

## Calculation of energy indicators in MJ, LHVs



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# 1 Overview

Two impact assessment methods are imported in the software OpenLCA version 1.6.3, that are ecoinvent v.3.3 LCIA methods and OpenLCA LCIA methods 1.5.6 v.3. In both methods CED methodology is considered with related impact categories. It is then possible to identify the impact factors (expressed in MJ, HHVs) that have to be calculated in MJ, LHVs (Figure 1 and Figure 2).

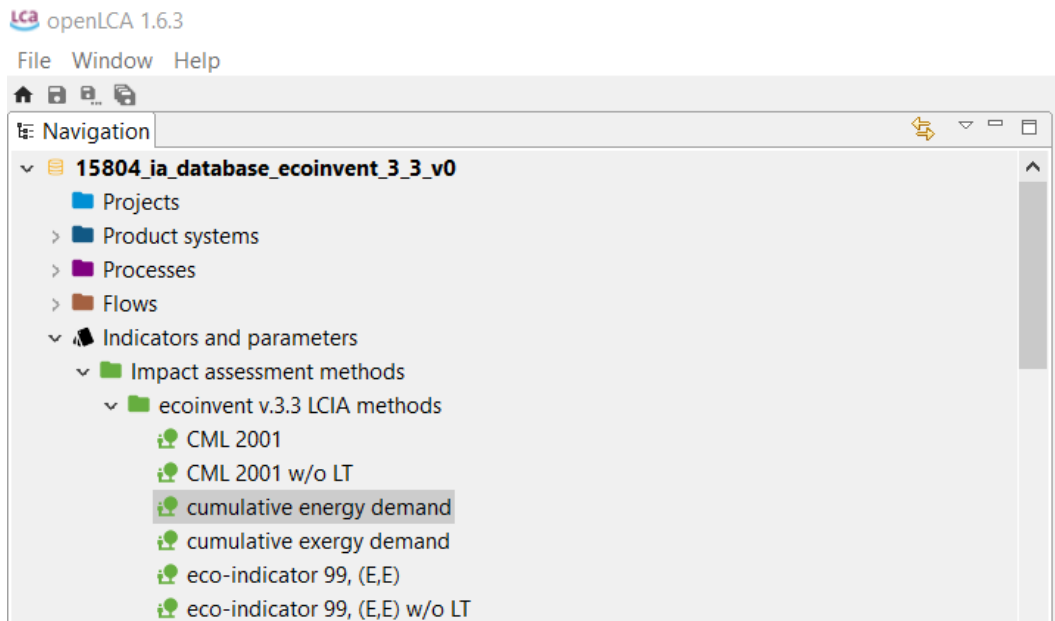


Figure 1: CED methodology, Ecoinvent methods

Console | Welcome | cumulative energy demand

**Impact assessment method: cumulative energy demand**

▼ Impact factors

Impact category: fossil - non-renewable energy resources, fossil

Flow	Category	Flow property	Factor	Unit	Uncertainty
Coal, brown, in ground	Resource/in ground	Mass	9.9	MJ-Eq/kg	none
Coal, hard, unspecified, in gr...	Resource/in ground	Mass	19.1	MJ-Eq/kg	none
Gas, mine, off-gas, process, ...	Resource/in ground	Volume	39.8	MJ-Eq/m3	none
Gas, natural, in ground	Resource/in ground	Volume	38.293	MJ-Eq/m3	none
Oil, crude, in ground	Resource/in ground	Mass	45.8	MJ-Eq/kg	none
Peat, in ground	Resource/biotic	Mass	9.9	MJ-Eq/kg	none

Figure 2: Impact factors from impact category in CED methodology, Ecoinvent methods

# 2 Approach

2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, Energy define in chapter 1.4.1.2 Box 1.1 a recommended conversion between Gross (HHV) and Net (LHV) calorific values (Figure 3).

**BOX 1.1**  
**CONVERSION BETWEEN GROSS AND NET CALORIFIC VALUES**

Units: MJ/kg - Megajoules per kilogram; 1 MJ/kg = 1 Gigajoule/tonne (GJ/tonne)

Gross CV (GCV) or 'higher heating value' (HHV) is the calorific value under laboratory conditions.

Net CV (NCV) or 'lower heating value' (LHV) is the useful calorific value in boiler plant. The difference is essentially the latent heat of the water vapour produced.

Conversions - Gross/Net (per ISO, for As Received\* figures) in MJ/kg:

$$Net\ CV = Gross\ CV - 0.212H - 0.0245M - 0.008Y$$

where M is percent Moisture, H is percent Hydrogen, Y is percent Oxygen (from ultimate analysis which determines the amount of carbon, hydrogen, oxygen, nitrogen and sulphur) As Received (i.e. includes Total Moisture (TM)).

Source: World Coal Institute (<http://www.worldcoal.org/pages/content/index.asp?PageID=190>), which provides more details.

Figure 3: Conversion between HHVs and LHVs

As the calculation of percent Moisture, Hydrogen and Oxygen for all the impact factors previously identified is not straightforward, the calculation of LHVs refers to the following sources which show tables with default Net Calorific Values:

- a. World Coal Institute<sup>1</sup>.
- b. 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, Energy. Chapter 1.4.1.3 and Table 1.2.
- c. Hydrogen Tools, Pacific Northwest National Laboratory<sup>2</sup>.
- d. IEA's Energy Statistics Manual (OECD/IEA 2005), Chapter 5.7 and Table A3.12<sup>3</sup>.
- e. ECN Phyllis 2. Database for biomass and waste. Energy Research Centre for the Netherlands<sup>4</sup>.
- f. Krajnc, N., Wood Fuels Handbook, Food and Agriculture Organization of the United Nations, Pristina 2015<sup>5</sup>. Table 10.
- g. Forest Products Laboratory, United States Forest Service<sup>6</sup>.

<sup>1</sup> [http://www.drummondco.com/wpcontent/uploads/coalconversionfacts200704\\_o6\\_2009.pdf](http://www.drummondco.com/wpcontent/uploads/coalconversionfacts200704_o6_2009.pdf)

<sup>2</sup> <https://h2tools.org/hyarc/calculator-tools/lower-and-higher-heating-values-fuels>

<sup>3</sup> <https://www.iea.org/publications/freepublications/publication/energy-statistics-manual.html>

<sup>4</sup> <https://www.ecn.nl/phyllis2>

<sup>5</sup> <http://www.fao.org/3/a-i4441e.pdf>

<sup>6</sup> <https://www.fpl.fs.fed.us/documnts/techline/fuel-value-calculator.pdf>

When the LHVs are taken from Table 1.2 in 2006 IPCC Guidelines (source b) the Net Calorific Value in the first column is considered for this report, but lower and upper limits of the 95% confidence intervals must be taken into account too.

## 2.1 Clarification on coal

The definition of LHVs for coal flows follows the coal classification suggested by IEA (International Energy Agency)<sup>7</sup>. The relationship between coal types is the following:

1. Hard coal, coal with HHV > 24 MJ/kg or with HHV < 24 MJ/kg and a Vitrinite mean Random Reflectance > 0.6 per cent.

- Anthracite: hard coal with HHV > 24 MJ/kg and a Vitrinite mean Random Reflectance > 2.0 per cent.

- Bituminous coal: coal with HHV > 24 MJ/kg and a Vitrinite mean Random Reflectance < 2.0 per cent or with HHV < 24 MJ/kg and a Vitrinite mean Random Reflectance > 0.6 per cent. Bituminous coal includes coking coal and other bituminous coal.

2. Brown coal, coal with HHV < 24 MJ/kg and a Vitrinite mean Random Reflectance < 0.6 per cent.

- Sub bituminous coal: brown coal with 20 MJ/kg < HHV < 24 MJ/kg.

- Lignite: brown coal with HHV < 20 MJ/kg.

This classification is used in the present report to identify the coal flows from their HHVs and find then corresponding LHVs in the tables from the sources already mentioned.

Furthermore, according to *2006 IPCC Guidelines, Volume Energy*, Chapter 1.4.1.2 and *IEA's Energy Statistics Manual (OECD/IEA 2005)*, Chapter 5.7, if net calorific values for coals are not available they can be estimated by subtracting 5% to the gross value. When this approximation is used, the source reference is expressed with letter d.

## 2.2 Clarification on oil and natural gas

According to *2006 IPCC Guidelines, Volume Energy*, Chapter 1.4.1.2 and *IEA's Energy Statistics Manual (OECD/IEA 2005)*, Table A3.12., if net calorific values for oil and natural gas are not

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<sup>7</sup> [http://www.iea.org/intereenerstat\\_v2/meeting/2009/Coal.pdf](http://www.iea.org/intereenerstat_v2/meeting/2009/Coal.pdf)

available, then they can be estimated by subtracting 5% and 10% to the gross value. Moreover, according to *IPCC Guidelines* the conversion  $LHV = 90\% HHV$  can be used for manufactured gas when there is no further information available. When this approximation is used, the source reference is expressed with letter d.

### 2.3 Clarification on wood

The calculation of “softwood, INW, standing” considers the density of larch (500 kg/m<sup>3</sup>) as a reference tree type for the flow, while “softwood, US PNW, standing” considers Douglas fir (density, 530 kg/m<sup>3</sup>). The reference tree for the flow “softwood, US SE, standing” is a pine (density, 400 kg/m<sup>3</sup>).

As no information was provided to define standing unspecified wood flow, the values for spruce were assumed in Phyllis 2 database.

### 2.4 Clarification on biomass.

When no specific information is provided for biomass energy, the values for wood waste from Phyllis 2 database are assumed. In the case of biomass-primary forest the heating values referred to spruce tree are considered.

### 2.5 HHVs and LHVs table organization

Table 2 is organized in 8 columns: indication of CED methodology (Ecoinvent or OpenLCA), reference ID for the flow, flow name, impact category name, units, HHVs and LHVs values, LHV source.

Table 1 summarizes the sources used for LHV calculation as they are reported with a letter in the last column of Table 2. If the flow name in the source shows some differences in comparison with the name of the impact factor, a clarification is added representing the name of the flow selected in the sources.

*Table 1: Sources for LHV calculation*

Letter	Source
a	World Coal Institute
b	IPCC Guidelines

c	Hydrogen Tools
d	IEA's energy statistics manual
e	Phyllis 2
f	Wood Fuels Handbook
g	Forest Products Laboratory

### 3 Impact factors in MJ, HHVs and LHV

Table 2: Impact factors, CED methodology in Ecoinvent v.3.3 and OpenLCA 1.5.6 v.3 methods, HHVs and LHVs (M = moisture content)

CED Methodology	REF_ID	FLOW_NAME	IMPACTCATEGORY_NAME	UNITS	HHVs	LHVs	LHV Source
Ecoinvent v.3.3	024c9722-1e88-412b-8c4b-10c532be8dca	Coal, brown, in ground	fossil - non-renewable energy resources, fossil	kg	9.90	9.41	d
Ecoinvent v.3.3	b6d0042d-0ef8-49ed-9162-a07ff1ccf750	Coal, hard, unspecified, in ground	fossil - non-renewable energy resources, fossil	kg	19.10	18.01	a, bituminous
Ecoinvent v.3.4	8bc09c04-2190-4ee2-9ee2-aeg88ccd4eoc	Energy, geothermal, converted	renewable energy resources, geothermal, converted	MJ	1	1	
Ecoinvent v.3.5	01c12fca-ad8b-4902-8b48-2d5afe3d3aof	Energy, gross calorific value, in biomass	biomass - renewable energy resources, biomass	MJ	1	0.93	e, wood waste, dry
Ecoinvent v.3.6	8842042d-7f07-45f8-bf43-fa83833d75de	Energy, gross calorific value, in biomass, primary forest	primary forest - non-renewable energy resources, primary forest	MJ	1	0.89	e, wood, spruce, M= 27%
Ecoinvent v.3.7	57c71b25-4663-4fad-9167-7ce5be3e8268	Energy, kinetic (in wind), converted	wind - renewable energy resources, kinetic (in wind), converted	MJ	1	1	



Ecoinvent v.3.8	codd7ccd-9e7a-42b3-b899-dfd18c215oca	Energy, potential (in hydropower reservoir), converted	water - renewable energy resources, potential (in barrage water), converted	MJ	1	1	
Ecoinvent v.3.9	a7ff17d4-d3fe-4a70-9f2e-392b34630772	Energy, solar, converted	solar - renewable energy resources, solar, converted	MJ	1	1	
Ecoinvent v.3.3	3ed5f377-344f-423a-b5ec-9a9a1162b944	Gas, mine, off-gas, process, coal mining	fossil - non-renewable energy resources, fossil	m3	39.80	35.82	a
Ecoinvent v.3.3	7c337428-fb1b-45c7-bbb2-2ee4d29e17ba	Gas, natural, in ground	fossil - non-renewable energy resources, fossil	m3	38.29	36.86	c, natural gas
Ecoinvent v.3.3	88do6db9-59a1-4719-9174-afeb1fa4026a	Oil, crude, in ground	fossil - non-renewable energy resources, fossil	kg	45.80	42.30	b, crude oil
Ecoinvent v.3.3	c5035ce2-5ee5-431f-a287-4b25da42be74	Peat, in ground	fossil - non-renewable energy resources, fossil	kg	9.90	9.76	b, peat
Ecoinvent v.3.3	2ba5e39b-adb6-4767-a51d-90c1cf32feg8	Uranium, in ground	nuclear - non-renewable energy resources, nuclear	kg	560000	560000	
OpenLCA 1.5.6 v.3	5a70cbea-10de-477b-ba2f-c219884b39e1	brown coal; 11.9 MJ/kg	Non-renewable resources - fossil	MJ	1.13	1.07	d

OpenLCA 1.5.6 v.3	52977b58-f9d3-411b-8620-0dc8d2d33cba	Coal, 18 MJ per kg, in ground	Non-renewable resources - fossil	kg	18.00	17.10	d
OpenLCA 1.5.6 v.3	aaa3f5e0-aeca-413f-ae80-f1a8a16576bf	biomass; 14.7 MJ/kg	Renewable resources - biomass	MJ	1.09	0.89	e, wood waste, M=25%
OpenLCA 1.5.6 v.3	b612133f-oc68-4e67-a749-9c18f828df77	Coal, 18 MJ per kg, in ground	Non-renewable resources - fossil	kg	18.00	17.10	d
OpenLCA 1.5.6 v.3	03599e77-3732-41ae-8d66-5e15c8bb34ba	Coal, 26.4 MJ per kg, in ground	Non-renewable resources - fossil	kg	26.40	25.80	b, other bituminous coal
OpenLCA 1.5.6 v.4	codd7ccd-9e7a-42b3-b899-dfd18c2150ca	Energy, potential (in hydropower reservoir), converted	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.3	7ae371af-8532-11e0-9d78-0800200c9a66	Coal, 26.4 MJ per kg, in ground	Non-renewable resources - fossil	kg	26.40	25.80	b, other bituminous coal
OpenLCA 1.5.6 v.3	506689e7-7821-48e8-a12c-0ee9a3b9e6ee	Coal, 29.3 MJ per kg, in ground	Non-renewable resources - fossil	kg	29.30	26.70	b, anthracite
OpenLCA 1.5.6 v.4	110b33da-6c5e-4f64-9837-cf6e6341619a	Nuclear energy	Non-renewable resources - nuclear	MJ	1	1	

OpenLCA 1.5.6 v.5	cec69965-a131-444d-94ed-a00677f6ef13	Coal, 29.3 MJ per kg, in ground	Non-renewable resources - fossil	kg	29.30	26.70	b,anthracite
OpenLCA 1.5.6 v.6	213fa9a5-5d8d-4990-9b38-f2c064161346	Coal, bituminous, 24.8 MJ per kg, in ground	Non-renewable resources - fossil	kg	24.80	23.71	a, bituminous
OpenLCA 1.5.6 v.7	007f79d8-5492-3378-a2cf-4de2cdd8a165	Coal, brown, 10 MJ per kg, in ground	Non-renewable resources - fossil	kg	10.00	9.50	d
OpenLCA 1.5.6 v.8	7ff56da9-d736-4903-b1ea-80ed85c5cfeo	Coal, brown, 10 MJ per kg, in ground	Non-renewable resources - fossil	kg	10.00	9.50	d
OpenLCA 1.5.6 v.9	24f94095-5627-4989-88e8-47e21983ee34	Energy, primary, from wind power	Renewable resources - wind	MJ	1	1	
OpenLCA 1.5.6 v.10	3e4d2966-6556-11dd-ad8b-o800200c9a66	Uranium	Non-renewable resources - nuclear	MJ	1	1	
OpenLCA 1.5.6 v.11	71e1cd1c-cof1-35dd-bod8-fbc23850do56	Coal, brown, 8 MJ per kg, in ground	Non-renewable resources - fossil	kg	8.00	7.60	d
OpenLCA 1.5.6 v.12	b4502f91-3aba-4ab2-b495-7f124807c5d6	Coal, brown, 8 MJ per kg, in ground	Non-renewable resources - fossil	kg	8.00	7.60	d

OpenLCA 1.5.6 v.13	024c9722-1e88-412b-8c4b-10c532be8dca	Coal, brown, in ground	Non-renewable resources - fossil	kg	9.90	9.41	d
OpenLCA 1.5.6 v.14	3945e033-dda4-4690-a889-f66e1f35bo2d	Coal, brown, in ground	Non-renewable resources - fossil	MJ	1	0.95	d
OpenLCA 1.5.6 v.15	ed65c408-2351-4f62-8430-dcd2f62ab70e	Uranium	Non-renewable resources - nuclear	kg	1.00	1.00	
OpenLCA 1.5.6 v.16	c5f0467d-ea04-49db-ae3a-ee4c90a0394e	Coal, brown, in ground	Non-renewable resources - fossil	kg	9.90	9.41	d
OpenLCA 1.5.6 v.17	c69c1aac-2cdo-4bcf-8c98-434ef19d3a88	Energy, potential (in hydropower reservoir), converted	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.18	4b9b9a1c-a21c-4280-9f75-735f2b343141	Energy, primary, from geothermal	Renewable resources - geothermal	MJ	1	1	
OpenLCA 1.5.6 v.19	ab131c31-ecd8-462c-ace9-3c4e9a9213e3	Coal, feedstock, 26.4 MJ per kg, in ground	Non-renewable resources - fossil	kg	26.40	25.80	b, other bituminous coal
OpenLCA 1.5.6 v.20	d8855bo3-3e44-4f74-b72e-23a56de3b46b	Coal, feedstock, 26.4 MJ per kg, in ground	Non-renewable resources - fossil	kg	26.40	25.80	b, other bituminous coal

OpenLCA 1.5.6 v.21	7ae371bo-8532-11eo-9d78-o80o2ooc9a66	Coal, hard, 30.7 MJ per kg, in ground	Non-renewable resources - fossil	kg	30.70	26.70	b, anthracite
OpenLCA 1.5.6 v.22	1be19e7o-468e-43dc-bfdo-f65odfb1db4o	Coal, hard, unspecified, in ground	Non-renewable resources - fossil	kg	19.10	18.01	a, bituminous
OpenLCA 1.5.6 v.23	b6doo42d-oef8-49ed-9162-a07ff1ccf75o	Coal, hard, unspecified, in ground	Non-renewable resources - fossil	kg	19.10	18.01	a, bituminous
OpenLCA 1.5.6 v.24	57c71b25-4663-4fad-9167-7ce5be3e8268	Energy, kinetic (in wind), converted	Renewable resources - wind	MJ	1	1	
OpenLCA 1.5.6 v.25	71876oaf-87f6-4o05-be1b-b5ccb8258b32	crude oil; 42.3 MJ/kg	Non-renewable resources - fossil	MJ	1.07	1.02	
OpenLCA 1.5.6 v.26	bb7aa8o5-ooc6-416a-9e93-4ee7b33671da	Energy, from coal	Non-renewable resources - fossil	MJ	1	0.95	d
OpenLCA 1.5.6 v.27	5bc2536a-5cb4-4c7a-9495-b21acd99ff9d	Energy, primary, from water power	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.28	d43946a1-f22e-4fb6-9ad1-c9cf36o351ac	Energy, from coal	Non-renewable resources - fossil	MJ	1	0.95	d

OpenLCA 1.5.6 v.29	3d1daf2e-31ad-4088-a814-679fod499e2f	Energy, from sulfur	Non-renewable resources - fossil	MJ	1	0.9-0.95	d, gas-solid
OpenLCA 1.5.6 v.30	3ed5f377-344f-423a-b5ec-9a9a1162b944	Gas, mine, off-gas, process, coal mining	Non-renewable resources - fossil	m3	39.80	35.82	a
OpenLCA 1.5.6 v.31	57705642-2dff-46b4-a776-6ae778997801	Gas, mine, off-gas, process, coal mining	Non-renewable resources - fossil	m3	39.80	35.82	a
OpenLCA 1.5.6 v.32	8cdcb4a5-5f12-4dd2-9fa4-15663ae85528	Gas, mine, off-gas, process, coal mining/kg	Non-renewable resources - fossil	kg	49.96	44.97	a
OpenLCA 1.5.6 v.33	b8b73d09-394b-4e05-8e08-6e77387dc2e4	Gas, mine, off-gas, process, coal mining/kg	Non-renewable resources - fossil	kg	49.96	44.97	a
OpenLCA 1.5.6 v.34	5beao6b9-bffe-484a-815c-ff5d934b911b	Gas, natural, 30.3 MJ per kg, in ground	Non-renewable resources - fossil	kg	30.30	27.27	d
OpenLCA 1.5.6 v.35	81b88765-3ac1-4206-a936-fec23c319ec1	Gas, natural, 30.3 MJ per kg, in ground	Non-renewable resources - fossil	kg	30.30	27.27	d
OpenLCA 1.5.6 v.36	6907e368-6a12-4f14-9125-doc2eeag1b63	Energy, kinetic (in wind), converted	Renewable resources - wind	MJ	1	1	

OpenLCA 1.5.6 v.37	6b78c48f-bacf-4597-ac6d-ec7d6a0c4411	Uranium oxide (U <sub>3</sub> O <sub>8</sub> ), 332 GJ per kg, in ore	Non-renewable resources - nuclear	kg	332000.0	332000.00	
OpenLCA 1.5.6 v.38	968b74bo-8018-464a-9376-7d881851072a	Gas, natural, 35 MJ per m <sub>3</sub> , in ground	Non-renewable resources - fossil	m <sub>3</sub>	35.00	31.50	d
OpenLCA 1.5.6 v.39	9854e081-33dc-489d-aca2-d164c87220da	Gas, natural, 35 MJ per m <sub>3</sub> , in ground	Non-renewable resources - fossil	m <sub>3</sub>	35.00	31.50	d
OpenLCA 1.5.6 v.40	o8d8474a-1b6a-42e4-b509-e9684d170ea1	Gas, natural, 36.6 MJ per m <sub>3</sub> , in ground	Non-renewable resources - fossil	m <sub>3</sub>	36.60	32.94	d
OpenLCA 1.5.6 v.41	35009b58-7a33-41aa-a15e-95b37717842b	Gas, natural, 36.6 MJ per m <sub>3</sub> , in ground	Non-renewable resources - fossil	m <sub>3</sub>	36.60	32.94	d
OpenLCA 1.5.6 v.42	730399c8-335f-43fo-b1b2-d3f1cb2617b9	Energy, solar, converted	Renewable resources - solar	MJ	1	1	
OpenLCA 1.5.6 v.43	7ae398b4-8532-11e0-9d78-o800200c9a66	Gas, natural, 46.8 MJ per kg, in ground	Non-renewable resources - fossil	kg	46.80	42.12	d
OpenLCA 1.5.6 v.44	a816a3b7-0e97-43c4-992e-6a4028316699	Gas, natural, 46.8 MJ per kg, in ground	Non-renewable resources - fossil	kg	46.80	42.12	d

OpenLCA 1.5.6 v.45	ad9c08fd-ea91-415d-95a9-7eb5116dc97a	Gas, natural, at extraction site	Non-renewable resources - fossil	kg	45.59	41.03	d
OpenLCA 1.5.6 v.46	5df3c6a9-a888-4b5d-9a94-f3f610d38756	Gas, natural, feedstock, 35 MJ per m3, in ground	Non-renewable resources - fossil	m3	35.00	31.50	d
OpenLCA 1.5.6 v.47	ded94170-7b12-4442-bbd3-aob1260a4dd9	Gas, natural, feedstock, 35 MJ per m3, in ground	Non-renewable resources - fossil	m3	35.00	31.50	d
OpenLCA 1.5.6 v.48	17604ce7-783f-4f9e-be49-09ad847fa75d	Gas, natural, feedstock, 46.8 MJ per kg, in ground	Non-renewable resources - fossil	kg	46.80	42.12	d
OpenLCA 1.5.6 v.49	7ae3bfc2-8532-11e0-9d78-0800200c9a66	Uranium, 2291 GJ per kg, in ground	Non-renewable resources - nuclear	kg	2291000	2291000.0	
OpenLCA 1.5.6 v.50	01c12fca-ad8b-4902-8b48-2d5afe3d3aof	Energy, gross calorific value, in biomass	Renewable resources - biomass	MJ	1	0.93	e, wood waste, dry
OpenLCA 1.5.6 v.51	b3eaaf76-0941-4d42-9edf-69c08c25cc00	Hard wood, dry matter, raw material	Renewable resources - biomass	kg	22.49	18.5-19.2	f, broad-leaf wood
OpenLCA 1.5.6 v.52	d508c71c-0761-421a-89e2-eb408051fe37	Gas, natural, feedstock, 46.8 MJ per kg, in ground	Non-renewable resources - fossil	kg	46.80	42.12	d



OpenLCA 1.5.6 v.53	dacfb71-fa74-4eec-aeb5-e2dd1409b64e	Renewable fuels	Renewable resources - biomass	kg	16.60	15.21	e, wood waste, M=12-5%
OpenLCA 1.5.6 v.54	77bb32cb-8876-4b2f-ae3a-7944fc1ef6c9	Gas, natural, in ground	Non-renewable resources - fossil	MJ	1	0.9	d
OpenLCA 1.5.6 v.55	7c337428-fb1b-45c7-bbb2-2ee4d29e17ba	Gas, natural, in ground	Non-renewable resources - fossil	m3	38.29	36.86	c, natural gas
OpenLCA 1.5.6 v.56	f752690a-1d38-4496-8e05-9de194966bd5	Gas, natural, in ground	Non-renewable resources - fossil	m3	38.29	36.86	c, natural gas
OpenLCA 1.5.6 v.57	5e94ceb8-e8ac-3a24-b02e-f24ad54a7393	Gas, off-gas, oil production, in ground	Non-renewable resources - fossil	m3	39.80	35.82	a
OpenLCA 1.5.6 v.58	8842042d-7fo7-45f8-bf43-fa83833d75de	Energy, gross calorific value, in biomass, primary forest	Non-renewable resources - primary forest	MJ	1	0.89	e, wood, spruce, M=27%
OpenLCA 1.5.6 v.59	72b01564-92fo-4d8e-ba33-80c71b19b113	Gas, off-gas, oil production, in ground	Non-renewable resources - fossil	m3	39.80	35.82	a
OpenLCA 1.5.6 v.60	bcf19dob-bod3-332d-a510-848c4f55a5e2	Gas, petroleum, 35 MJ per m3, in ground	Non-renewable resources - fossil	m3	35.00	31.50	a

OpenLCA 1.5.6 v.61	f70b9100-1667-4410-95bf-3e0f2ed7a46d	Gas, petroleum, 35 MJ per m3, in ground	Non-renewable resources - fossil	m3	35.00	31.50	a
OpenLCA 1.5.6 v.62	8b2d584c-30e9-4bof-9fe7-aebd2d945f7a	Energy, primary, from water power	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.63	9525b6c8-9996-4da5-a161-982ce8014e61	hard coal; 26.3 MJ/kg	Non-renewable resources - fossil	MJ	1.04	0.99	d
OpenLCA 1.5.6 v.64	8bc09c04-2190-4ee2-9ee2-aeg988ccd4e0c	Energy, geothermal, converted	Renewable resources - geothermal	MJ	1	1	
OpenLCA 1.5.6 v.65	bb2c690e-159d-4f13-ae03-8d69a67f9cc1	soft wood (dry matter)	Renewable resources - biomass	kg	14.90	12.92	g, softwood (kiln dried)
OpenLCA 1.5.6 v.66	badefaa0-fb1e-4cbo-bac1-480058554f3c	Lignite, 11 MJ per kg, in ground	Non-renewable resources - fossil	kg	11.00	9.30	e, coal, lignite
OpenLCA 1.5.6 v.67	8c9153ab-995e-425c-bddc-642e6dbbfffcc	Wood and wood waste, 20.9 MJ per kg, oven-dry basis	Renewable resources - biomass	kg	20.90	19.05	e, wood waste, daf value
OpenLCA 1.5.6 v.68	c3b83c04-c25a-4d40-bbd2-ee4ad47144f7	metallurgical coal	Non-renewable resources - fossil	kg	27.35	25.98	d

OpenLCA 1.5.6 v.69	5b524c90-9008-420f-a5dc-4a9843a3a724	Methane	Non-renewable resources - fossil	kg	35.90	31.42	e, M= 35.5%
OpenLCA 1.5.6 v.70	8b9c9b8e-58a0-4e77-aode-82d17cb44e59	Methane	Non-renewable resources - fossil	kg	35.90	31.42	e, M= 35.5%
OpenLCA 1.5.6 v.71	99e5d02d-84e4-4b75-9e73-29bebc534c48	Wood and wood waste, 9.5 MJ per kg	Renewable resources - biomass	kg	9.50	7.64	e, wood waste, M=50%
OpenLCA 1.5.6 v.72	c2035468-120a-459e-8415-df51576e9b4a	natural gas; 44.1 MJ/kg	Non-renewable resources - fossil	MJ	1.11	1.00	d
OpenLCA 1.5.6 v.73	a7ff17d4-d3fe-4a70-9f2e-392b34630772	Energy, solar, converted	Renewable resources - solar	MJ	1	1	
OpenLCA 1.5.6 v.74	e7961ae5-1a17-40d9-8a79-9e2c1bd09398	Oil sand (10% bitumen) (in MJ)	Non-renewable resources - fossil	MJ	1.10	1.04	d
OpenLCA 1.5.6 v.75	7eacfbe5-79da-4c3c-8cd2-679f4d2272ab	Wood, soft, INW, standing	Renewable resources - biomass	m3	7078	6235	e, wood, larch, M= 29.5%
OpenLCA 1.5.6 v.76	b7d01aa2-7469-480a-aad7-cebc7d1d6292	Oil sand (100% bitumen) (in MJ)	Non-renewable resources - fossil	MJ	1.10	1.04	d

OpenLCA 1.5.6 v.77	6ea27a5b-fb6d-489d-b874-9occa86a30c6	Oil, crude, 38400 MJ per m3, in ground	Non-renewable resources - fossil	m3	38400	36480	d
OpenLCA 1.5.6 v.78	7ae3bfc5-8532-11e0-9d78-o800200c9a66	Wood, soft, US PNW, standing/m3	Renewable resources - biomass	m3	7897	6561.4	e, wood, douglas fir, M= 33%
OpenLCA 1.5.6 v.79	e47d3de4-eeb9-4aca-a692-5e1a72b54dcc	Oil, crude, 38400 MJ per m3, in ground	Non-renewable resources - fossil	m3	38400	36480	d
OpenLCA 1.5.6 v.80	01918e03-46b5-4d15-9e48-01e3332859cc	Oil, crude, 41 MJ per kg, in ground	Non-renewable resources - fossil	kg	41.00	38.95	d
OpenLCA 1.5.6 v.81	55e2d07c-aaf6-45e4-a512-9c6ab19e09f9	Oil, crude, 41 MJ per kg, in ground	Non-renewable resources - fossil	kg	41.00	38.95	d
OpenLCA 1.5.6 v.82	7ae398bf-8532-11e0-9d78-o800200c9a66	Oil, crude, 42 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.00	39.90	d
OpenLCA 1.5.6 v.83	a65e5f73-a72a-4bc8-a4e3-58bfaf33baaa	Oil, crude, 42 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.00	39.90	d
OpenLCA 1.5.6 v.84	ba6f789b-egde-4c5d-87a1-d85b4b76bc74	Energy, primary, from solar energy	Renewable resources - solar	MJ	1	1	

OpenLCA 1.5.6 v.85	5d1c7444-561f-41a5-90bc-db10b6d47e19	Oil, crude, 42.6 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.60	40.47	d
OpenLCA 1.5.6 v.86	7ae3bfc6-8532-11e0-9d78-0800200c9a66	Wood, soft, US SE, standing/m3	Renewable resources - biomass	m3	5960	5264	e, wood, pine, M=28,5%
OpenLCA 1.5.6 v.87	dd4953b2-e6af-4006-942f-1b9ff1499572	Oil, crude, 42.6 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.60	40.47	d
OpenLCA 1.5.6 v.88	5cf8e94c-94ee-4a99-be6e-592cad4abba1	Oil, crude, 42.7 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.70	40.57	d
OpenLCA 1.5.6 v.89	04202049-6556-11dd-ad8b-0800200c9a66	Energy, primary, from waves	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.90	7ff5e639-4e7e-4708-8947-c4d1c499d331	Oil, crude, 42.7 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.70	40.57	d
OpenLCA 1.5.6 v.91	7fe7f6f1-c9cb-4fe3-9322-a1194d5a7ce3	Oil, crude, feedstock, 41 MJ per kg, in ground	Non-renewable resources - fossil	kg	41.00	38.95	d
OpenLCA 1.5.6 v.92	88951df2-e064-468f-acd6-aegoc30bo8ca	Oil, crude, feedstock, 41 MJ per kg, in ground	Non-renewable resources - fossil	kg	41.00	38.95	d

OpenLCA 1.5.6 v.93	oe652c80-3587-4af3-8c40-d6e6607f7ea8	Oil, crude, feedstock, 42 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.00	39.90	d
OpenLCA 1.5.6 v.94	f2b1f4ad-2e19-4851-9615-11c1324355cd	Energy, primary, from waves	Renewable resources - water	MJ	1	1	
OpenLCA 1.5.6 v.95	c6e7e174-ff4e-4c4f-b727-f448389dboc8	Energy, primary, from wind power	Renewable resources - wind	MJ	1	1	
OpenLCA 1.5.6 v.96	897eac83-f116-4c80-9264-38916e1877e3	Oil, crude, feedstock, 42 MJ per kg, in ground	Non-renewable resources - fossil	kg	42.00	39.90	d
OpenLCA 1.5.6 v.97	55031fb3-9c72-4bcc-b320-e190790bbc74	Oil, crude, in ground	Non-renewable resources - fossil	kg	45.80	42.30	b, crude oil
OpenLCA 1.5.6 v.98	47ede456-cb14-44fd-bc8e-01cb1bee4af1	Water, barrage	Renewable resources - water	kg	0.01	0.01	
OpenLCA 1.5.6 v.99	627afo4c-e8d1-4e53-8boe-df254f6a22f3	Oil, crude, in ground	Non-renewable resources - fossil	MJ	1	0.95	d
OpenLCA 1.5.6 v.100	88do6db9-59a1-4719-9174-afeb1fa4026a	Oil, crude, in ground	Non-renewable resources - fossil	kg	45.80	42.30	b, crude oil

OpenLCA 1.5.6 v.101	384e875d-2237-4d74-8f62-6bo4173f656b	Peat, in ground	Non-renewable resources - fossil	kg	9.90	9.76	b, peat
OpenLCA 1.5.6 v.102	d97297e0-853d-11e0-9d78-o800200c9a66	Wood, unspecified, standing/kg	Renewable resources - biomass	kg	14.90	13.33	e, wood, spruce, M=27%
OpenLCA 1.5.6 v.103	8f8db08d-1f39-417c-b98b-643509352592	wood; 14.7 MJ/kg	Renewable resources - biomass	MJ	1.08	0.89	e, wood, spruce, M=28%
OpenLCA 1.5.6 v.104	63114809-7f24-457e-9424-613b56678c03	Peat, in ground	Non-renewable resources - fossil	MJ	1	0.986	b, peat
OpenLCA 1.5.6 v.105	c5035ce2-5ee5-431f-a287-4b25da42be74	Peat, in ground	Non-renewable resources - fossil	kg	9.90	9.76	b, peat
OpenLCA 1.5.6 v.106	1939f8a8-d868-4eb3-9b2c-5feeda942af3	peat; 8.4 MJ/kg	Non-renewable resources - fossil	MJ	1.13	0.77	e, peat, M=60.5%
OpenLCA 1.5.6 v.107	5dab9fob-1eab-4809-942f-98141doc7d28	Pit gas	Non-renewable resources - fossil	kg	44.77	40.29	d
OpenLCA 1.5.6 v.108	2ba5e39b-adb6-4767-a51d-90c1cf32fe98	Uranium, in ground	Non-renewable resources - nuclear	kg	560000	560000	

OpenLCA 1.5.6 v.109	d340bcfb-77bb-34f2-8052-b598a2cdf17e	Water, barrage	Renewable resources - water	kg	0.01	0.01	
OpenLCA 1.5.6 v.110	f54b7f8d-f473-495e-8fc4-637859ab6e3a	Energy, geothermal, converted	Renewable resources - geothermal	MJ	1	1	
OpenLCA 1.5.6 v.111	f5e85aac-ba83-4875-9bcb-d30d1683fe64	Energy, gross calorific value, in biomass, primary forest	Non-renewable resources - primary forest	MJ	1	0.89	e, wood, spruce, M=27%
OpenLCA 1.5.6 v.112	cco84f21-5d55-45b9-bba7-80ae6ba94132	Pit gas	Non-renewable resources - fossil	m3	39.80	35.82	d
OpenLCA 1.5.6 v.113	782718b9-e84e-47b7-be6a-17eaab19c432	Pit Methane (in MJ)	Non-renewable resources - fossil	MJ	1.11	1.00	d
OpenLCA 1.5.6 v.114	f85eb4eb-3342-4283-a8ad-4d2c94e5aae2	Energy, primary, from geothermal	Renewable resources - geothermal	MJ	1	1	
OpenLCA 1.5.6 v.115	f92cd1d9-f342-43b4-8d38-a787c945cod5	Energy, primary, from solar energy	Renewable resources - solar	MJ	1	1	



## 4 Documentation

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