PM as well as trace elements for solid fossil fuel combustion datasets, are the most relevant LCI parameters along the full supply chain are covered. The updated key emissions contribute more than 70 % of greenhouse gas emissions and more than 35 % of the total environmental impacts of coal mining as well as more than 85 % of greenhouse gas emissions and more than 75 % of total environmental impacts of coal combustion in the case of the Chinese hard coal mining and combustion datasets. This corresponds to a total of more than 90 % greenhouse gas emissions and more than 85 % of total environmental impacts of the solid fossil fuel supply chains for electricity that are updated with this update (see Fig. 5.1). Other indirect environmental impacts caused by infrastructure like power plants or coal mines, or flue gas treatment only contribute very little to the overall environmental impacts (also see Fig. 4.1) and it is therefore justified to limit the update to the key emissions given their relevance for the overall results.

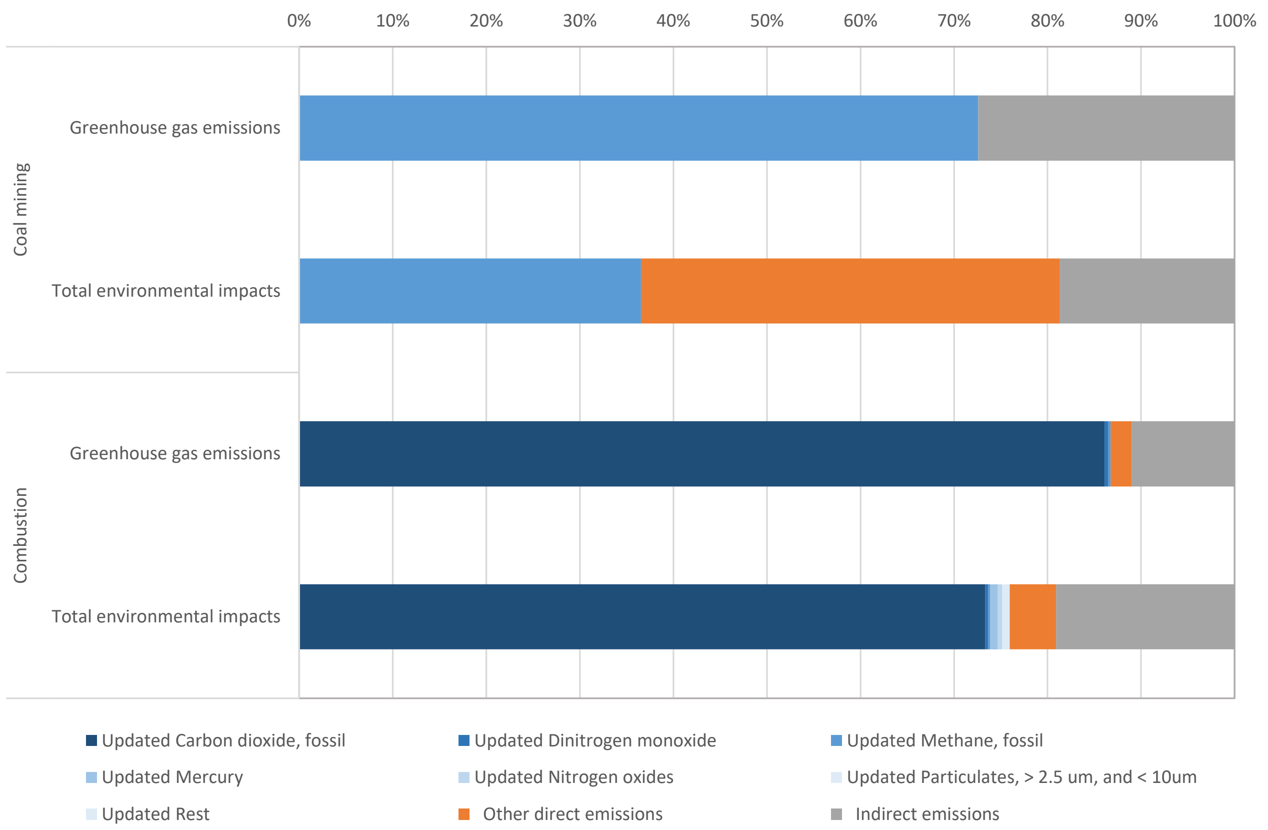

Fig. 5.1: **Contribution of the updated emissions to the total results for greenhouse gas emissions according to IPCC (2021) and total environmental impacts according to Ecological Scarcity Method 2021 (FOEN, 2021) per kg coal mined (mining) and per MJ of coal burned in power plant (combustion) for the Chinese coal mining and combustion dataset**

5.2 Data collection and representativeness

In general, the data collection mainly relied on the most recent national and international statistical data for emissions, efficiencies and trade from the years 2018 to 2020. The statistical datasets are comprehensive and consistent across all different countries covered by this update with a few exceptions, where additional data sources were needed to complement the national and international statistical data. The data collection for the coal mining activities, the hard coal supply mixes as well as the solid fossil fuel combustion and electricity generation are described in more detail in the sections 5.2.1, 5.2.2 and 5.2.3.

5.2.1 Coal mining (methane emissions only)

Data used to derive updated methane emissions from hard coal mining were collected from national statistics compiled by the United States Environmental Protection Agency (EPA) and the International Energy Agency (IEA) complemented with data from the UNFCCC, DFFE and GHGPI. Both data sources rely on consistent methodologies and are considered to be of good quality. Furthermore, both sources cover the main producing countries of each supply region considered in this update project.

National coal production data from IEA follow definitions for products and flows based on those of the Joint IEA/Eurostat/UNECE annual energy questionnaires, and on the United Nations International Recommendations on Energy Statistics (International Energy Agency (IEA), 2019).

National methane emission data from EPA are based on a combination of publicly available emission estimates from nationally prepared GHG reports and EPA estimates based on IPCC Tier 1 emission factors, following IPCC Guidelines for National Greenhouse Gas Inventories and Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (US Environmental Protection Agency (EPA), 2019). The EPA database represents a complete set of global methane emission estimates, regardless of available country-reported data. For most countries, EPA estimates include country specific data. Only where no country-reported data were available., EPA used Tier 1-calculated emission estimates.

Within this update project, methane emissions from lignite and peat mining were not derived on country level. Instead, they were calculated based on the IPCC Tier 1 emission factor for surface mining and conversion factor for methane (Intergovernmental Panel on Climate Change (IPCC), 2006). This simplified approach was justified as surface mining operations typically emit orders of magnitude less methane than underground mining (US Environmental Protection Agency (EPA), 2019) and surface mining is not considered a key category in the update project.

5.2.2 Hard coal supply mix

The data for the update of the hard coal supply mixes has been collected from the most recent IEA statistics on coal production (OECD, 2020b) and coal trade (OECD, 2020a). For India, China and Europe as a region, the IEA production statistics (OECD, 2020b) had to be supplemented with information on coal trade from Alvarez at al. (2020) due to lacking detail in the trade statistics or incompatible resolutions. The quality of the IEA statistics on coal production and trade is regarded as very high because it is a consistent and reliable data source for all the hard coal supply mixes. The supplemented information on coal from Alvarez at al. (2020) was adjusted to the traded volume in the coal production statistics of the IEA and is also considered as reliable to describe the coal trade between the different world regions.

5.2.3 Solid fossil fuel combustion and electricity / heat generation

The data collection for this update prioritises different types of data for the different parameters that are being updated. National statistics from International Energy Agency (IEA) (International Energy Agency (IEA), 2021) as well as the European Eurostat data (European Commission (EC), 2022) aim at representation of entire countries for a given time period. Such data is used for the trade of fuels (e.g. coal imports and exports), electricity and heat generation from power plants (for production volumes and allocation between co-products), as well as the necessary fuel inputs (to calculate fuel efficiencies). For OECD countries, these data sources are assumed to be of good quality as they are aligned with the national data collection procedures of the national statistical offices and hence the data is not subject to major data transformation or interpretation problems. More problems have been documented with non-OECD countries and especially some main economies in Asia. For example, the Chinese statistical offices also collect data on coal power generation, but the classification of coal types does not follow the same approach as in OECD countries and hence, all Chinese coal for coal power generation is reported as the most common type, bituminous coal. In addition, bottom-up data may indicate an underestimation of co-generation of heat and power for some Asian economies (e.g. Chinese bottom-up data (China Electricity Council (CEC), 2015a, 2015b, 2016) suggests a heat-to-power ratio of 1:2, whereas the IEA (International Energy Agency (IEA), 2021) only documents a ratio of 1:4), but no bottom-up data source is complete enough to finally confirm or disprove this trend. Overall, this type of national data is generally subject to an extensive amount of consistency checks and is furthermore widely used and tested in numerous application scenarios, so there is a rather high trust in the data representativeness. At the same time, there are no alternative data sources of similar coverage and level of detail.

Bottom-up measurements are the preferred data source for emission intensities of most airborne pollutants. In case of carbon dioxide, methane or carbon monoxide emission intensities, the standardized average emission factors of the IPCC (Intergovernmental Panel on Climate Change (IPCC), 2006) are used, which are based on measurements and carbon balances per fuel type. For key air pollutants like SO_2, NO_x, PM and mercury, there are plant-level measurements of the major installations per country. And finally, other airborne pollutants for coal power plants are based on the recommended average emission factors per coal type of the European Union (EMEP/EEA, 2019), which have also been derived from several bottom-up emission measurement campaigns. The recent plant-specific bottom-up emission measurements are most specific in terms of regional and temporal appropriateness for the intended scope of this update project, but typically only cover a part of the major installations in each country, not necessarily all of the pollutants are included, and especially smaller sites or emission amounts below individual national reporting thresholds may be somewhat underrepresented. Furthermore, differences in substance nomenclature or measurement techniques can also present challenges in terms of comparability. Implicit extrapolations fill data gaps.

Emission factor approaches, on the other hand, may lead to more robust results, especially when only few measurements are available, or the pollutant emissions largely result from material balances. At the same time, they are generally not available at the same temporal and spatial resolution of the more detailed bottom-up measurements per plant. As the trace elements (except mercury) are used from the most recent version of EMEP/EEA guidebooks (dating back only few years) (EMEP/EEA, 2019), it is assumed that they can still be considered appropriate for the current updates where comprehensive recent measurements are lacking. To some extent, individual plants may report some trace elements (for example in the European Union), but these are assumed to be too scattered and hence their representativeness is unclear (e.g. do only major emitters report?), so these have not been selected as data source for robustness reasons. The previous approach of the coal power datasets in the UVEK datasets was based on theoretical considerations, mass balances and several assumptions instead of emission measurements, so we assume that the current approach leads to more reliable results despite less differentiation between emitting regions. Nevertheless, the spread between emission intensities of trace elements for different sites is rather wide, and so the uncertainties remain large.

Several aspects of the UVEK coal power datasets (like inputs and outputs of flue gas treatment, the water balance, or non-airborne pollutant emissions) are taken over from previous versions of the UVEK database as their update is outside the scope of the current project. Data quality and representativeness of such data is reported in detail in the former documentation (Röder et al., 2007), but some inconsistencies are created in the current update due its incremental nature (e.g. there are nowadays more types of flue gas treatment and their application may be more widespread than in the past). As the LCIA results of coal power generation are shaped by greenhouse gas emissions and PM-related air pollution when assessing them with the Ecological Scarcity LCIA method, their influence on overall impact scores remains limited (see Fig. 4.1 and Fig. 5.1).

5.3 Coal mining

The update of the coal mining datasets in the UVEK in this report was limited to methane emissions being updated. However, the methane emissions from coal mining are the most important emission with regard to the environmental impact of coal mining as shown in Fig. 4.2 Fig. 4.6, Fig. 4.10 and Fig. 4.11.

For the future updates it is advised to increase resolution for coal mining datasets to cover the most important coal exporting countries relevant for Europe, India and China. According to the current coal trade statistics for the year 2020 of the IEA (OECD, 2020a), this should include the countries Venezuela, Colombia, Indonesia and Kazakhstan.

Furthermore, the update could also be expanded to other emissions, inputs and outputs of the coal mining activities. However, this is not considered as a high priority due to their low contribution to the final environmental impacts of electricity generation from coal.

5.4 Supply mixes

The hard coal supply mixes have been comprehensively updated based on the most recent available hard coal production and trade statistics. However, Venezuela, Colombia, Indonesia, and Kazakhstan are relevant import countries for Europe, India as well as China and should be modelled individually as already discussed in the section above. The structure of the updated hard coal supply mixes allows to distinguish the individual countries of origin, but the missing countries have been approximated with their corresponding world regions.

Since this update focused on electricity generation from solid fossil fuels, the hard coal supply mixes are modelled for steam coal (used for electricity generation) and not for coking coal (used for steel production). However, the UVEK database uses the same hard coal supply mix for electricity generation (steam coal) and steel production (coking coal). It would be advised to introduce new supply mix datasets for coking coal in the next update of the steel supply chain in the UVEK database. Due to the different quality requirements coking coal has different origins (mostly Australia) than steam coal.

5.5 Combustion

The update of the heating values of the different solid fossil fuels has been omitted with this update. Main reasons are the limited data availability on heating values from solid fossil fuels from different origins as well as the complexity of the update because the resource extraction in the coal mining datasets has to be adjusted accordingly. The harmonisation of the heating value for all supply mixes would lead to inconsistencies in the calculations of primary energy demand of burned solid fossil fuels and distorted results, mainly for India due to the generally low heating value of Indian hard coal. If the heating values are to be adjusted in the next update, a consistent update of resource extraction in the coal mining datasets would be required to guarantee meaningful results.

The update of the solid fossil fuel combustion datasets focussed on the 24 most important air pollutants and trace elements for which consistent and comprehensive data is available. However, an expansion to other emissions, input and outputs or infrastructure are not considered as priority since these 24 most important air pollutants and trace elements are responsible for the majority of environmental impacts. Nevertheless, a wider range of substances would help to provide a more comprehensive picture of the impacts caused by the sector.

5.6 Electricity generation

The datasets for electricity generation from solid fossil fuels have been comprehensively updated within this update and there are no recommendations to improve the actualisation of these datasets.

5.7 General conclusion

The update of the complete solid fossil supply chain for electricity generation in the UVEK database from coal mining to electricity generation as described in this report is comprehensive and important for the UVEK database. The current supply chains in UVEK:2018 were outdated and contributed significantly to a variety of different environmental impacts. This update covers the key emissions, methane for the coal mining datasets, CO_2 and priority air pollutants like NO_x, SO_2, PM as well as trace pollutants for solid fossil fuel combustion datasets all and is a significant improvement of the UVEK database. In general, the update leads to a harmonisation of inventory models and differences in the impact assessment results from different electricity generation datasets were reduced. However, with greenhouse gas emissions of 0.861 kg CO_2-eq. – 1.35 kg CO_2-eq. per kWh electricity from hard coal, lignite and peat power generation solid fossil fuels remains among the technologies with the highest contribution to the global climate crisis.

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ANNEX LCI: HARD COAL, LIGNITE AND PEAT MINING

Tab. 5.1: Life Cycle Inventory models for coal mining in the different world regions with adjusted methane emissions; adjusted values compared to the current version are marked with light and dark orange colour.

	Name	Location	InfrastructureProcess	Unit	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	lignite, at mine	peat, at mine	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				AU	CN	CPA	EEU	IN	RLA	RNA	RU	ZA	RER	NORDEL			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0			
	Unit				kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg			
product	hard coal, at mine	AU	0	kg	1	0	0	0	0	0	0	0	0	0	0			
	hard coal, at mine	CN	0	kg	0	1	0	0	0	0	0	0	0	0	0			
	hard coal, at mine	CPA	0	kg	0	0	1	0	0	0	0	0	0	0	0			
	hard coal, at mine	EEU	0	kg	0	0	0	1	0	0	0	0	0	0	0			
	hard coal, at mine	IN	0	kg	0	0	0	0	1	0	0	0	0	0	0			
	hard coal, at mine	RLA	0	kg	0	0	0	0	0	1	0	0	0	0	0			
	hard coal, at mine	RNA	0	kg	0	0	0	0	0	0	1	0	0	0	0			
	hard coal, at mine	RU	0	kg	0	0	0	0	0	0	0	1	0	0	0			
	hard coal, at mine	ZA	0	kg	0	0	0	0	0	0	0	0	1	0	0			
	lignite, at mine	RER	0	kg	0	0	0	0	0	0	0	0	0	1	0			
	peat, at mine	NORDEL	0	kg	0	0	0	0	0	0	0	0	0	0	1			
technosphere	open cast mine, hard coal	GLO	1	unit	2.27E-11	0	1.00E-12	0	2.86E-11	3.33E-11	1.93E-11	1.10E-11	1.67E-11	0	0	0	0.00	0
	underground mine, hard coal	GLO	1	unit	1.07E-11	0	3.23E-11	3.33E-11	4.66E-12	0	1.40E-11	2.23E-11	1.67E-11	0	0	0	0.00	0
	open cast mine, peat	NORDEL	1	unit	0	0	0	0	0	0	0	0	0	0	1.00E-11	1	1.00	per definition
	underground mine, hard coal	CN	1	unit	0	3.33E-11	0	0	0	0	0	0	0	0	0	0	0.00	0
	open cast mine, lignite	RER	1	unit	0	0	0	0	0	0	0	0	0	1.00E-11	0	0	0.00	0
	tap water, at user	RER	0	kg	1.80E-1	4.42E-1	4.42E-1	5.14E-1	5.81E-1	2.00E-1	3.55E-1	5.03E-1	2.06E-1	0	0	0	0.00	0
	blasting	RER	0	kg	1.62E-3	6.00E-5	1.25E-4	7.60E-5	1.05E-3	2.00E-3	1.13E-3	7.67E-4	1.48E-3	0	0	0	0.00	0
	reinforcing steel, at plant	RER	0	kg	0	1.10E-3	0	0	0	0	0	0	0	0	0	0	0.00	0
	pulpwood, spruce, sustainable forest management, measured as solid wood under bark, at forest road	DE	0	m3	0	2.18E-6	0	0	0	0	0	0	0	0	0	0	0.00	0
	electricity, high voltage, production ENTSO, at grid	ENTSO	0	kWh	1.79E-2	0	1.29E-2	4.58E-2	0	1.00E-2	2.51E-2	9.30E-2	1.39E-2	2.00E-2	2.00E-2	1	2.00	own assumption
	electricity, hard coal, at power plant	CN	0	kWh	0	4.25E-2	0	0	0	0	0	0	0	0	0	0	0.00	0
	electricity, hard coal, at power plant	IN	0	kWh	0	0	0	0	5.58E-2	0	0	0	0	0	0	0	0.00	0
	heat, at hard coal industrial furnace 1-10MW	RER	0	MJ	3.52E-2	1.07E-1	1.07E-1	1.10E-1	8.58E-2	0	4.62E-2	7.37E-2	5.53E-2	0	0	0	0.00	0
	diesel, burned in building machine, average	CH	0	MJ	6.55E-2	2.42E-2	2.42E-2	2.23E-2	3.20E-1	1.20E-1	3.37E-2	4.18E-2	4.83E-2	1.50E-2	1.50E-2	1	2.00	own assumption
	disposal, spoil from lignite mining, in surface landfill	GLO	0	kg	0	0	0	0	0	0	0	0	0	1.11E+1	0	0	0.00	0
	disposal, tailings from hard coal milling, in impoundment	GLO	0	kg	3.09E-1	1.55E-1	1.55E-1	2.71E-1	1.84E-1	2.50E-1	4.15E-1	2.71E-1	2.70E-1	0	0	0	0.00	0
	disposal, spoil from coal mining, in surface landfill	GLO	0	kg	1.71E+1	1.64E+0	5.00E+0	2.12E+0	3.48E+0	4.74E+0	6.11E+0	7.40E+0	7.70E+0	0	0	0	0.00	0
emission resource, land	Transformation, from unknown	-	-	m2	8.80E-5	1.60E-4	1.60E-4	6.30E-5	1.54E-4	9.70E-5	1.57E-4	8.00E-5	4.10E-5	3.70E-5	3.70E-5	1	3.00	own assumption
	Transformation, to mineral extraction site	-	-	m2	4.40E-5	1.10E-5	1.10E-5	0	2.45E-5	2.50E-5	3.70E-5	2.30E-5	2.20E-5	3.70E-5	3.70E-5	1	3.00	own assumption
	Occupation, mineral extraction site	-	-	m2a	5.30E-3	1.30E-3	1.30E-3	0	2.94E-3	3.00E-3	4.50E-3	2.70E-3	2.70E-3	1.11E-3	1.10E-3	1	3.00	own assumption
	Transformation, to dump site	-	-	m2	4.40E-5	1.50E-4	1.50E-4	6.30E-5	1.56E-4	7.20E-5	1.20E-4	5.70E-5	1.90E-5	0	0	0	0.00	0
	Occupation, dump site	-	-	m2a	5.30E-3	1.80E-2	1.80E-2	7.60E-3	1.87E-2	8.70E-3	1.50E-2	6.90E-3	2.20E-3	0	0	0	0.00	0
	Transformation, from mineral extraction site	-	-	m2	0	0	0	0	0	0	0	0	0	3.70E-5	3.70E-5	1	3.00	own assumption
	Transformation, to arable	-	-	m2	0	0	0	0	0	0	0	0	0	3.70E-5	3.70E-5	1	3.00	own assumption
	Transformation, from forest	-	-	m2	0	0	0	0	2.71E-5	0	0	0	0	0	0	0	0.00	0
emission resource, in ground	Coal, hard, unspecified, in ground	-	-	kg	1.38E+0	1.21E+0	1.11E+0	1.36E+0	8.23E-1	1.25E+0	1.32E+0	1.23E+0	1.30E+0	0	0	0	0.00	0
	Gas, mine, off-gas, process, coal mining	-	-	Nm3	4.40E-3	1.27E-2	1.27E-2	1.33E-2	2.33E-3	2.00E-4	8.60E-3	1.49E-2	5.20E-3	0	0	0	0.00	0
	Coal, brown, in ground	-	-	kg	0	0	0	0	0	0	0	0	0	1.00E+0	0	0	0.00	0
emission resource, biotic	Peat, in ground	-	-	kg	0	0	0	0	0	0	0	0	0	0	1.00E+0	1	1.00	per definition
emission resource, in water	Water, well, in ground	-	-	m3	1.30E-3	2.63E-3	2.63E-3	1.69E-3	2.63E-3	1.30E-3	5.40E-4	1.24E-3	3.70E-4	3.50E-3	3.50E-3	1	2.00	own assumption
emission air, low population density	Heat, waste	-	-	MJ	6.44E-2	1.53E-1	4.64E-2	1.65E-1	0	3.60E-2	9.04E-2	3.35E-1	5.00E-2	7.20E-2	7.20E-2	1	2.00	own assumption
	Methane, fossil	-	-	kg	2.35E-3	5.92E-3	5.82E-3	1.12E-2	0	8.38E-3	3.46E-3	7.90E-3	5.33E-4	8.04E-4	8.04E-4	1	1.50	(1,1,1,1,1,1,BU:1.5), updated emissions b
	Particulates, > 10 um	-	-	kg	3.04E-4	1.09E-4	1.09E-4	1.00E-4	0	4.00E-4	2.74E-4	1.99E-4	2.50E-4	4.00E-4	4.00E-4	1	2.00	own assumption
	Radon-222	-	-	kBq	1.20E-2	2.16E-2	1.20E-2	1.20E-2	0	1.20E-2	1.20E-2	1.20E-2	1.20E-2	3.00E-3	3.00E-3	1	5.00	own assumption
emission air, unspecified	Methane, fossil	-	-	kg	0	0	0	0	1.27E-3	0	0	0	0	0	0	0	0.00	0
	Carbon dioxide, fossil	-	-	kg	0	0	0	0	2.92E-3	0	0	0	0	0	0	0	0.00	0
	Particulates, > 10 um	-	-	kg	0	0	0	0	3.64E-3	0	0	0	0	0	0	0	0.00	0
	Radon-222	-	-	kBq	0	0	0	0	1.63E-2	0	0	0	0	0	0	0	0.00	0
	Sulfur dioxide	-	-	kg	0	0	0	0	2.74E-5	0	0	0	0	0	0	0	0.00	0
emission water, river	Aluminium	-	-	kg	0	0	0	0	1.00E-6	0	0	0	0	0	0	0	0.00	0
	Ammonium, ion	-	-	kg	0	0	0	0	1.00E-6	0	0	0	0	0	0	0	0.00	0
	Chloride	-	-	kg	0	0	0	0	3.52E-5	0	0	0	0	0	0	0	0.00	0
	Fluoride	-	-	kg	0	0	0	0	3.11E-7	0	0	0	0	0	0	0	0.00	0
	Iron, ion	-	-	kg	0	0	0	0	6.88E-6	0	0	0	0	0	0	0	0.00	0
	Manganese	-	-	kg	0	0	0	0	3.57E-7	0	0	0	0	0	0	0	0.00	0
	Copper, ion	-	-	kg	0	0	0	0	3.85E-9	0	0	0	0	0	0	0	0.00	0
	Nickel, ion	-	-	kg	0	0	0	0	1.00E-7	0	0	0	0	0	0	0	0.00	0
	Oils, unspecified	-	-	kg	0	0	0	0	1.74E-7	0	0	0	0	0	0	0	0.00	0
	Suspended solids, unspecified	-	-	kg	0	0	0	0	7.08E-5	0	0	0	0	0	0	0	0.00	0
	BOD5, Biological Oxygen Demand	-	-	kg	0	0	0	0	2.69E-6	0	0	0	0	0	0	0	0.00	0
	COD, Chemical Oxygen Demand	-	-	kg	0	0	0	0	2.56E-5	0	0	0	0	0	0	0	0.00	0
	TOC, Total Organic Carbon	-	-	kg	0	0	0	0	9.46E-6	0	0	0	0	0	0	0	0.00	0
	DOC, Dissolved Organic Carbon	-	-	kg	0	0	0	0	9.46E-6	0	0	0	0	0	0	0	0.00	0
	Strontium	-	-	kg	0	0	0	0	5.00E-6	0	0	0	0	0	0	0	0.00	0
	Sulfate	-	-	kg	0	0	0	0	1.89E-4	0	0	0	0	0	0	0	0.00	0
	Nitrate	-	-	kg	0	0	0	0	5.39E-6	0	0	0	0	0	0	0	0.00	0
	Zinc, ion	-	-	kg	0	0	0	0	1.00E-7	0	0	0	0	0	0	0	0.00	0
emission water, ground-	Aluminium	-	-	kg	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	0	0	0.00	0
	Ammonium, ion	-	-	kg	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	0	0	0.00	0
	Chloride	-	-	kg	5.34E-3	1.62E-2	1.62E-2	1.67E-2	0	0	7.01E-3	1.12E-2	8.35E-3	0	0	0	0.00	0
	Fluoride	-	-	kg	3.00E-6	3.00E-6	3.00E-6	3.00E-6	0	3.00E-6	3.00E-6	3.00E-6	3.00E-6	0	0	0	0.00	0
	Iron, ion	-	-	kg	2.00E-6	2.00E-6	2.00E-6	2.00E-6	0	2.00E-6	2.00E-6	2.00E-6	2.00E-6	1.60E-3	1.60E-3	1	2.00	own assumption
	Manganese	-	-	kg	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	1.00E-6	1.00E-6	1.00E-6	1.00E-6	0	0	0	0.00	0
	Nickel, ion	-	-	kg	1.00E-7	1.00E-7	1.00E-7	1.00E-7	0	1.00E-7	1.00E-7	1.00E-7	1.00E-7	0	0	0	0.00	0
	Solids, inorganic	-	-	kg	6.80E-5	3.00E-6	3.00E-6	0	0	1.00E-4	5.80E-5	3.30E-5	5.00E-5	3.50E-3	3.50E-3	1	2.00	own assumption
	Suspended solids, unspecified	-	-	kg	1.50E-5	1.50E-5	1.50E-5	1.50E-5	0	1.50E-5	1.50E-5	1.50E-5	1.50E-5	0	0	0	0.00	0
	Strontium	-	-	kg	5.00E-6	5.00E-6	5.00E-6	5.00E-6	0	5.00E-6	5.00E-6	5.00E-6	5.00E-6	0	0	0	0.00	0
	Sulfate	-	-	kg	5.00E-4	5.00E-4	5.00E-4	5.00E-4	0	5.00E-4	5.00E-4	5.00E-4	5.00E-4	3.30E-3	3.30E-3	1	2.00	own assumption
	Zinc, ion	-	-	kg	1.00E-7	1.00E-7	1.00E-7	1.00E-7	0	1.00E-7	1.00E-7	1.00E-7	1.00E-7	0	0	0	0.00	0

Tab. 5.2: Meta information for coal mining datasets in the different world regions with adjusted methane emissions

ReferenceFunction	Name	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	hard coal, at mine	lignite, at mine	peat, at mine
Geography	Location	AU	CN	CPA	EEU	IN	RLA	RNA	RU	ZA	RER	NORDEL
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
DataSetInformatic	Type	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	Included processes: The dataset is based on "hard coal at mine" CPA. The generic mine CPA dataset quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is recovered methane. Specific processes for this CN dataset are: electricity supply from local coal power plant and grid (CN); blasting, steel, and wood requirements.	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	included processes not available	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module. Not included is the methane recovered.	Included processes: The module represents average operational conditions in the relevant geographical region. It quantifies the directly affected area and occupation during operation of the mine. Electricity, heat, and diesel requirements for mining operation are included. Pumped groundwater, explosives, emissions to air and water, and solid waste complete the module.	Included processes: The module quantifies the directly affected area and occupation during operation and restoration of the mine. Electricity requirements and some diesel for mining operation are included, as well as the groundwater pumped out of the mine.	Included processes: The module quantifies the directly affected area, electricity requirements and some diesel for mining operation and the extraction of groundwater.
	Amount	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Steinkohle, ab Bergwerk	Braunkohle, ab Bergwerk	Torf, ab Bergwerk
	Synonyms		0			0						
	GeneralComment	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 1.05, taking into account the difference in the upper heating value of raw coal of this region (120.1 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Specific items for this CN dataset are: electricity supply from local coal power plant and grid (CN) (averages for Shanxi Province); blasting, steel, and wood requirements (averages for Shanxi); emission of methane (China avarege); emission of CO2 and SO2 from uncontrolled coal fires (estimated country-wide). Other data have been taken from the dataset CPA. Average data for coal mining in the CPA region are from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 1.03, taking into account the difference in the upper heating value of raw coal of this region (19.7 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 0.84, taking into account the difference in the upper heating value of raw coal of this region (16.1 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, comment not available	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. Due to a lack of data, the upper heating value of raw coal of this region had to be estimated as the used worldwide average of 19.1 MJ/kg n order to enable a consistent calculation of the cumulative energy demand. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from heavy oil industrial boilers, and diesel uses are included. The use of	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 1.01, taking into account the difference in the upper heating value of raw coal of this region (19.3 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 0.91, taking into account the difference in the upper heating value of raw coal of this region (17.3 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Average data for coal mining in the specific region have been taken from a summary study on material flows and energy uses. Data are normalized by the mass unit of produced coal, including preparation and without differentiating steam coal from the rest. In order to enable a consistent calculation of the cumulative energy demand, the extracted mass of raw coal was adjusted by a factor of 1.05, taking into account the difference in the upper heating value of raw coal of this region (20.1 MJ/kg), compared to the used worldwide average of 19.1 MJ/kg. Mine reclamation is not included in this module, because it mostly concerns the tailings, which are described in a separate module. Electricity, heating from	Update 2022 by ZHAW only updated methane emissions at mine, Remark: Recultivation to arable area is taken into account. Electricity and diesel uses are included. Electricity supply is modelled with the UCTE mix, because there is no detailed information about local conditions. Heat requirements are not accounted for because: heat use is only mentioned in a few cases; heat is also used for briquette production and its allocation to different uses is not given; heat is usually produced as coproduct by mine-mouth cogenerating plants for which no module has been developed. Particle emissions are calculated on the basis of direct measurements of total particles made in Germany between mining areas and nearest populated areas. Radon emissions are extrapolated from data for hard coal mining.	Update 2022 by ZHAW only updated methane emissions at mine, Remark: In first approximation same conditions as for open cast mine, lignite, RER, are assumed.;
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	lignite	lignite
	SubCategory	production	production	production	production	production	production	production	production	production	production	production
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Braunkohle	Braunkohle
	LocalSubCategory	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung
	Formula											
	StatisticalClassification											
	CASNumber											
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText											
Geography	Text	Geography: Region specific.	Geography: Region specific (Shanxi Province and county-wide) with integration from generic mine.	Geography: Region specific.	Geography: Region specific.	Geography: Unspecified	Geography: Region specific.	Geography: Region specific.	Geography: Region specific.	Geography: Region specific.	Geography: Average European conditions around the beginning of the 1990s..	Geography: No information.
Technology	Text	Technology: Not specified.	Technology: Not specified.	Technology: Not specified.	Technology: Not specified.	Technology: Unspecified	Technology: Not specified.	Technology: Not specified.	Technology: Not specified.	Technology: Not specified.	Technology: No specific information available.	Technology: No specific information available.
Representativene	Percent											
	ProductionVolume											
	SamplingProcedure	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature
	Extrapolations	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: from Europe	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text	Extrapolations: see Geography/Text
	UncertaintyAdjustments	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none	Uncertainty adjustments: none
DataGeneratorAn	Person	52	52	52	52	52	52	52	52	52	52	52
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode											
	CountryCode											
	PageNumbers											
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails											

ANNEX LCI: HARD COAL SUPPLY MIXES

Tab. 5.3: Life Cycle Inventory models for coal supply mixes for European countries, India, China and the United States according to coal production (OECD, 2020b) and coal trade (OECD, 2020a) statistics of the International Energy Agency statistics for the year 2020 and Alvarez (2020); adjusted values compared to the current version are marked with light and dark orange colour.

	Name	Location	InfrastructureProcess	Unit	hard coal mix, at regional storage	hard coal supply mix, at regional storage	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				UCTE	US	AT	BE	CN	CZ	DE	ES	FR	HR	IT	IN	NL	PL	PT	SK			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Unit				kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg			
product	hard coal mix, at regional storage	UCTE	0	kg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix, at regional storage	US	0	kg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	AT	0	kg	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	BE	0	kg	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	CN	0	kg	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	CZ	0	kg	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	DE	0	kg	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
	hard coal supply mix	ES	0	kg	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
	hard coal supply mix	FR	0	kg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0			
	hard coal supply mix	HR	0	kg	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
	hard coal supply mix	IT	0	kg	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0			
	hard coal supply mix	IN	0	kg	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
	hard coal supply mix	NL	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0			
	hard coal supply mix	PL	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0			
	hard coal supply mix	PT	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
	hard coal supply mix	SK	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
technosphere	hard coal, at mine	CN	0	kg	0	0	0	0	9.25E-1	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Production China based on IEA coal prodcution statistics 2020
	hard coal, at mine	RNA	0	kg	0	9.89E-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Production North America based on IEA coal production statistics 2020
	hard coal, at regional storage	EEU	0	kg	3.02E-1	0	0	0	0	3.70E-1	0	0	0	0	0	0	0	7.85E-1	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Production Europe based on IEA coal production statistics 2020
	hard coal, at regional storage	IN	0	kg	0	0	0	0	0	0	0	0	0	0	0	8.20E-1	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Production from India based on IEA coal production statistics 2020
	hard coal, at regional storage	AU	0	kg	0	0	0	7.05E-2	1.65E-2	0	0	4.24E-2	1.23E-1	0	0	3.96E-3	1.14E-2	1.56E-3	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Australia based on IEA coal import statistics 2020
	hard coal, at regional storage	RU	0	kg	4.53E-1	6.84E-4	3.30E-1	7.37E-1	8.90E-3	1.52E-1	6.76E-1	5.89E-1	4.94E-1	1.02E-1	7.22E-1	6.93E-3	5.84E-1	1.77E-1	0	5.95E-1	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Russia based on IEA coal import statistics 2020
	hard coal, at regional storage	RU	0	kg	0	0	0	0	0	0	8.07E-3	7.18E-2	3.13E-3	0	5.48E-2	0	0	1.65E-2	0	0	1	1.05	(1,1,1,3,1,1,BU:1.05) Import from Kazakhstan (proxy) based on IEA coal import statistics 2020
	hard coal, at regional storage	ZA	0	kg	1.84E-2	0	0	6.41E-2	0	0	2.11E-2	0	1.87E-1	1.12E-1	0	4.35E-2	2.45E-2	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from South Africa based on IEA coal import statistics 2020
	hard coal, at regional storage	EEU	0	kg	0	0	5.74E-1	0	0	4.66E-1	8.72E-3	0	2.50E-7	7.86E-1	0	0	0	0	0	1.63E-1	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Poland based on IEA coal import statistics 2020
	hard coal, at regional storage	EEU	0	kg	0	0	2.01E-2	0	0	0	1.77E-4	0	0	0	0	0	0	7.57E-4	0	1.17E-1	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Czech Republic based on IEA coal import statistics 2020
	hard coal, at regional storage	EEU	0	kg	0	3.05E-4	7.50E-2	1.16E-1	0	1.28E-2	8.64E-2	9.26E-2	1.92E-2	0	3.87E-2	0	2.34E-2	2.56E-4	1.00E+0	1.15E-1	1	1.05	(1,1,1,3,1,1,BU:1.05) Import from other (proxy) based on IEA coal import statistics 2020
	hard coal, at regional storage	RNA	0	kg	4.90E-2	0	9.64E-5	4.16E-3	0	0	1.06E-1	1.50E-2	4.92E-2	0	6.66E-2	6.93E-3	2.31E-1	1.48E-3	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from United States based on IEA coal import statistics 2020
	hard coal, at regional storage	RLA	0	kg	1.77E-1	8.96E-3	0	8.13E-3	0	0	9.39E-2	1.28E-1	1.25E-1	0	1.05E-1	0	1.04E-1	1.76E-2	0	1.02E-2	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Colombia based on based on IEA coal import statistics 2020
	hard coal, at regional storage	RLA	0	kg	0	0	0	0	0	0	0	6.10E-2	1.40E-5	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05) Import from Venezuela based on based on IEA coal import statistics 2020
	hard coal, at regional storage	IN	0	kg	0	1.48E-3	0	0	4.91E-2	0	0	0	0	0	1.21E-2	1.19E-1	2.24E-2	0	0	0	1	1.05	(1,1,1,3,1,1,BU:1.05) Import from Indonesia (proxy) based on IEA coal import statistics 2020
	transport, freight, rail	RER	0	tkm	2.39E+0	0	1.91E+0	4.29E+0	0	1.09E+0	3.50E+0	3.56E+0	2.60E+0	1.01E+0	5.36E-1	4.69E-1	3.14E+0	1.18E+0	2.02E-1	3.39E+0	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	transport, transoceanic freight ship	OCE	0	tkm	3.96E+0	1.36E-1	1.78E-3	4.56E+0	6.96E-1	0	3.58E+0	4.75E+0	1.05E+1	2.75E+0	3.18E+0	2.27E+0	6.95E+0	3.75E-1	0	1.73E-1	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	transport, barge	RER	0	tkm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	transport, freight, lorry, fleet average	RER	0	tkm	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	4.00E-2	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	transport, freight, rail, diesel	US	0	tkm	0	4.04E-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	transport, coal freight, rail	CN	0	tkm	0	0	0	0	4.56E-1	0	0	0	0	0	0	0	0	0	0	0	1	2.10	(4,3,1,1,1,5,BU:2) Estimated transport distances based on supply mix, own calcuation
	electricity, medium voltage, production ENTSO, at grid	ENTSO	0	kWh	9.80E-3	0	7.20E-3	1.40E-2	0	7.20E-3	8.81E-3	1.15E-2	1.41E-2	7.92E-3	1.41E-2	0	1.38E-2	7.20E-3	1.45E-2	9.22E-3	1	3.00	own assumption
	electricity, low voltage, at grid	US	0	kWh	0	7.20E-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	electricity, medium voltage, at grid	CN	0	kWh	0	0	0	0	1.70E-2	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	electricity, medium voltage, at grid	IN	0	kWh	0	0	0	0	0	0	0	0	0	0	0	9.80E-3	0	0	0	0	0	0.00	0
emission resource, land	Transformation, from unknown	-	-	m2	1.36E-5	1.00E-5	1.00E-5	1.94E-5	1.00E-5	1.00E-5	1.22E-5	1.60E-5	1.96E-5	1.10E-5	1.96E-5	1.36E-5	1.92E-5	1.00E-5	2.01E-5	1.28E-5	1	3.00	own assumption
	Transformation, to industrial area	-	-	m2	1.36E-5	1.00E-5	1.00E-5	1.94E-5	1.00E-5	1.00E-5	1.22E-5	1.60E-5	1.96E-5	1.10E-5	1.96E-5	1.36E-5	1.92E-5	1.00E-5	2.01E-5	1.28E-5	1	3.00	own assumption
	Occupation, industrial area	-	-	m2a	1.36E-3	1.00E-3	1.00E-3	1.94E-3	1.00E-3	1.00E-3	1.22E-3	1.60E-3	1.96E-3	1.10E-3	1.96E-3	1.36E-3	1.92E-3	1.00E-3	2.01E-3	1.28E-3	1	3.00	own assumption
emission air, low population density	Heat, waste	-	-	MJ	3.53E-2	2.59E-2	2.59E-2	5.04E-2	6.12E-2	2.59E-2	3.17E-2	4.14E-2	5.07E-2	2.85E-2	5.09E-2	0	4.97E-2	2.59E-2	5.20E-2	3.32E-2	1	3.00	own assumption
	Particulates, > 10 um	-	-	kg	1.00E-3	2.00E-3	1.00E-3	1.00E-3	2.00E-3	1.00E-3	1.00E-3	1.00E-3	1.00E-3	1.00E-3	1.00E-3	0	1.00E-3	1.00E-3	1.00E-3	1.00E-3	1	10.00	own assumption
emission water, ground-	Arsenic, ion	-	-	kg	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	4.00E-11	1	2.00	own assumption
	BOD5, Biological Oxygen Demand	-	-	kg	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1	3.00	own assumption
	Cadmium, ion	-	-	kg	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1	5.00	own assumption
	Chloride	-	-	kg	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	2.00E-6	1	5.00	own assumption
	Chromium, ion	-	-	kg	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	1	3.00	own assumption
	COD, Chemical Oxygen Demand	-	-	kg	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1.00E-7	1	3.00	own assumption
	Copper, ion	-	-	kg	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1.00E-9	1	5.00	own assumption
	Iron, ion	-	-	kg	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	2.00E-9	1	10.00	own assumption
	Lead	-	-	kg	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	1	5.00	own assumption
	Manganese	-	-	kg	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	2.00E-7	1	2.50	own assumption
	Nickel, ion	-	-	kg	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	1	10.00	own assumption
	Selenium	-	-	kg	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	1	2.00	own assumption
	Solids, inorganic	-	-	kg	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1	2.50	own assumption
	Suspended solids, unspecified	-	-	kg	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1.00E-4	1	2.00	own assumption
	Sulfate	-	-	kg	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	4.00E-5	1	5.00	own assumption
	Tin, ion	-	-	kg	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	1	10.00	own assumption
emission air, high population density	Particulates, > 10 um	-	-	kg	0	0	0	0	0	0	0	0	0	0	0	1.00E-3	0	0	0	0	0	0.00	0

Tab. 5.4: **Meta information of the Life Cycle Inventory models for coal supply mixes for European countries, India, China and the United States**

ReferenceFunction	Name	hard coal mix, at regional storage	hard coal supply mix, at regional storage	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix	hard coal supply mix
Geography	Location	UCTE	US	AT	BE	CN	CZ	DE	ES	FR	HR	IT	IN	NL	PL	PT	SK
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
DataSetInformatio	Type	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Average US hard coal for domestic supply. The coal requirement includes the total losses from mining to the power plant. The dataset includes emissions from groundwater and particle emissions from the storage, coal loss during storage, energy demand for coal loading and unloading, land use, and hard coal transport from mining to the power plant.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal, assumed all domestic for CN. The module includes transport from mines to power plants	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	unspecified	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.	Included processes: Country-specific supply of coal by producing regions. The module includes all transport from the storage in producing regions to power plants in the specific country.
	Amount	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Steinkohle - Mix, ab Regionallager	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix	Steinkohle - Mix
	Synonyms		0			0							0				
	GeneralComment	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: Average US coal quality (UHV=25.2MJ/kg). Dust from load/unload operations is included, as well as hard coal transport from mining to the power plant. Average coal losses are considered. Average emissions to groundwater due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: Average transport distance for coal from Chinese statistics 2004. Average coal losses assumed 3%. Other values are from similar datasets for European countries. Dust from transport and load/unload operations is included. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.;	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, unspecified	Update 2022 by ZHAW only updated domestic production shares and shares of imports, emark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.	Update 2022 by ZHAW only updated domestic production shares and shares of imports, Remark: For each exporting region, average transport distances specific for the country have been estimated. Dust from transport and load/unload operations is included. Average coal losses are considered. Average emissions to water due to leaching from coal heaps at storage at receiving terminal is estimated from the literature.
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	fuels	production	production	production	production	production	production	production	production	production	production	production	production	production	production	production
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Brenn- und Treibstoffe	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung	Bereitstellung
	Formula																
	StatisticalClassification																
	CASNumber																
TimePeriod	StartDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText																
Geography	Text	Geography: Transports are import country-soecific, while losses are generic	Geography: Average US conditions	Geography: Transports are import country-specific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transport distance is from CN Statistics. Losses are best guess for CN based on literature.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Unspecified	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.	Geography: Transports are import country-soecific, while losses are generic.
Technology	Text	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified	Technology: Not specified
Representativene	Percent																
	ProductionVolume																
	SamplingProcedure	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	unspecified	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature	Sampling procedure: literature
	Extrapolations	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: from Europe Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none	Extrapolations: see Geography/Text Uncertainty adjustments: none
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode																
	CountryCode																
	PageNumbers																
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails																

ANNEX LCI: HARD COAL COMBUSTION ("BURNED IN" DATASETS)

Tab. 5.5: Life Cycle Inventory models for hard coal combustion and emission profiles ("burned in" datasets); adjusted values compared to the current version are marked with light and dark orange colour.

	Name	Location	InfrastructureProcess	Unit	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				AT	BE	CN	CZ	DE	ES	FR	HR	IN	IT	NL	PL	PT	RU	SK	US			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Unit				MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ			
product	hard coal, burned in power plant	AT	0	MJ	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	BE	0	MJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	CN	0	MJ	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	CZ	0	MJ	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	DE	0	MJ	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	ES	0	MJ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	FR	0	MJ	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	HR	0	MJ	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
	hard coal, burned in power plant	IN	0	MJ	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0			
	hard coal, burned in power plant	IT	0	MJ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
	hard coal, burned in power plant	NL	0	MJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0			
	hard coal, burned in power plant	PL	0	MJ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
	hard coal, burned in power plant	PT	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0			
	hard coal, burned in power plant	RU	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0			
	hard coal, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
	hard coal, burned in power plant	US	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
technosphere	hard coal power plant	RER	1	unit	1.30E-12	1.30E-12	0	1.30E-12	1.30E-12	1.30E-12	1.30E-12	1.30E-12	0	1.30E-12	1.30E-12	1.30E-12	1.30E-12	1.30E-12	1.30E-12	1.30E-12	1	3.02	(3,3,2,3,1,3);
	hard coal power plant	CN	1	unit	0	0	1.30E-12	0	0	0	0	0	1.30E-12	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	AT	0	kg	4.51E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	BE	0	kg	0	4.15E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	CN	0	kg	0	0	4.53E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	CZ	0	kg	0	0	0	4.52E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	DE	0	kg	0	0	0	0	4.17E-2	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	ES	0	kg	0	0	0	0	0	4.23E-2	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	FR	0	kg	0	0	0	0	0	0	4.24E-2	0	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	HR	0	kg	0	0	0	0	0	0	0	4.52E-2	0	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	IN	0	kg	0	0	0	0	0	0	0	0	6.68E-2	0	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	IT	0	kg	0	0	0	0	0	0	0	0	0	4.29E-2	0	0	0	0	0	0	0	0.00	0
	hard coal supply mix	NL	0	kg	0	0	0	0	0	0	0	0	0	0	4.32E-2	0	0	0	0	0	0	0.00	0
	hard coal supply mix	PL	0	kg	0	0	0	0	0	0	0	0	0	0	0	4.53E-2	0	0	0	0	0	0.00	0
	hard coal supply mix	PT	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	4.25E-2	0	0	0	0	0.00	0
	hard coal, at regional storage	RU	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	4.94E-2	0	0	0	0.00	0
	hard coal supply mix	SK	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.50E-2	0	0	0.00	0
	hard coal supply mix, at regional storage	US	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.95E-2	1	1.20	based on possible variation in coal quality affecting the heating value
	chlorine, liquid, production mix, at plant	RER	0	kg	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1	2.00	estimate taken from european power plants (Röder et al. 2004)
	light fuel oil, at regional storage	RER	0	kg	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.51E-4	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1.70E-5	1	2.00	estimate taken from european power plants (Röder et al. 2004)
	water, completely softened, at plant	RER	0	kg	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	0	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	1	2.00	estimate taken from european power plants (Röder et al. 2004)
	water, decarbonised, at plant	RER	0	kg	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.27E-2	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1	2.00	estimate taken from european power plants (Röder et al. 2004)
	SOx retained, in hard coal flue gas desulphurisation	RER	0	kg	8.03E-04	7.25E-04	8.04E-04	6.34E-04	7.85E-04	6.98E-04	6.79E-04	7.82E-04	4.06E-04	7.88E-04	8.08E-04	7.32E-04	7.71E-04	9.95E-05	7.59E-04	7.42E-04	1	2.56	(5,5,5,5,5,5,BU:1.05)based on difference of a
	NOx retained, in SCR	GLO	0	kg	1.59E-04	1.15E-04	1.90E-04	8.41E-05	1.55E-04	1.15E-04	9.42E-05	1.67E-04	9.01E-05	1.70E-04	1.88E-04	1.29E-04	1.57E-04	3.67E-05	1.70E-04	1.52E-04	1	2.56	(5,5,5,5,5,5,BU:1.05)based on difference of a
	transport, freight, rail	RER	0	tkm	4.35E-4	5.66E-4	0	5.75E-4	4.82E-4	3.51E-4	4.99E-4	1.44E-4	0	5.61E-4	4.29E-4	4.77E-4	4.66E-4	3.56E-4	3.56E-4	0	0	0.00	0
	transport, coal freight, rail	CN	0	tkm	0	0	1.35E-6	0	0	0	0	0	1.35E-6	0	0	0	0	0	0	0	0	0.00	0
	transport, freight, lorry, fleet average	RER	0	tkm	0	0	6.75E-7	1.15E-4	0	1.30E-4	0	6.70E-5	6.75E-7	0	0	1.43E-4	0	8.70E-5	8.70E-5	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	AT	0	kg	2.47E-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	BE	0	kg	0	3.22E-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	PL	0	kg	0	0	7.15E-3	0	0	0	0	0	3.17E-2	0	0	7.15E-3	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	CZ	0	kg	0	0	0	5.75E-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	DE	0	kg	0	0	0	0	2.63E-4	0	0	0	0	0	0	0	0	0	0	2.68E-3	1	2.00	average figure for whole US; can considerably vary for single regions
	disposal, hard coal ash, 0% water, to residual material landfill	ES	0	kg	0	0	0	0	0	6.51E-3	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	FR	0	kg	0	0	0	0	0	0	2.82E-4	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	HR	0	kg	0	0	0	0	0	0	0	3.35E-3	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	IT	0	kg	0	0	0	0	0	0	0	0	0	3.05E-4	0	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	NL	0	kg	0	0	0	0	0	0	0	0	0	0	2.35E-4	0	0	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	PT	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	2.59E-4	0	0	0	0	0.00	0
	disposal, hard coal ash, 0% water, to residual material landfill	SK	0	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	4.35E-3	4.35E-3	0	0	0.00	0
	disposal, residue from cooling tower, 30% water, to sanitary landfill	CH	0	kg	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	5.00E-6	1	2.00	estimate taken from european power plants (Röder et al. 2004)
resource, in water	Water, cooling, unspecified natural origin	-	-	m3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	1	2.00	estimate taken from european power plants (Röder et al. 2004)
emission water, river	Heat, waste	-	-	MJ	1.35E-1	1.44E-1	0	1.65E-1	1.44E-1	1.44E-1	1.45E-1	1.45E-1	0	1.41E-1	1.45E-1	1.54E-1	1.41E-1	1.39E-1	1.39E-1	1.54E-1	1	1.50	calculated from energy balance; also depends on assumed share of colling tower vs. River cooling
emission water, unspecified	Heat, waste	-	-	MJ	0	0	1.45E-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
emission air, high population density	Heat, waste	-	-	MJ	5.11E-1	5.46E-1	5.67E-1	6.25E-1	5.47E-1	5.48E-1	5.51E-1	5.51E-1	0	5.51E-1	5.52E-1	5.84E-1	5.34E-1	5.27E-1	5.27E-1	5.85E-1	1	1.50	calculated from energy balance; also depends on assumed share of colling tower vs. River cooling
	Antimony	-	-	kg	7.81E-11	3.10E-10	1.98E-9	6.26E-11	8.65E-11	5.36E-10	1.31E-9	3.15E-10	1.74E-7	2.31E-10	1.67E-11	5.71E-10	2.25E-10	1.98E-9	1.98E-9	3.63E-10	1	5.00	average US figure, based on available literature
	Arsenic	-	-	kg	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Barium	-	-	kg	5.19E-9	3.44E-8	1.22E-7	4.17E-9	5.71E-9	5.10E-8	4.20E-8	2.14E-8	1.13E-7	3.24E-8	3.10E-9	2.35E-8	2.03E-8	1.22E-7	1.22E-7	0	0	0.00	0
	Benzene	-	-	kg	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.62E-8	1	2.00	average US figure, based on available literature
	Benzo(a)pyrene	-	-	kg	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	7.67E-13	1	2.00	average US figure, based on available literature
	Boron	-	-	kg	2.12E-7	3.41E-7	7.00E-7	2.44E-7	1.23E-7	6.51E-7	3.68E-7	3.68E-7	7.00E-7	3.74E-7	1.88E-7	2.13E-7	4.33E-7	7.00E-7	7.00E-7	0	0	0.00	0
	Bromine	-	-	kg	8.48E-8	1.53E-7	5.71E-7	9.76E-8	6.36E-8	2.94E-7	2.14E-7	2.49E-7	5.71E-7	1.53E-7	5.26E-8	5.71E-7	2.74E-7	2.63E-7	2.63E-7	0	0	0.00	0
	Butane	-	-	kg	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	0	0	0.00	0
	Cadmium	-	-	kg	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	9.00E-10	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Carbon dioxide, fossil	-	-	kg	0.0946	0.0946	0.0946	0.094555	0.094634	0.094721	0.0946	0.0946	0.094866	0.0946	0.0946	0.0946	0.0946	0.0946	0.095297	0.095457	1	1.07	(2,1,1,1,1,1,BU:1.05)calculated from fuel composition and emission factors (based on International Energy Agency data and IPCC guidelines)
	Carbon monoxide, fossil	-	-	kg	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	1	5.26	(1,1,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Chromium	-	-	kg	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Chromium VI	-	-	kg	2.61E-11	3.82E-10	1.41E-9	2.07E-11	8.11E-11	5.23E-10	4.58E-10	2.37E-10	3.44E-9	3.61E-10	3.59E-11	2.59E-10	2.65E-10	1.41E-9	1.41E-9	1.60E-9	1	5.00	average US figure, based on available literature
	Cobalt	-	-	kg	1.83E-10	1.51E-9	4.72E-9	1.46E-10	3.26E-10	2.18E-9	1.82E-9	7.88E-10	5.78E-9	1.07E-9	7.45E-11	1.24E-9	9.56E-10	4.72E-9	4.72E-9	2.02E-9	1	5.00	average US figure, based on available literature
	Copper	-	-	kg	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Dinitrogen monoxide	-	-	kg	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1	1.50	(2,1,1,1,1,1,BU:1.5)calculated from fuel composition and emission factors (based on International Energy Agency data and IPCC guidelines)
	Ethane	-	-	kg	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	0	0	0.00	0
	Formaldehyde	-	-	kg	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	4.85E-9	1	2.00	average US figure, based on available literature
	Hydrocarbons, aliphatic, alkanes, unspecified	-	-	kg	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	1.26E-8	1	2.00	average US figure, based on available literature
	Hydrocarbons, aliphatic, unsaturated	-	-	kg	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	0	0	0.00	0
	Hydrogen chloride	-	-	kg	3.60E-6	9.19E-6	3.05E-5	4.14E-6	2.08E-6	1.31E-5	1.24E-5	1.92E-5	3.05E-5	5.52E-6	1.06E-6	3.05E-5	9.14E-6	2.79E-5	2.79E-5	2.42E-5	1	2.00	average US figure, based on available literature
	Hydrogen fluoride	-	-	kg	2.74E-6	3.96E-6	2.73E-6	3.16E-6	1.30E-6	4.23E-6	2.93E-6	1.07E-6	2.73E-6	2.55E-6	1.13E-6	2.73E-6	3.40E-6	4.30E-6	4.30E-6	3.03E-6	1	2.00	average US figure, based on available literature
	Iodine	-	-	kg	1.59E-8	7.55E-8	2.92E-7	1.83E-8	2.37E-8	1.35E-7	9.20E-8	9.76E-8	2.92E-7	7.38E-8	2.97E-8	2.92E-7	1.12E-7	1.20E-7	1.20E-7	0	0	0.00	0
	Lead	-	-	kg	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	7.30E-09	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Lead-210	-	-	kBq	7.51E-7	2.55E-5	1.21E-4	6.00E-7	1.61E-6	7.29E-5	3.95E-5	1.49E-5	1.21E-4	2.10E-5	6.76E-7	1.64E-5	1.57E-5	1.21E-4	1.21E-4	1.25E-5	1	3.00	average US figure, based on available literature
	Manganese	-	-	kg	2.58E-9	9.12E-9	6.03E-8	2.09E-9	1.22E-9	1.33E-8	9.90E-9	5.52E-9	6.04E-8	6.96E-9	4.48E-10	1.24E-8	5.50E-9	6.03E-8	6.03E-8	9.89E-9	1	5.00	average US figure, based on available literature
	Mercury	-	-	kg	1.40E-09	1.40E-09	1.40E-09	1.40E-09	8.80E-10	6.90E-10	1.40E-09	1.40E-09	1.14E-08	9.20E-10	3.10E-10	6.07E-09	3.00E-10	1.40E-09	1.40E-09	1.40E-09	1	5.26	(1,2,1,1,1,1,BU:5)calculated from reported emissions (US Environmental Protection Agency)
	Methane, fossil	-	-	kg	1.00E-05	1.00E-05	1.00E-05	9.97E-06	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1	1.50	(2,1,1,1,1,1,BU:1.5)calculated from fuel composition and emission factors (based on International Energy Agency data and IPCC guidelines)
	Molybdenum	-	-	kg	1.59E-10	5.75E-10	2.15E-9	1.25E-10	3.62E-10	8.72E-10	7.10E-10	6.44E-10	4.27E-8	4.77E-10	5.65E-11	7.05E-10	4.37E-10	2.15E-9	2.15E-9	0	0	0.00	0
	Nickel	-	-	kg	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	4.90E-09	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Nitrogen oxides	-	-	kg	5.00E-05	9.40E-05	1.91E-05	0.0001249	5.43E-05	9.44E-05	0.0001148	4.22E-05	0.0001189	3.92E-05	2.11E-05	8.00E-05	5.19E-05	0.0001723	3.89E-05	5.67E-05	1	1.50	(1,1,1,1,1,1,BU:1.5)calculated from reported emissions (US Environmental Protection Agency)
	PAH, polycyclic aromatic hydrocarbons	-	-	kg	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	6.78E-11	1	3.23	(1,3,5,1,1,1,BU:3)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Particulates, < 2.5 um	-	-	kg	0	0	3.00E-08	3.90E-07	0	6.00E-07	4.50E-07	1.03E-06	6.02E-06	0	0	1.82E-06	0	2.43E-05	0	3.54E-06	1	3.00	(1,1,1,1,1,1,BU:3)calculated from reported emissions (US Environmental Protection Agency)
	Particulates, > 10 um	-	-	kg	0	7.40E-07	2.60E-07	7.20E-07	0	8.50E-07	6.70E-07	1.32E-06	7.69E-06	0	0	1.91E-06	0	2.25E-05	0	2.08E-06	1	1.50	(1,1,1,1,1,1,BU:1.5)calculated from reported emissions (US Environmental Protection Agency)
	Particulates, > 2.5 um, and < 10um	-	-	kg	2.58E-06	4.70E-06	2.73E-06	3.08E-06	1.15E-06	3.20E-06	2.35E-06	4.62E-06	8.59E-06	1.27E-06	7.30E-07	3.73E-06	8.90E-07	1.32E-05	2.21E-06	3.05E-06	1	2.00	(1,1,1,1,1,1,BU:2)calculated from reported emissions (US Environmental Protection Agency)
	Pentane	-	-	kg	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	0	0	0.00	0
	Polonium-210	-	-	kBq	1.37E-6	4.66E-5	2.22E-4	1.10E-6	2.95E-6	1.33E-4	7.22E-5	2.72E-5	2.22E-4	3.84E-5	1.24E-6	3.00E-5	2.87E-5	2.22E-4	2.22E-4	1.25E-5	1	3.00	average US figure, based on available literature
	Potassium-40	-	-	kBq	1.61E-6	9.14E-6	2.99E-5	1.29E-6	2.12E-6	1.43E-5	1.28E-5	6.65E-6	1.17E-5	1.05E-5	1.03E-6	4.03E-6	8.03E-6	2.99E-5	2.99E-5	1.74E-5	1	3.00	average US figure, based on available literature
	Propane	-	-	kg	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	0	0	0.00	0
	Propene	-	-	kg	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	0	0	0.00	0
	Radium-226	-	-	kBq	1.94E-7	6.58E-6	3.14E-5	1.55E-7	4.16E-7	1.88E-5	1.02E-5	3.83E-6	3.38E-4	5.41E-6	1.74E-7	4.23E-6	4.05E-6	3.14E-5	3.14E-5	3.95E-6	1	3.00	average US figure, based on available literature
	Radium-228	-	-	kBq	1.95E-7	3.80E-6	9.28E-6	1.57E-7	2.12E-7	5.76E-6	5.37E-6	1.56E-6	9.99E-5	2.82E-6	9.39E-8	1.58E-6	2.41E-6	9.28E-6	9.28E-6	2.34E-6	1	3.00	average US figure, based on available literature
	Radon-220	-	-	kBq	2.83E-4	2.85E-4	6.50E-4	3.26E-4	2.73E-4	3.27E-4	2.83E-4	2.88E-4	6.50E-4	2.71E-4	2.73E-4	3.66E-4	2.76E-4	3.00E-4	3.00E-4	3.62E-4	1	3.00	average US figure, based on available literature
	Radon-222	-	-	kBq	5.02E-4	5.06E-4	3.66E-4	5.79E-4	4.85E-4	5.82E-4	5.02E-4	5.12E-4	3.66E-4	4.81E-4	4.85E-4	6.50E-4	4.90E-4	5.33E-4	5.33E-4	6.58E-4	1	3.00	average US figure, based on available literature
	Selenium	-	-	kg	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	2.30E-08	1	5.26	(1,3,5,1,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Strontium	-	-	kg	7.75E-10	4.01E-8	1.11E-7	6.26E-10	7.14E-10	7.04E-8	4.33E-8	1.68E-8	3.56E-8	2.80E-8	4.32E-10	2.32E-8	2.54E-8	1.11E-7	1.11E-7	0	0	0.00	0
	Sulfur dioxide	-	-	kg	1.68E-05	9.47E-05	1.60E-05	0.0001856	3.46E-05	0.0001218	0.0001412	3.77E-05	0.0004145	3.25E-05	1.16E-05	8.80E-05	4.94E-05	0.0007205	6.14E-05	7.81E-05	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from reported emissions (US Environmental Protection Agency)
	Thorium-228	-	-	kBq	1.05E-7	2.05E-6	5.00E-6	8.47E-8	1.14E-7	3.10E-6	2.89E-6	8.40E-7	5.38E-5	1.52E-6	5.06E-8	8.49E-7	1.30E-6	5.00E-6	5.00E-6	1.55E-6	1	3.00	average US figure, based on available literature
	Thorium-232	-	-	kBq	1.65E-7	3.22E-6	7.86E-6	1.33E-7	1.79E-7	4.87E-6	4.54E-6	1.32E-6	8.46E-5	2.38E-6	7.95E-8	1.33E-6	2.04E-6	7.86E-6	7.86E-6	1.55E-6	1	3.00	average US figure, based on available literature
	Toluene	-	-	kg	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	4.84E-9	1	2.00	average US figure, based on available literature
	Uranium-238	-	-	kBq	1.62E-7	5.48E-6	2.61E-5	1.29E-7	3.47E-7	1.57E-5	8.49E-6	3.19E-6	2.61E-5	4.51E-6	1.45E-7	3.53E-6	3.37E-6	2.61E-5	2.61E-5	4.94E-6	1	3.00	average US figure, based on available literature
	Vanadium	-	-	kg	5.20E-10	6.33E-9	2.79E-8	4.17E-10	6.53E-10	1.24E-8	8.72E-9	5.17E-9	2.79E-8	4.88E-9	1.92E-10	6.22E-9	5.49E-9	2.79E-8	2.79E-8	0	0	0.00	0
	Xylene	-	-	kg	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	7.46E-10	1	2.00	average US figure, based on available literature
	Zinc	-	-	kg	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1	5.26	(1,3,5,3,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	-	kg	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1	1.78	(1,2,5,1,1,1,BU:1.5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Polychlorinated biphenyls	-	-	kg	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	1	3.23	(1,3,5,3,1,1,BU:3)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Benzene, hexachloro-	-	-	kg	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	1	3.23	(1,3,5,3,1,1,BU:3)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
emission air, unspecified	Carbon black	-	-	kg	5.16E-08	9.40E-08	5.46E-08	6.16E-08	2.30E-08	6.40E-08	4.70E-08	9.24E-08	1.72E-07	2.54E-08	1.46E-08	7.46E-08	1.78E-08	2.64E-07	4.42E-08	6.10E-08	1	5.26	(1,3,5,3,1,1,BU:5)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	-	kg	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1	3.23	(1,3,5,3,1,1,BU:3)based on available emission factors (EMEP/EEA air pollutant emission inventory guidebook)

Tab. 5.6: Meta information of the Life Cycle Inventory models for hard coal combustion and emission profiles (“burned in” datasets)

ReferenceFunction	Name	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant	hard coal, burned in power plant
Geography	Location	AT	BE	CN	CZ	DE	ES	FR	HR	IN	IT	NL	PL	PT	RU	SK	US
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ
DataSetInformatio	Type	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. 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The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. 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The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. 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	Amount	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk	Steinkohle, in Kraftwerk
	Synonyms			0						0					0		
	GeneralComment	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO2, CH4 and N2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO2, CH4 and N2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. 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For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used based on legal emission limits in the region and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO2, CH4 and N2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. 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	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula																
	StatisticalClassification																
	CASNumber																
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText																
Geography	Text	AT in 2019	BE in 2019	CN in 2019	CZ in 2019	DE in 2019	ES in 2019	FR in 2019	HR in 2019	IN in 2019	IT in 2019	NL in 2019	PL in 2019	PT in 2019	RU in 2019	SK in 2019	US in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	95	95	55	95	95	95	95	95	95	95	95	95	95	95	95	95
	ProductionVolume	12 PJ	420 TJ	45000 PJ	24 PJ	490 PJ	130 PJ	38 PJ	14 PJ	11000 PJ	180 PJ	150 PJ	690 PJ	52 PJ	1000 PJ	7800 TJ	9600 PJ
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode																
	CountryCode																
	PageNumbers																
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails																

ANNEX LCI: LIGNITE AND PEAT COMBUSTION (“BURNED IN” DATASETS)

Tab. 5.7: Life Cycle Inventory models for lignite and peat combustion and emission profiles (“burned in” datasets); adjusted values compared to the current version are marked with light and dark orange colour.

	Name	Location	InfrastructureProcess	Unit	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	peat, burned in power plant	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				BA	RS	CZ	DE	GR	HU	MK	PL	SI	SK	ENTSO-E			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0			
	Unit				MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ			
	lignite, burned in power plant	BA	0	MJ	1	0	0	0	0	0	0	0	0	0	0			
	lignite, burned in power plant	RS	0	MJ	0	1	0	0	0	0	0	0	0	0	0			
	lignite, burned in power plant	CZ	0	MJ	0	0	1	0	0	0	0	0	0	0	0			
	lignite, burned in power plant	DE	0	MJ	0	0	0	1	0	0	0	0	0	0	0			
	lignite, burned in power plant	GR	0	MJ	0	0	0	0	1	0	0	0	0	0	0			
	lignite, burned in power plant	HU	0	MJ	0	0	0	0	0	1	0	0	0	0	0			
	lignite, burned in power plant	MK	0	MJ	0	0	0	0	0	0	1	0	0	0	0			
	lignite, burned in power plant	PL	0	MJ	0	0	0	0	0	0	0	1	0	0	0			
	lignite, burned in power plant	SI	0	MJ	0	0	0	0	0	0	0	0	1	0	0			
	lignite, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	0	1	0			
	peat, burned in power plant	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	0	1			
technosphere	lignite power plant	RER	1	unit	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	9.72E-13	1	3.50	own estimation
	lignite, at mine	RER	0	kg	9.71E-2	1.27E-1	8.93E-2	1.15E-1	1.94E-1	1.16E-1	1.33E-1	1.20E-1	1.01E-1	9.90E-2	0	0	0.00	0
	peat, at mine	NORDEL	0	kg	0	0	0	0	0	0	0	0	0	0	1.14E-1	1	1.07	(2,1,1,1,1,1); see power plant data base for details
	chlorine, liquid, production mix, at plant	RER	0	kg	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1.00E-5	1	2.50	own estimation
	water, completely softened, at plant	RER	0	kg	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	6.00E-3	1	2.00	own estimation
	water, decarbonised, at plant	RER	0	kg	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1.50E-1	1	2.00	own estimation
	SOx retained, in lignite flue gas desulphurisation	GLO	0	kg	1.20E-03	4.67E-04	1.59E-03	1.64E-03	1.52E-03	1.60E-03	0.00E+00	1.59E-03	1.65E-03	1.53E-03	1.65E-03	1	2.56	(5,5,5,5,5,5,BU:1.05)based on differer
	NOx retained, in SCR	GLO	0	kg	1.36E-04	1.14E-04	1.66E-04	1.71E-04	1.72E-04	1.41E-04	1.00E-04	1.57E-04	1.83E-04	1.68E-04	1.65E-04	1	2.56	(5,5,5,5,5,5,BU:1.05)based on differer
	transport, freight, rail	RER	0	tkm	2.12E-5	2.53E-5	2.22E-4	7.50E-6	3.76E-5	2.79E-5	1.75E-5	1.29E-5	1.95E-5	2.74E-4	7.50E-6	1	2.10	(4,2,2,3,1,5); average distance is guesstimate
	disposal, lignite ash, 0% water, to opencast refill	BA	0	kg	2.01E-2	0	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	CS	0	kg	0	2.40E-2	0	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	CZ	0	kg	0	0	1.11E-2	0	0	0	0	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	DE	0	kg	0	0	0	7.13E-3	0	0	0	0	0	0	7.05E-3	1	1.50	(5,1,1,1,1,1); calculated from mass balance
	disposal, lignite ash, 0% water, to opencast refill	GR	0	kg	0	0	0	0	3.57E-2	0	0	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	HU	0	kg	0	0	0	0	0	2.65E-2	0	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	MK	0	kg	0	0	0	0	0	0	1.66E-2	0	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	PL	0	kg	0	0	0	0	0	0	0	1.23E-2	0	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	SI	0	kg	0	0	0	0	0	0	0	0	1.86E-2	0	0	0	0.00	0
	disposal, lignite ash, 0% water, to opencast refill	SK	0	kg	0	0	0	0	0	0	0	0	0	1.68E-2	0	0	0.00	0
resource, in water	Water, cooling, unspecified natural origin	-	-	m3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	3.50E-3	1	2.00	own estimation
emission air, low population density	Heat, waste	-	-	MJ	7.00E-1	6.98E-1	6.82E-1	6.72E-1	6.55E-1	7.13E-1	6.78E-1	6.57E-1	6.77E-1	7.51E-1	6.72E-1	1	1.50	own estimation
	Antimony	-	-	kg	5.13E-9	8.84E-9	1.63E-10	1.31E-11	4.12E-9	9.72E-10	5.31E-9	8.97E-10	1.94E-9	5.73E-10	1.31E-11	1	7.00	own estimation
	Arsenic	-	-	kg	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1.43E-08	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Barium	-	-	kg	3.21E-8	5.52E-8	2.04E-9	4.36E-9	2.68E-8	7.60E-9	3.32E-8	4.41E-8	1.32E-8	4.90E-9	4.36E-9	1	7.00	own estimation
	Benzene	-	-	kg	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	2.17E-7	1	3.00	own estimation
	Benzo(a)pyrene	-	-	kg	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	2.00E-13	1	3.00	own estimation
	Boron	-	-	kg	4.39E-6	5.73E-6	1.60E-6	2.07E-6	8.32E-6	3.96E-6	5.97E-6	2.75E-7	4.11E-6	3.00E-6	2.07E-6	1	7.00	own estimation
	Bromine	-	-	kg	1.17E-7	1.54E-7	2.14E-8	2.76E-8	2.19E-7	9.45E-8	1.60E-7	1.23E-7	1.06E-7	6.73E-8	2.76E-8	1	3.00	own estimation
	Butane	-	-	kg	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1.90E-8	1	3.00	own estimation
	Cadmium	-	-	kg	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Carbon dioxide, fossil	-	-	kg	0.101	0.100993	0.101	0.100954	0.101	0.101	0.101	0.101	0.101	0.100994	0.106	1	1.07	(2,1,1,1,1,1,BU:1.05)calculated from fu
	Carbon monoxide, fossil	-	-	kg	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	8.70E-06	1	5.26	(1,1,5,3,1,1,BU:5)based on available e
	Chromium	-	-	kg	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	9.10E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Chromium VI	-	-	kg	4.94E-11	8.51E-10	3.14E-11	2.40E-11	4.13E-10	1.17E-10	5.12E-10	1.09E-9	2.02E-10	7.55E-11	2.40E-11	1	4.00	based on range of data
	Cobalt	-	-	kg	4.81E-9	8.29E-9	3.06E-10	8.73E-11	4.02E-9	1.14E-9	4.98E-9	7.72E-10	1.97E-9	7.35E-10	8.73E-11	1	7.00	own estimation
	Copper	-	-	kg	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Dinitrogen monoxide	-	-	kg	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1.50E-06	1	1.50	(2,1,1,1,1,1,BU:1.5)calculated from fu
	Ethane	-	-	kg	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	4.10E-8	1	3.00	own estimation
	Formaldehyde	-	-	kg	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	5.80E-8	1	3.00	own estimation
	Hydrocarbons, aliphatic, alkanes, unspecified	-	-	kg	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	2.19E-7	1	3.00	own estimation
	Hydrocarbons, aliphatic, unsaturated	-	-	kg	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	2.16E-7	1	3.00	own estimation
	Hydrogen chloride	-	-	kg	7.44E-6	9.72E-6	6.79E-7	2.93E-6	4.59E-5	3.77E-6	1.01E-5	2.04E-6	6.60E-6	3.87E-6	2.93E-6	1	3.00	own estimation
	Hydrogen fluoride	-	-	kg	2.31E-6	3.02E-6	6.32E-7	8.17E-7	4.34E-6	1.97E-6	3.14E-6	2.06E-6	2.13E-6	1.45E-6	8.17E-7	1	3.00	own estimation
	Iodine	-	-	kg	8.78E-8	1.15E-7	2.00E-8	2.59E-8	1.64E-7	7.29E-8	1.19E-7	7.60E-8	8.01E-8	5.29E-8	2.59E-8	1	4.00	own estimation
	Lead	-	-	kg	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Lead-210	-	-	kBq	3.68E-5	6.35E-5	5.86E-7	1.25E-6	2.90E-5	6.11E-6	3.82E-5	2.26E-5	1.33E-5	3.35E-6	1.25E-6	1	5.00	own estimation
	Manganese	-	-	kg	6.41E-9	1.11E-8	2.04E-10	1.09E-9	5.15E-9	1.22E-9	6.64E-9	2.90E-8	2.42E-9	7.16E-10	1.09E-9	1	7.00	own estimation
	Mercury	-	-	kg	2.90E-09	2.90E-09	6.67E-09	3.55E-09	4.64E-09	2.90E-09	2.90E-09	8.43E-09	2.90E-09	2.90E-09	2.90E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Methane, fossil	-	-	kg	1.00E-05	9.98E-06	1.00E-05	9.88E-06	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	9.99E-06	1.00E-06	1	1.50	(2,1,1,1,1,1,BU:1.5)calculated from fu
	Molybdenum	-	-	kg	4.49E-9	7.73E-9	2.85E-10	8.73E-11	3.75E-9	1.06E-9	4.65E-9	4.98E-9	1.84E-9	6.86E-10	8.73E-11	1	7.00	own estimation
	Nickel	-	-	kg	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	9.70E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Nitrogen oxides	-	-	kg	0.000111	0.0001335	8.08E-05	7.64E-05	7.55E-05	0.0001058	0.0001468	9.03E-05	6.40E-05	7.86E-05	8.21E-05	1	1.50	(1,1,1,1,1,1,BU:1.5)calculated from re
	PAH, polycyclic aromatic hydrocarbons	-	-	kg	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	6.94E-11	1	3.23	(1,3,5,3,1,1,BU:3)based on available e
	Particulates, < 2.5 um	-	-	kg	1.08E-05	1.03E-05	4.02E-06	1.89E-06	4.79E-06	3.20E-06	1.69E-05	3.16E-06	1.76E-06	2.39E-06	2.52E-06	1	3.00	(1,1,1,1,1,1,BU:3)calculated from repo
	Particulates, > 10 um	-	-	kg	1.91E-05	1.37E-05	2.90E-07	0	1.33E-06	3.80E-06	4.42E-05	3.20E-07	0	2.00E-07	0	1	1.50	(1,1,1,1,1,1,BU:1.5)calculated from re
	Particulates, > 2.5 um, and < 10um	-	-	kg	1.71E-05	1.17E-05	6.50E-07	0	2.24E-06	4.70E-06	3.75E-05	5.60E-07	0	3.30E-07	5.10E-07	1	2.00	(1,1,1,1,1,1,BU:2)calculated from repo
	Pentane	-	-	kg	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1.47E-7	1	3.00	own estimation
	Polonium-210	-	-	kBq	6.73E-5	1.16E-4	1.07E-6	2.29E-6	5.29E-5	1.12E-5	6.98E-5	4.12E-5	2.43E-5	6.13E-6	2.29E-6	1	5.00	own estimation
	Potassium-40	-	-	kBq	5.97E-6	1.03E-5	3.80E-7	8.12E-7	4.99E-6	1.41E-6	6.18E-6	8.31E-6	2.45E-6	9.13E-7	8.12E-7	1	5.00	own estimation
	Propane	-	-	kg	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	3.50E-8	1	3.00	own estimation
	Propene	-	-	kg	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1.60E-8	1	3.00	own estimation
	Radium-226	-	-	kBq	9.51E-6	1.64E-5	1.51E-7	3.24E-7	7.47E-6	1.58E-6	9.85E-6	5.82E-6	3.43E-6	8.65E-7	3.24E-7	1	5.00	own estimation
	Radium-228	-	-	kBq	3.09E-6	5.33E-6	1.48E-7	3.16E-7	2.54E-6	6.60E-7	3.21E-6	3.72E-6	1.22E-6	4.09E-7	3.16E-7	1	5.00	own estimation
	Radon-220	-	-	kBq	1.17E-4	1.53E-4	1.07E-4	1.38E-4	2.33E-4	1.39E-4	1.59E-4	1.45E-4	1.21E-4	1.18E-4	1.38E-4	1	5.00	own estimation
	Radon-222	-	-	kBq	2.07E-4	2.72E-4	1.90E-4	2.45E-4	4.14E-4	2.47E-4	2.83E-4	2.57E-4	2.16E-4	2.09E-4	2.45E-4	1	5.00	own estimation
	Selenium	-	-	kg	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	4.50E-08	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Strontium	-	-	kg	3.37E-8	5.80E-8	2.14E-10	4.58E-10	2.61E-8	5.10E-9	3.49E-8	4.49E-8	1.18E-8	2.65E-9	4.58E-10	1	7.00	own estimation
	Sulfur dioxide	-	-	kg	0.000484	0.0012133	8.86E-05	4.38E-05	0.0001586	8.12E-05	0.0028229	9.47E-05	3.14E-05	0.0001496	2.61E-05	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from r
	Thorium-228	-	-	kBq	1.67E-6	2.87E-6	7.95E-8	1.70E-7	1.37E-6	3.55E-7	1.73E-6	2.00E-6	6.57E-7	2.20E-7	1.70E-7	1	5.00	own estimation
	Thorium-232	-	-	kBq	2.62E-6	4.51E-6	1.25E-7	2.67E-7	2.15E-6	5.58E-7	2.71E-6	3.15E-6	1.03E-6	3.46E-7	2.67E-7	1	5.00	own estimation
	Toluene	-	-	kg	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1.09E-7	1	3.00	own estimation
	Uranium-238	-	-	kBq	7.92E-6	1.37E-5	1.26E-7	2.70E-7	6.23E-6	1.31E-6	8.21E-6	4.85E-6	2.86E-6	7.21E-7	2.70E-7	1	5.00	own estimation
	Vanadium	-	-	kg	2.24E-8	3.87E-8	3.57E-10	1.09E-10	1.76E-8	3.72E-9	2.32E-8	8.29E-9	8.11E-9	2.04E-9	1.09E-10	1	7.00	own estimation
	Xylene	-	-	kg	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	9.22E-7	1	3.00	own estimation
	Zinc	-	-	kg	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	8.80E-09	1	5.26	(1,3,5,3,1,1,BU:5)based on available e
	Heat, waste	-	-	MJ	7.00E-1	6.98E-1	6.82E-1	6.72E-1	6.55E-1	7.13E-1	6.78E-1	6.57E-1	6.77E-1	7.51E-1	6.72E-1	1	1.50	own estimation
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	-	kg	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1	1.78	(1,2,5,3,1,1,BU:1.5)based on available
	Polychlorinated biphenyls	-	-	kg	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	3.30E-15	1	3.23	(1,3,5,3,1,1,BU:3)based on available e
	Benzene, hexachloro-	-	-	kg	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	6.70E-12	1	3.23	(1,3,5,3,1,1,BU:3)based on available e
emission air, unspecified	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	-	kg	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1.00E-14	1	3.23	(1,3,5,3,1,1,BU:3)based on available e
	Carbon black	-	-	kg	1.08E-07	1.03E-07	4.02E-08	1.89E-08	4.79E-08	3.20E-08	1.69E-07	3.16E-08	1.76E-08	2.39E-08	2.52E-08	1	3.23	(1,3,5,3,1,1,BU:3)based on available e

Tab. 5.8: Meta information of the Life Cycle Inventory models for lignite and peat combustion and emission profiles ("burned in" datasets).

ReferenceFunction	Name	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	lignite, burned in power plant	peat, burned in power plant
Geography	Location	BA	RS	CZ	DE	GR	HU	MK	PL	SI	SK	ENTSO-E
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ
DataSetInformatio	Type	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.	Energy conversion for energy supply. Use of fuel oil for startup is accounted for. Particle removal is included in this module. DeSOx and DeNOx are described in different modules; they are applied here according to a simplified estimate assuming an average unabated emission and the specific abated regional emission rates; SOx and NOx emissions are the reduced ones. It is assumed that 25 % of the plants are river cooled, 75 % use cooling tower (average UCTE). The water treatment is described in separate modules. The disposal of non-recycled ashes is modelled separately.
	Amount	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Braunkohle, in Kraftwerk	Torf, in Kraftwerk
	Synonyms											
	GeneralComment	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. 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For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.	The module describes the operation of an average plant in the region. The plant is used for middle load with 4000 hours of operation at full capacity per year. The plant is assumed to operate 150000 hours during its lifetime. For the assessment of main characteristics (LHV, sulphur and ash content of coal, efficiency of the plant) and criteria emissions (SOx, NOx, particles, mercury) a bottom-up approach has been used and supplemented by typical emission factors in cases of data gaps (based on EEA/EPA). CO_2, CH_4 and N_2O emissions have been derived from fuel types (from IEA data) and IPCC emission factors. Airborne emission data has been updated for 2019, whereas other inputs and outputs come from the original dataset. The dataset consists on the collection of information about single plants.
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1
	Category	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula											
	StatisticalClassification											
	CASNumber											
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText											
Geography	Text	BA in 2019	RS in 2019	CZ in 2019	DE in 2019	GR in 2019	HU in 2019	MK in 2019	PL in 2019	SI in 2019	SK in 2019	ENTSO-E in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	95	95	95	95	95	95	95	95	95	95	95
	ProductionVolume	130 PJ	270 PJ	330 PJ	1000 PJ	35 PJ	40 PJ	38 PJ	390 PJ	35 PJ	16 PJ	45 PJ
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.	Extrapolations for some exchanges applied where not all plants in the region reported complete data. See exchange comments for details.
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode											
	CountryCode											
	PageNumbers											
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails											

ANNEX LCI: ELECTRICITY GENERATION FROM HARD COAL

Tab. 5.9: Life Cycle Inventory models for electricity generation from hard coal (all values updated).

	Name	Location	InfrastructureProcess	Unit	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				AT	BE	CENTREL	CN	CZ	DE	ES	FR	HR	IT	IN	NL	PL	PT	RU	SK	UCTE	US	ENTSO-E			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Unit				kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh			
	electricity, hard coal, at power plant	AT	0	kWh	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	BE	0	kWh	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	CENTREL	0	kWh	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	CN	0	kWh	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	CZ	0	kWh	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	DE	0	kWh	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	ES	0	kWh	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	FR	0	kWh	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	HR	0	kWh	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	IT	0	kWh	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	IN	0	kWh	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	NL	0	kWh	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0			
	electricity, hard coal, at power plant	PL	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
	electricity, hard coal, at power plant	PT	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0			
	electricity, hard coal, at power plant	RU	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
	electricity, hard coal, at power plant	SK	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0			
	electricity, hard coal, at power plant	UCTE	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0			
	electricity, hard coal, at power plant	US	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
	electricity, hard coal, at power plant	ENTSO-E	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
technosphere	hard coal, burned in power plant	AT	0	MJ	7.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	BE	0	MJ	0	9.51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	CN	0	MJ	0	0	0	10.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	CZ	0	MJ	0	0	0	0	11.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	DE	0	MJ	0	0	0	0	0	9.17	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	ES	0	MJ	0	0	0	0	0	0	10.11	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	FR	0	MJ	0	0	0	0	0	0	0	11.14	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	HR	0	MJ	0	0	0	0	0	0	0	0	9.53	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	IT	0	MJ	0	0	0	0	0	0	0	0	0	10.11	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	IN	0	MJ	0	0	0	0	0	0	0	0	0	0	10.61	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	NL	0	MJ	0	0	0	0	0	0	0	0	0	0	0	8.5	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	PL	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	9.69	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	PT	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	9.8	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	RU	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.14	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.32	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	AT	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.28E-2	0	7.79E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	BE	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.09E-4	0	4.93E-4	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	CZ	0	kWh	0	0	2.66E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.04E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	DE	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.74E-1	0	2.89E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	ES	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.10E-1	0	6.70E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	FR	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.05E-2	0	1.86E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	HR	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.31E-2	0	8.01E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	IT	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.59E-1	0	9.67E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	NL	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.53E-1	0	9.36E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	PL	0	kWh	0	0	9.62E-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.75E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	PT	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.72E-2	0	2.88E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, hard coal, at power plant	SK	0	kWh	0	0	1.12E-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.37E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	US	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.13	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate

Tab. 5.10: Meta information of the Life Cycle Inventory models for electricity generation from hard coal.

ReferenceFunction	Name	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant
Geography	Location	AT	BE	CENTREL	CN	CZ	DE	ES
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0
ReferenceFunctio	Unit	kWh	kWh	kWh	kWh	kWh	kWh	kWh
DataSetInformatic	Type	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1
	IncludedProcesses	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the ENTSO-E region adjusted for co-generation (using allocation based on exergy content) since data for the specific region was not plausible.	Electricity output at busbar. The dataset is composed of the electricity generation in covered sub-regions and thus uses the average net efficiencies of power plants in those regions adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1	1
	LocalName	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk
	Synonyms							
	GeneralComment	The average allocated net electrical efficiency is about 48.3 %. The electricity generation of this technology in the region is at about 1400 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 37.9 %. The electricity generation of this technology in the region is at about 100 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 37.9 %. The electricity generation of this technology in the region is at about 200 TWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.7 %. The electricity generation of this technology in the region is at about 4500 TWh based on IEA.	The average allocated net electrical efficiency is about 31.3 %. The electricity generation of this technology in the region is at about 1900 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 39.3 %. The electricity generation of this technology in the region is at about 53000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.6 %. The electricity generation of this technology in the region is at about 12000 GWh based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula							
	StatisticalClassification							
	CASNumber							
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1
	OtherPeriodText							
Geography	Text	AT in 2019	BE in 2019	ENTSO-E in 2019	CN in 2019	CZ in 2019	DE in 2019	ES in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100	100
	ProductionVolume	1400 GWh	100 GWh	200 TWh	4500 TWh	1900 GWh	53000 GWh	12000 GWh
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0
	CompanyCode							
	CountryCode							
	PageNumbers							
ProofReading	Validator	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails							

ReferenceFunction	Name	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant
Geography	Location	FR	HR	IT	IN	NL	PL
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0
ReferenceFunctio	Unit	kWh	kWh	kWh	kWh	kWh	kWh
DataSetInformatic	Type	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1
	IncludedProcesses	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1
	LocalName	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk
	Synonyms						
	GeneralComment	The average allocated net electrical efficiency is about 32.3 %. The electricity generation of this technology in the region is at about 3400 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 37.8 %. The electricity generation of this technology in the region is at about 1500 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.6 %. The electricity generation of this technology in the region is at about 18000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 33.9 %. The electricity generation of this technology in the region is at about 1100 TWh based on IEA.	The average allocated net electrical efficiency is about 42.4 %. The electricity generation of this technology in the region is at about 17000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 37.2 %. The electricity generation of this technology in the region is at about 69000 GWh based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula						
	StatisticalClassification						
	CASNumber						
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1
	OtherPeriodText						
Geography	Text	FR in 2019	HR in 2019	IT in 2019	IN in 2019	NL in 2019	PL in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100
	ProductionVolume	3400 GWh	1500 GWh	18000 GWh	1100 TWh	17000 GWh	69000 GWh
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0
	CompanyCode						
	CountryCode						
	PageNumbers						
ProofReading	Validator	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails						

ReferenceFunction	Name	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant	electricity, hard coal, at power plant
Geography	Location	PT	RU	SK	UCTE	US	ENTSO-E
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0
ReferenceFunctio	Unit	kWh	kWh	kWh	kWh	kWh	kWh
DataSetInformatic	Type	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1
	IncludedProcesses	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset is composed of the electricity generation in covered sub-regions and thus uses the average net efficiencies of power plants in those regions adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset is composed of the electricity generation in covered sub-regions and thus uses the average net efficiencies of power plants in those regions adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1
	LocalName	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk	Strom, ab Steinkohlekraftwerk
	Synonyms		0				
	GeneralComment	The average allocated net electrical efficiency is about 36.7 %. The electricity generation of this technology in the region is at about 5300 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.5 %. The electricity generation of this technology in the region is at about 97 TWh based on IEA.	The average allocated net electrical efficiency is about 38.6 %. The electricity generation of this technology in the region is at about 800 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 37.9 %. The electricity generation of this technology in the region is at about 200 TWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.5 %. The electricity generation of this technology in the region is at about 950 TWh based on IEA.	The average allocated net electrical efficiency is about 37.9 %. The electricity generation of this technology in the region is at about 200 TWh based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula						
	StatisticalClassification						
	CASNumber						
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1
	OtherPeriodText						
Geography	Text	PT in 2019	RU in 2019	SK in 2019	ENTSO-E in 2019	US in 2019	ENTSO-E in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100
	ProductionVolume	5300 GWh	97 TWh	800 GWh	200 TWh	950 TWh	200 TWh
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0
	CompanyCode						
	CountryCode						
	PageNumbers						
ProofReading	Validator	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails						

ANNEX LCI: ELECTRICITY GENERATION FROM LIGNITE AND PEAT

Tab. 5.11: Life Cycle Inventory models for electricity generation from lignite and peat (all values updated).

	Name	Location	InfrastructureProcess	Unit	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, peat, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				BA	RS	CZ	DE	GR	HU	MK	PL	SI	SK	ENTSO-E	CENTREL	UCTE	ENTSO-E			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Unit				kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh			
product	electricity, lignite, at power plant	BA	0	kWh	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	RS	0	kWh	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	CZ	0	kWh	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	DE	0	kWh	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	GR	0	kWh	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	HU	0	kWh	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	MK	0	kWh	0	0	0	0	0	0	1	0	0	0	0	0	0	0			
	electricity, lignite, at power plant	PL	0	kWh	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
	electricity, lignite, at power plant	SI	0	kWh	0	0	0	0	0	0	0	0	1	0	0	0	0	0			
	electricity, lignite, at power plant	SK	0	kWh	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
	electricity, peat, at power plant	ENTSO-E	0	kWh	0	0	0	0	0	0	0	0	0	0	1	0	0	0			
	electricity, lignite, at power plant	CENTREL	0	kWh	0	0	0	0	0	0	0	0	0	0	0	1	0	0			
	electricity, lignite, at power plant	UCTE	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
	electricity, lignite, at power plant	ENTSO-E	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
technosphere	lignite, burned in power plant	BA	0	MJ	12.72	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	RS	0	MJ	0	11.54	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	CZ	0	MJ	0	0	10.24	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	DE	0	MJ	0	0	0	9.9	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	GR	0	MJ	0	0	0	0	11.59	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	HU	0	MJ	0	0	0	0	0	11.2	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	MK	0	MJ	0	0	0	0	0	0	11.3	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	PL	0	MJ	0	0	0	0	0	0	0	10.19	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	SI	0	MJ	0	0	0	0	0	0	0	0	9.36	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	0	12.42	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	peat, burned in power plant	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	0	8.98	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	DE	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	6.35E-2	4.29E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	GR	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	1.46E-1	9.85E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	BA	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	6.76E-1	4.56E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	MK	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	6.97E-2	4.70E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	SI	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	2.13E-2	1.44E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	RS	0	kWh	0	0	0	0	0	0	0	0	0	0	0	0	2.37E-2	1.60E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	CZ	0	kWh	0	0	0	0	0	0	0	0	0	0	0	4.24E-1	0	1.38E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	HU	0	kWh	0	0	0	0	0	0	0	0	0	0	0	4.74E-2	0	1.54E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	PL	0	kWh	0	0	0	0	0	0	0	0	0	0	0	5.12E-1	0	1.66E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	electricity, lignite, at power plant	SK	0	kWh	0	0	0	0	0	0	0	0	0	0	0	1.70E-2	0	5.54E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate

Tab. 5.12: Meta information of the Life Cycle Inventory models for electricity generation from lignite and peat.

ReferenceFunction	Name	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, peat, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant	electricity, lignite, at power plant
Geography	Location	BA	RS	CZ	DE	GR	HU	MK	PL	SI	SK	ENTSO-E	CENTREL	UCTE	ENTSO-E
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
DataSetInformatio	Type	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Electricity output at busbar. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Torfkraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk	Strom, ab Braunkohlekraftwerk
	Synonyms														
	GeneralComment	The average allocated net electrical efficiency is about 28.3 %. The electricity generation of this technology in the region is at about 9900 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 31.2 %. The electricity generation of this technology in the region is at about 23000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.2 %. The electricity generation of this technology in the region is at about 32000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 36.4 %. The electricity generation of this technology in the region is at about 110 TWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 31.1 %. The electricity generation of this technology in the region is at about 11000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 32.1 %. The electricity generation of this technology in the region is at about 3600 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 31.9 %. The electricity generation of this technology in the region is at about 3300 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 35.3 %. The electricity generation of this technology in the region is at about 38000 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 38.5 %. The electricity generation of this technology in the region is at about 3700 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 29 %. The electricity generation of this technology in the region is at about 1300 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 40.1 %. The electricity generation of this technology in the region is at about 4900 GWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 33.7 %. The electricity generation of this technology in the region is at about 260 TWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 33.7 %. The electricity generation of this technology in the region is at about 260 TWh based on Eurostat/IEA.	The average allocated net electrical efficiency is about 33.7 %. The electricity generation of this technology in the region is at about 260 TWh based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Category	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula														
	StatisticalClassification														
	CASNumber														
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText														
Geography	Text	BA in 2019	RS in 2019	CZ in 2019	DE in 2019	GR in 2019	HU in 2019	MK in 2019	PL in 2019	SI in 2019	SK in 2019	ENTSO-E in 2019	ENTSO-E in 2019	ENTSO-E in 2019	ENTSO-E in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	ProductionVolume	9900 GWh	23000 GWh	32000 GWh	110 TWh	11000 GWh	3600 GWh	3300 GWh	38000 GWh	3700 GWh	1300 GWh	4900 GWh	260 TWh	260 TWh	260 TWh
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode														
	CountryCode														
	PageNumbers														
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails														

ANNEX LCI: HEAT COGENERATION FROM HARD COAL

Tab. 5.13: Life Cycle Inventory models for heat cogeneration from hard coal (all values updated).

	Name	Location	InfrastructureProcess	Unit	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				AT	BE	CN	CZ	DE	ES	FR	IT	NL	PL	RU	SK	US	ENTSO-E			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Unit				MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ			
	heat, hard coal, at cogen, allocation exergy	AT	0	MJ	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	BE	0	MJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	CN	0	MJ	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	CZ	0	MJ	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	DE	0	MJ	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	ES	0	MJ	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	FR	0	MJ	0	0	0	0	0	0	1	0	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	IT	0	MJ	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	NL	0	MJ	0	0	0	0	0	0	0	0	1	0	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	PL	0	MJ	0	0	0	0	0	0	0	0	0	1	0	0	0	0			
	heat, hard coal, at cogen, allocation exergy	RU	0	MJ	0	0	0	0	0	0	0	0	0	0	1	0	0	0			
	heat, hard coal, at cogen, allocation exergy	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	0	1	0	0			
	heat, hard coal, at cogen, allocation exergy	US	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
	heat, hard coal, at cogen, allocation exergy	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
technosphere	hard coal, burned in power plant	AT	0	MJ	0.88	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	BE	0	MJ	0	0.83	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	CN	0	MJ	0	0	0.96	0	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	CZ	0	MJ	0	0	0	1.06	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	DE	0	MJ	0	0	0	0	0.77	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	ES	0	MJ	0	0	0	0	0	0.83	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	FR	0	MJ	0	0	0	0	0	0	0.97	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	IT	0	MJ	0	0	0	0	0	0	0	0.84	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	NL	0	MJ	0	0	0	0	0	0	0	0	0.73	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	PL	0	MJ	0	0	0	0	0	0	0	0	0	0.86	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	RU	0	MJ	0	0	0	0	0	0	0	0	0	0	0.97	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0.91	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	hard coal, burned in power plant	US	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0.96	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	AT	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1.91E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	CZ	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	7.19E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	DE	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	3.13E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	FR	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	7.27E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	IT	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	7.73E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	NL	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	9.65E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	PL	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	5.59E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	heat, hard coal, at cogen, allocation exergy	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	1.18E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate

Tab. 5.14: Meta information of the Life Cycle Inventory models for heat cogeneration from hard coal.

ReferenceFunction	Name	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy	heat, hard coal, at cogen, allocation exergy
Geography	Location	AT	BE	CN	CZ	DE	ES	FR	IT	NL	PL	RU	SK	US	ENTSO-E
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ
DataSetInformatic	Type	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the ENTSO-E region adjusted for co-generation (using allocation based on exergy content) since data for the specific region was not plausible.	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the ENTSO-E region adjusted for co-generation (using allocation based on exergy content) since data for the specific region was not plausible.	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie	Nutzwärme, Steinkohle, ab BHKW, Allokation Exergie
	Synonyms											0			
	GeneralComment	The average allocated fuel input per heat output is about 0.88 MJ/MJ. The heat supply of this technology in the region is at about 3900 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about NA MJ/MJ. The amount of heat supply of this technology in the region is unknown.	The average allocated fuel input per heat output is about 0.96 MJ/MJ. The heat supply of this technology in the region is at about 4200 PJ based on IEA.	The average allocated fuel input per heat output is about 1.06 MJ/MJ. The heat supply of this technology in the region is at about 15000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.77 MJ/MJ. The heat supply of this technology in the region is at about 65000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about NA MJ/MJ. The amount of heat supply of this technology in the region is unknown.	The average allocated fuel input per heat output is about 0.97 MJ/MJ. The heat supply of this technology in the region is at about 1500 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.84 MJ/MJ. The heat supply of this technology in the region is at about 1600 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.73 MJ/MJ. The heat supply of this technology in the region is at about 2000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.86 MJ/MJ. The heat supply of this technology in the region is at about 120 PJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.91 MJ/MJ. The heat supply of this technology in the region is at about 2400 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.96 MJ/MJ. The heat supply of this technology in the region is at about 26000 TJ based on IEA.	The average allocated fuel input per heat output is about 0.97 MJ/MJ. The heat supply of this technology in the region is at about 260 PJ based on IEA.	The average allocated fuel input per heat output is about 0.83 MJ/MJ. The heat supply of this technology in the region is at about 240 PJ based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Category	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal	hard coal
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle	Steinkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula														
	StatisticalClassification														
	CASNumber														
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText														
Geography	Text	AT in 2019	BE in 2019	CN in 2019	CZ in 2019	DE in 2019	ES in 2019	FR in 2019	IT in 2019	NL in 2019	PL in 2019	SK in 2019	US in 2019	RU in 2019	ENTSO-E in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	ProductionVolume	3900 TJ	unknown	4200 PJ	15000 TJ	65000 TJ	unknown	1500 TJ	1600 TJ	2000 TJ	120 PJ	2400 TJ	26000 TJ	260 PJ	240 PJ
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode														
	CountryCode														
	PageNumbers														
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails														

ANNEX LCI: HEAT COGENERATION FROM LIGNITE AND PEAT

Tab. 5.15: Life Cycle Inventory models for heat cogeneration from lignite and peat (all values updated).

	Name	Location	InfrastructureProcess	Unit	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	Heat, peat, at cogen, allocation exergy	Heat, lignite, at cogen, allocation exergy	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				BA	CZ	DE	GR	HU	PL	RS	SI	SK	ENTSO-E	ENTSO-E			
	InfrastructureProcess				0	0	0	0	0	0	0	0	0	0	0			
	Unit				MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ			
product	Heat, lignite, at cogen, allocation exergy	BA	0	MJ	1	0	0	0	0	0	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	CZ	0	MJ	0	1	0	0	0	0	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	DE	0	MJ	0	0	1	0	0	0	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	GR	0	MJ	0	0	0	1	0	0	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	HU	0	MJ	0	0	0	0	1	0	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	PL	0	MJ	0	0	0	0	0	1	0	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	RS	0	MJ	0	0	0	0	0	0	1	0	0	0	0			
	Heat, lignite, at cogen, allocation exergy	SI	0	MJ	0	0	0	0	0	0	0	1	0	0	0			
	Heat, lignite, at cogen, allocation exergy	SK	0	MJ	0	0	0	0	0	0	0	0	1	0	0			
	Heat, peat, at cogen, allocation exergy	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	1	0			
	Heat, lignite, at cogen, allocation exergy	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	0	1			
technosphere	lignite, burned in power plant	BA	0	MJ	0.93	0	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	CZ	0	MJ	0	0.95	0	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	DE	0	MJ	0	0	0.78	0	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	GR	0	MJ	0	0	0	1.04	0	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	HU	0	MJ	0	0	0	0	1.04	0	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	PL	0	MJ	0	0	0	0	0	0.9	0	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	RS	0	MJ	0	0	0	0	0	0	1.03	0	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	SI	0	MJ	0	0	0	0	0	0	0	1.19	0	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	lignite, burned in power plant	SK	0	MJ	0	0	0	0	0	0	0	0	1.1	0	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	peat, burned in power plant	ENTSO-E	0	MJ	0	0	0	0	0	0	0	0	0	0.77	0	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	BA	0	MJ	0	0	0	0	0	0	0	0	0	0	1.75E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	RS	0	MJ	0	0	0	0	0	0	0	0	0	0	3.79E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	CZ	0	MJ	0	0	0	0	0	0	0	0	0	0	5.42E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	DE	0	MJ	0	0	0	0	0	0	0	0	0	0	2.48E-1	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	GR	0	MJ	0	0	0	0	0	0	0	0	0	0	2.85E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	HU	0	MJ	0	0	0	0	0	0	0	0	0	0	6.30E-3	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	PL	0	MJ	0	0	0	0	0	0	0	0	0	0	3.96E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	SI	0	MJ	0	0	0	0	0	0	0	0	0	0	1.69E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate
	Heat, lignite, at cogen, allocation exergy	SK	0	MJ	0	0	0	0	0	0	0	0	0	0	6.39E-2	1	1.05	(1,1,1,1,1,1,BU:1.05)calculated from IEA Extended World Energy Balances for 2019; uncertainty own estimate

Tab. 5.16: Meta information of the Life Cycle Inventory models for heat cogeneration from lignite and peat.

ReferenceFunction	Name	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy	heat, peat, at cogen, allocation exergy	heat, lignite, at cogen, allocation exergy
Geography	Location	BA	CZ	DE	GR	HU	PL	RS	SI	SK	ENTSO-E	ENTSO-E
ReferenceFunctio	InfrastructureProcess	0	0	0	0	0	0	0	0	0	0	0
ReferenceFunctio	Unit	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ	MJ
DataSetInformatic	Type	1	1	1	1	1	1	1	1	1	1	1
	Version	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	energyValues	0	0	0	0	0	0	0	0	0	0	0
	LanguageCode	en	en	en	en	en	en	en	en	en	en	en
	LocalLanguageCode	de	de	de	de	de	de	de	de	de	de	de
DataEntryBy	Person	50	50	50	50	50	50	50	50	50	50	50
	QualityNetwork	1	1	1	1	1	1	1	1	1	1	1
ReferenceFunctio	DataSetRelatesToProduct	1	1	1	1	1	1	1	1	1	1	1
	IncludedProcesses	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).	Heat output at the plant gate. The dataset uses the average net efficiency of power plants in the region adjusted for co-generation (using allocation based on exergy content).
	Amount	1	1	1	1	1	1	1	1	1	1	1
	LocalName	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie	Nutzwärme, Torf, ab BHKW, Allokation Exergie	Nutzwärme, Braunkohle, ab BHKW, Allokation Exergie
	Synonyms											
	GeneralComment	The average allocated fuel input per heat output is about 0.93 MJ/MJ. The heat supply of this technology in the region is at about 1400 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 1.03 MJ/MJ. The heat supply of this technology in the region is at about 3000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.95 MJ/MJ. The heat supply of this technology in the region is at about 43000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.78 MJ/MJ. The heat supply of this technology in the region is at about 20000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 1.04 MJ/MJ. The heat supply of this technology in the region is at about 2300 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 1.04 MJ/MJ. The heat supply of this technology in the region is at about 500 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.9 MJ/MJ. The heat supply of this technology in the region is at about 3200 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 1.19 MJ/MJ. The heat supply of this technology in the region is at about 1400 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 1.1 MJ/MJ. The heat supply of this technology in the region is at about 5100 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.77 MJ/MJ. The heat supply of this technology in the region is at about 17000 TJ based on Eurostat/IEA.	The average allocated fuel input per heat output is about 0.92 MJ/MJ. The heat supply of this technology in the region is at about 93000 TJ based on Eurostat/IEA.
	InfrastructureIncluded	1	1	1	1	1	1	1	1	1	1	1
	Category	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite	lignite
	SubCategory	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants	power plants
	LocalCategory	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle	Braunkohle
	LocalSubCategory	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke	Kraftwerke
	Formula											
	StatisticalClassification											
	CASNumber											
TimePeriod	StartDate	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
	EndDate	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
	DataValidForEntirePeriod	1	1	1	1	1	1	1	1	1	1	1
	OtherPeriodText											
Geography	Text	BA in 2019	RS in 2019	CZ in 2019	DE in 2019	GR in 2019	HU in 2019	PL in 2019	SI in 2019	SK in 2019	ENTSO-E in 2019	ENTSO-E in 2019
Technology	Text	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.	Average installed technology.
Representativene	Percent	100	100	100	100	100	100	100	100	100	100	100
	ProductionVolume	1400 TJ	3000 TJ	43000 TJ	20000 TJ	2300 TJ	500 TJ	3200 TJ	1400 TJ	5100 TJ	17000 TJ	93000 TJ
	SamplingProcedure	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.	Databases/ literature data based on regional statistics.
	Extrapolations	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.	No relevant extrapolations.
	UncertaintyAdjustments	none	none	none	none	none	none	none	none	none	none	none
DataGeneratorAn	Person	51	51	51	51	51	51	51	51	51	51	51
	DataPublishedIn	2	2	2	2	2	2	2	2	2	2	2
	ReferenceToPublishedSource	41	41	41	41	41	41	41	41	41	41	41
	Copyright	1	1	1	1	1	1	1	1	1	1	1
	AccessRestrictedTo	0	0	0	0	0	0	0	0	0	0	0
	CompanyCode											
	CountryCode											
	PageNumbers											
ProofReading	Validator	54	54	54	54	54	54	54	54	54	54	54
	Details	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023	27.07.2023
	OtherDetails											

Annex Replacement File

Tab. 5.17: List of obsolete datasets and their replacements (digital version in the excel file "ecoinvent-names-v2.0-ZHAW-v1.xlsx", tab "replacements".

Replacements

	760	200	200	497	498	401	662	495	496	493	403	601	602
	companyCode	IndexNumber	LocalName	LocalCatego	LocalSubC	Name	Location	Category	SubCategory	structure-Proc	unit	StartDate	EndDate
~~From~~	~~PSI~~	~~34091~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~ERCOT~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34092~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~FRCC~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34093~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~MRO~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34094~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~NPCC~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34095~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~RFC~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34096~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~SERC~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34097~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~SPP~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
	~~PSI~~	~~34098~~	~~Steinkohle, in Kraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in power plant~~	~~WECC~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~2004~~	~~2004~~
To	ZHAW	Z-03-016	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	US	hard coal	power plants	0	MJ	2018	2020
~~From~~	~~PSI~~	~~34083~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~ERCOT~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34084~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~FRCC~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34085~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~MRO~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34086~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~NPCC~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34087~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~RFC~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34088~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~SERC~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34089~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~SPP~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
	~~PSI~~	~~34090~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~WECC~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2004~~	~~2004~~
To	ZHAW	Z-04-020	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	US	hard coal	power plants	0	kWh	2018	2020
~~From~~	~~PSI~~	~~34119~~	~~Steinkohle, in Kohlebergwerk - K~~	~~Steinkohle~~	~~Kraftwerke~~	~~hard coal, burned in coal mine po~~	~~CN~~	~~hard coal~~	~~power plants~~	~~0~~	~~MJ~~	~~1999~~	~~2002~~
To	ZHAW	Z-03-003	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	CN	hard coal	power plants	0	MJ	2018	2020
~~From~~	~~PSI~~	~~34117~~	~~Strom, ab Kohlebergwerk - Stein~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at coal mine~~	~~CN~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
To	ZHAW	Z-04-005	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	CN	hard coal	power plants	0	kWh	2018	2020
~~From~~	~~ZHAW~~	~~Z-04-019~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~UCTE~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
	~~ZHAW~~	~~Z-04-004~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~CENTREL~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
	~~PSI~~	~~2122~~	~~Strom, ab Steinkohlekraftwerk~~	~~Steinkohle~~	~~Kraftwerke~~	~~electricity, hard coal, at power pla~~	~~NORDEL~~	~~hard coal~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
To	ZHAW	Z-04-021	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	ENTSO-E	hard coal	power plants	0	kWh	2018	2020
~~From~~	~~PSI~~	~~5363~~	~~Torf, in Kraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~peat, burned in power plant~~	~~NORDEL~~	~~lignite~~	~~power plants~~	~~0~~	~~MJ~~	~~2000~~	~~2000~~
To	ZHAW	Z-05-011	Torf, in Kraftwerk	Braunkohle	Kraftwerke	peat, burned in power plant	ENTSO-E	lignite	power plants	0	MJ	2018	2020
~~From~~	~~PSI~~	~~5362~~	~~Strom, ab Torfkraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~electricity, peat, at power plant~~	~~NORDEL~~	~~lignite~~	~~power plants~~	~~0~~	~~kWh~~	~~2000~~	~~2000~~
To	ZHAW	Z-06-011	Strom, ab Torfkraftwerk	Braunkohle	Kraftwerke	electricity, peat, at power plant	ENTSO-E	lignite	power plants	0	kWh	2018	2020
~~From~~	~~PSI~~	~~2491~~	~~Braunkohle, in Kraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~lignite, burned in power plant~~	~~CS~~	~~lignite~~	~~power plants~~	~~0~~	~~MJ~~	~~2000~~	~~2000~~
To	ZHAW	Z-05-002	Braunkohle, in Kraftwerk	Braunkohle	Kraftwerke	lignite, burned in power plant	RS	lignite	power plants	0	MJ	2018	2020
From	~~PSI~~	~~2138~~	~~Strom, ab Braunkohlekraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~electricity, lignite, at power plant~~	~~CS~~	~~lignite~~	~~power plants~~	~~0~~	~~kWh~~	~~2000~~	~~2000~~
To	ZHAW	Z-06-002	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	RS	lignite	power plants	0	kWh	2018	2020
~~From~~	~~ZHAW~~	~~Z-06-012~~	~~Strom, ab Braunkohlekraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~electricity, lignite, at power plant~~	~~CENTREL~~	~~lignite~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
	~~ZHAW~~	~~Z-06-013~~	~~Strom, ab Braunkohlekraftwerk~~	~~Braunkohle~~	~~Kraftwerke~~	~~electricity, lignite, at power plant~~	~~UCTE~~	~~lignite~~	~~power plants~~	~~0~~	~~kWh~~	~~2018~~	~~2020~~
To	ZHAW	Z-06-014	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	ENTSO-E	lignite	power plants	0	kWh	2018	2020

ANNEX LIST OF OBSOLETE DATASETS

Tab. 5.18: List of obsolete datasets (digital version in the excel file "ecoinvent-names-v2.0-ZHAW-v1.xlsx", tab "replacements".

Obsolete datasets

	PSI	2429	Steinkohle, ab Bergwerk	Steinkohle	Bereitstellur	hard coal, at mine	WEU	hard coal	production	0	kg	2000	2000
	PSI	5366	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	NORDEL	hard coal	power plants	0	MJ	2000	2000
	PSI	34119	Steinkohle, in Kohlebergwerk - K	Steinkohle	Kraftwerke	hard coal, burned in coal mine pov	CN	hard coal	power plants	0	MJ	1999	2002
	PSI	34091	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	ERCOT	hard coal	power plants	0	MJ	2004	2004
	PSI	34092	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	FRCC	hard coal	power plants	0	MJ	2004	2004
	PSI	34093	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	MRO	hard coal	power plants	0	MJ	2004	2004
	PSI	34094	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	NPCC	hard coal	power plants	0	MJ	2004	2004
	PSI	34095	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	RFC	hard coal	power plants	0	MJ	2004	2004
	PSI	34096	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	SERC	hard coal	power plants	0	MJ	2004	2004
	PSI	34097	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	SPP	hard coal	power plants	0	MJ	2004	2004
	PSI	34098	Steinkohle, in Kraftwerk	Steinkohle	Kraftwerke	hard coal, burned in power plant	WECC	hard coal	power plants	0	MJ	2004	2004
	ZHAW	Z-04-019	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	UCTE	hard coal	power plants	0	kWh	2018	2020
	ZHAW	Z-04-004	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	CENTREL	hard coal	power plants	0	kWh	2018	2020
	PSI	2122	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	NORDEL	hard coal	power plants	0	kWh	2018	2020
	PSI	34117	Strom, ab Kohlebergwerk - Steinl	Steinkohle	Kraftwerke	electricity, hard coal, at coal mine	CN	hard coal	power plants	0	kWh	2018	2020
	PSI	34083	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	ERCOT	hard coal	power plants	0	kWh	2004	2004
	PSI	34084	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	FRCC	hard coal	power plants	0	kWh	2004	2004
	PSI	34085	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	MRO	hard coal	power plants	0	kWh	2004	2004
	PSI	34086	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	NPCC	hard coal	power plants	0	kWh	2004	2004
	PSI	34087	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	RFC	hard coal	power plants	0	kWh	2004	2004
	PSI	34088	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	SERC	hard coal	power plants	0	kWh	2004	2004
	PSI	34089	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	SPP	hard coal	power plants	0	kWh	2004	2004
	PSI	34090	Strom, ab Steinkohlekraftwerk	Steinkohle	Kraftwerke	electricity, hard coal, at power pla	WECC	hard coal	power plants	0	kWh	2004	2004
	PSI	2488	Braunkohle, in Kraftwerk	Braunkohle	Kraftwerke	lignite, burned in power plant	AT	lignite	power plants	0	MJ	2000	2000
	PSI	2491	Braunkohle, in Kraftwerk	Braunkohle	Kraftwerke	lignite, burned in power plant	CS	lignite	power plants	0	MJ	2000	2000
	PSI	2490	Braunkohle, in Kraftwerk	Braunkohle	Kraftwerke	lignite, burned in power plant	ES	lignite	power plants	0	MJ	2000	2000
	PSI	2492	Braunkohle, in Kraftwerk	Braunkohle	Kraftwerke	lignite, burned in power plant	FR	lignite	power plants	0	MJ	2000	2000
	PSI	5363	Torf, in Kraftwerk	Braunkohle	Kraftwerke	peat, burned in power plant	NORDEL	lignite	power plants	0	MJ	2000	2000
	PSI	2136	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	AT	lignite	power plants	0	kWh	2000	2000
	PSI	2138	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	CS	lignite	power plants	0	kWh	2000	2000
	PSI	2137	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	ES	lignite	power plants	0	kWh	2000	2000
	PSI	2139	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	FR	lignite	power plants	0	kWh	2000	2000
	ZHAW	Z-06-012	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	CENTREL	lignite	power plants	0	kWh	2018	2020
	ZHAW	Z-06-013	Strom, ab Braunkohlekraftwerk	Braunkohle	Kraftwerke	electricity, lignite, at power plant	UCTE	lignite	power plants	0	kWh	2018	2020
	PSI	5362	Strom, ab Torfkraftwerk	Braunkohle	Kraftwerke	electricity, peat, at power plant	NORDEL	lignite	power plants	0	kWh	2000	2000

ANNEX: FULL REPORT OF COAL SUPPLY FROM 2007