

Life cycle inventories of electricity mixes

Report

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Commissioned by

CarbonMinds

Imprint

Citation	Maresa Bussa; Angelo Stefanel; Niels Jungbluth (2025) Life cycle inventories of electricity mixes. ESU-services Ltd. commissioned by ecoinvent, Schaffhausen, Switzerland, https://esu-services.ch/data/public-lci-reports/
Validation	
Contractor	ESU-services Ltd., fair consulting in sustainability Vorstadt 10, CH-8200 Schaffhausen www.esu-services.ch Phone 0041 44 940 61 32 info@esu-services.ch
Financing	This report was financed by CarbonMinds.
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Version	21.05.25 09:37 https://esuserVICES-my.sharepoint.com/personal/jungbluth_esu-services_ch/Documents/ESU-intern/772 CarbonMinds LCI data/Bericht/bussa-2025-LCI for electricity mixes-v1.0.docx

Abstract

This study aims to develop a flexible and easily updatable model for electricity mixes, integrating various data sources to create comprehensive background databases. The model focuses on market mix composition for 120 countries and 10 regions, providing mixes at high, medium, and low voltage levels while adhering to the ecoinvent v3 structure. The research evaluates multiple data sources for modelling electricity mixes:

- ENTSO-E: Offers detailed energy source breakdowns for European countries, including generation and trade flows.
- EUROSTAT: Provides generation data with clearer category definitions but less detail than ENTSO-E.
- Energy Institute: Covers generation data of selected countries but lacks import breakdowns and detailed categorization.
- U.S. EIA: Offers global coverage but with limited import breakdowns and energy source categorization.
- United Nations: Provides trade flow data for all countries.

The model prioritizes EUROSTAT and ENTSO-E data for their comprehensive information, followed by the Energy Institute and EIA data for remaining countries. This approach ensures adaptability, extensibility, and the ability to incorporate new statistical data promptly, allowing for country-specific modifications and the inclusion of additional countries as needed.

Contents

IMPRINT	III
ABSTRACT	IV
CONTENTS	V
ABBREVIATIONS	VI
1 INTRODUCTION	11
2 DATA SOURCES FOR INDIVIDUAL COUNTRIES AND REGIONS	11
2.1 Countries modelled with ENTSO and EUROSTAT data	11
2.2 Countries modelled with EI data	13
2.3 Countries modelled with EIA data	15
2.4 Regions	15
3 MATCHING OF STATISTICAL CATEGORIES AND TECHNOLOGY FACTORS	18
4 LIFE CYCLE INVENTORY OF HIGH VOLTAGE MIXES	21
5 LIFE CYCLE INVENTORY OF MEDIUM VOLTAGE MIXES	22
6 LIFE CYCLE INVENTORY OF LOW VOLTAGE MIXES	23
7 OUTLOOK	24
8 REFERENCES	25

Abbreviations

AE	United Arab Emirates
AF	Afghanistan
AL	Albania
AM	Armenia
AN	Netherlands Antilles
AO	Angola
AR	Argentina
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BD	Bangladesh
BE	Belgium
BG	Bulgaria
BH	Bahrain
BN	Brunei
BO	Bolivia
BR	Brazil
BY	Belarus
CA	Canada
CA-AB	Canada-Alberta
CA-BC	Canada-British Columbia
CA-MB	Canada-Manitoba
CA-NB	Canada-New Brunswick
CA-NF	Canada-Newfoundland and Labrador
CA-NS	Canada-Nova Scotia
CA-NT	Canada-Northwest Territories
CA-NU	Canada-Nunavut
CA-ON	Canada-Ontario
CA-PE	Canada-Prince Edward Island
CA-QC	Canada-Quebec
CA-SK	Canada-Saskatchewan
CA-YK	Canada-Yukon
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CL	Chile
CM	Cameroon
CN	China
CN-AH	China-Anhui
CN-BJ	China-Beijing
CN-CCG	China-Central China Grid
CN-CQ	China-Chongqing
CN-CSG	China-China Southern Power Grid
CN-ECGC	China-East China Grid Company
CN-FJ	China-Fujian
CN-GD	China-Guangdong
CN-GS	China-Gansu
CN-GX	China-Guangxi

Abbreviations

CN-GZ	China-Guizhou
CN-HA	China-Henan
CN-HB	China-Hubei
CN-HE	China-Hebei
CN-HL	China-Heilongjiang
CN-HN	China-Hunan
CN-HU	China-Hubei
CN-JL	China-Jilin
CN-JS	China-Jiangsu
CN-JX	China-Jiangxi
CN-NCGC	China-North China Grid Company
CN-NECG	China-Northeast China Grid
CN-NM	China-Inner Mongolia
CN-NWG	China-Northwest Grid
CN-NX	China-Ningxia
CN-QH	China-Qinghai
CN-SA	China-Shaanxi
CN-SC	China-Sichuan
CN-SD	China-Shandong
CN-SH	China-Shanghai
CN-SWG	China-Southwest Grid
CN-SX	China-Shanxi
CN-TJ	China-Tianjin
CN-XJ	China-Xinjiang
CN-XZ	China-Tibet
CN-YN	China-Yunnan
CN-ZJ	China-Zhejiang
CO	Colombia
CR	Costa Rica
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
DO	Dominican Republic
DZ	Algeria
EC	Ecuador
EG	Egypt
EI	Energy Institute
EIA	U.S. Energy Information Administration
EMEA	Europe, Middle East, Africa
ENTSO	European Network of Transmission System Operators
ENTSO-E	European Network of Transmission System Operators for Electricity
ES	Spain
EU-27	EU-27 Member States
EUROSTAT	European Statistical Office
FI	Finland
FR	France
GA	Gabon
GB	Great Britain
GE	Georgia
GH	Ghana
GLO	Global
GQ	Equatorial Guinea

Abbreviations

GR	Greece
GT	Guatemala
HR	Croatia
HU	Hungary
ID	Indonesia
IE	Ireland
IL	Israel
IN	India
IN-AP	India-Andhra Pradesh
IN-AR	India-Arunachal Pradesh
IN-AS	India-Assam
IN-BR	India-Bihar
IN-CT	India-Chhattisgarh
IN-DL	India-Delhi
IN-DN	India-Dadra and Nagar Haveli
IN-GA	India-Goa
IN-GJ	India-Gujarat
IN-HP	India-Himachal Pradesh
IN-HR	India-Haryana
IN-JH	India-Jharkhand
IN-JK	India-Jammu and Kashmir
IN-KA	India-Karnataka
IN-KL	India-Kerala
IN-MH	India-Maharashtra
IN-ML	India-Meghalaya
IN-MN	India-Manipur
IN-MP	India-Madhya Pradesh
IN-MZ	India-Mizoram
IN-NL	India-Nagaland
IN-OR	India-Odisha
IN-PB	India-Punjab
IN-PY	India-Puducherry
IN-RJ	India-Rajasthan
IN-SK	India-Sikkim
IN-TN	India-Tamil Nadu
IN-TR	India-Tripura
IN-UP	India-Uttar Pradesh
IN-UT	India-Uttarakhand
IN-WB	India-West Bengal
IQ	Iraq
IR	Iran
IS	Iceland
IT	Italy
JM	Jamaica
JO	Jordan
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KH	Cambodia
KP	North Korea
KR	South Korea
KW	Kuwait
KZ	Kazakhstan

Abbreviations

LK	Sri Lanka
LT	Lithuania
LU	Luxembourg
LY	Libya
MA	Morocco
ME	Montenegro
MM	Myanmar
MX	Mexico
MY	Malaysia
NE	Niger
NG	Nigeria
NI	Nicaragua
NL	Netherlands
NO	Norway
NWE	Northwest Europe
NZ	New Zealand
OM	Oman
PE	Peru
PG	Papua New Guinea
PH	Philippines
PK	Pakistan
PL	Poland
PT	Portugal
PY	Paraguay
QA	Qatar
RLA	Latin America and the Caribbean
RNA	Northern America
RO	Romania
RoW	Rest-of-World
RS	Serbia
RU	Russia
SA	Saudi Arabia
SAPAC	South Asia Pacific
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SR	Suriname
SS	South Sudan
SY	Syria
TD	Chad
TH	Thailand
TJ	Tajikistan
TM	Turkmenistan
TN	Tunisia
TR	Turkey
TT	Trinidad and Tobago
TW	Taiwan
TZ	Tanzania
UA	Ukraine
UN	United Nations
UN-EASIA	Eastern Asia

Abbreviations

UN-WASIA	Western Asia
US	United States
US-ASCC	United States - Alaska Systems Coordinating Council
US-HICC	United States - Hawaii Coordinating Council
US-MRO	United States - Midwest Reliability Organization
US-NPCC	United States - Northeast Power Coordinating Council
US-RFC	United States - Reliability First Corporation
US-SERC	United States - Southeastern Electric Reliability Council
US-TRE	United States - Texas Reliability Entity
US-WECC	United States - Western Electricity Coordinating Council
UY	Uruguay
UZ	Uzbekistan
VE	Venezuela
VI	U.S. Virgin Islands
VN	Vietnam
YE	Yemen
ZM	Zambia

1 Introduction

The goal of this study is to develop a model for electricity mixes that facilitates easy updating and the integration of various data sources. Up-to-date electricity mixes are crucial in background databases due to their rapid evolution, significant influence on the environmental impacts of numerous processes, and the growing trend towards electrification across various sectors. This study focuses primarily on market mix composition, while infrastructure requirements and losses will not be updated. Additionally, individual electricity generation datasets will remain unchanged. The modelling approach will adhere to the structure of ecoinvent v3, providing mixes at high, medium, and low voltage levels for 120 country and 10 regions.

2 Data sources for individual countries and regions

To model electricity mixes at country level, several data sources are available, each with its own strengths and limitations.

ENTSO-E (2024) provides comprehensive data for the reference year 2023, covering generation and trade flows for most European countries. One of its key advantages is the detailed breakdown of energy sources. However, it is important to note that the definitions for some categories, such as "other" are not clearly specified.

EUROSTAT (2024) offers generation data for 2023, presenting a different set of characteristics. While its breakdown is less detailed than that of ENTSO-E, it compensates with clearer category definitions. The Energy Institute's dataset for 2023 focuses on generation data but is limited in scope. It covers only selected countries and lacks a country-level breakdown of imports. Furthermore, the categorization of energy sources is less detailed than that provided by ENTSO-E and EUROSTAT.

The Energy Institute (2024) provides generation data of selected countries but lacks import breakdowns and detailed categorization.

The U.S. Energy Information Administration (2025) provides generation data for 2023 with global coverage (for few countries the latest data are from 2021). However, similar to the Energy Institute, it does not offer a breakdown of imports at the country level and presents a less detailed categorization of energy sources.

The United Nations Comtrade (2025) database offers trade flow data for all countries, with reference years 2023.

Since the combination of EUROSTAT (2024) and ENTSO-E (2024) data gave the most detailed information, they were used whenever possible. The Energy Institute's data was considered the second best option, while all remaining countries were modelled with EIA data.

2.1 Countries modelled with ENTSO and EUROSTAT data

The exclusive use of ENTSO (2024) data is unsuitable due to the significant role of the "other" category in some countries' electricity profiles. Additionally, there is ambiguity regarding the classification of combined heat and power natural gas plants, with inconsistent handling observed across different countries. To address these limitations, a multi-source approach is adopted:

1. Main energy carrier production data is sourced from EUROSTAT (2024), which provides broader, more clearly defined categories.
2. These broader categories are then refined using relative shares from ENTSO (2024) data. For example, the distinction between lignite and hard coal is made using this method.

The modelling of electricity imports is based on ENTSO (2024) electricity trade data. These data refer to physical electricity flows and do not include guarantees of origins and are hence used without any adjustments. This approach is used for AT, BE, BA, BG, CZ, DK, FI, FR, DE, GR, HU, IE, IT, LT, LU, ME, NL, NO, PL, PT, RO, RS, SK, SI, ES and SE.

The ecoinvent database offers multiple dataset options for many refined categories, such as different sizes of wind power plants for electricity from wind. However, detailed information at this granular level is not unavailable. To overcome this, the relative breakdown within the ecoinvent 3.10 dataset (ecoinvent Centre 2023) was utilized to distribute the energy within the refined categories. This approach is exemplified in Fig. 2.1, which illustrates the methodology for modelling electricity generation from coal in Germany.

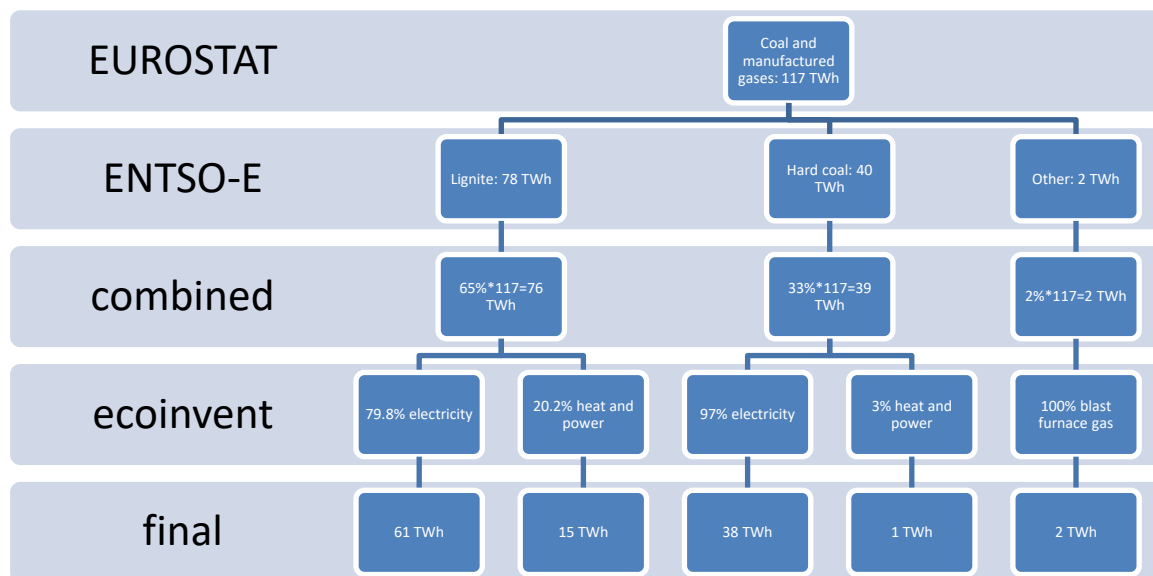


Fig. 2.1 Procedure for linking statistical data with generation datasets (exemplary for electricity generation from coal in Germany)

Tab. 2.1 provides an overview of the categories used by EUROSTAT (2024) and ENTSO-E (2024). In the case of Austria, the data was contradictory. According to ENTSO-E (2024), electricity was generated from photovoltaics, whereas no electricity from photovoltaics was listed in EUROSTAT (2024). However, a higher proportion of other fuels was reported. As other sources support the data from ENTO-E (2024), their value for electricity from photovoltaics is assumed.

Tab. 2.1 Matching of Eurostat (2024) and ENTSO-E (2024) categories

Eurostat	ENTSO-E
Coal and manufactured gases	Fossil Brown coal/Lignite
	Fossil Coal-derived gas
	Fossil Hard coal
	Fossil Peat
	Other
Combustible fuels - non-renewable	Waste
Combustible fuels - renewable	Biomass
Geothermal	Geothermal
Hydro	Hydro Pumped Storage
	Hydro Run-of-river and poundage
	Hydro Water Reservoir
Natural gas	Fossil Gas
Nuclear fuels and other fuels n.e.c.	Nuclear
Oil and petroleum products (excluding biofuel portion)	Fossil Oil
Other fuels n.e.c.	
Other renewable energies	Other renewable
Solar photovoltaic	Solar
Solar thermal	
Wind off shore	Wind Offshore
Wind on shore	Wind Onshore

2.2 Countries modelled with EI data

Data from the Energy Institute (2024) are used to model the electricity mixes of the following countries; AE, AR, AU, BR, CA, CN, EG, GB, ID, IN, IR, JP, KR, KZ, MX, MY, RU, SA, TH, TR, TW, UA, US and VN

The energy categories used by the Energy Institute (2024) do not align directly with the ecoinvent dataset structure. In most cases several datasets can be matched to the same category. To address this discrepancy, again the relative breakdown within the ecoinvent 3.10 dataset (ecoinvent Centre 2023) is utilized to distribute energy within categories.

Since the Energy Institute (2024) does not provide a detailed breakdown of trade flows, these are modelled based on UN data (United Nations Comtrade 2025). These data present challenges in terms of data quality, which varies depending on the reporting entity. Notably, corresponding import and export flows do not always match. In cases where both flows are provided, the average value was used to reconcile discrepancies. It is further important to note that UN data includes non-physical flows, such as guarantees of origin, which may not represent actual energy transfers. Hence, trade between non-neighbouring countries is excluded from the analysis to focus on physical flows.

Special attention was given to Brazil, Canada, China, India, and the United States, which are originally modelled with various subregions in ecoinvent and then combined into market groups at the country level. A significant challenge arises from the availability of electricity generation datasets specifically for individual subregions in ecoinvent, while EI and UN data are only available at the country level. To address this, the data on electricity generation from the Energy Institute is allocated to subregions based on their share in ecoinvent market groups, and corrected for trade between subregions. These datasets are then combined to a dataset on country-level, to which imports from neighbouring flows are added. This approach is complicated for CN and IN since generation datasets were available on more granular level than the subregions (see Tab. 2.2). Hence, the share of some technologies has to be distributed to several generation datasets from different regions. In these cases, the relative original contribution of each original dataset is kept.

The subregional electricity mixes are modelled as auxiliary datasets only, for further modelling the datasets at country level should be used.

Tab. 2.2 Correlation between countries, subregions of the electricity mixes and subregions of the generation datasets

Country	Subregions mix	Subregions generation
BR	BR-North-eastern grid	BR-North-eastern grid
	BR-Northern grid	BR-Northern grid
	BR-South-eastern/Mid-western grid	BR-South-eastern/Mid-western grid
	BR-Southern grid	BR-Southern grid
CA	CA-AB	CA-AB
	CA-BC	CA-BC
	CA-MB	CA-MB
	CA-NB	CA-NB
	CA-NF	CA-NF
	CA-NS	CA-NS
	CA-NT	CA-NT
	CA-NU	CA-NU
	CA-ON	CA-ON
	CA-PE	CA-PE
	CA-QC	CA-QC
	CA-SK	CA-SK
	CA-YK	CA-YK
CN	CN-CCG	CN-HE
		CN-HN
		CN-HU
		CN-JX
	CN-CSG	CN-GD
		CN-GX
		CN-GZ
		CN-HA
	CN-ECGC	CN-YN
		CN-AH
		CN-FJ
		CN-JS
	CN-NCGC	CN-SH
		CN-ZJ
		CN-BJ
		CN-HB
	CN-NECG	CN-HL
		CN-SD
		CN-SX
		CN-TJ
	CN-NWG	CN-HL
		CN-JL
		CN-LN
		CN-NM
	CN-SWG	CN-GS
		CN-NX
		CN-QH
		CN-SA
CN-SWG	CN-XJ	
	CN-CQ	
	CN-SC	
	CN-XZ	
IN	IN-Eastern grid	IN-BR
		IN-JH
		IN-OR
		IN-SK
	IN-North-eastern grid	IN-WB
		IN-AR
		IN-AS
		IN-ML
		IN-MN
		IN-MZ
		IN-NL
		IN-TR
	IN-Northern grid	IN-DL
		IN-HP
		IN-HR
		IN-JK
		IN-PB
		IN-RJ
		IN-UP
		IN-UT
	IN-Southern grid	IN-AP
		IN-KA
		IN-KL
		IN-PY
	IN-Western grid	IN-TN
		IN-CT
		IN-DN
		IN-GA
IN-GJ		
IN-MH		
IN-MP		
US		US-ASCC
	US-HICC	US-HICC
	US-MRO	US-MRO
	US-NPCC	US-NPCC
	US-RFC	US-RFC
	US-SERC	US-SERC
	US-TRE	US-TRE
US-WECC	US-WECC	

2.3 Countries modelled with EIA data

Data from EIA (2025) is used to model the electricity mixes for AF, AL, DZ, AO, AM, AZ, BH, BD, BY, BO, BN, KH, CM, TD, CL, CO, CG, CR, CI, HR, CU, DO, EC, GQ, GA, GE, GH, GT, IS, IQ, IL, JM, JO, KE, KP, KW, KG, LY, MA, MM, AN, NZ, NI, NE, NG, OM, PK, PG, PY, PE, PH, QA, SN, SG, SS, LK, SR, CH, SY, TJ, TZ, TT, TN, TM, UY, UZ, VE, VI, YE and ZM

As for the other sources, the categories used by the EIA (2025) did not align directly with the ecoinvent dataset structure. In most cases several datasets could be matched to the same category. To address this discrepancy, again the relative breakdown within the ecoinvent 3.10 dataset (ecoinvent Centre 2023) was utilized to distribute electricity generation within categories. Trade flows were modeled using UN data (United Nations Comtrade 2025) due to the limited information provided by the EIA. Reported trade between non-neighbouring countries was omitted to ensure the analysis focused on physical flows.

In this study, the geographical coverage was expanded by modeling several countries not previously included in ecoinvent 3.10 (ecoinvent Centre 2023): AF, TD, GQ, AN, PG, SR and VI. To accurately represent these nations, data on losses and infrastructure requirements were derived from countries with comparable Human Development Index scores¹ within the same region. Additionally, for these countries new datasets to model electricity transmission from high to medium voltage and from medium to low voltage were modelled.

2.4 Regions

In this study, 10 regional electricity mixes were modelled based on definitions provided by the commissioner (see Tab. 2.3). The regional mixes were calculated using consumption volumes from countries within each defined region. To ensure accuracy, it was ensured that at least 95% of the consumption for each region was modelled using country-specific datasets. The regional datasets do not include losses or infrastructure inputs, as these were already incorporated in the country-specific electricity mix inputs. Some inaccuracies were observed in the model, as countries with different data sources were sometimes grouped within the same region.

¹ <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>

Tab. 2.3 Definition of regions: 1 indicates country belongs to the region (highlighted in green), 0 indicates country does not belong to the region

Country	GLO	EU-27	RoW	EMEA	SAPAC	NWE	UN-EASIA	RLA	RNA	UN-WASIA
AF	1	0	1	0	1	0	0	0	0	0
AL	1	0	1	1	0	0	0	0	0	0
DZ	1	0	1	1	0	0	0	0	0	0
AO	1	0	1	1	0	0	0	0	0	0
AR	1	0	1	0	0	0	0	1	0	0
AM	1	0	1	1	0	0	0	0	0	1
AU	1	0	1	0	1	0	0	0	0	0
AT	1	1	0	1	0	1	0	0	0	0
AZ	1	0	1	1	0	0	0	0	0	1
BH	1	0	1	1	0	0	0	0	0	1
BD	1	0	1	0	1	0	0	0	0	0
BY	1	0	1	1	0	0	0	0	0	0
BE	1	1	0	1	0	1	0	0	0	0
BO	1	0	1	0	0	0	0	1	0	0
BA	1	0	1	1	0	0	0	0	0	0
BR	1	0	1	0	0	0	0	1	0	0
BN	1	0	1	0	1	0	0	0	0	0
BG	1	1	0	1	0	0	0	0	0	0
KH	1	0	1	0	1	0	0	0	0	0
CM	1	0	1	1	0	0	0	0	0	0
CA	1	0	1	0	0	0	0	0	1	0
TD	1	0	1	1	0	0	0	0	0	0
CL	1	0	1	0	0	0	0	1	0	0
CN	1	0	1	0	0	0	1	0	0	0
CO	1	0	1	0	0	0	0	1	0	0
CG	1	0	1	1	0	0	0	0	0	0
CR	1	0	1	0	0	0	0	1	0	0
CI	1	0	1	1	0	0	0	0	0	0
HR	1	1	0	1	0	0	0	0	0	0
CU	1	0	1	0	0	0	0	1	0	0
CZ	1	1	0	1	0	0	0	0	0	0
KP	1	0	1	0	0	0	1	0	0	0
DK	1	1	0	1	0	1	0	0	0	0
DO	1	0	1	0	0	0	0	1	0	0
EC	1	0	1	0	0	0	0	1	0	0
EG	1	0	1	1	0	0	0	0	0	0
GQ	1	0	1	1	0	0	0	0	0	0
FI	1	1	0	1	0	1	0	0	0	0
FR	1	1	0	1	0	1	0	0	0	0
GA	1	0	1	1	0	0	0	0	0	0
GE	1	0	1	1	0	0	0	0	0	1
DE	1	1	0	1	0	1	0	0	0	0
GH	1	0	1	1	0	0	0	0	0	0
GR	1	1	0	1	0	0	0	0	0	0
GT	1	0	1	0	0	0	0	1	0	0
HU	1	1	0	1	0	0	0	0	0	0
IS	1	0	1	1	0	1	0	0	0	0
IN	1	0	1	0	1	0	0	0	0	0
ID	1	0	1	0	1	0	0	0	0	0
IR	1	0	1	0	1	0	0	0	0	0
IQ	1	0	1	1	0	0	0	0	0	1
IE	1	1	0	1	0	1	0	0	0	0
IL	1	0	1	1	0	0	0	0	0	1
IT	1	1	0	1	0	0	0	0	0	0
JM	1	0	1	0	0	0	0	1	0	0
JP	1	0	1	0	0	0	1	0	0	0
JO	1	0	1	1	0	0	0	0	0	1
KZ	1	0	1	1	0	0	0	0	0	0
KE	1	0	1	1	0	0	0	0	0	0
KW	1	0	1	1	0	0	0	0	0	1
KG	1	0	1	1	0	0	0	0	0	0

Tab. 2.3 continued

Country	GLO	EU-27	RoW	EMEA	SAPAC	NWE	UN-EASIA	RLA	RNA	UN-WASIA
LY	1	0	1	1	0	0	0	0	0	0
LT	1	1	0	1	0	1	0	0	0	0
LU	1	1	0	1	0	1	0	0	0	0
MY	1	0	1	0	1	0	0	0	0	0
MX	1	0	1	0	0	0	0	1	0	0
ME	1	0	1	1	0	0	0	0	0	0
MA	1	0	1	1	0	0	0	0	0	0
MM	1	0	1	0	1	0	0	0	0	0
NL	1	1	0	1	0	1	0	0	0	0
AN	1	0	1	0	0	0	0	1	0	0
NZ	1	0	1	0	1	0	0	0	0	0
NI	1	0	1	0	0	0	0	1	0	0
NE	1	0	1	1	0	0	0	0	0	0
NG	1	0	1	1	0	0	0	0	0	0
NO	1	0	1	1	0	1	0	0	0	0
OM	1	0	1	1	0	0	0	0	0	1
PK	1	0	1	0	1	0	0	0	0	0
PG	1	0	1	0	1	0	0	0	0	0
PY	1	0	1	0	0	0	0	1	0	0
PE	1	0	1	0	0	0	0	1	0	0
PH	1	0	1	0	1	0	0	0	0	0
PL	1	1	0	1	0	0	0	0	0	0
PT	1	1	0	1	0	0	0	0	0	0
QA	1	0	1	1	0	0	0	0	0	1
KR	1	0	1	0	0	0	1	0	0	0
RO	1	1	0	1	0	0	0	0	0	0
RU	1	0	1	1	0	0	0	0	0	0
SA	1	0	1	1	0	0	0	0	0	1
SN	1	0	1	1	0	0	0	0	0	0
SG	1	0	1	0	1	0	0	0	0	0
SK	1	1	0	1	0	0	0	0	0	0
SI	1	1	0	1	0	0	0	0	0	0
SS	1	0	1	1	0	0	0	0	0	0
ES	1	1	0	1	0	0	0	0	0	0
LK	1	0	1	0	1	0	0	0	0	0
SR	1	0	1	0	0	0	0	1	0	0
SE	1	1	0	1	0	1	0	0	0	0
CH	1	0	1	1	0	1	0	0	0	0
SY	1	0	1	1	0	0	0	0	0	1
TW	1	0	1	0	0	0	1	0	0	0
TJ	1	0	1	1	0	0	0	0	0	0
TH	1	0	1	0	1	0	0	0	0	0
TT	1	0	1	0	0	0	0	1	0	0
TN	1	0	1	1	0	0	0	0	0	0
TR	1	0	1	1	0	0	0	0	0	1
TM	1	0	1	1	0	0	0	0	0	0
UA	1	0	1	1	0	0	0	0	0	0
AE	1	0	1	1	0	0	0	0	0	1
GB	1	0	1	1	0	1	0	0	0	0
TZ	1	0	1	1	0	0	0	0	0	0
US	1	0	1	0	0	0	0	0	1	0
VI	1	0	1	0	0	0	0	1	0	0
UY	1	0	1	0	0	0	0	1	0	0
UZ	1	0	1	1	0	0	0	0	0	0
VE	1	0	1	0	0	0	0	1	0	0
VN	1	0	1	0	1	0	0	0	0	0
YE	1	0	1	1	0	0	0	0	0	1
ZM	1	0	1	1	0	0	0	0	0	0
RS	1	0	1	1	0	0	0	0	0	0

3 Matching of statistical categories and technology factors

As described in the preceding chapter, the statistical categories from the utilized data sources can be matched to various datasets from ecoinvent. The differences in environmental impacts can be significant, for instance, when electricity from coal is modelled as electricity-only production, versus combined heat and power generation. Since most countries employ different technologies for the same energy carriers, a structured approach was needed due to the unavailability of such granular data.

In SimaPro, ecoinvent datasets are classified into different categories, with the category for electricity generation datasets typically referring to the energy carrier. Few adjustments are required to facilitate an easy mapping of statistical categories to ecoinvent dataset categories (see Tab. 3.1). Within each adjusted category of ecoinvent datasets, "technology factors" are calculated, describing the allocation of the electricity generation of that category to specific datasets for each country, based on the original datasets from ecoinvent 3.10 (ecoinvent Centre 2023).

Tab. 3.1 Mapping of statistical categories to dataset categories. Doublings are highlighted in red.

Energy Institute	EIA	ENTSO-E/Eurostat	Ecoinvent	Ecoinvent adjust
Other renewables #	Biomass and waste (billion kWh)		Biofuels	Biofuels
Other renewables #	Biomass and waste (billion kWh)	Biomass	Biomass	Biomass
Coal	Coal (billion kWh)	Fossil Hard coal	Coal	Coal
Natural Gas	Natural gas (billion kWh)	Fossil Gas	Gas	Gas
Other renewables #	Geothermal (billion kWh)	Geothermal	Geothermal	Geothermal
Other [#]	Hydroelectric pumped storage (bill	Hydro Pumped Storage	Hydro	HydroPumped
Hydro	Hydroelectricity (billion kWh)	Hydro Run-of-river and poundage	Hydro	HydroRunOfRiver
Hydro	Hydroelectricity (billion kWh)	Hydro Water Reservoir	Hydro	HydroReservoir
Coal	Coal (billion kWh)	Fossil Brown coal/Lignite	Lignite	Lignite
Nuclear energy	Nuclear (billion kWh)	Nuclear	Nuclear	Nuclear
Oil	Oil (billion kWh)	Fossil Oil	Oil	Oil
Other [#]		Fossil Peat	Peat	Peat
Solar	Solar (billion kWh)	Solar	Photovoltaic	Photovoltaic
Other [#]	Biomass and waste (billion kWh)	Waste	Waste	Waste
Other [#]	Other gases (billion kWh)	Fossil Coal-derived gas	Waste	CoalGas
Wind	Wind (billion kWh)	Wind Onshore	Wind	OnshoreWind
Wind	Wind (billion kWh)	Wind Offshore	Wind	OffshoreWind
Other renewables #	Biomass and waste (billion kWh)	Biomass	Wood	Wood
Other [#]	Other gases (billion kWh)	Other	Waste	OtherConventional
Other renewables #	Biomass and waste (billion kWh)		Waste	OtherRenewable

For some countries, it was found that reported energy carriers are not present in the mix of that country in ecoinvent 3.10 (ecoinvent Centre 2023), resulting in unavailable technology factors. In such cases, technology factors from a similar country within the same region and with a comparable state of development are used. For example, when the previous mix of Angola did not include solar, technology factors from Zambia are applied (see Tab. 3.2 for adjustments made).

Tab. 3.2 Countries used to model general flows (infrastructure losses) and technology factors (green: new countries, yellow: adjustments)

Country	General	Biofuels	Biomass	Coal	Gas	Geothermal	Hydro Pumped	Hydro RunOfRiver	Hydro Reservoir	Lignite	Nuclear	Oil	Peat	Photovoltaic	Waste	CoalGas	Onshore Wind	Offshore Wind	Wood	Other Conventional	Other Renewable
AE	AE	JO	JO	AE	AE	JO	AE	AE	AE	AE	BE	AE	AE	AE	AE	AE	JO	JO	JO	AE	JO
AF	YE	YE	YE	TJ	YE	YE	TJ	TJ	TJ	YE	YE	YE	YE	YE	YE	YE	YE	YE	YE	YE	YE
AN	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
AO	AO	TZ	TZ	AO	AO	AO	AO	AO	AO	AO	AO	AO	AO	ZM	TZ	AO	AO	AO	TZ	AO	TZ
AR	AR	CL	CL	AR	AR	CL	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	CL	AR	CL
AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	DE	AT
AZ	AZ	IR	IR	AZ	AZ	AZ	AZ	AZ	AZ	AZ	AZ	AZ	AZ	AZ	IR	AZ	AZ	AZ	IR	AZ	IR
BD	BD	IN-Eastern grid	IN-Eastern grid	BD	BD	BD	BD	BD	BD	BD	BD	BD	BD	BD	IN-Eastern grid	BD	BD	BD	IN-Eastern grid	BD	IN-Eastern grid
BG	BG	BG	BG	BG	BG	BG	BG	BG	CZ	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG
BH	BH	BH	BH	BH	BH	BH	BH	BH	BH	BH	BH	BH	BH	SA	BH	BH	KW	KW	BH	BH	BH
BN	BN	BN	BN	MY	BN	BN	BN	BN	BN	MY	BN	BN	BN	BN	BN	BN	BN	BN	BN	BN	BN
BO	BO	PE	PE	BO	BO	BO	BO	BO	BO	BO	BO	BO	BO	BO	PE	BO	BO	BO	PE	BO	PE
BY	BY	BY	BY	RU	BY	BY	BY	BY	BY	RU	BY	BY	BY	BY	BY	BY	BY	BY	BY	BY	BY
CG	CG	CG	CG	CG	AO	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG	CG
CH	CH	CH	CH	CH	CH	CH	AT	CH	CH	CH	CH	AT	CH	CH	CH	CH	CH	CH	CH	CH	CH
CI	CI	TZ	TZ	CI	CI	CI	CI	CI	CI	CI	CI	CI	CI	CI	TZ	CI	CI	CI	TZ	CI	TZ
CM	CM	TZ	TZ	CM	AO	CM	CM	CM	CM	CM	CM	CM	CM	NA	TZ	CM	CM	CM	TZ	CM	TZ
CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	BR-North-eastern grid	CO	CO	CO	BR-North-eastern grid	CO
CR	CR	GT	GT	CR	CR	CR	CR	CR	CR	CR	CR	CR	CR	CR	GT	CR	CR	CR	GT	CR	GT
CU	CU	DO	DO	CU	CU	CU	CU	CU	CU	CU	CU	CU	CU	CU	DO	CU	CU	CU	DO	CU	DO
DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	DZ	ES	DZ	DZ	DZ	ES	DZ	DZ
EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	BR-North-eastern grid	EC	EC	EC	BR-North-eastern grid	EC
GA	GA	TZ	TZ	GA	GA	GA	GA	GA	GA	GA	GA	GA	GA	GA	TZ	GA	GA	GA	TZ	GA	TZ
GE	GE	GE	GE	GE	GE	GE	GE	GE	GE	GE	GE	GE	GE	AZ	GE	GE	GE	GE	GE	GE	GE
GH	GH	TZ	TZ	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	TZ	GH	GH	GH	TZ	GH	TZ
GQ	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH	GH
GR	GR	GR	GR	GR	GR	GR	GR	GR	CZ	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR
HU	HU	HU	HU	HU	HU	HU	HU	HU	CZ	HU	HU	HU	HU	HU	HU	HU	HU	HU	HU	HU	HU
ID	ID	ID	ID	ID	ID	ID	PH	ID	ID	ID	ID	ID	ID	PH	ID	PH	PH	PH	ID	PH	ID
IE	IE	IE	IE	IS	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	DE	IE
IL	IL	JO	JO	IL	IL	IL	IL	EG	EG	IL	IL	IL	IL	IL	JO	IL	EG	EG	JO	ES	IL
IR	IR	IR	IR	TR	IR	IR	IR	IR	IR	TR	IR	IR	IR	IR	IR	IR	IR	IR	IR	IR	IR
IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	NO	IS	IS	IS	IS	IS	IS	IS
IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	DE	IT	DE	IT
JM	JM	DO	DO	JM	JM	JM	JM	JM	JM	JM	JM	JM	JM	JM	DO	JM	JM	JM	DO	JM	DO
JO	JO	JO	JO	JO	JO	JO	JO	JO	JO	JO	JO	EG	JO	JO	JO	JO	JO	JO	JO	JO	JO
KE	KE	TZ	TZ	KE	KE	KE	KE	KE	KE	KE	KE	KE	KE	KE	TZ	KE	KE	KE	TZ	KE	TZ
KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	RU	KG	KG	KG	KG	KG	KG	KG
KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	VN	VN	KH	KH	KH
LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	PL	LT
LU	LU	LU	LU	LU	LU	LU	LU	LU	DE	LU	LU	LU	LU	LU	LU	LU	LU	LU	LU	LU	LU
MA	MA	TZ	TZ	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	TZ	MA	MA	MA	TZ	MA	TZ

Matching of statistical categories and technology factors

Country	General	Biofuels	Biomass	Coal	Gas	Geothermal	Hydro Pumped	Hydro RunOfRiver	Hydro Reservoir	Lignite	Nuclear	Oil	Peat	Photovoltaic	Waste	CoalGas	Onshore Wind	Offshore Wind	Wood	Other Conventional	Other Renewable
ME	ME	ME	ME	ME	ME	ME	ME	ME	HR	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME
NE	NE	NE	NE	NE	NG	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NG	NG	TZ	TZ	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	TZ	NG	NG	NG	TZ	NG	TZ
NI	NI	TZ	TZ	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	TZ	NI	NI	NI	TZ	NI	TZ
NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	BE	NL	NL	NL	NL	NL	NL
NO	NO	NO	NO	NO	NO	NO	NO	SE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	NZ	JP	NZ	NZ	NZ	JP	NZ
OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	OM	KW	KW	OM	OM	OM
PG	MM	MM	MM	MM	MM	PH	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM	MM
PL	PL	PL	PL	PL	PL	PL	PL	PL	CZ	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL
PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	ES	PT
PY	PY	UY	UY	PY	PY	PY	PY	PY	PY	PY	BO	PY	BO	UY	PY	PY	PY	PY	UY	PY	UY
QA	QA	JO	JO	QA	QA	QA	QA	QA	QA	QA	QA	QA	QA	SA	JO	QA	QA	QA	JO	QA	JO
RO	RO	RO	RO	RO	RO	RO	RO	RO	CZ	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	HU	RS
SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	EG	EG	SA	SA	SA
SK	SK	SK	SK	SK	SK	SK	SK	SK	SK	CZ	SK	SK	SK	SK	CZ	SK	SK	SK	SK	CZ	SK
SN	SN	TZ	TZ	MA	SN	SN	SN	MA	MA	SN	SN	SN	SN	SN	TZ	SN	SN	SN	TZ	SN	TZ
SR	BO	BR-Northern grid	BR-Northern grid	BO	BO	BO	BO	BO	BO	BO	BO	BO	BO	BO	BR-Northern grid	BO	BO	BO	BR-Northern grid	BO	BR-Northern grid
SY	SY	IR	IR	SY	SY	SY	SY	SY	SY	SY	SY	SY	SY	IR	IR	SY	IR	IR	IR	SY	IR
TD	NE	PK	PK	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	PK	NE	SN	SN	PK	NE	PK
TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	RU	TJ	TJ	TJ	TJ	TJ	TJ	TJ
TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM
TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	TN	ES	TN
TR	TR	TR	TR	TR	TR	TR	HU	TR	TR	TR	TR	TR	HU	TR	HU	HU	TR	TR	TR	HU	TR
TW	TW	JP	JP	TW	TW	JP	TW	TW	TW	TW	TW	TW	TW	TW	TW	TW	TW	TW	JP	TW	JP
UA	UA	RO	RO	UA	UA	RO	UA	UA	UA	UA	UA	UA	UA	UA	UA	UA	UA	UA	RO	UA	RO
UY	UY	UY	UY	UY	AR	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY	UY
UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	UZ	RU	UZ	UZ	KZ	KZ	UZ	UZ	UZ
VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	VE	CO	CO	VE	VE	VE
VI	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
VN	VN	VN	VN	VN	VN	VN	PH	VN	VN	VN	VN	VN	PH	VN	PH	PH	PH	PH	VN	PH	VN
ZM	ZM	TZ	TZ	ZM	ZM	ZM	ZM	ZM	ZM	ZM	ZM	ZM	ZM	ZM	TZ	ZM	ZM	ZM	TZ	ZM	TZ

4 Life cycle inventory of high voltage mixes

In ecoinvent's model of the energy distribution systems, most energy carriers are introduced into the mix at high voltage levels, with the sole exceptions being electricity generated from waste and photovoltaic sources. The mixes on high voltage level account for infrastructure requirements and emissions associated with distribution processes on high voltage level. Additionally, distribution losses are considered. In this study, the electricity mixes, including both production and imports, were updated, while the original values from ecoinvent 3.10 (ecoinvent Centre 2023) were retained for infrastructure, losses, and emissions data. For countries newly incorporated into the model, proxy values for infrastructure, losses, and emissions were derived from comparable nations, ensuring a consistent approach across the entire dataset. Tab. 4.1 exemplarily shows the unit process raw data for the dataset "electricity, high voltage {DK}| market for electricity, high voltage | Cut-off, U".

The transmission from high to medium voltage incorporates losses incurred during this process. For existing countries, no adjustments were made to the transmission dataset, and infrastructure inputs, emissions, and losses remained unchanged. However, for newly analysed countries, transmission losses were estimated based on data from similar countries, ensuring a consistent approach across the study. Tab. 5.1 exemplarily shows the unit process raw data for the newly developed medium voltage datasets for Chad.

Tab. 5.1 Unit process raw data for the electricity mix on low voltage level of TD.

Name	Location	Infrastructure	Process	Unit	Electricity, medium voltage {TD} market for electricity, medium voltage Cut-off, U	Electricity, medium voltage {TD} electricity voltage transformation from high to medium voltage Cut-off, U
Location					TD kWh	TD kWh
Unit						
Electricity, medium voltage {TD} market for electricity, medium voltage Cut-off, U	TD	0	kWh	1		
Electricity, medium voltage {TD} electricity voltage transformation from high to medium voltage Cut-off, U	TD	0	kWh			1
Transmission network, electricity, medium voltage {GLO} market for transmission network, electricity, medium voltage Cut-off, U	GLO	1	km	1.86E-8		
Sulfur hexafluoride, liquid {RoW} market for sulfur hexafluoride, liquid Cut-off, U	RoW	0	kg	1.60E-7		
Electricity, high voltage {TD} market for electricity, high voltage Cut-off, U	TD	0	kWh			1.01E+0
Electricity, medium voltage {TD} market for electricity, medium voltage Cut-off, U	TD	0	kWh	8.16E-3		
Electricity, medium voltage {TD} electricity voltage transformation from high to medium voltage Cut-off, U	TD	0	kWh	1.00E+0		
Sulfur hexafluoride	-	-	kg	1.60E-7		

6 Life cycle inventory of low voltage mixes

The electricity mix at the low voltage level primarily comprises electricity transmitted from medium voltage systems, supplemented by electricity generated from photovoltaic installations where applicable. Infrastructure inputs, emissions, and losses were kept constant for existing countries. The transmission from medium to low voltage includes inherent losses, which are accounted for in the transmission dataset. For countries previously studied, no adjustments were made to the transmission dataset. However, for newly analysed countries, transmission losses were estimated based on data from similar countries, ensuring a standardized approach across the study. Tab. 6.1 Tab. 5.1 exemplarily shows the unit process raw data for the dataset “electricity, high voltage {DK}| market for electricity, high voltage | Cut-off, U”.

Tab. 6.1 Unit process raw data for the electricity mix on low voltage level of DK

Name	Location	InfrastructureProcess	Unit	Electricity, low voltage {DK} market for electricity, low voltage Cut-off, U	UncertaintyType	StandardDeviation95%	GeneralComment
Location				DK			
Unit				kWh			
Electricity, low voltage {DK} market for electricity, low voltage Cut-off, U	DK	0	kWh	1			
Distribution network, electricity, low voltage {GLO} market for distribution network, electricity, low voltage Cut-off, U	GLO	1	km	8.74E-8	1	3.11	(3,2,4,4,3,BU:3); Same value as in ecoinvent 3.10 for DK.; Estimation. Data overtaken from Switzerland. Swiss data are calculated values based on the electricity transported in this voltage level (36796 GWh) and the total low voltage power line length in Switzerland (cables and aerial lines - 128646 km). Lifetime is assumed to be 40 years. See Itten&Frischknecht 2012, Tab. 4.1 and Tab. 4.3.
Sulfur hexafluoride, liquid {RER} market for sulfur hexafluoride, liquid Cut-off, U	RER	0	kg	6.27E-9	1	1.11	(1,1,3,1,1,BU:1.05); Same value as in ecoinvent 3.10 for DK.; Calculated value
Electricity, low voltage {DK} market for electricity, low voltage Cut-off, U	DK	0	kWh	1.12E-2	0		Same value as in ecoinvent 3.10 for DK.; Calculated from electricity generation and trade statistics. See general comment for validity and sources.
Electricity, low voltage {DK} electricity voltage transformation from medium to low voltage Cut-off, U	DK	0	kWh	9.36E-1	0		; Calculated from electricity generation and trade statistics. See general comment for validity and sources.
Electricity, low voltage {DK} electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted Cut-off, U	DK	0	kWh	3.53E-2	0		Dataset selection based on ecoinvent 3.10 for DK.; Calculated from electricity generation and trade statistics. See general comment for validity and sources.
Electricity, low voltage {DK} electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted Cut-off, U	DK	0	kWh	2.83E-2	0		Dataset selection based on ecoinvent 3.10 for DK.; Calculated from electricity generation and trade statistics. See general comment for validity and sources.
Sulfur hexafluoride	-	-	kg	6.27E-9	1	1.54	(3,2,3,4,2,BU:1.5); Same value as in ecoinvent

7 Outlook

The electricity mix model has been developed to optimize adaptability and extensibility. The model architecture facilitates smooth updates upon the release of new statistical data, enabling prompt integration of current information. It allows for the modification of electricity sources on a per-country basis, accommodating changes in the use statistical sources. The framework supports the incorporation of additional countries, enabling expansion of the analysis to include previously unexamined countries. Moreover, the design permits adjustments of technology factors, infrastructure requirements, emissions, and losses to align with updated ecoinvent data.

8 References

- ecoinvent Centre 2023 ecoinvent Centre (2023) ecoinvent data v3.10, Cut-Off model. Swiss Centre for Life Cycle Inventories, Zurich, Switzerland, retrieved from: <https://ecoinvent.org>.
- EI 2024 EI (2024) Energy Institute Statistical Review of World Energy. Energy Institute, London, retrieved from: <https://www.energyinst.org/statistical-review/home>.
- European Network of Transmission System Operators for Electricity (ENTSO-E) 2024 European Network of Transmission System Operators for Electricity (ENTSO-E) (2024) Transparency Platform, retrieved from: <https://transparency.entsoe.eu/>.
- EUROSTAT 2024 EUROSTAT (2024) Net electricity generation by type of fuel - monthly data, retrieved from: https://ec.europa.eu/eurostat/databrowser/view/nrg_cb_pem/default/table?lang=en&category=nrg.nrg_quant.nrg_quantm.nrg_cb_m.
- U.S. Energy Information Administration 2025 U.S. Energy Information Administration (2025) Electricity, retrieved from: <https://www.eia.gov/international/data/world/electricity/electricity-generation>.
- United Nations Comtrade 2025 United Nations Comtrade (2025) Trade of electricity (Commodity Code 2716), retrieved from: <https://comtradeplus.un.org/TradeFlow?Frequency=A&Flows=M&CommodityCodes=2716&Partners=76&Reporters=all&period=2023&AggregateBy=none&BreakdownMode=plus>.