

## The database ÖKOBAU.DAT in openLCA and SimaPro



Version: openLCA 1.4.1 beta6; SimaPro 8.0.4

Date: April 2015

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**GreenDELTA**

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## 1. Ökobau.dat – Background

Ökobau.dat is a German database for construction materials and building services provided by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). It has been developed within the framework of the on-going BMUB-sponsored research initiative “Zukunft Bau” by PE International AG, KIT-Institute for Applied Computer Science, and Online Now! GmbH in collaboration with the German building materials industry. The aim is to provide a harmonized database for environmental assessments of buildings and different construction materials, serving as a common basis for all architects, planners and LCA practitioners who seek to make complete cradle to grave analysis of products & services of the building sector. All Ökobau.dat datasets are made available by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). A version for openLCA and SimaPro was created by GreenDelta, including a translation to English; it can be downloaded from <https://nexus.openlca.org/>, in German and English language.

The database comprises more than 1,300 datasets covering diverse building materials, as well as construction, transport and operational processes, which can be broadly grouped into the following categories:

- Mineral building materials
- Insulation material
- Timber products
- Metals
- Lacquers and sealants
- Plastic building materials
- Components of windows, doors and curtains
- Technical installations of buildings
- Others

Ökobau.dat datasets represent “**Environmental product declarations**” (EPDs), as they already contain the quantified environmental impacts of these diverse construction-related products, expressed in a number of so-called “Indikatoren”, i.e. impact categories. Some of the datasets are producer-specific and verified EPD datasets; others are generic (country/market technology average) records, while all datasets are compliant with requirements and methodological

specifications of the DIN EN 15804:2012-04. The DIN EN 15804 is the German equivalent to the European EN 15804 standard, titled “Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products”, which sets the methodological framework for quantifying and communicating the environmental impacts associated with the life cycle of construction materials and buildings.

## 2. Ökobau.dat in openLCA

Like many databases, Ökobau.dat can also be imported into openLCA and used for performing complete life cycle assessments of construction work and buildings (under German conditions).

However in contrast to more common databases, datasets in Ökobau.dat do not contain details on **separate material & energy inputs** into processes, nor do they provide information on **specific emissions** from processes, on upstream processes or on other aspects of a product system, which can usually be manually edited for each individual process in other databases with non-EPD datasets. On the other hand, having datasets in EPD-format means that processes in Ökobau.dat contain finalized **category indicator results** and thus do not require a separate impact assessment. The following sub-chapters discuss these differences and features of Ökobau.dat in more detail.

### 2.1 Importing Ökobau.dat into openLCA

Ökobau.dat can be easily imported into openLCA like all other databases. If you right click the navigation pane on the openLCA software window, and select “import database”, you can then search for the Ökobau.dat file (in .zolca-format) which you downloaded from Nexus and select it. The database will be imported into openLCA and can be activated by double-clicking it.

### 2.2 How Ökobau.dat looks like in openLCA

#### A- Elementary and product flows

Common databases, such as ecoinvent, GaBi, ELCD etc., provide a large number of **elementary flows**, as well as product and waste flows, which can be used as specific inputs or outputs of unit processes. In **Ökobau.dat there are no elementary flows as such**. Instead so-called

“**Indikatoren**” constitute the only “elementary” flows in the database (*see* Figure 1). They are environmental impact categories, which show the aggregated contributions of a product or a process to relevant ecologic and economic aspects (indicators), such as emissions to soil, water and air, resource depletion or generation of solid wastes. These “*indicator elementary flows*” provide the means for expressing the environmental impact of the included construction products & services in correspondence with an EPD-format. Examples of such indicator flows are:

- Stratospheric ozone depletion potential (ODP), expressed in CFC 11-eq.
- Use of fresh water (FW)
- Radioactive waste disposal (RWD)
- Exported electric energy (EEE)
- Hazardous waste disposal, to landfill (HWD)
- Abiotic depletion potential for non-fossil resources, ADP-elements (ADPE), expressed in Sb-eq.
- Acidification Potential of soil and water (AP), expressed in SO<sub>2</sub>-eq.
- ...

In addition to the (“elementary”) indicator flows, Ökobau.dat comprises **product flows**, which represent the **outputs** of production processes in the database, outputs of waste treatment processes and outputs of other operations and services available as process datasets in Ökobau.dat (see Figure 1).

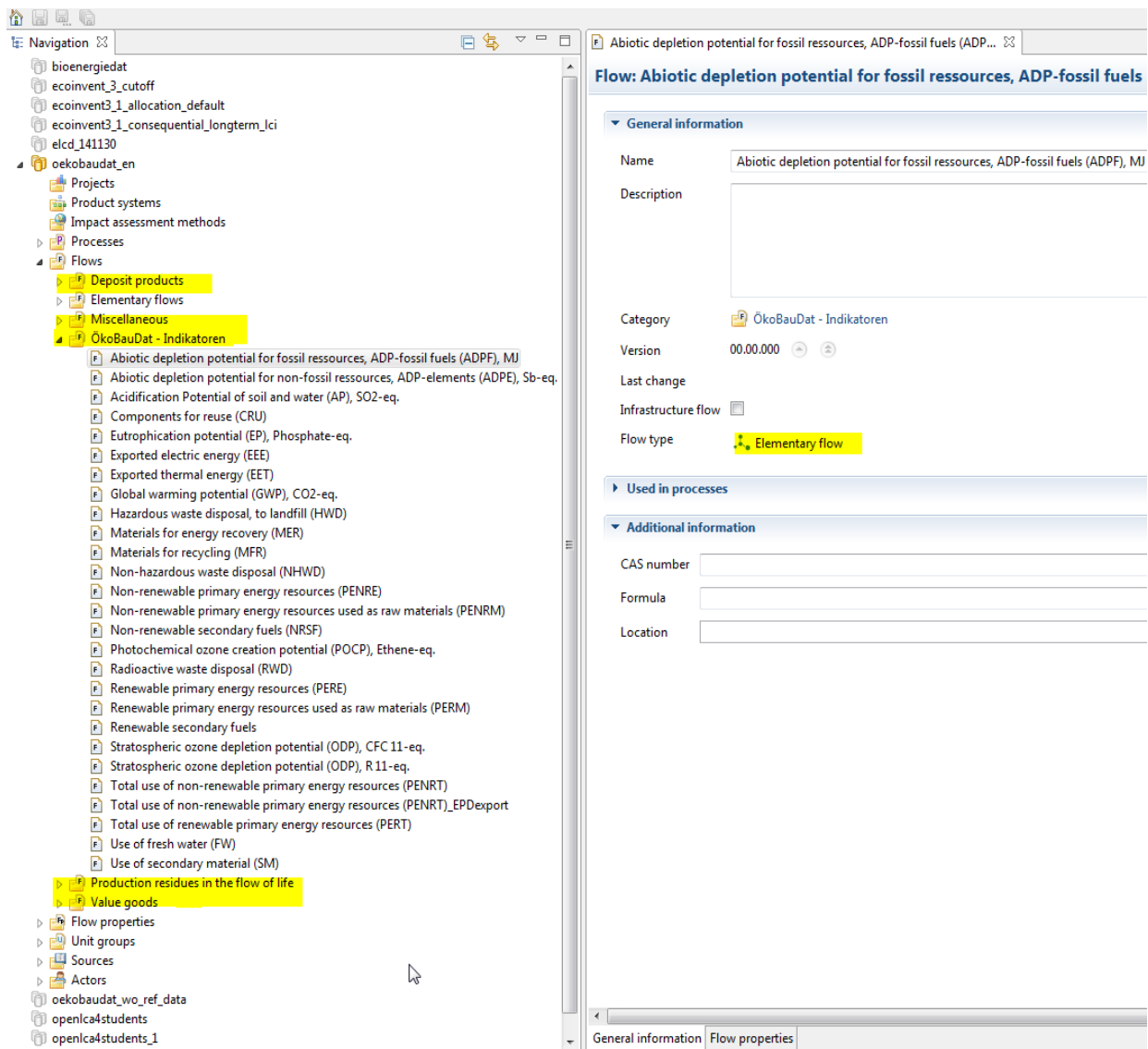
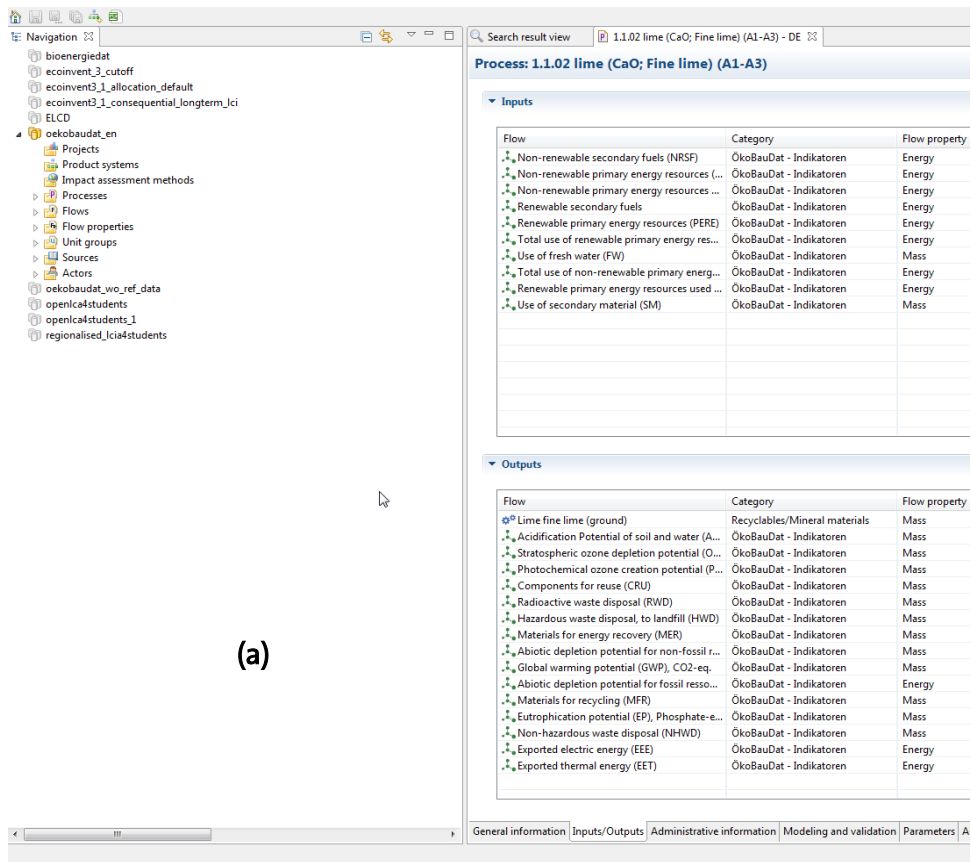


Figure 1: Elementary and product flows in Ökobau.dat<sup>1</sup>

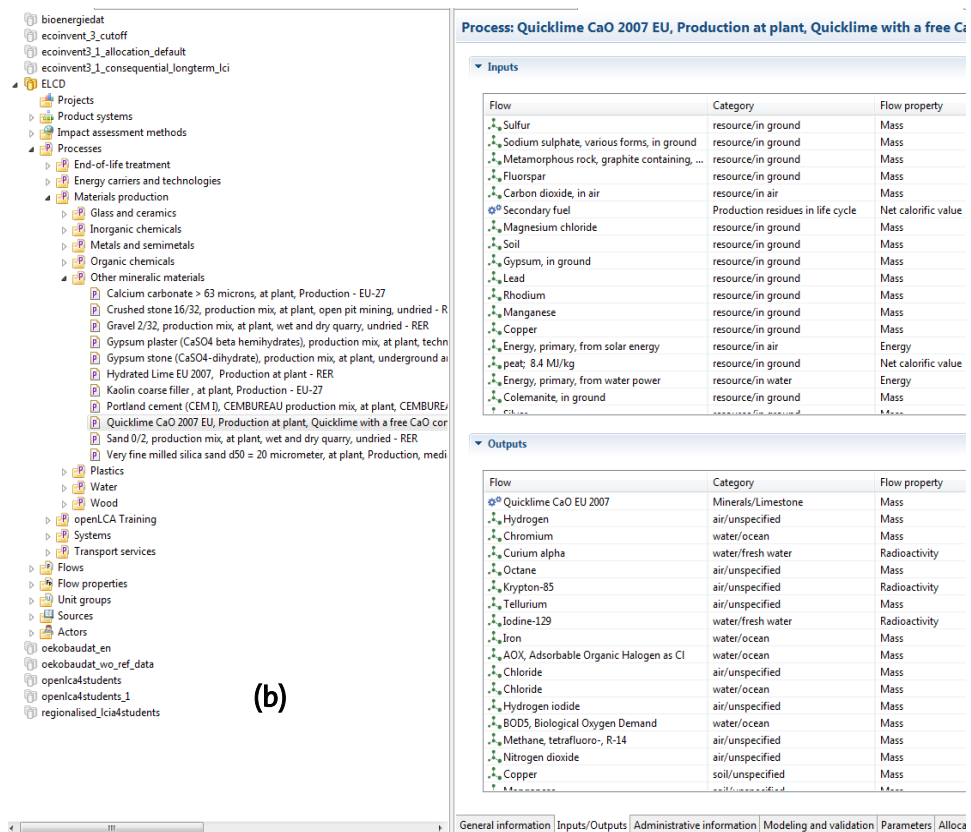
## B- Processes

Contrary to commonly used databases (e.g. GaBi), where input and output flows of processes usually show **aggregated inventory results** of the raw materials & energy consumed & of the specific emissions produced over the whole life cycle of the modelled system, processes in Ökobau.dat show already **aggregated impact assessment results** (category indicator results) as “elementary” inputs and outputs of processes. For illustration of this core difference between regular process datasets and EPD datasets, Figure 2 shows a similar process – the production of lime – both in Ökobau.dat and in the ELCD database.

<sup>1</sup> Note that the “elementary flows” tab shown in the database’s navigation comprises the reference data, which can be automatically imported in openLCA with a new database. They are not elementary flows of Ökobau.dat.



(a)



(b)

Figure 2: Input and output flows of unit processes in Ökobau.dat vs. ELCD; (a) Process: lime (CaO, Fine lime) production in Ökobau.dat, (b) Process: Quicklime (CaO) production in ELCD

The “indicator flows” used as inputs & outputs of processes in Ökobau.dat may or **may not** be accounting for **upstream material & energy inputs** and **pre-chain emissions** depending on the specific system-boundary set for each process, i.e. the **life cycle stages** included in the impact assessment. The EN15804 defines six different life cycle stages, each composed of pre-defined “**information modules**” which constitute the total environmental interventions of a product in the respective stage of its supply chain: the product stage (modules A1-A3), the construction process stage (modules A4, A5), the use stage – related to the building fabric (modules B1-B5), the use stage – related to the operation of the building (modules B6, B7), the end-of-life stage (modules C1-C4), and benefits and loads beyond the system boundary (module D) (*for further details, see* information box 1). This subdivision of a product’s supply chain in life cycle stages and their constituent information modules is reflected consistently in the structure of Ökobau.dat. All available process datasets comprise the EPD information of a construction material, product or service in **one** separate life cycle stage, i.e. in the product’s production, use or disposal phase (*see* Figure 3). Any aggregated EPD information over several life cycle stages must be created manually (*see* section 2.2, C- LCAs from cradle to grave). The life cycle stage and the information modules which have been included for calculating the indicator flows (impact assessment results) of a given process are pointed out in each process’s name and in the dataset’s general description field. For instance, the process “**5.1.01 exterior paint primer dispersion (A1-A3)**” includes the impact assessment results of the ‘product stage’ (modules A1-A3) of the material at hand.



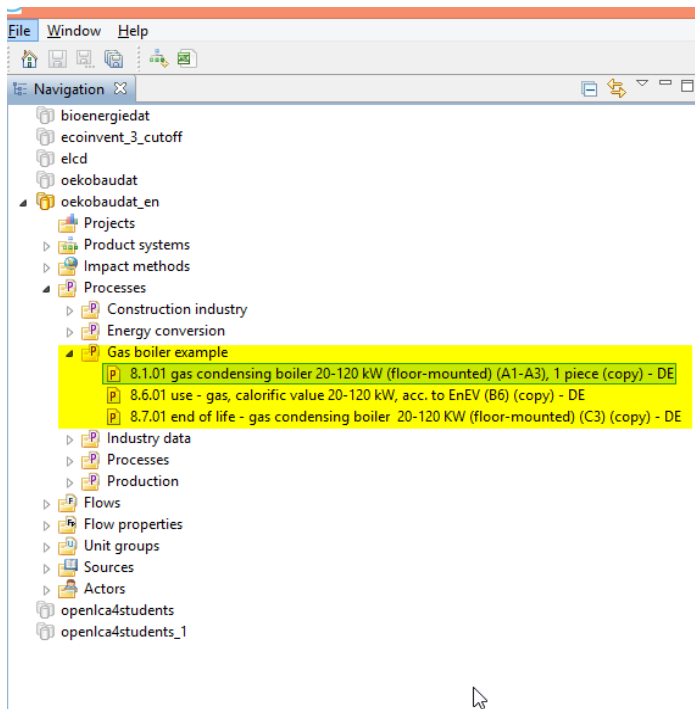


Figure 3: Available datasets for the life cycle stages “product stage”, “use stage” and “end-of-life stage” of a gas condensing boiler in Ökobaudat

### Information box 1: Life cycle stages and their constituent information modules acc. to the EN15804

The product category rules for environmental product declarations of construction products and construction services as brought forward by the European standard EN15804:2012 adopt an “information modules” approach with respect to the life cycle stages covered by an EPD. The environmental information in a cradle to grave EPD shall thus be subdivided into the following life cycle stages and information module groups:

- **The ‘Product stage’ comprising:**

A1 – raw material supply, including processing of secondary material input

A2 – transport of raw material and secondary material to the manufacturer

A3 – manufacture of the construction products, and all upstream processes from cradle to grave

Modules A1-A3 thereby account for all upstream processes for the production stage of a given building material, including raw material extraction, manufacture and transport of intermediate products, processing of secondary input materials (e.g. recycling processes) and their transport to the production plant, provision of all auxiliary and operation materials and energy, the actual manufacturing process of the product at hand, as well as for the complete waste treatment or landfilling of waste streams arising along the entire production phase (cradle to gate). The “product stage” (modules A1-A3) covers the minimum number of processes that must be present in an EPD.

Note: modules A1, A2, and A3 may be declared as one aggregated module A1 - A3.

- **The ‘Construction Process stage’ comprising:**

A4 – transport of construction products to the building site

A5 – the building installation/ construction

- **The ‘Use stage’ – related to the building fabric comprising:**

B1 – use of the installed product, service or appliance (refers to e.g. the release of substances from painted surfaces over the use phase; emissions arising during assembly/ application phase – e.g. emissions during application of facade paints – are counted in module A5)

B2 – maintenance of the product

B3 – repair of the product

B4 – replacement of the product

B5 – refurbishment of the construction product

- **The ‘Use stage’ – related to the operation of building comprising:**

B6 – operational energy

B7 – operational water use

This use stage also includes processing and transportation of any waste arising on site from the use of energy/water.

- **The ‘End-of-life stage’ comprising:**

C1 – demolition of the building/building product

C2 – transport of the demolition waste or the end-of-life construction product to waste processing facility

C3 – waste processing operations for reuse, recovery or recycling

C4 – final disposal of end-of-life construction product

The end-of-life stage of a construction product starts when it is replaced, dismantled or deconstructed from the building (or at the building’s end-of-life) and does not provide any further functionality.

- **‘Benefits and loads beyond the system boundary’:**

D – reuse/ recovery/ recycling potential evaluated as net impacts and benefits.

Whenever any product system outputs have reached the end-of-waste state (i.e. they can be commonly used for specific purposes, there is an existing market for them, they fulfil technical requirements for specific purposes and their use will not lead to overall adverse effects), the benefits or loads from the use of such end-of-waste state materials in another product system (i.e. beyond the system boundary) are reported in this module.

Depending on the life cycle stages included in an EPD and their constituent modules, three types of EPDs can be created: cradle to gate, cradle to gate with options, and cradle to grave. Only a ‘cradle to grave EPD’ allows for products comparison, provided they share the same functionality (functional unit).

## C- Impact Assessment Method

As there is no common life cycle impact assessment method (e.g. CML2001, IPCC2007, ReciPe etc.), which recognizes the “indicator-flows” of Ökobau.dat and assigns them to impact categories with related characterization factors, a new life cycle impact assessment method has been created in openLCA for use in combination with Ökobau.dat. The impact categories of this method are **equivalent to the “Ökobau.dat indicators”**. Given that these “indicator flows” are already aggregated category indicator results (impact assessment results), the ÖKOBAUDAT impact assessment method attributes a **characterization factor of 1** to each indicator flow to turn the seemingly “inventory results” into “category indicator results” (see Figure 4). Adding a new impact assessment method despite Ökobau.dat datasets already containing the finalized impact assessment allows the user to utilize all available features in openLCA for the analysis, graphic representation and discussion of the LCIA results (e.g. impact category contributions, contribution tree, Sankey diagram etc.).

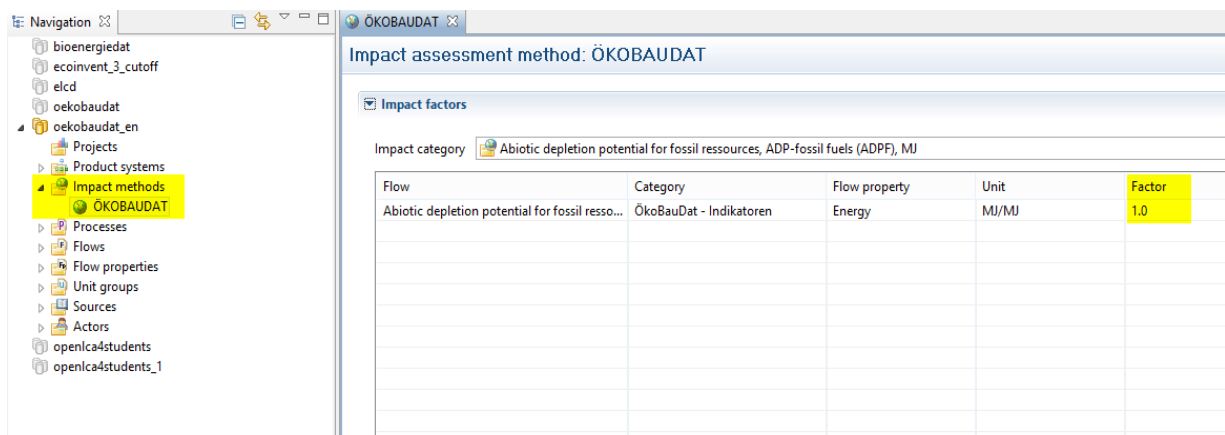


Figure 4: Impact assessment method ÖKOBAUDAT for use in combination with the database

## 2.3 Working with Ökobau.dat in openLCA

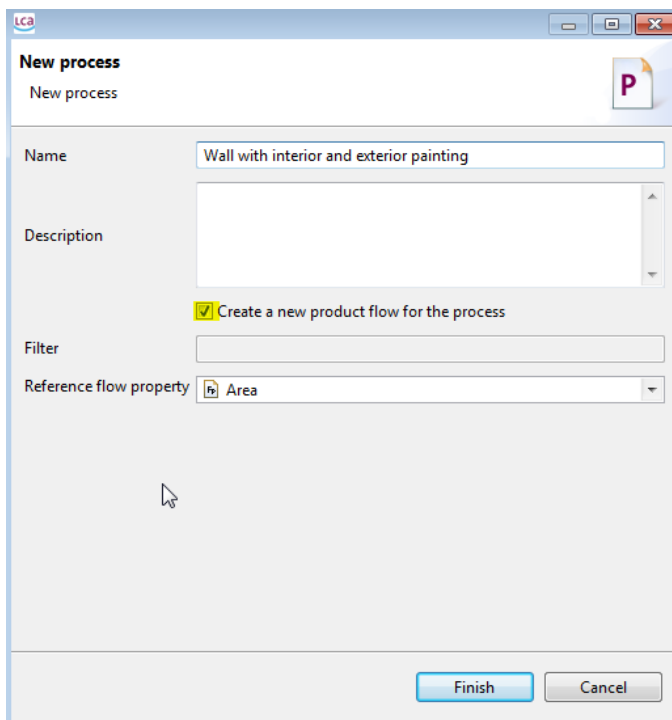
### A- Creating new processes

Ökobau.dat includes EPD datasets for building materials (e.g. cement), for product components (e.g. bricks), for building elements assembled from materials or components (e.g. external wall), as well as for different house appliances (e.g. air conditioner) and construction services (e.g. excavation).

**Adding a new process** for any new building material, component, equipment or service requires **one of two things**:

- (1) either already existing EPD results for the product of interest, comprising all environmental information of the product over its life cycle stages. The EPD information can be then translated into inputs and outputs of a new process, using the Ökobau.dat “elementary” indicator flows, **or**
- (2) the process to be added represents an assembly of materials, products or components, for which product flows (and associated background EPD information/ environmental impacts) exist in the database and can be used as input flows into the new process.

The second option allows evaluating the sustainability of entire buildings over their different life cycle stages (construction, use, demolition) by incorporating the separate EPD results of all the constituent materials, product components and construction/ deconstruction operations into one product system and calculating the associated LCIA results. For illustration, a new hypothetical process for the creation of a wall with interior and exterior painting will be added in openLCA, using product inputs which already exist in the database (*see* Figure 5)



Process: Wall (with interior\_exterior painting)

Inputs							
Flow	Category	Flow property	Unit	Amount	Uncertainty	Default provi...	Pedigree unc...
Expanded clay, lightweight c...	Recyclables/Mineral ...	Volume	m3	0.3	none		
Paint (silicate emulsion)	Recyclables/Mineral ...	Mass	kg	1.0	none		
Facade paint	Recyclables/Mineral ...	Mass	kg	1.0	none		
Primers and facade paints (sil...	Recyclables/Coatings	Mass	kg	1.0	none		
Outputs							
Flow	Category	Flow property	Unit	Amount	Uncertainty	Avoided prod...	Pedigree unc...
Wall (with interior& exterior ...		Area	m2	1.0	none		

Figure 5: Input and output flows for a hypothetical process of creating a wall with exterior and interior painting using existing Ökobau.dat datasets

### B- Life cycle impact assessment using Ökobau.dat

As previously mentioned, processes in Ökobau.dat do not require a separate LCIA. The “indicator flows” used as elementary input and output flows of processes are already aggregated impact assessment results. Consequently, there is no need to perform the typical classification and characterization steps of an LCIA as is the case in regular databases. Due to this constellation, “quick LCIA results” of a product system are possible to calculate in openLCA without the use of any impact assessment method.

To calculate the LCIA results of the above example process – wall with exterior and interior painting – a product system on the basis of this process must first be created (see Figure 6&7). Calculating “Quick results” of the product system will provide an analysis of **flow contributions** to the product system, i.e. the aggregated environmental profile of the created wall (see Figure 8).

Figure 9 on the other hand shows the LCIA results of the same product system, if the LCIA method ÖKOBAUDAT is used for the calculation of results instead of only calculating “Quick results” using no LCIA method. In this case, the LCIA analysis results utilize more features and tools of openLCA.

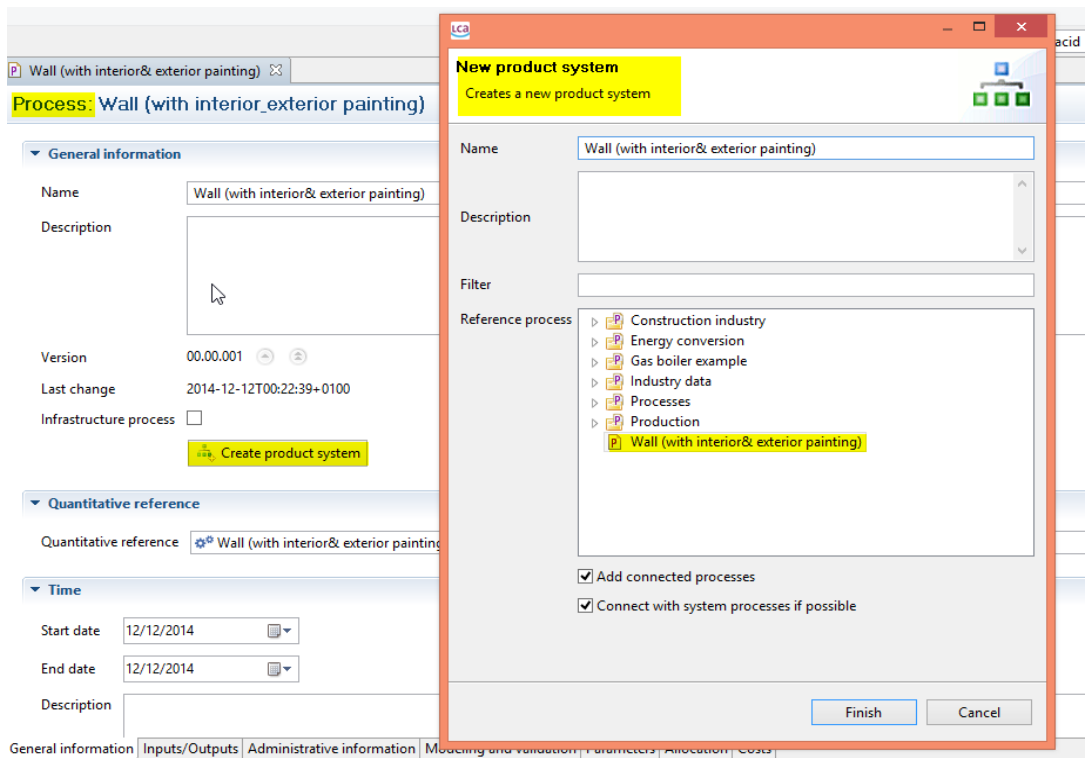


Figure 6:

Creation of a product system on the basis of the hypothetical process of creating a wall with exterior and interior painting

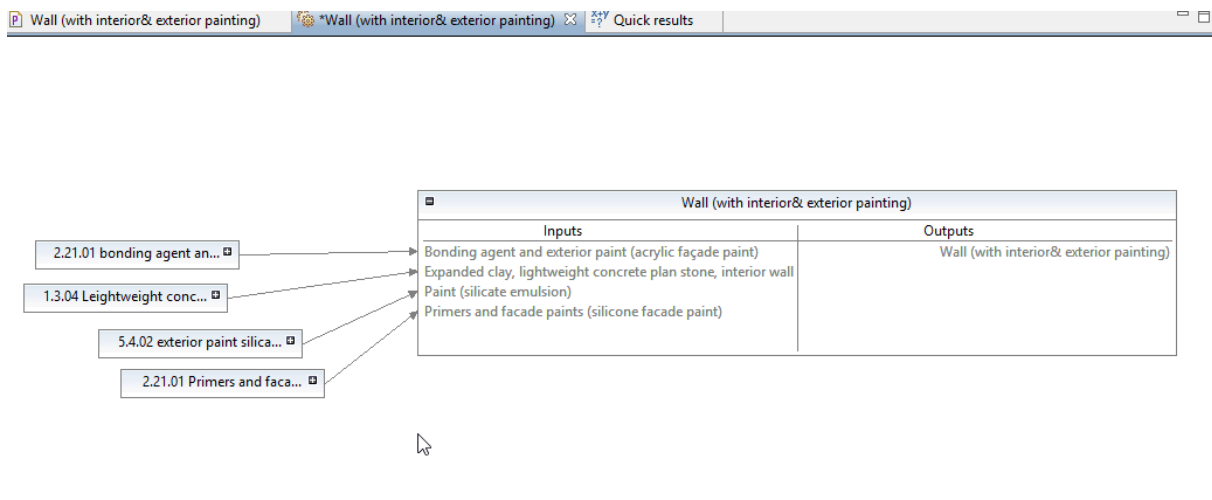


Figure 7: Model Graph of the hypothetical product system “wall with exterior and interior painting”

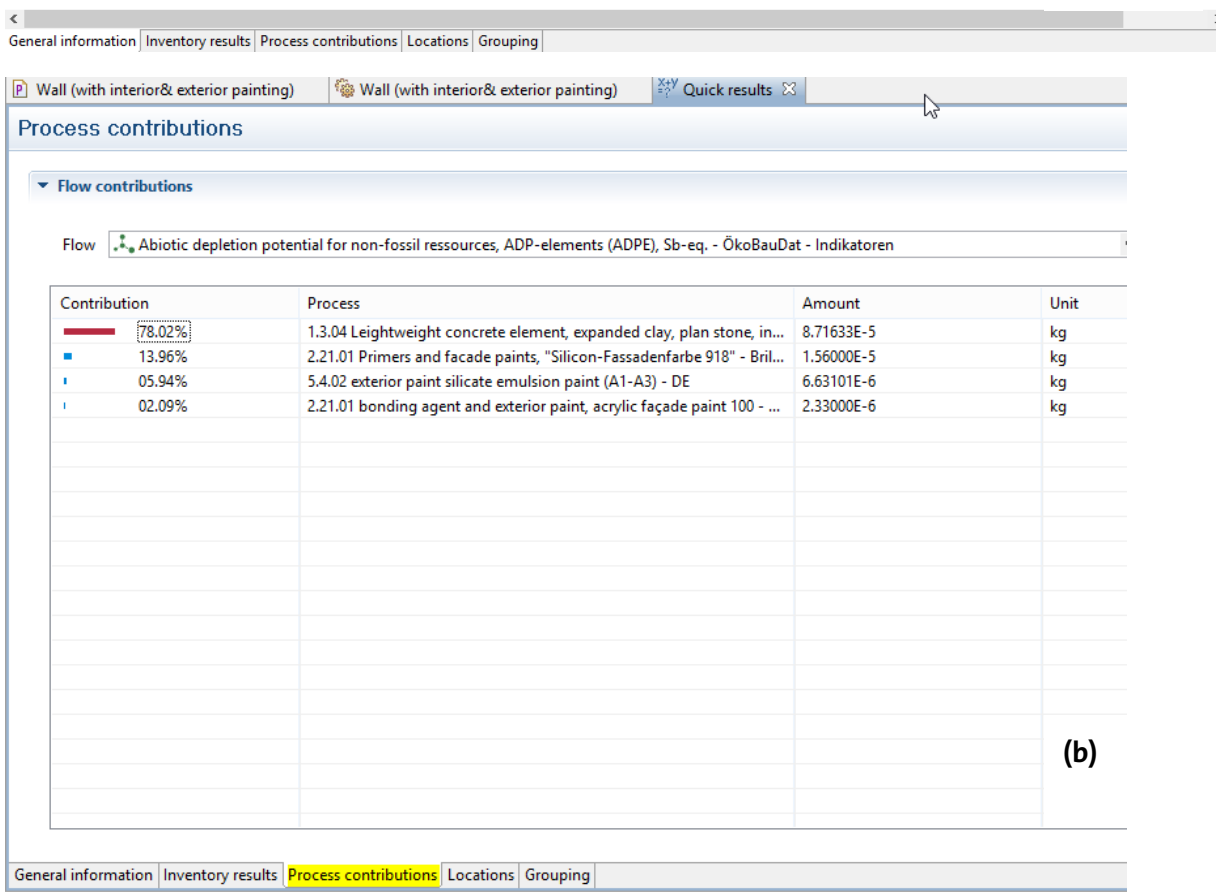
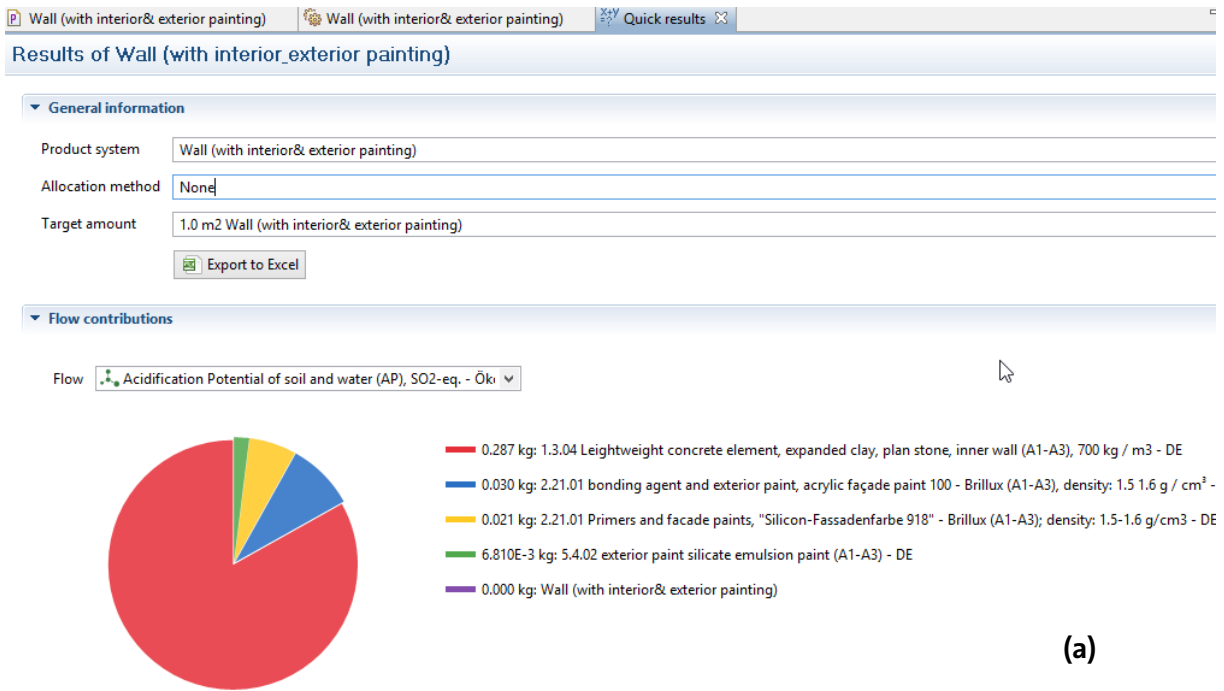


Figure 8 (a, b): Quick results for the product system "wall with interior and exterior painting" in Ökobau.dat; no LCIA method applied.

## Analysis result of Wall (with interior\_exterior painting)

**General information**

Product system: Wall (with interior& exterior painting)

Target amount: 1.0 m2 Wall (with interior& exterior painting)

Impact method: ÖKOBAUDAT

[Export to Excel](#)

**Flow contributions**

**Impact contributions**

Impact category: Total use of non-renewable primary energy resources (PEN)

■ 7.542E2 MJ: 1.3.04 Leightweight concrete element, expanded clay, plan stone, inner wall (A1-A3), 700 kg / m3 - DE  
■ 32.500 MJ: 2.21.01 bonding agent and exterior paint, acrylic façade paint 100 - Brillux (A1-A3), density: 1.5 1.6 g / cm<sup>3</sup> - DE  
■ 28.447 MJ: 5.4.02 exterior paint silicate emulsion paint (A1-A3) - DE  
■ 26.300 MJ: 2.21.01 Primers and facade paints, "Silicon-Fassadenfarbe 918" - Brillux (A1-A3); density: 1.5-1.6 g/cm3 - DE  
■ 0.000 MJ: Wall (with interior& exterior painting)

(a)

## Process contributions

**Flow contributions**

Flow: Stratospheric ozone depletion potential (ODP), R 11-eq. - ÖkoBauDat - Indikatoren

Contribution	Process	Amount	Unit
66.18%	2.21.01 Primers and facade paints, "Silicon-Fassadenfarbe 918" - Brillux (A1-A3); density: 1.5-1.6 g/cm3 - DE	2.70000E-8	kg
33.82%	2.21.01 bonding agent and exterior paint, acrylic façade paint 100 - Brillux (A1-A3), density: 1.5 1.6 g / cm <sup>3</sup> - DE	1.38000E-8	kg

**Impact contributions**

Impact category: Stratospheric ozone depletion potential (ODP), R 11-eq.

Contribution	Process	Amount	Unit
66.18%	2.21.01 Primers and facade paints, "Silicon-Fassadenfarbe 918" - Brillux (A1-A3); density: 1.5-1.6 g/cm3 - DE	2.70000E-8	kg R11-Äqv.
33.82%	2.21.01 bonding agent and exterior paint, acrylic façade paint 100 - Brillux (A1-A3), density: 1.5 1.6 g / cm <sup>3</sup> - DE	1.38000E-8	kg R11-Äqv.

## Contribution tree

Flows: Stratospheric ozone depletion potential (ODP), R 11-eq. - C

Impact categories: Radioactive waste disposal (RWD)

Contribution	Process	Amount	Unit
100.00%	Wall (with interior& exterior painting)	0.02358	kg
87.21%	1.3.04 Leightweight concrete element, expanded clay, plan stone, in...	0.02056	kg
05.05%	2.21.01 Primers and facade paints, "Silicon-Fassadenfarbe 918" - Brillux (A1-A3); density: 1.5-1.6 g/cm3 - DE	0.00119	kg
04.22%	5.4.02 exterior paint silicate emulsion paint (A1-A3) - DE	0.00099	kg
03.52%	2.21.01 bonding agent and exterior paint, acrylic façade paint 100 - Brillux (A1-A3), density: 1.5 1.6 g / cm <sup>3</sup> - DE	0.00083	kg

(c)

Figure 9: (a, b, c): Analysis results for the product system "wall with exterior and interior painting" in Ökobau.dat, using the LCIA method ÖKOBAUDAT



## C- LCA from cradle to grave

For certain construction materials and building products in Ökobau.dat environmental impact information is available for all their life cycle stages (e.g. for all technical building installations such as appliances for lighting, heating, ventilation, transport between floors etc.). If datasets for several life cycle stages/ information modules of a given product exist, they can be merged into one product system for a consideration of the full life cycle of the respective product.

Taking the same example from above, several datasets are available in Ökobau.dat for the different life cycle stages of a gas condensing boiler:

- For the product phase (modules A1-A3): “8.1.01 gas condensing boiler 20-120 kW (floor-mounted) (A1-A3), 1 piece”
- For the use stage, related to operation of building (modules B6, B7): “8.6.01 8.6.01 use - gas, calorific value 20-120 kW, acc. to EnEV (B6)”
- For the end-of-life stage (modules C1-C4): “8.7.01 end of life - gas condensing boiler 20-120 KW (floor-mounted) (C3)”

To connect all three life cycle stages of the boiler together and calculate the total environmental impacts over its entire life cycle (EPD from cradle to grave), one way is to use the output of each life cycle stage as an input flow of the following stage. Given that many processes in the database may be providing the same output, when doing this, attention must be given to choosing the right “provider process” for the respective input. This is achieved by identifying the “default provider” for the input flow to be exactly the process describing the previous life cycle stage of the modelled product (*see* Figure 10).

Another way of modelling the life cycle would be to use the output of the “use stage” (= the thermal heat) as input in the product stage of the boiler and then the boiler itself is the input into the “end-of-life stage” for waste treatment. In terms of the LCIA results, it doesn’t make any difference in which way we connect the three phases, just from a modelling perspective, this second approach would probably be more intuitive.

Process: 8.1.01 gas condensing boiler 20-120 kW (floor-mounted) (A1-A3), 1 piece (copy)

Inputs

Flow	Category	Flow property	Unit	Amount	Uncertainty	Default provider	Pedigree uncertai...
Use of fresh water (FW)	ÖkoBauDat - Indikatoren	Mass	kg	3299.4905264085	none		
Renewable secondary fuels	ÖkoBauDat - Indikatoren	Energy	MJ	-5.68092160088239	none		
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	498.08	none		
Total use of renewable primary energ...	ÖkoBauDat - Indikatoren	Energy	MJ	3257.64992944622	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	3257.64992944622	none		
Use of secondary material (SM)	ÖkoBauDat - Indikatoren	Mass	kg	134.979187607496	none		
Total use of non-renewable primary e...	ÖkoBauDat - Indikatoren	Energy	MJ	27144.4894391694	none		
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	26646.4094391694	none		
Non-renewable secondary fuels (NRSF)	ÖkoBauDat - Indikatoren	Energy	MJ	-60.7825272897392	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	0.0	none		

(a)

Outputs

Flow	Category	Flow property	Unit	Amount	Uncertainty	Avoided product	Pedigree uncertai...
Gas condensing boiler	Assemblies/Heaters	Mass	kg	283.0	none		
Components for reuse (CRU)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Non-hazardous waste disposal (NHW...	ÖkoBauDat - Indikatoren	Mass	kg	11622.5028850326	none		
Hazardous waste disposal, to landfill (...)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Materials for recycling (MFR)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		

Process: 8.6.01 use - gas, calorific value 20-120 kW, acc. to EnEV (B6) (copy)

Inputs

Flow	Category	Flow property	Unit	Amount	Uncer...	Default provider	Pedigree
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	0.0	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	0.0	none		
Renewable secondary fuels	ÖkoBauDat - Indikatoren	Energy	MJ	3.39716412734724...	none		
Non-renewable secondary fuels (NRSF)	ÖkoBauDat - Indikatoren	Energy	MJ	3.57640765924024...	none		
Use of fresh water (FW)	ÖkoBauDat - Indikatoren	Mass	kg	0.00558053351068...	none		
Total use of non-renewable primary e...	ÖkoBauDat - Indikatoren	Energy	MJ	3.9196545709892	none		
Use of secondary material (SM)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	0.00509791489287...	none		
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	3.9196545709892	none		
Total use of renewable primary energ...	ÖkoBauDat - Indikatoren	Energy	MJ	0.00509791489287...	none		
Gas condensing boiler	Assemblies/Heaters	Mass	kg	283.0	none	8.1.01 gas condensing boiler 20-120 kW (floor-mounted) (A1-A3...	

(b)

Outputs

Flow	Category	Flow property	Unit	Amount	Uncertainty	Avoided product	Pedigree uncertai...
Thermal energy (MJ)	Energy sources/Thermal ene...	Net calorific value	MJ	3.6	none		
Components for reuse (CRU)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Global warming potential (GWP), CO...	ÖkoBauDat - Indikatoren	Mass	kg	0.237560899066978	none		
Eutrophication potential (EP), Phosph...	ÖkoBauDat - Indikatoren	Mass	kg	8.53613247735954...	none		
Hazardous waste disposal, to landfill (...)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Stratospheric ozone depletion potenti...	ÖkoBauDat - Indikatoren	Mass	kg	9.78253256602363...	none		
Photochemical ozone creation potent...	ÖkoBauDat - Indikatoren	Mass	kg	2.45573921194114...	none		
Radioactive waste disposal (RWD)	ÖkoBauDat - Indikatoren	Mass	kg	3.03020570485854...	none		

\*8.7.01 end of life - gas condensing boiler 20-120 KW (floor-mounted) (C3) (copy) - DE \*8.6.01 use - gas, calorific value 20-120 kW, acc. to EnEV (B6) (copy) - DE

Process: 8.7.01 end of life - gas condensing boiler 20-120 KW (floor-mounted) (C3) (copy)

Inputs

Flow	Category	Flow property	Unit	Amount	Uncertainty	Default provider	Pedigree uncertai...
Renewable secondary fuels	ÖkoBauDat - Indikatoren	Energy	MJ	0.01518981763142	none		
Use of fresh water (FW)	ÖkoBauDat - Indikatoren	Mass	kg	1.77851756467384	none		
Total use of non-renewable primary e...	ÖkoBauDat - Indikatoren	Energy	MJ	40.0591573591654	none		
Total use of renewable primary energ...	ÖkoBauDat - Indikatoren	Energy	MJ	1.77229923749739	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	1.77229923749739	none		
Use of secondary material (SM)	ÖkoBauDat - Indikatoren	Mass	kg	0.0	none		
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	40.0591573591654	none		
Non-renewable secondary fuels (NRSF)	ÖkoBauDat - Indikatoren	Energy	MJ	0.06922677280492...	none		
Renewable primary energy resources ...	ÖkoBauDat - Indikatoren	Energy	MJ	0.0	none		
Non-renewable primary energy resou...	ÖkoBauDat - Indikatoren	Energy	MJ	0.0	none		
Thermal energy (MJ)	Energy sources/Thermal ene...	Net calorific value	MJ	3.6	none	8.6.01 use - gas, calorific value 20-...	

(c)

Figure 10 (a,b,c): Inputs and outputs of connected life cycle stages of a “gas condensing boiler, 10-120 kW (floor mounted)”, incl. product stage (A1-A3), use stage (B6) and end-of-life stage (C3)

Creating a product system on the basis of the process “8.7.01 end of life - gas condensing boiler 20-120 KW (floor-mounted) (C3)” and choosing to add all connected process will generate a product system, which comprises all the life cycle stages of the boiler. The model graph of this product system is shown in Figure 11. Like any other product system the LCIA results of the total life cycle of the gas condensing boiler can be calculated using the LCIA method ÖKOBAUDAT (see Figure 12).

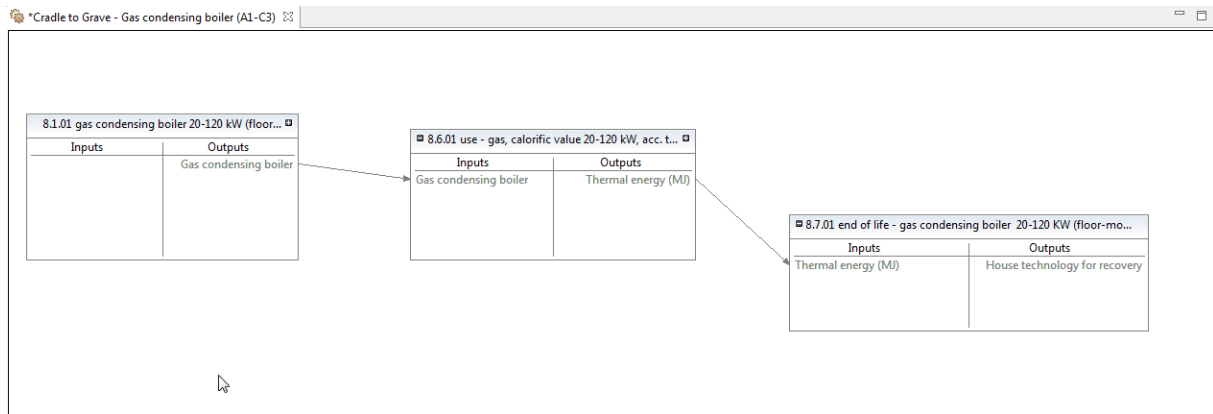


Figure 11: Model graph for the complete life cycle of a “gas condensing boiler”, connecting the Ökobau.dat process datasets for the separate ‘product’, ‘use’, and ‘end-of-life’ stage

## Analysis result of Cradle to Grave - Gas condensing boiler (A1-C3)

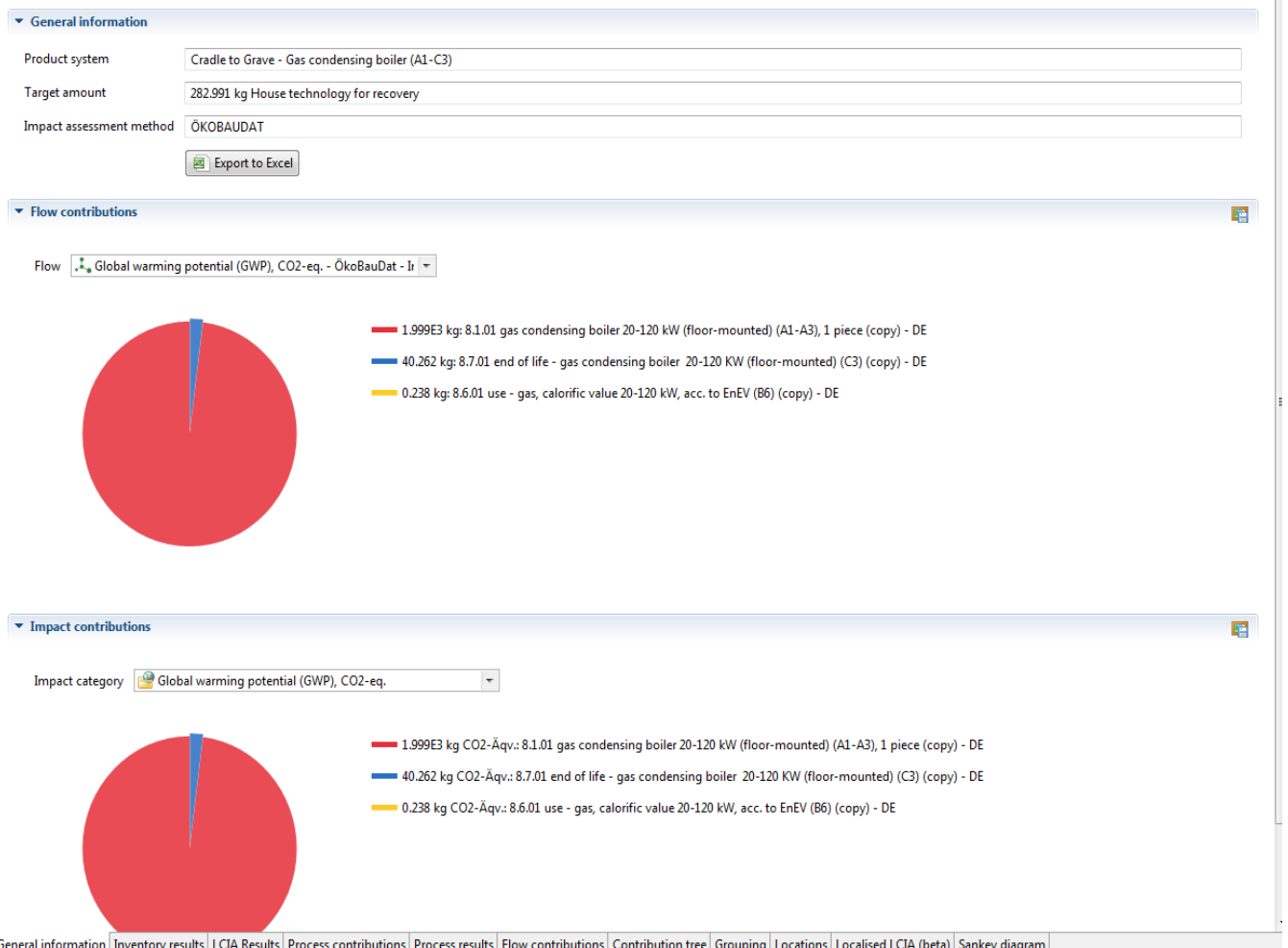


Figure 12: LCIA results for the complete life cycle of a “gas condensing boiler” using Ökobau.dat datasets

### 3. Ökobau.dat in SimaPro

Ökobau.dat can also be imported into SimaPro and used to perform LCAs of complete buildings and construction work. The following section will describe the use of Ökobau.dat in SimaPro (for details on the concept of an EPD database and the general structure of Ökobau.dat, see previous chapter).

#### 3.1 Importing Ökobau.dat into SimaPro

To import Ökobau.dat into SimaPro you have **two options**:

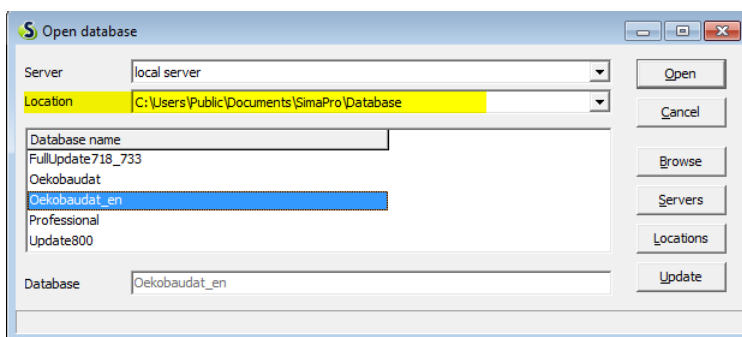
- (1) importing the database using a .zip-file or
- (2) importing the database into an existing SimaPro database.

Each option enables you to use the database in a different way in SimaPro. Below is a description of each option’s advantages and procedures for importing the database.

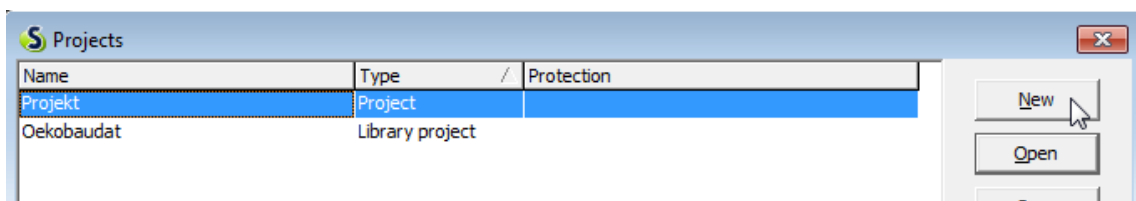
- [Option 1: Importing Ökobau.dat using the .zip-file:](#)

If you choose to download the .zip-file, you can work with Ökobau.dat as a “standalone database”, whose datasets are all contained in a library. You must first unzip the file, preferably into your regular SimaPro “Database” folder, where all your other SimaPro databases are saved. That way, the database will appear in your list of available databases when you run the software and go to "Open SimaPro Database".

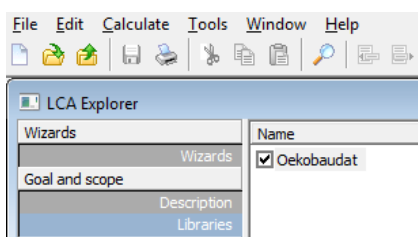
You can then start SimaPro and choose to open Ökobau.dat, either by browsing for the folder where you’ve chosen to unzip the file, or by just selecting the database from your list of SimaPro databases.

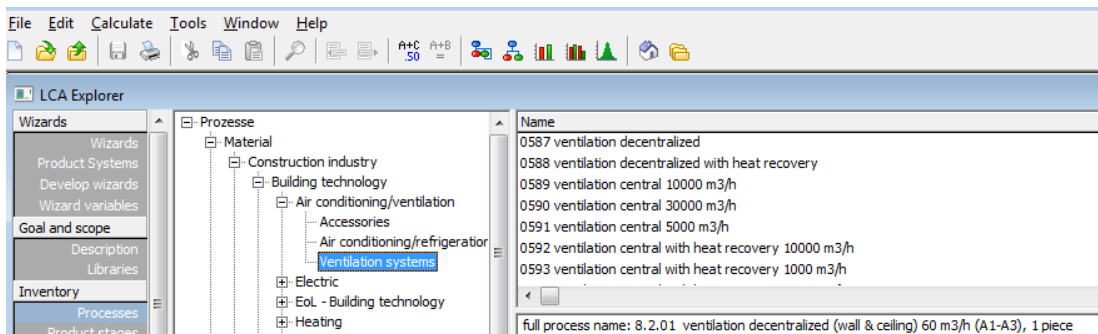


When you have opened the database, you must select an existing project or create a new one in order to begin working with it. A **Library project** will already exist in the database, which only represents the data SimaPro draws back on for this database and is not really a “project” in the strict sense. Therefore, you should always create your own project.



In your now open database and active project, you will find all process datasets of Ökobau.dat in a library. To begin working with these datasets make sure to select the respective library under the tab “Libraries” in the navigation pane of SimaPro.

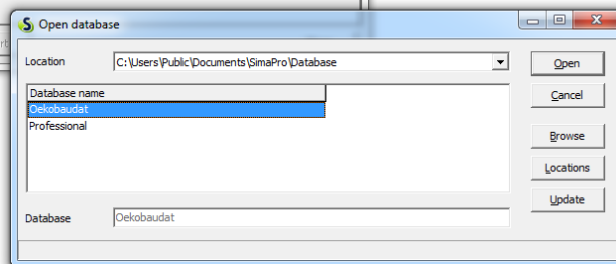
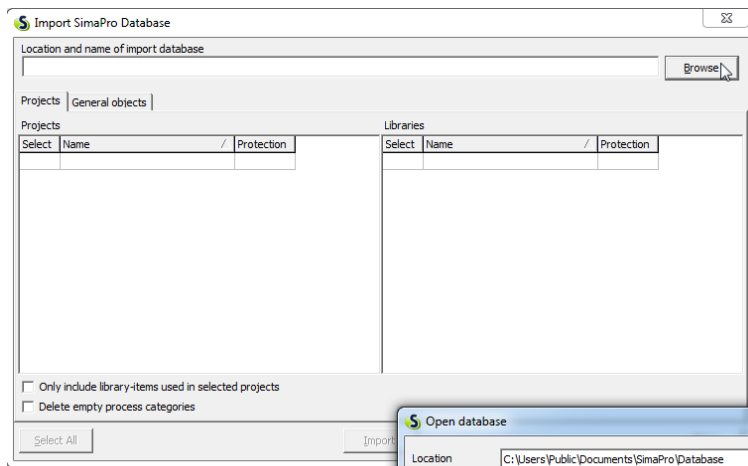
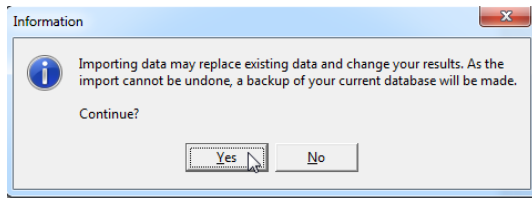
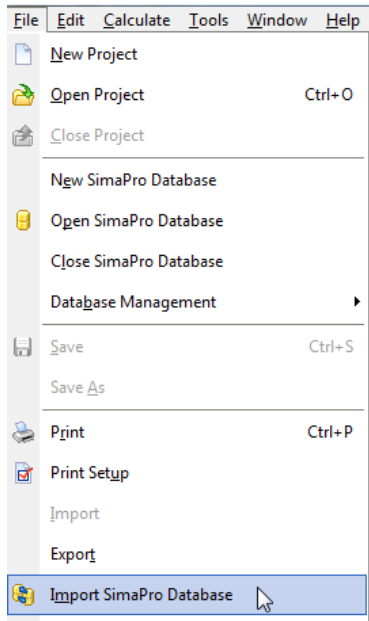


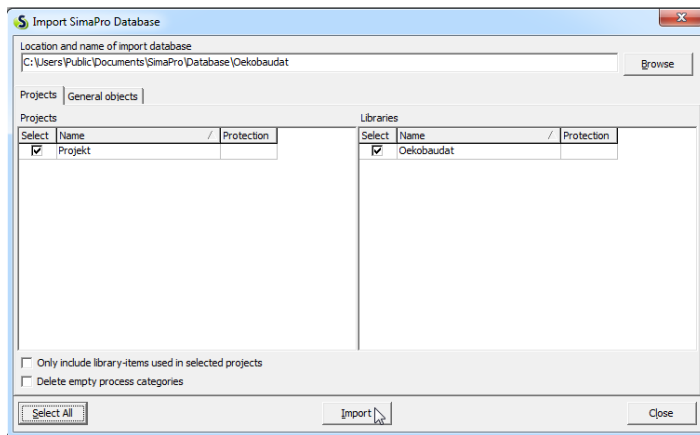


The advantage of having all datasets **in a library** is that, in every new project you create **within this database**, the Ökobau.dat library will be accessible and so will all the datasets it includes. By closing Ökobau.dat and opening another database (e.g. SimaPro Professional) you will not be able to access Ökobau.dat datasets from the “Libraries” tab anymore. If, however, you need to **integrate Ökobau.dat into existing databases** to use its datasets simultaneously with other datasets (option 2).

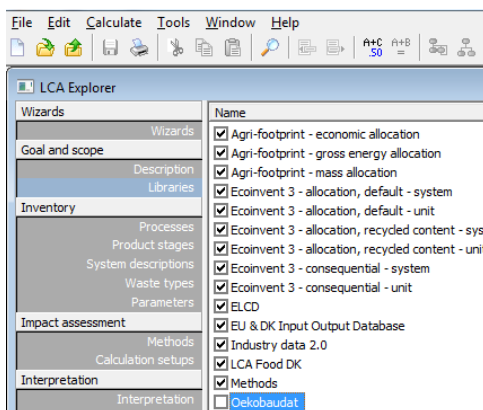
- **Option 2: Importing Ökobau.dat in an existing SimaPro database:**

You can import the Ökobau.dat into an existing database to use its datasets alongside all other already existing datasets of this database. Like in the first option unzip the file, preferably into your regular SimaPro “Database” folder, where all your other SimaPro databases are saved. Start SimaPro and open the database in which the import is to take place. [Click on “File” → “Import SimaPro Database” → click “Yes” to continue → in the opening window browse for the import database and click “Open”. Select all import elements and click on the “Import” button. A window opens, click “OK” and confirm in the next step the import again. SimaPro is doing an automatically backup before the import process begins].





If you open an existing project or you create a new one, the datasets of the Ökobau.dat are available under the tab "Processes - Material - Construction Industry" in the navigation area of SimaPro. Please consider, that the datasets of Ökobau.dat will be accessible through **all projects** of the database as well. If you don't want to use the Ökobau.dat in a project you can unselect it in the LCA Explorer under "Goal and Scope" in the library section.



## 3.2 How Ökobau.dat looks like in SimaPro

### A- Elementary flows

In SimaPro the Ökobau.dat “indicator flows” are found under “substances” as elementary flows. Indicator flows which express the aggregated results on **the use of materials or energy in processes** (e.g. non-renewable primary energy resources or fresh water use), are listed as “raw materials”, while indicator flows expressing the aggregated environmental impact of processes are listed as “non material emissions” (*see* Figure 13).



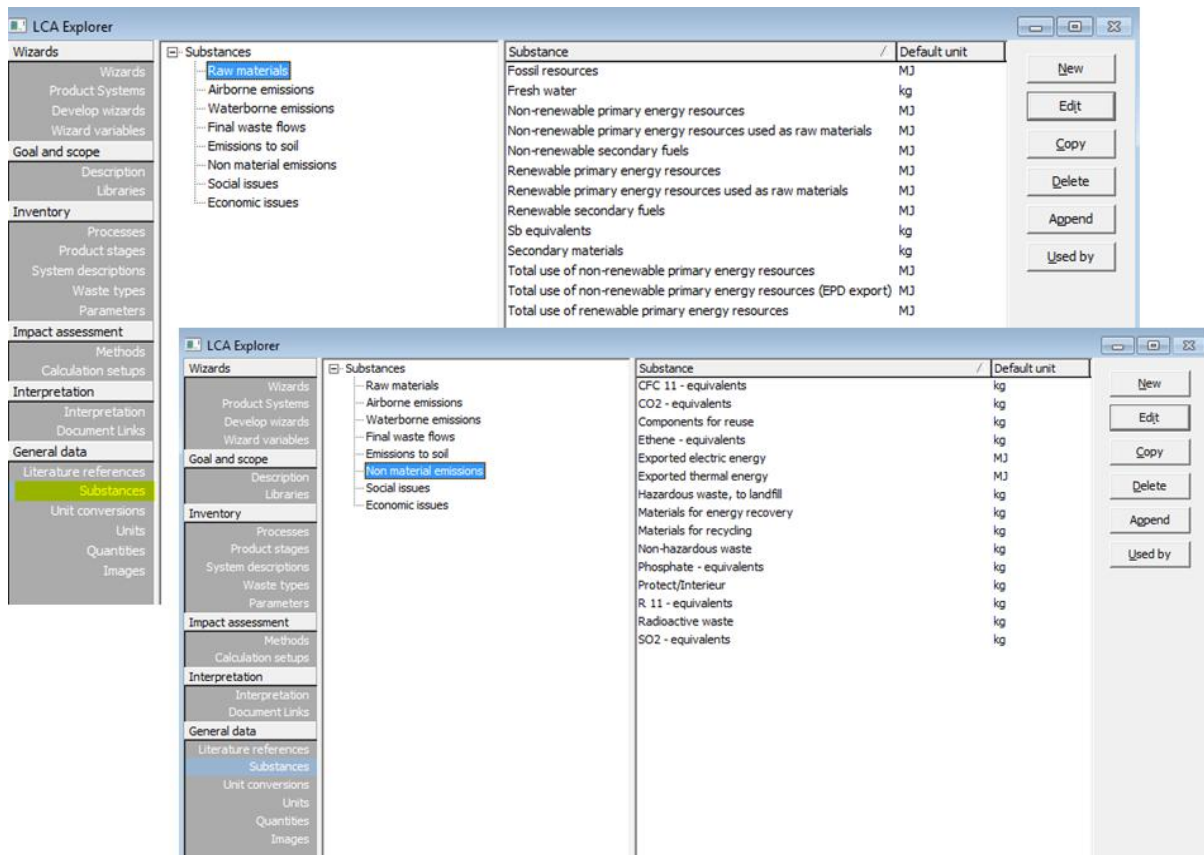


Figure 13: Ökobau.dat “indicator flows” in SimaPro listed as “raw materials” or “non-material emissions”

## B- Processes

All the datasets in Ökobau.dat are imported into SimaPro as *material-producing* processes, even if they are processes of the use (modules B1-B7) or disposal phase (modules C1-C4) of a given product (see Figure 14). The life cycle stages and information modules, which have been included in the calculation of the indicator flows (i.e. the impact assessment results) of each process, are indicated in the ‘comment field’ of each process’s documentation tab (see Figure 15)

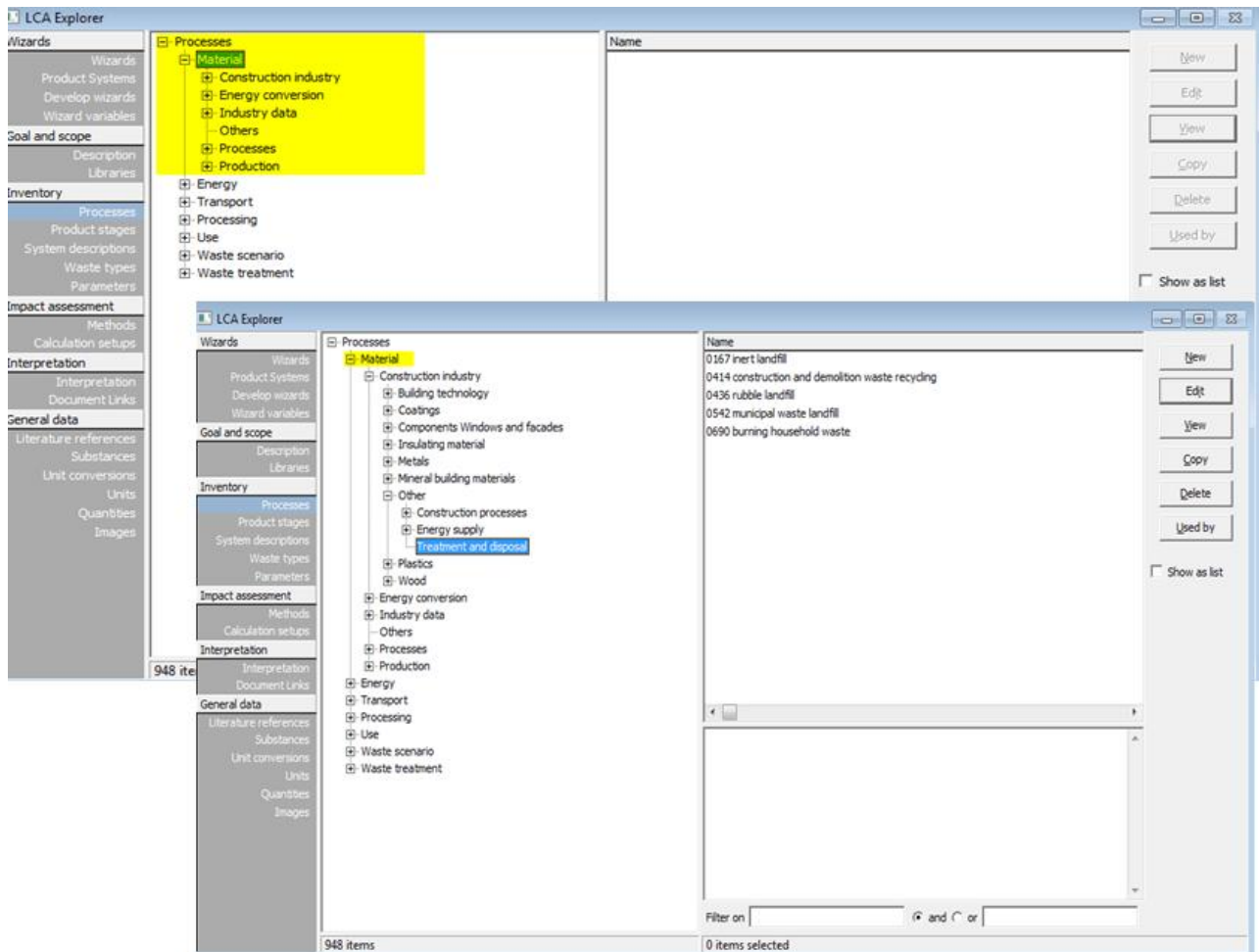


Figure 14: Process datasets of Ökobau.dat listed as “material-producing” processes, including processes of the ‘use stage’ (modules B1 - B7) or the ‘end-of-life’ stage (modules C1-C4) of materials and products in the database

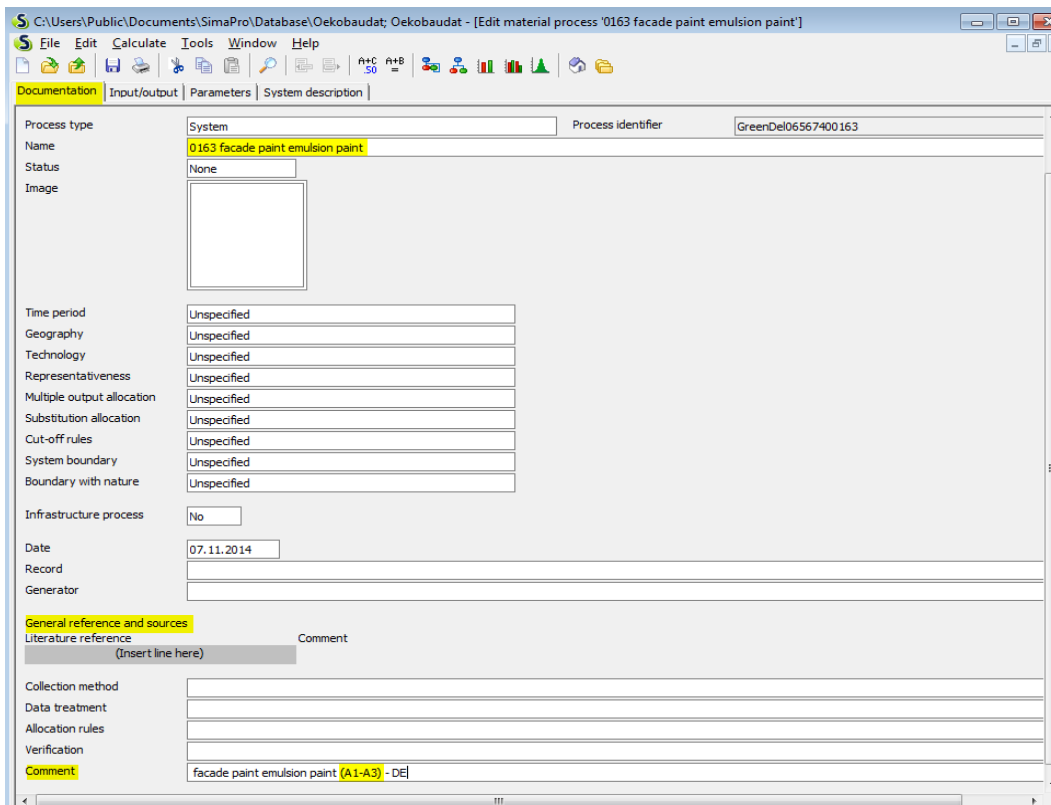


Figure 15: Documentation of processes in Ökobau.dat indicating included information modules

All the included processes show their aggregated impact assessment results as “known inputs from nature” (i.e. raw materials) or as “non-material emissions” – in accordance with the classification of the indicator flows under substances. In addition, each process includes one “known output to technosphere”, which is exactly the **product output** (e.g. 1 kg of cement) or **provided service** (e.g. days of elevator average utilization) of the process dataset at hand. Figure 16 illustrates again the process of ‘lime production’ from Ökobau.dat in SimaPro.

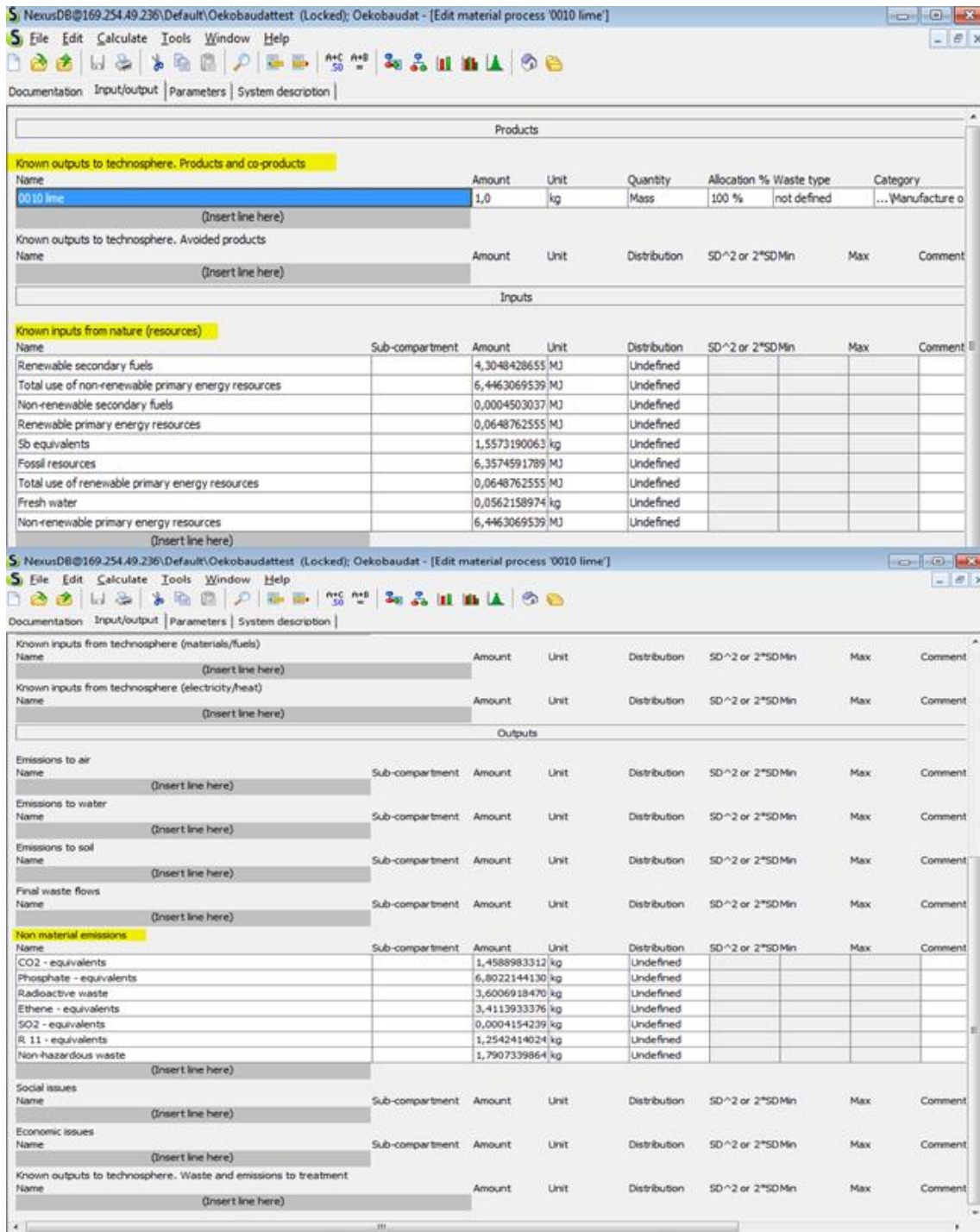


Figure 16: Inputs and Outputs of the process “1.02 lime (CaO; Fine lime) (A1-A3)” in SimaPro, using the Ökobau.dat database. Input & output indicator flows appear either as “inputs from technosphere” or as “non-material emissions”

### C- Impact Assessment Method

Despite containing EPD datasets, a new impact assessment method has been created in SimaPro – “Ökobau.dat” – for use in combination with the database in order to be able to use all features of SimaPro for analysis and graphic representation of impact assessment results.

For each indicator flow an **equivalent impact category** is created, which comprises the associated flow with a characterization factor of 1 (see Figure 17).

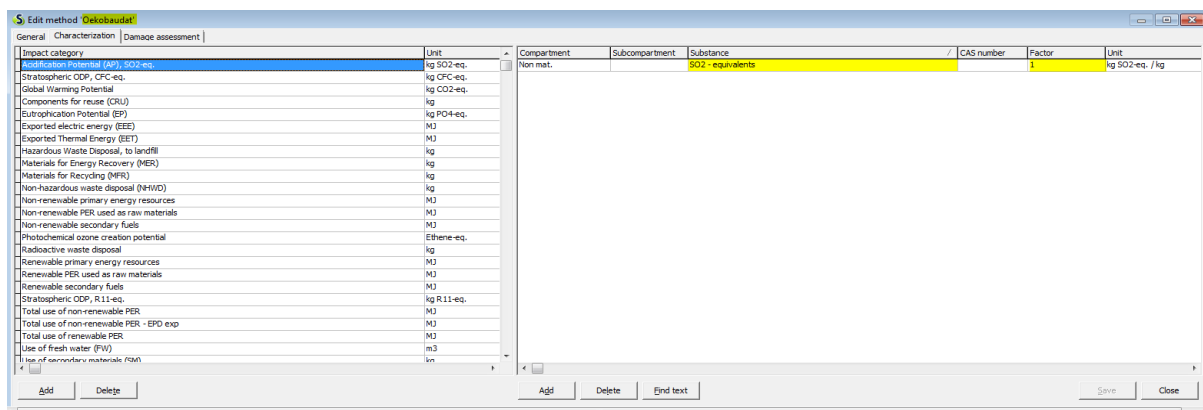


Figure 17: Creating a new LCIA method “Ökobau.dat” for use in combination with the database in SimaPro

### 3.3 Working with Ökobau.dat in SimaPro

#### A- Creating new processes

Similar to openLCA, adding a new process into SimaPro using Ökobau.dat requires either already available EPD results for the product or the new process is an assembly of materials, products and services, which already exist as products in the database.

For illustration, the same hypothetical process used in section 2.2 for the creation of a wall with interior and exterior painting will be created in SimaPro. All construction materials, building components or construction operations available in the database can be used as “known inputs from technosphere” to any newly added process (see Figure 18).

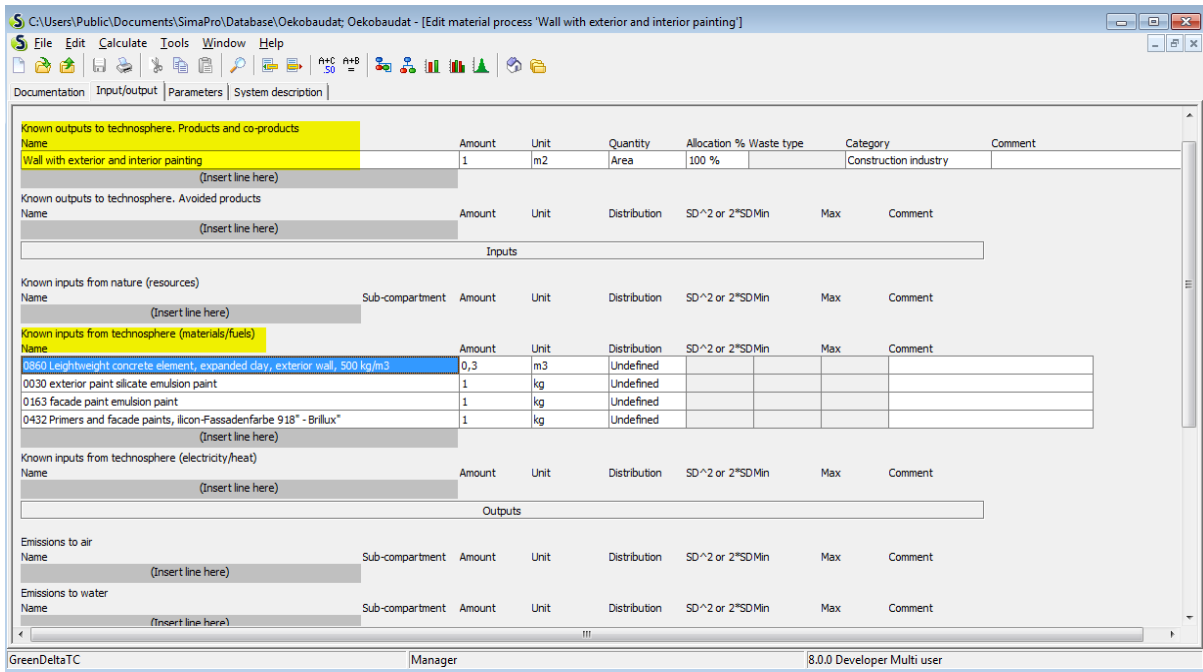


Figure 18: Creating a hypothetical process “wall with exterior and interior painting” in SimaPro using Ökobau.dat

## B- Life cycle impact assessment using Ökobau.dat

For illustration, an LCIA will be performed twice for the newly added process (“wall with exterior and interior painting”): once without using the LCIA method “Ökobau.dat” and once with application of the method.

Calculating “Analysis results” in SimaPro without indicating an impact assessment method, will allow the user to see **inventory results, a network diagram and a tree diagram**. Since the “inventory results” of EPD datasets (or combinations of several EPD datasets into one product) are already aggregated impact assessment results, all three features of SimaPro show the environmental impacts of the created wall without choosing an impact assessment method, yet with fewer possibilities to analyze/ interpret and illustrate the results (*see* Figure 19). Figure 20 shows the analysis results of the same process, with utilization of the impact assessment method “Ökobau.dat”.

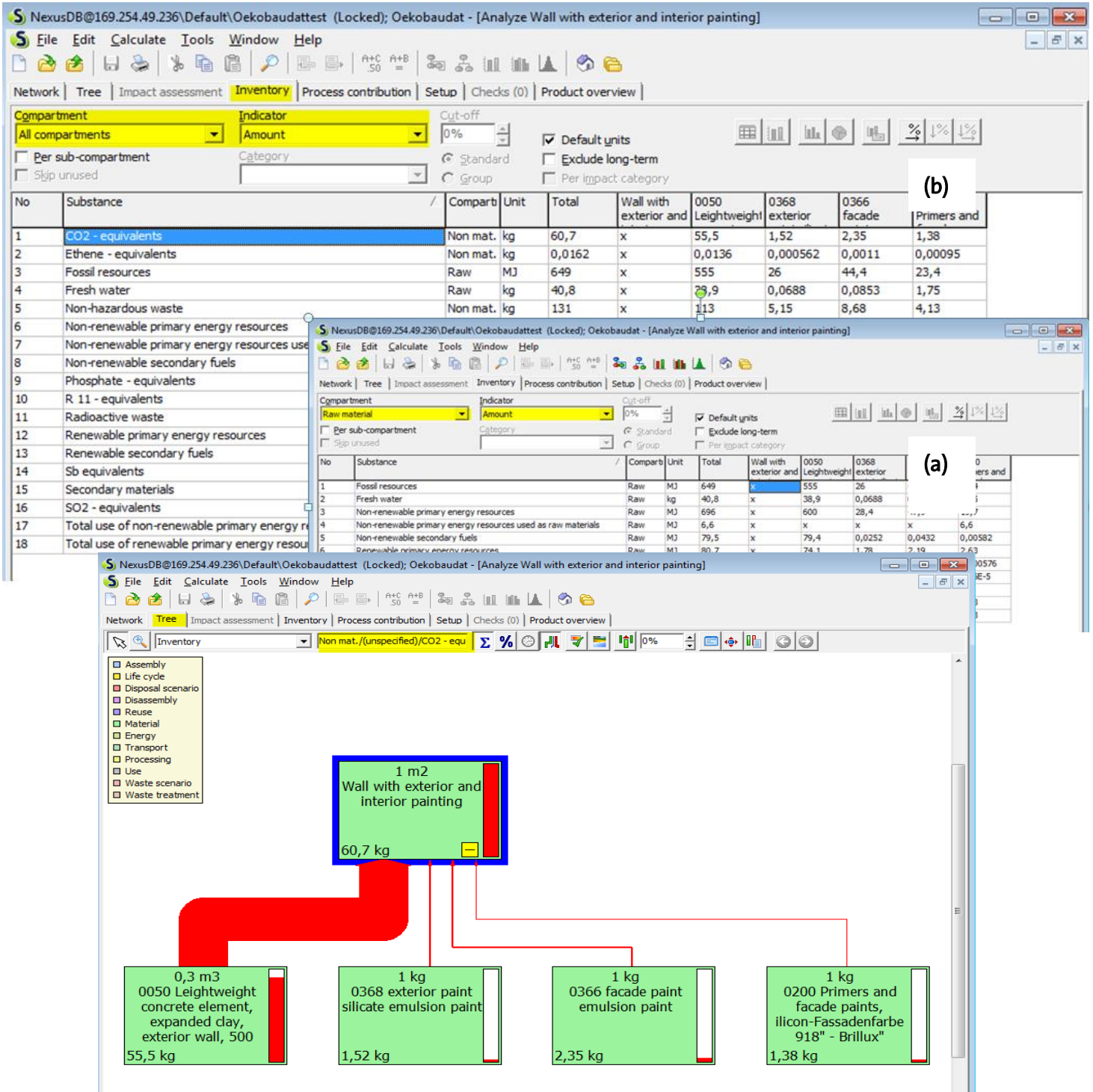
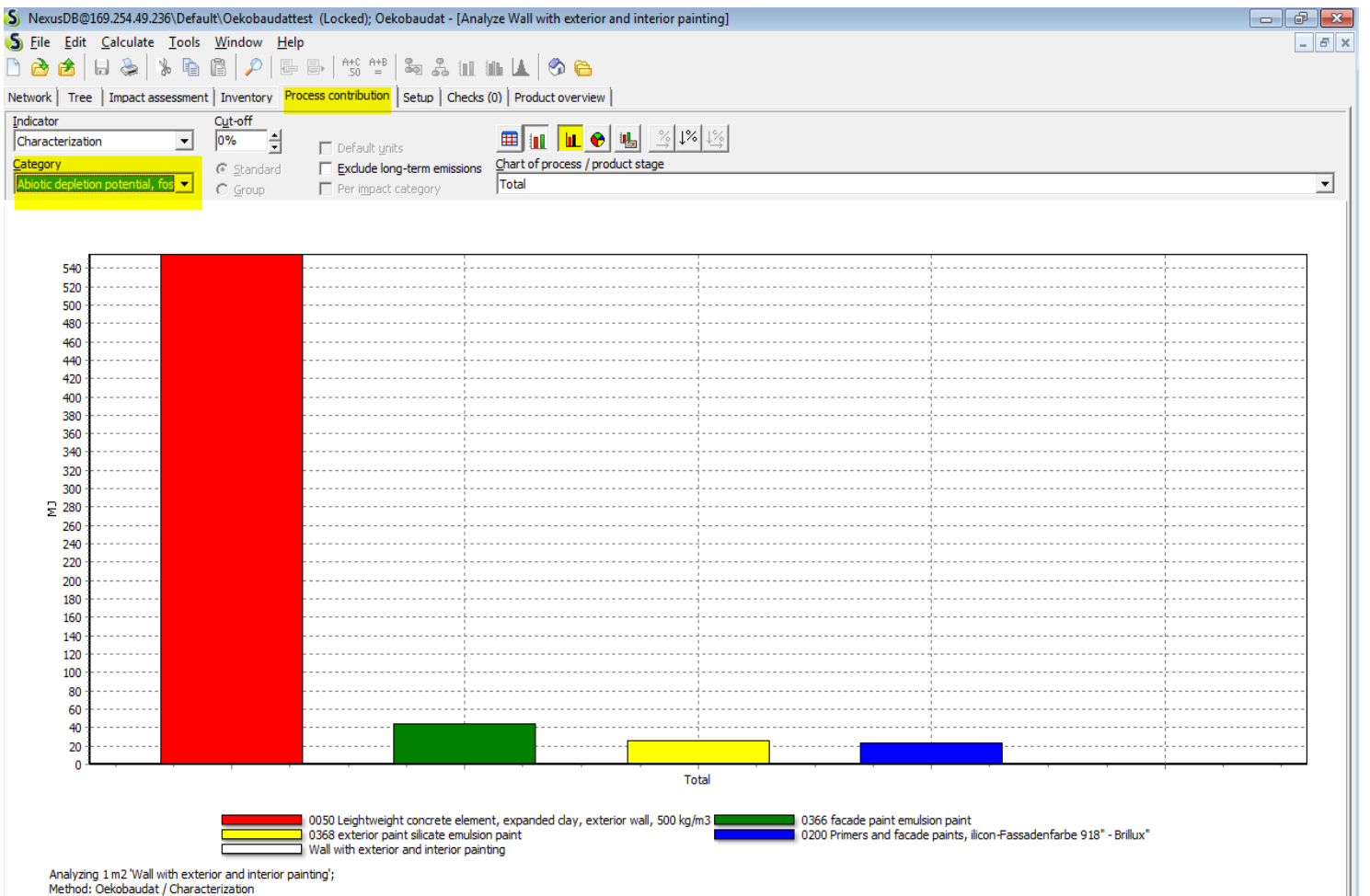
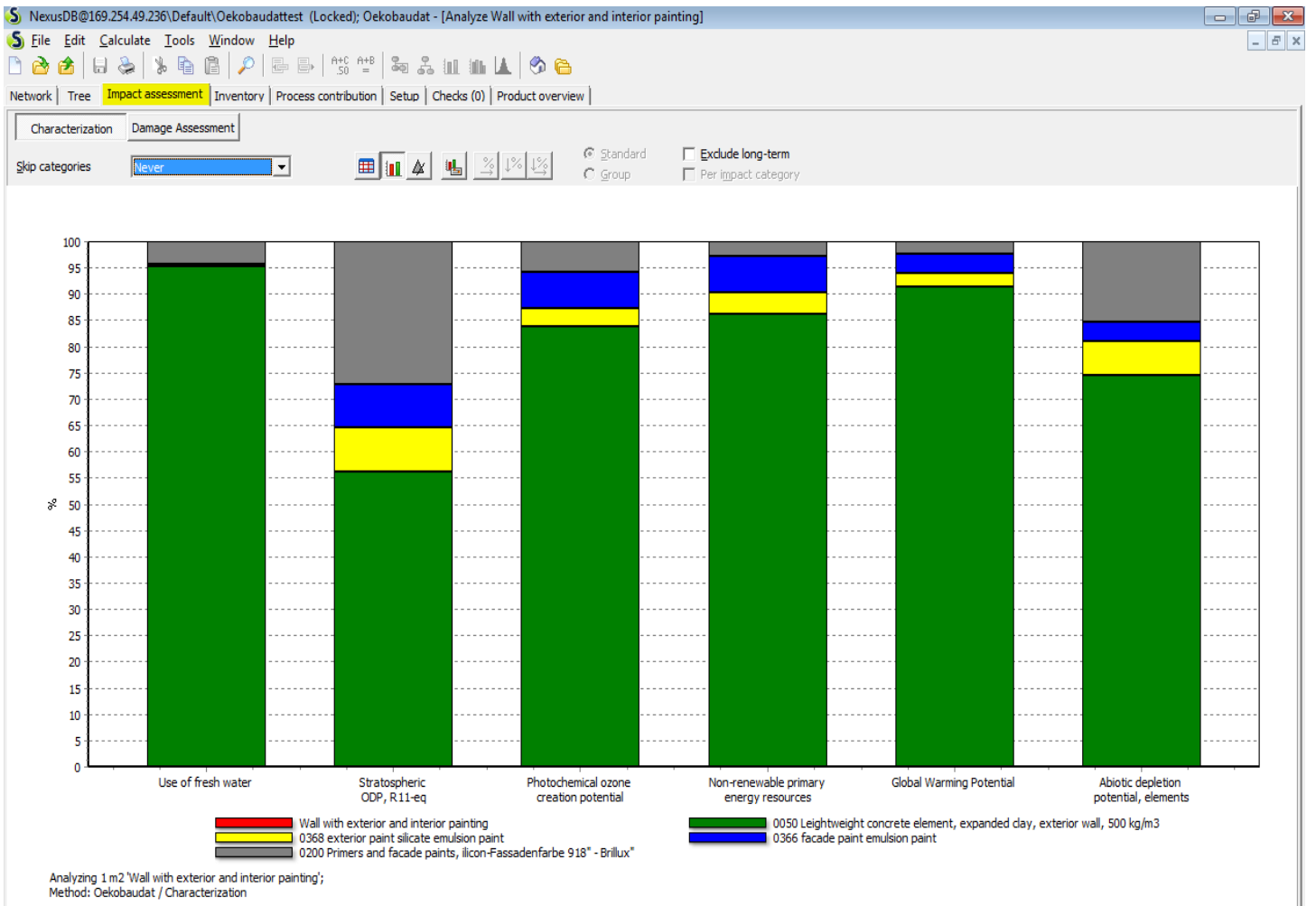
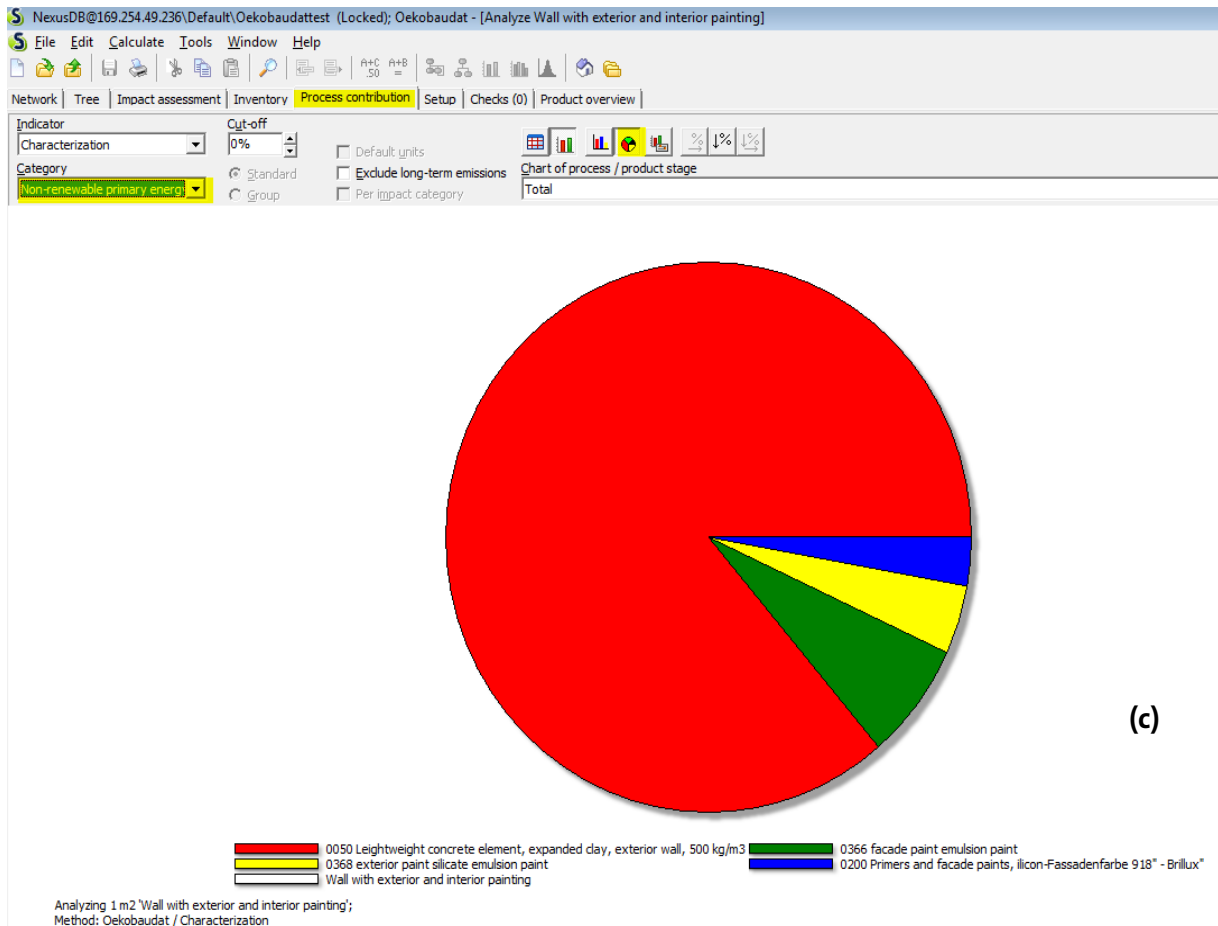


Figure 19: Analysis results of the hypothetical process “wall with exterior and interior painting”, without indicating a LCIA method; (a) “Inventory results” – all compartments/ raw materials, (b) Tree of the product system, showing the relative contribution of each wall component, as exemplified by the indicator flow “CO2-eq.”







(c)

Figure 20: Analysis results of the hypothetical process “wall with exterior and interior painting”, using the LCIA method “Ökobau.dat”; (a) Relative contribution of each material input in selected impact categories; (b) Process contributions in absolute terms in a selected impact category – bar chart; (c) Process contributions in absolute terms in a selected impact category – pie chart

### C- LCA from cradle to grave

If process datasets exist in Ökobau.dat for several life cycle stages of a given product (i.e. for information modules A1-A3, B1-B4/ B5-B6 and/or C1-C4), they can be connected to calculate the aggregated environmental impacts of that product over its complete life cycle in the pre-defined Ökobau.dat indicators (impact categories). In order to connect the process datasets from different life cycle stages of a given product, the output of one stage should be used as an input flow into the next stage. The same example from section “2.2, C-LCA from cradle to grave” of a gas condensing boiler is used here to illustrate the possibility to conduct an LCA of a complete supply chains using Ökobau.dat (see Figure 21). Figure 22 shows examples of the LCIA results of a gas condensing boiler over its ‘product’, ‘use’ and ‘end-of-life’ stage, using SimaPro tools for illustration.

**Edit material process '0640 copy use - gas calorific value 120-400 kW'**

Documentation | Input/output | Parameters | System description

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %	Waste type	Category
0640 copy use - gas calorific value 120-400 kW	3,6	MJ	Energy	100 %		LCA Gas condensing boiler
(Insert line here)						

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
(Insert line here)						

Inputs

Known inputs from nature (resources)

Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
Renewable secondary fuels		3,3949200904	MJ	Undefined			
Sb equivalents		1,1887967736	kg	Undefined			
Non-renewable secondary fuels		0,0003573878	MJ	Undefined			
Total use of non-renewable primary energy resources		3,9026757333	MJ	Undefined			
Fresh water		0,0098720734	kg	Undefined			
Fossil resources		3,8880204475	MJ	Undefined			
Renewable primary energy resources		0,0093362811	MJ	Undefined			
Total use of renewable primary energy resources		0,0093362811	MJ	Undefined			
Non-renewable primary energy resources		3,9026757333	MJ	Undefined			
(Insert line here)							

Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
0515 copy gas condensing boiler of 120-400 kW	974	kg	Undefined			
(Insert line here)						

(a)

**Edit material process '0725 copy end of life - gas condensing boiler 120-400 kW'**

Documentation | Input/output | Parameters | System description

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %	Waste type	Category
0725 copy end of life - gas condensing boiler 120-400 kW	973,323	kg	Mass	100 %	not defined	LCA Gas condensing boiler
(Insert line here)						

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
(Insert line here)						

Inputs

Known inputs from nature (resources)

Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
Total use of non-renewable primary energy resources		139,36475552	MJ	Undefined			
Fresh water		6,8627141298	kg	Undefined			
Total use of renewable primary energy resources		6,7895610811	MJ	Undefined			
Sb equivalents		1,8353107003	kg	Undefined			
Non-renewable secondary fuels		0,2333031565	MJ	Undefined			
Fossil resources		128,95142491	MJ	Undefined			
Renewable secondary fuels		0,0496212576	MJ	Undefined			
Renewable primary energy resources		6,7895610811	MJ	Undefined			
Non-renewable primary energy resources		139,36475552	MJ	Undefined			
(Insert line here)							

Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
0640 copy use - gas calorific value 120-400 kW	3,6	MJ	Undefined			
(Insert line here)						

Known inputs from technosphere (electricity/heat)

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
(Insert line here)						

Outputs

(b)

Figure 21 (a, b): Connecting process datasets available in Ökobau.dat for the different life cycle stages of a “gas condensing boiler, 120-400 kW” in SimaPro

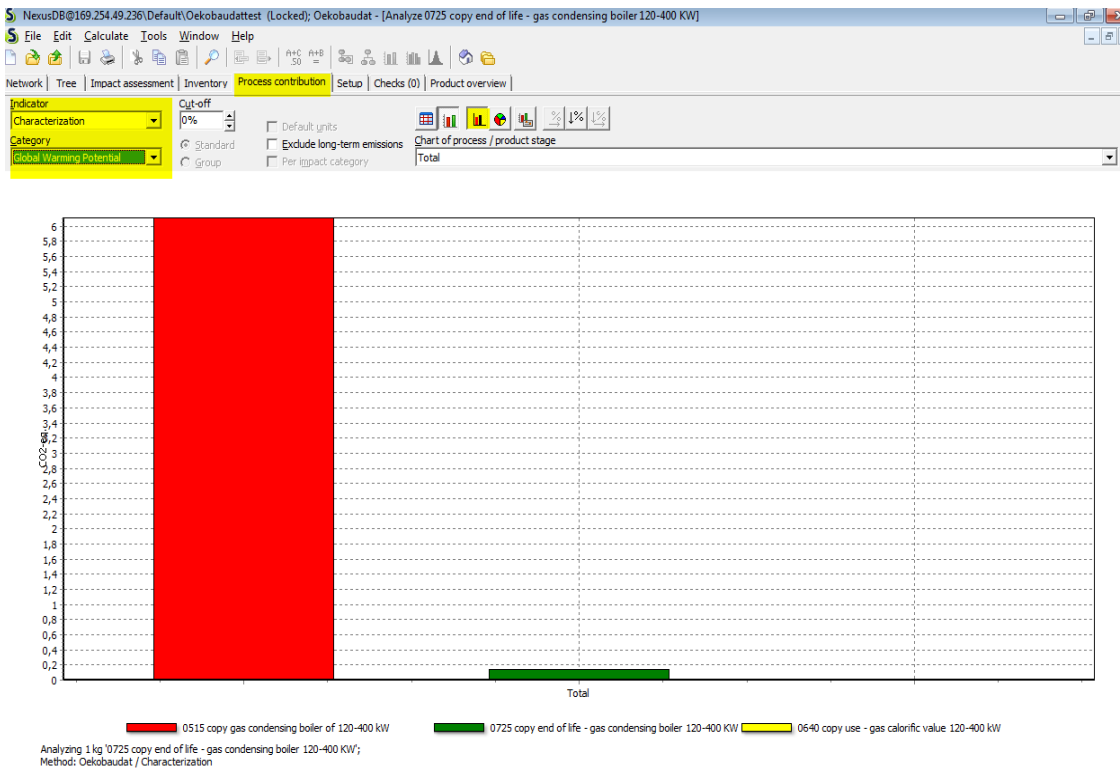
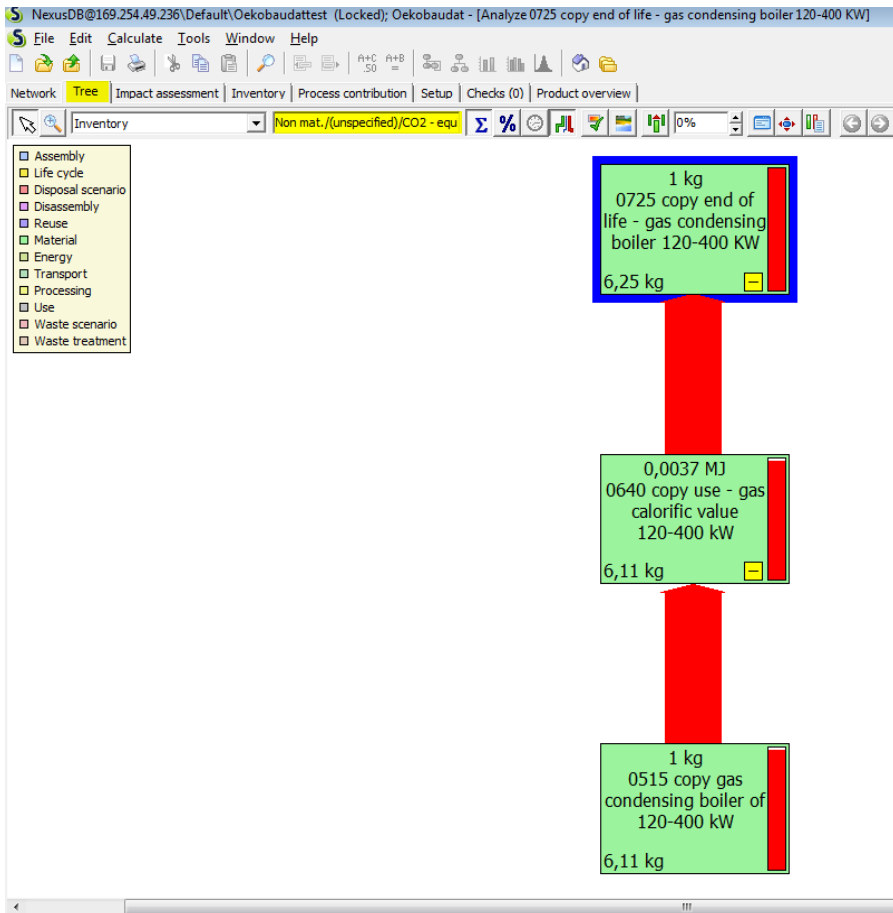


Figure 22: LCIA results of the complete cradle to grave assessment of a “gas condensing boiler of 120-400 kW) in SimaPro, using Ökobau.dat datasets and different result illustration tools

## 4. Summary

Ökobau.dat is a German database for construction materials and services, made available by the BBSR with the aim to provide a common and secure data source for performing complete cradle to grave analysis of buildings and construction work. Ökobau.dat contains more than 1,300 datasets, which represent “Environmental product declarations” (EPDs) compliant with requirements and methodological specifications of the DIN EN 15804:2012-04. This means that all included materials, products and services already contain their environmental impact assessment results, expressed in a number of pre-defined “indicators”, i.e. impact categories.

Ökobau.dat can be imported into openLCA and SimaPro and used to conduct LCAs of construction materials, buildings and construction work. Unlike “regular” databases with non-EPD datasets, Ökobau.dat processes do not require a separate life cycle impact assessment. Calculating the LCIA results for an existing process dataset, or for a combination of products from the database, without indicating any specific impact assessment method already provides the environmental profile of the product at hand. Nevertheless, a new LCIA method, “Ökobau.dat”, has been created in both softwares, openLCA and SimaPro, in order to enable users to utilize all available features and tools of the software for a complete analysis, interpretation and illustration of the LCIA results.

Process datasets in Ökobau.dat can represent one separate life cycle stages of a given product, i.e. its ‘product’, ‘use’ or ‘end-of-life’ stage. To perform complete cradle-to-grave analysis of a material or product, the different datasets must be connected into one product system and the aggregated EPD results over the whole life cycle of the product calculated. That way materials, products and buildings can be assessed and compared from raw material extraction to deconstruction/ demolition and end-of-life treatment.