



GreenDelta



EVERSUS



ESA LCA DB End-User Experience

ESA LCA DB Team
17th October 2023

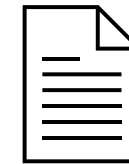
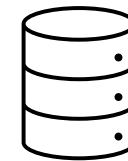
Agenda

1. Overview
2. Database Guided tour
3. Updates
4. Gaps
5. openLCA Converter Tool
6. Webtool Questionnaire
7. Next steps
8. Why update to the new ESA LCA DB?

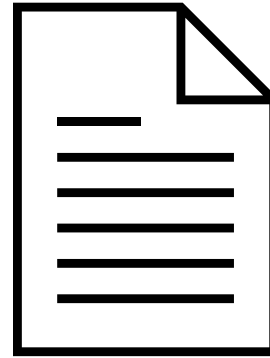
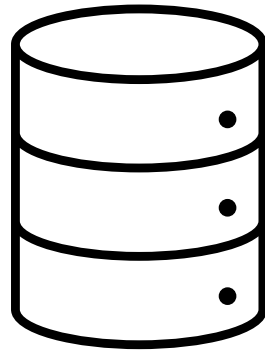
ESA LCA DB End-User Experience Project Scope, Team and Presenters



Ionut Grozea
Suzana Vladescu



Project Scope
build, consolidate and maintain
an operational and up-to-date
environmental LCA database and
provide support services to the
ESA LCA Database end-users.



ESA LCA DB External v1.2.0

Background DB updates
Structure updates
New datasets
Dataset updates

Converter Tool

SimaPro to/from openLCA
ESA LCA DB External v1.2.0 in openLCA

Web Tool Questionnaire

Work in progress

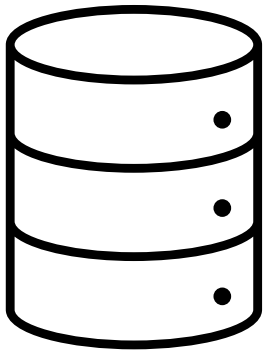
Guidelines for Datasets

For ESA LCA Deliveries
Work in progress

Public User Manual

for ESA LCA DB External v1.2.0

ESA LCA DB – Database tour



ESA LCA DB External (v1.2.0f e3.9.1)

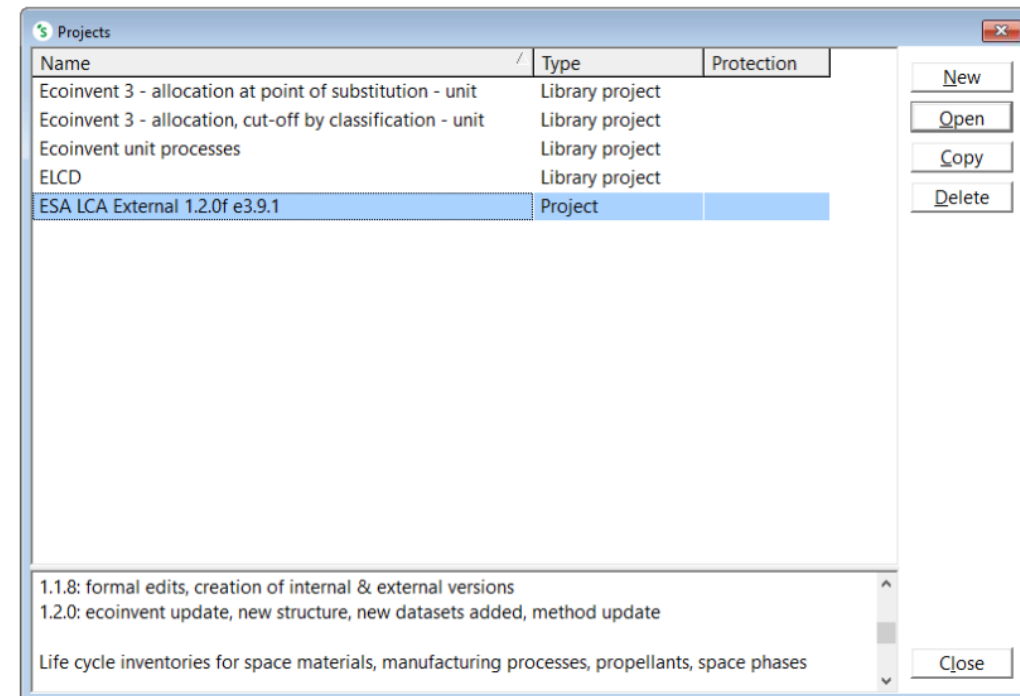
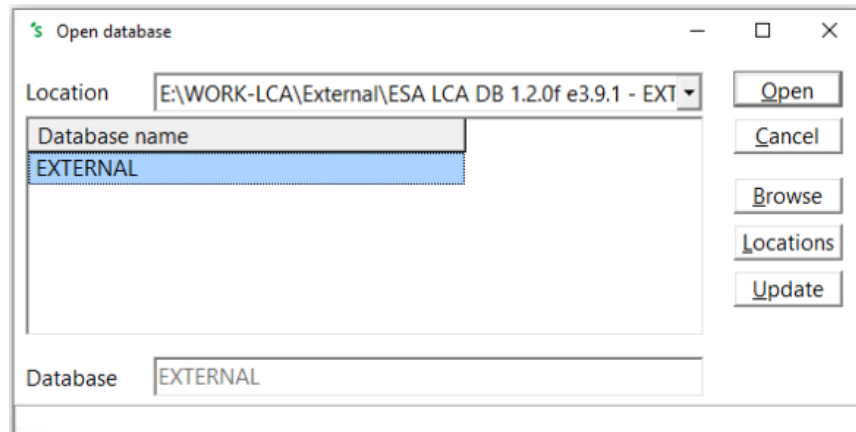
SimaPro version

Password-protected zip file

Available on ESA Platform

Unzip and open External DB

- ❑ Unzip the External ESA LCA DB, using the password given
- ❑ In SimaPro > “open SimaPro database” , browse and select the external DB





- Wizards
- Wizards
- Goal and scope**
- Description
- Libraries
- Inventory**
- Processes
- Product stages
- System descriptions
- Waste types
- Parameters
- Impact assessment**
- Methods
- Calculation setups
- Interpretation**
- Interpretation
- Document Links
- General data**
- Literature references
- Substances
- Units
- Quantities
- Images

- Processes
 - Material
 - ESA I - Material groups
 - ESA II - Chemicals
 - ESA III - Propellants
 - ESA IV - Electrical components
 - ESA V - Materials - Obsolete datasets
 - Energy
 - Transport
 - ESA I - Transport
 - ESA II - Transport - Obsolete datasets
 - Processing
 - ESA I - Process group
 - ESA II - Propellant handling
 - ESA III - Processing - Obsolete datasets
 - Use
 - ESA I - Ground segment
 - ESA II - Manpower & travels
 - ESA III - Launch segment
 - ESA IV - Space segment
 - ESA V - Testing and inspections
 - ESA VI - Missions
 - ESA VII - Use - Obsolete datasets
 - Waste scenario
 - Waste treatment
 - ESA I - Waste treatment
 - ESA II - Waste treatment - Obsolete datasets

Unit	Project	Status	Name

Show as list

774 items

0 items selected

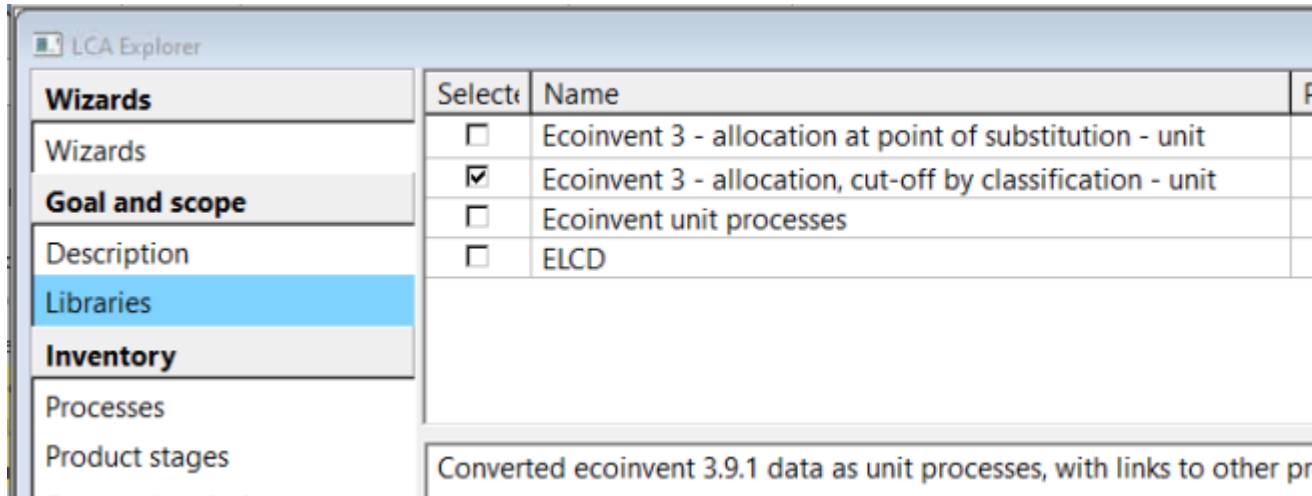
Filter on and or

Clear

Activate Windows
 Go to Settings to activate Windows.

Visualize External DB

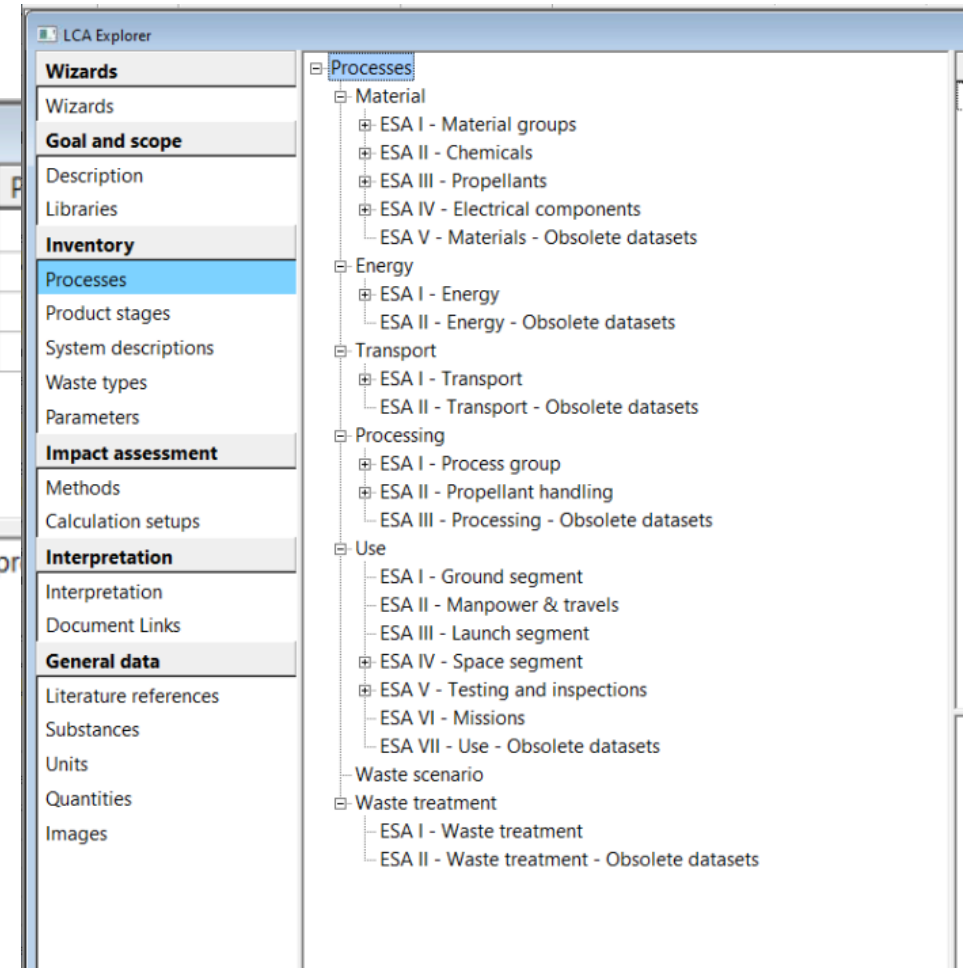
❑ Ecoinvent 3.9.1



Select	Name
<input type="checkbox"/>	Ecoinvent 3 - allocation at point of substitution - unit
<input checked="" type="checkbox"/>	Ecoinvent 3 - allocation, cut-off by classification - unit
<input type="checkbox"/>	Ecoinvent unit processes
<input type="checkbox"/>	ELCD

Converted ecoinvent 3.9.1 data as unit processes, with links to other pr

❑ ESA LCA DB processes



- Material
 - ESA I - Material groups
 - ESA II - Chemicals
 - ESA III - Propellants
 - ESA IV - Electrical components
 - ESA V - Materials - Obsolete datasets
- Energy
 - ESA I - Energy
 - ESA II - Energy - Obsolete datasets
- Transport
 - ESA I - Transport
 - ESA II - Transport - Obsolete datasets
- Processing
 - ESA I - Process group
 - ESA II - Propellant handling
 - ESA III - Processing - Obsolete datasets
- Use
 - ESA I - Ground segment
 - ESA II - Manpower & travels
 - ESA III - Launch segment
 - ESA IV - Space segment
 - ESA V - Testing and inspections
 - ESA VI - Missions
 - ESA VII - Use - Obsolete datasets
- Waste scenario
- Waste treatment
 - ESA I - Waste treatment
 - ESA II - Waste treatment - Obsolete datasets

ESA LCA DB End-User Experience Database Tour



Process

The screenshot shows the 'Edit energy process' dialog box for the process 'Electricity, fuel oil and hydropower (FG) | production mix | Cut-off, U'. The 'Input/output' tab is active, showing a table of products, inputs, and outputs.

Products							
Outputs to technosphere: Products and co-products	Amount	Unit	Quantity	Allocation	Category	Comment	
Electricity, fuel oil and hydropower (FG) production mix Cut-off, U	1	kWh	Energy	100 %	ESA L...High Voltage	FRANCE	

Inputs							
Inputs from technosphere: materials/fuels	Amount	Unit	Distribution	SD2 or 2SD	Min	Max	Comment
Electricity, high voltage (FR) electricity production, oil Cut-off, U	0.287	kWh	Lognormal	1.05			(1,1,1,1,1); national and international statistics
Electricity, high voltage (BR-North-eastern grid) electricity production, hy	0.713	kWh	Lognormal	1.05			(1,1,1,1,1); national and international statistics

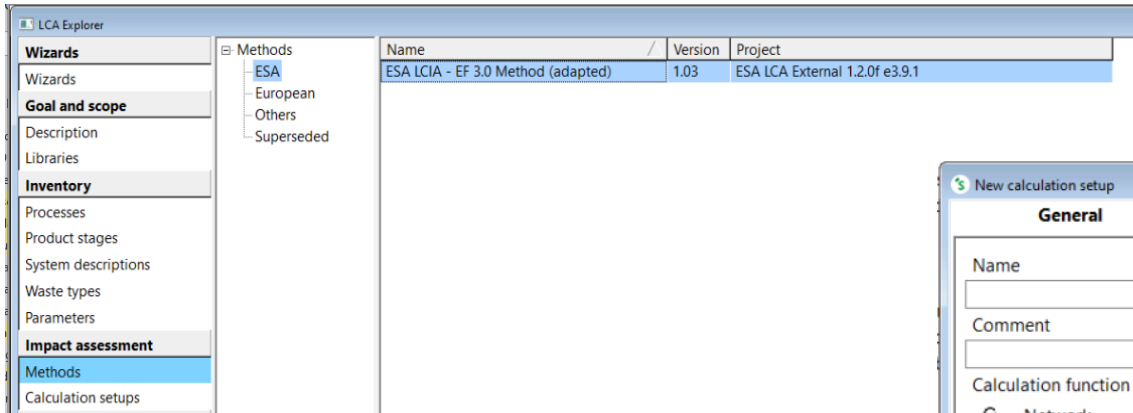
Outputs							
Emissions to air	Amount	Unit	Distribution	SD2 or 2SD	Min	Max	Comment
Add							

Local category: Elektrizität
 Local subcategory: Erzeugungsmix
 Source file: 00676.XML

Filter on [] and [] or [] Clear

774 items | 1 item selected

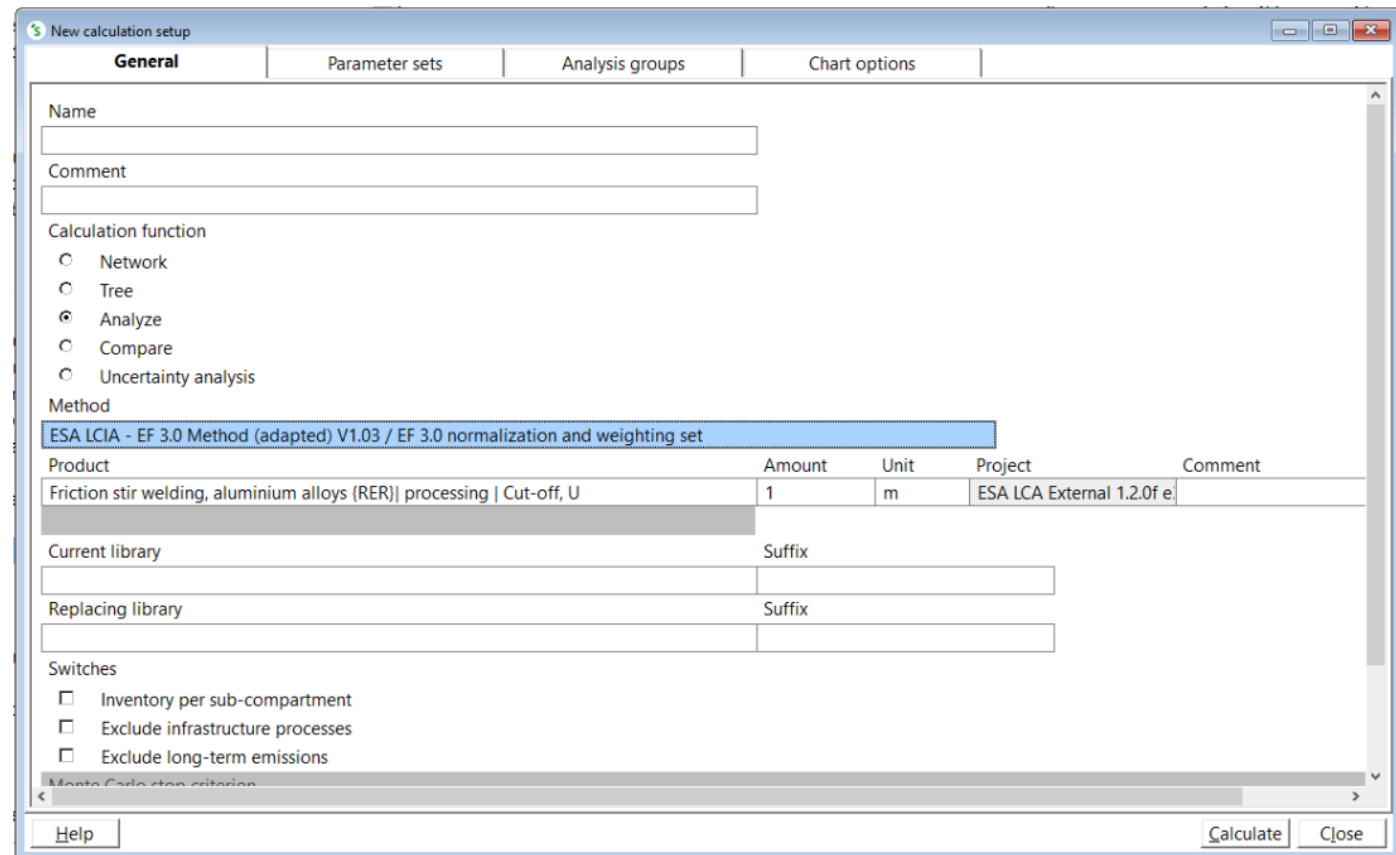
❑ ESA LCIA EF 3.0 Method (adapted)



The screenshot shows the 'LCA Explorer' window. On the left is a navigation tree with categories: Wizards, Goal and scope, Inventory, Impact assessment, and Methods. The 'Methods' category is expanded, showing a tree structure: ESA, European, Others, and Superseded. The main pane displays a table of methods:

Name	Version	Project
ESA LCIA - EF 3.0 Method (adapted)	1.03	ESA LCA External 1.2.0f e3.9.1

❑ Analyse with new LCIA method



The screenshot shows the 'New calculation setup' dialog box with the 'General' tab selected. It contains the following fields and options:

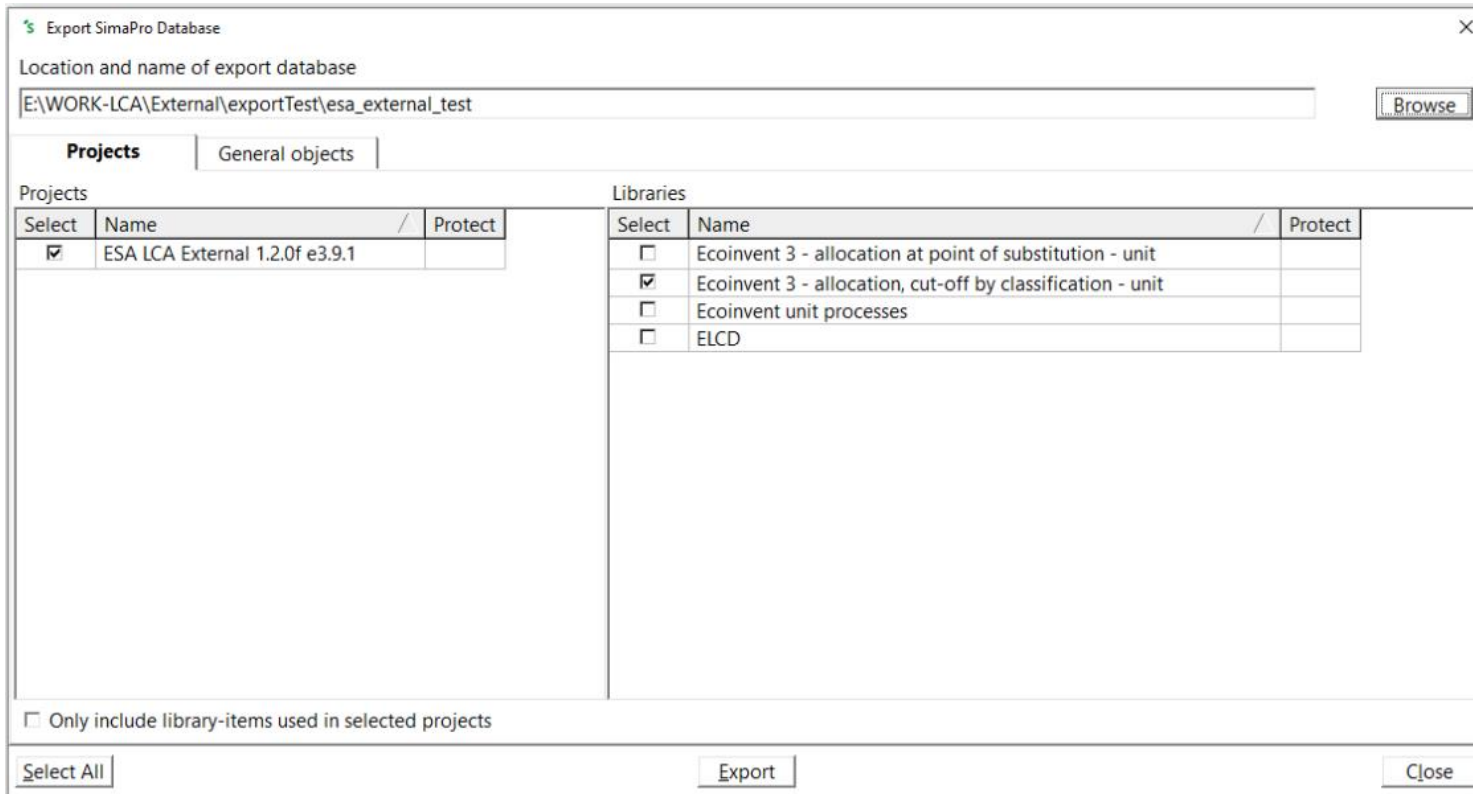
- Name: [Text input field]
- Comment: [Text input field]
- Calculation function:
 - Network
 - Tree
 - Analyze
 - Compare
 - Uncertainty analysis
- Method: **ESA LCIA - EF 3.0 Method (adapted) V1.03 / EF 3.0 normalization and weighting set**
- Table with columns: Product, Amount, Unit, Project, Comment.

Product	Amount	Unit	Project	Comment
Friction stir welding, aluminium alloys (RER) processing Cut-off, U	1	m	ESA LCA External 1.2.0f e	
- Current library: [Text input field] Suffix
- Replacing library: [Text input field] Suffix
- Switches:
 - Inventory per sub-compartment
 - Exclude infrastructure processes
 - Exclude long-term emissions
- Monte Carlo stop criterion: [Text input field]

Buttons: Help, Calculate, Close

Export options from ESA LCA DB – nx1, native SimaPro

nx1 full Database



Export SimaPro Database

Location and name of export database
E:\WORK-LCA\External\exportTest\esa_external_test

Projects | General objects

Projects

Select	Name	Protect
<input checked="" type="checkbox"/>	ESA LCA External 1.2.0f e3.9.1	

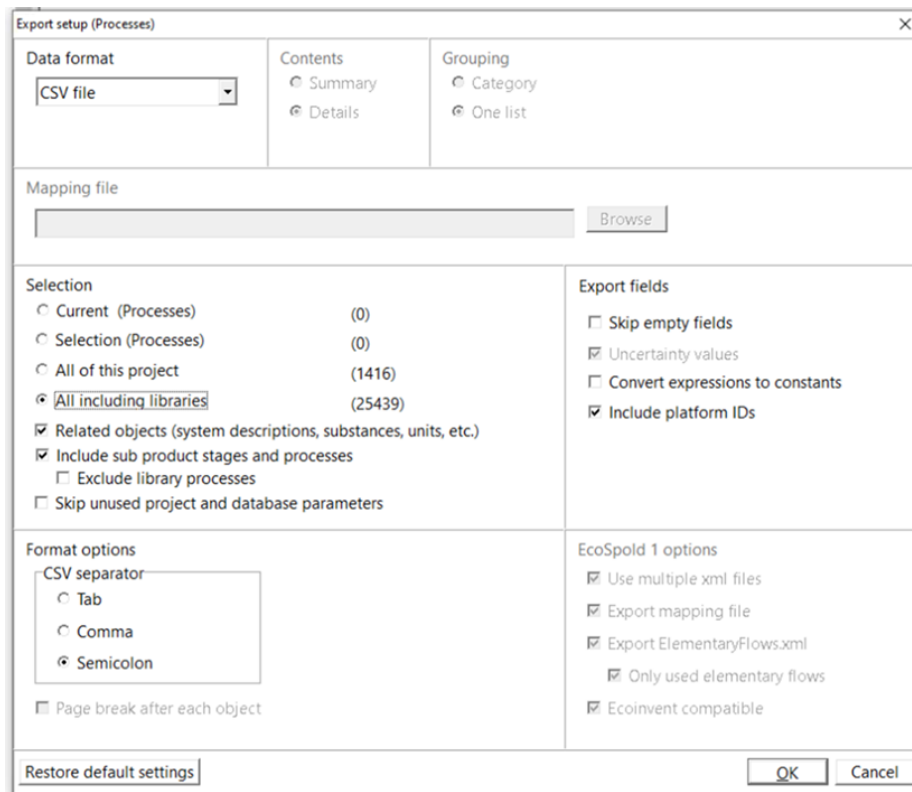
Libraries

Select	Name	Protect
<input type="checkbox"/>	Ecoinvent 3 - allocation at point of substitution - unit	
<input checked="" type="checkbox"/>	Ecoinvent 3 - allocation, cut-off by classification - unit	
<input type="checkbox"/>	Ecoinvent unit processes	
<input type="checkbox"/>	ELCD	

Only include library-items used in selected projects

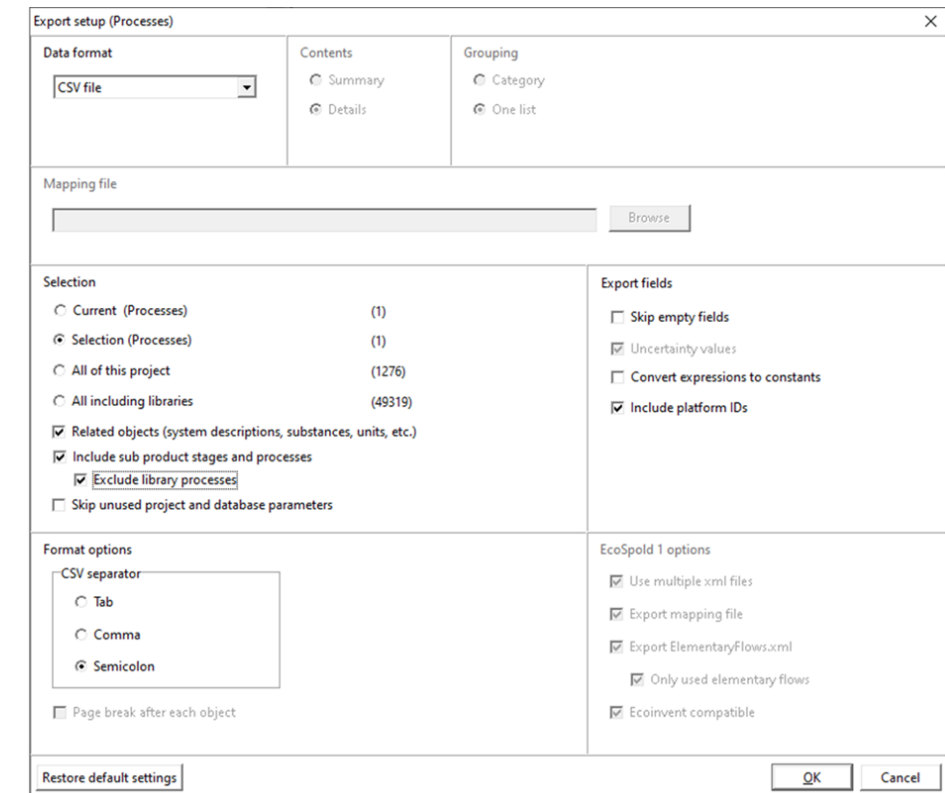
Export options from ESA LCA DB - .csv versions

❑ .csv full Database



The screenshot shows the 'Export setup (Processes)' dialog box. The 'Data format' is set to 'CSV file'. Under 'Contents', 'Details' is selected. Under 'Grouping', 'One list' is selected. The 'Mapping file' field is empty with a 'Browse' button. In the 'Selection' section, 'All including libraries' (25439) is selected, along with 'Related objects (system descriptions, substances, units, etc.)', 'Include sub product stages and processes', and 'Skip unused project and database parameters'. The 'Export fields' section has 'Uncertainty values', 'Convert expressions to constants', and 'Include platform IDs' checked. The 'Format options' section has 'Semicolon' selected as the 'CSV separator' and 'Page break after each object' checked. The 'EcoSpold 1 options' section has 'Use multiple xml files', 'Export mapping file', 'Export ElementaryFlows.xml', 'Only used elementary flows', and 'Ecoinvent compatible' checked. Buttons for 'Restore default settings', 'OK', and 'Cancel' are at the bottom.

❑ .csv selected Process



The screenshot shows the 'Export setup (Processes)' dialog box. The 'Data format' is set to 'CSV file'. Under 'Contents', 'Details' is selected. Under 'Grouping', 'One list' is selected. The 'Mapping file' field is empty with a 'Browse' button. In the 'Selection' section, 'Selection (Processes)' (1) is selected, along with 'Related objects (system descriptions, substances, units, etc.)', 'Include sub product stages and processes', 'Exclude library processes', and 'Skip unused project and database parameters'. The 'Export fields' section has 'Skip empty fields' unchecked, 'Uncertainty values' checked, 'Convert expressions to constants' unchecked, and 'Include platform IDs' checked. The 'Format options' section has 'Semicolon' selected as the 'CSV separator' and 'Page break after each object' unchecked. The 'EcoSpold 1 options' section has 'Use multiple xml files', 'Export mapping file', 'Export ElementaryFlows.xml', 'Only used elementary flows', and 'Ecoinvent compatible' checked. Buttons for 'Restore default settings', 'OK', and 'Cancel' are at the bottom.

ESA LCA DB – Updates

- 1.ecoinvent update, obsolete datasets
2. Structure changes
3. Inclusion of ETS data
4. Newly implemented LCIA method
5. Public User Manual
6. Guidelines for Datasets

ecoinvent

- ❑ ecoinvent is the background DB used for the ESA LCA DB
- ❑ The previous version of ESA LCA DB (v1.1.8) was based on ecoinvent 3.5
- ❑ For this release (v1.2.0), the ecoinvent DB has been updated to the new version 3.9.1



The ecoinvent update process includes:

- ❑ The integration of new datasets
- ❑ The update of old datasets with new ones (most of them are automatically replaced)

- ❑ However, several processes from older ecoinvent versions are no longer supported and they are considered obsolete, i.e. they are not automatically replaced
 - These datasets need to be manually replaced
 - All obsolete datasets **in use the ESA LCA DB** have been replaced; however, the current database still contains obsolete datasets (resulting from the ecoinvent update) that have not been replaced, as they were not utilised by any ESA LCA DB datasets.
 - It is user responsibility **to not use any obsolete datasets** when creating new datasets.

ecoinvent obsolete datasets – how to avoid them

- ❑ In SimaPro, the obsolete datasets are contained within Folders called “Obsolete”: when choosing datasets from the DB, the LCA Project user should pay attention to not select datasets from this folder. Moreover, in the Documentation tab of these processes, the Comment field states that the correspondence process is obsolete.

Documentation	Input/output	Parameters	System description
Process type	Unit process		Process identifier
Infrastructure process	No		Status
Date	3/18/2018		Image
Comment	This process is no longer part of the ecoinvent database and will not be updated. Please choose another process.		



ecoinvent obsolete datasets – how to avoid them

- ❑ If any obsolete dataset is used in the model, when calculating the results of the assessment, SimaPro provides a warning message, indicating which process(es) are obsolete. In this case, the dataset(s) should be replaced.

📌 Calculation warnings

Calculation

No	Type	Message
1	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
2	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
3	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
4	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
5	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
6	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
7	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
8	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
9	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
10	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
11	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
12	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.
13	Warning	This process is tagged as being obsolete. Please try to replace it by another up-to-date process.

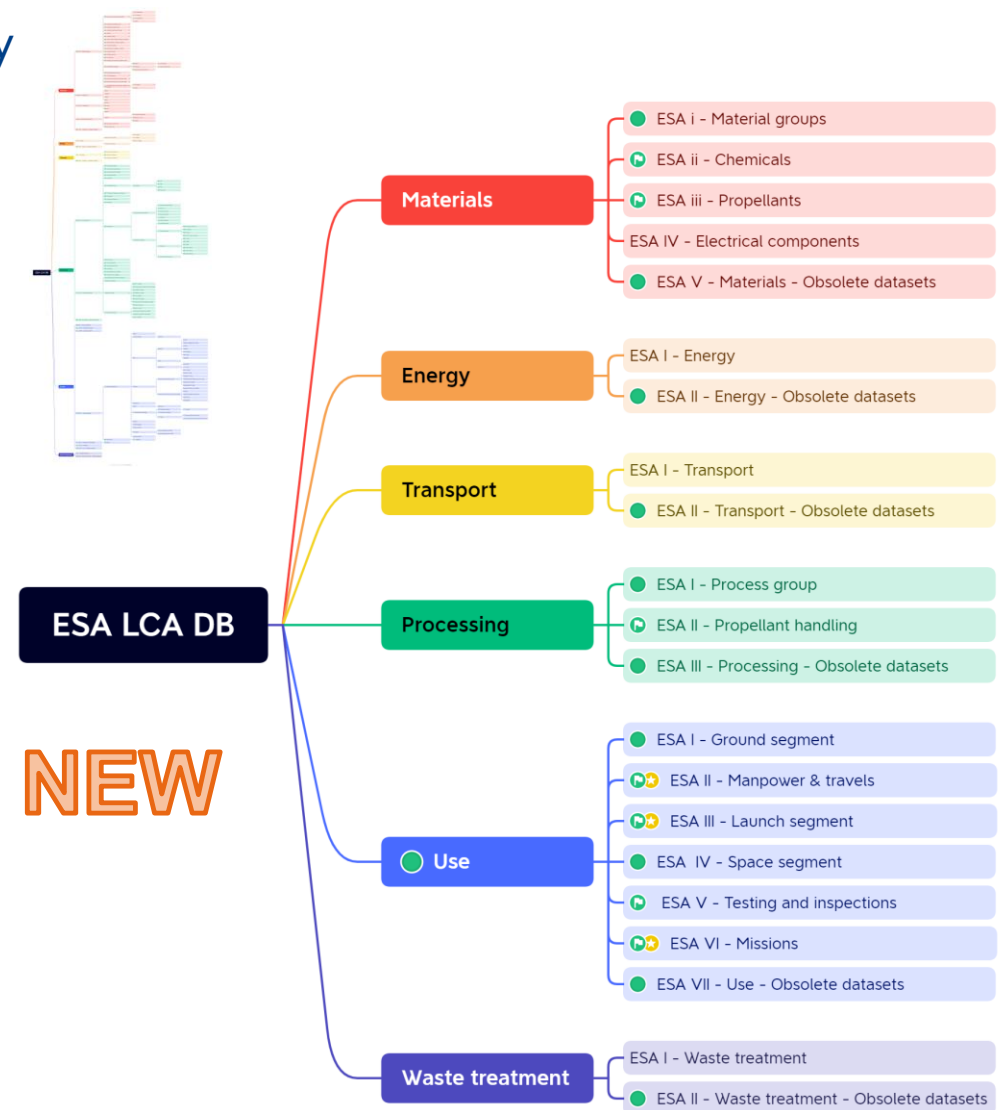
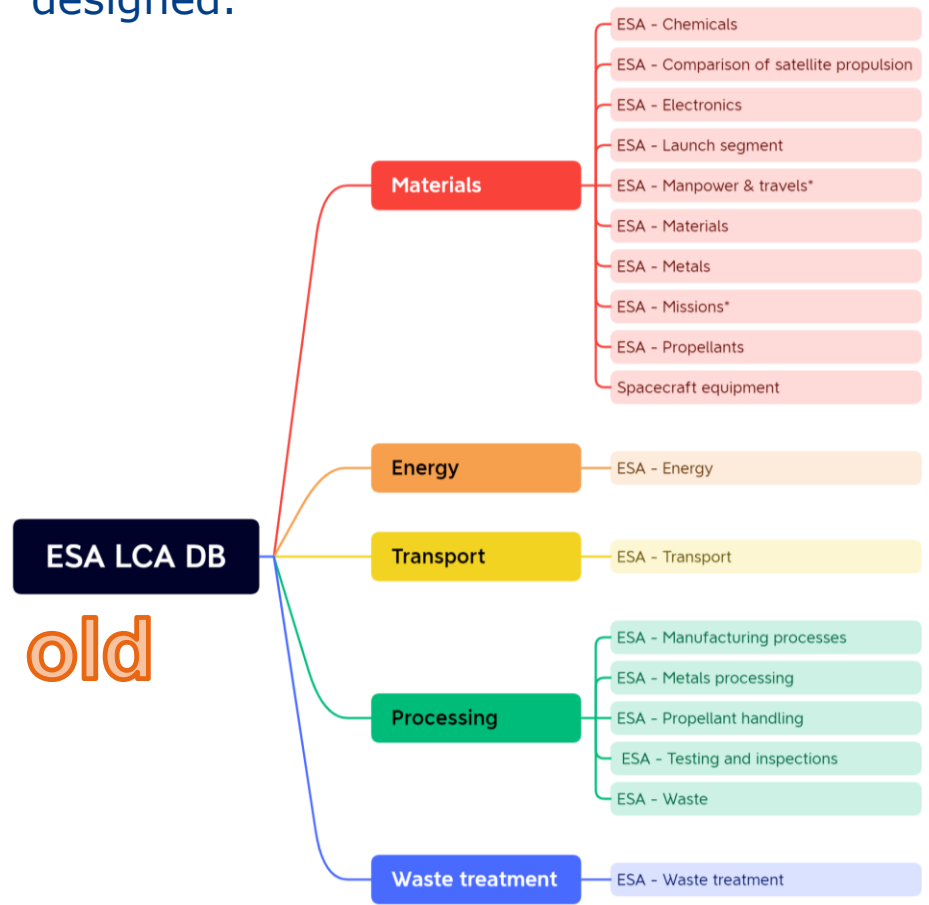


ESA LCA DB End-User Experience Structure changes

Legend:

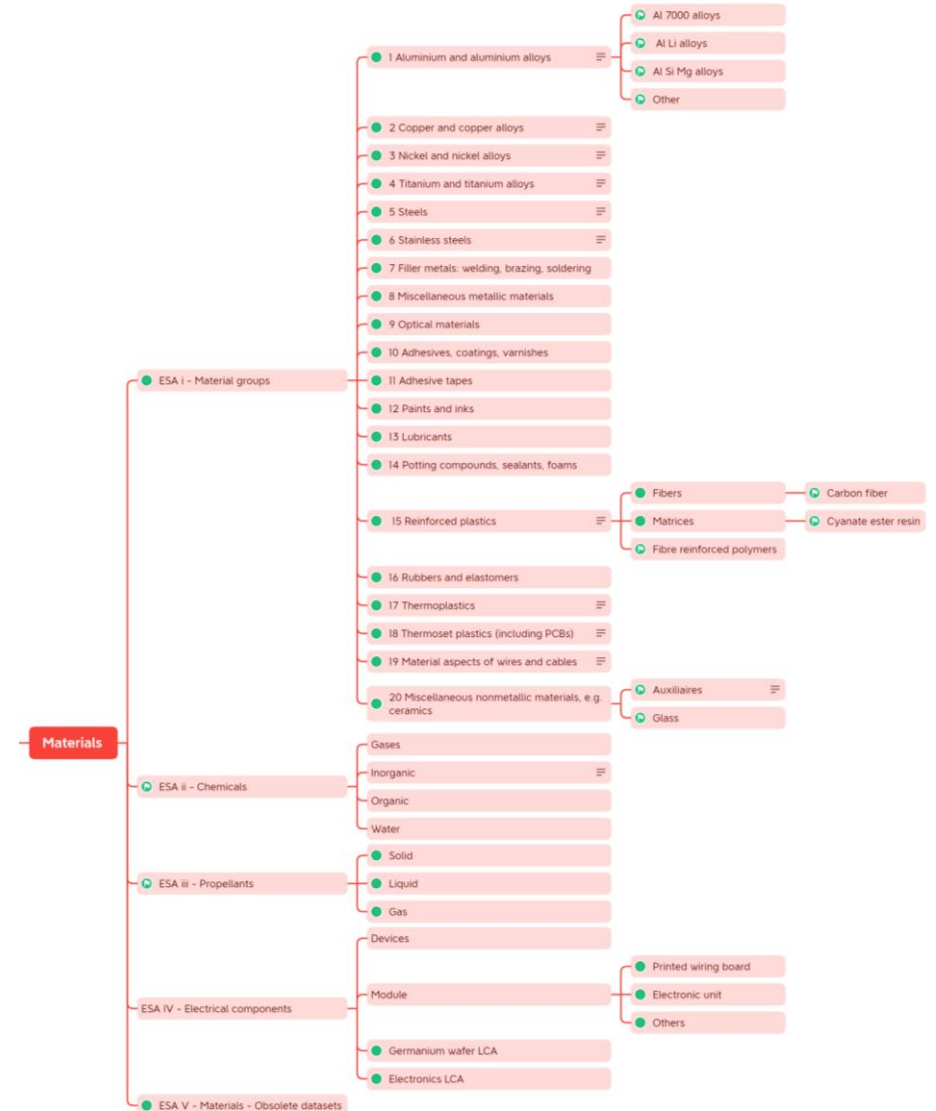
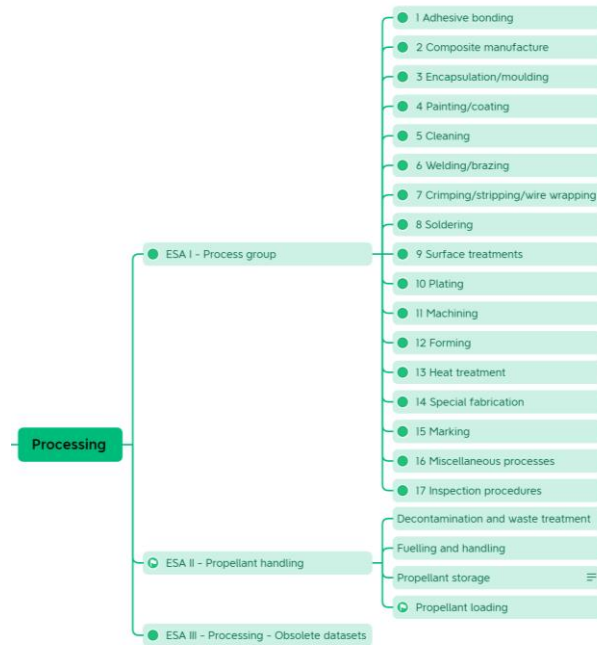
- new category
- ➔ moved category
- only in the Internal DB (empty folder in the External DB)

□ The structure of the ESA LCA Database was updated by using a top-down perspective assessment and re-designed.



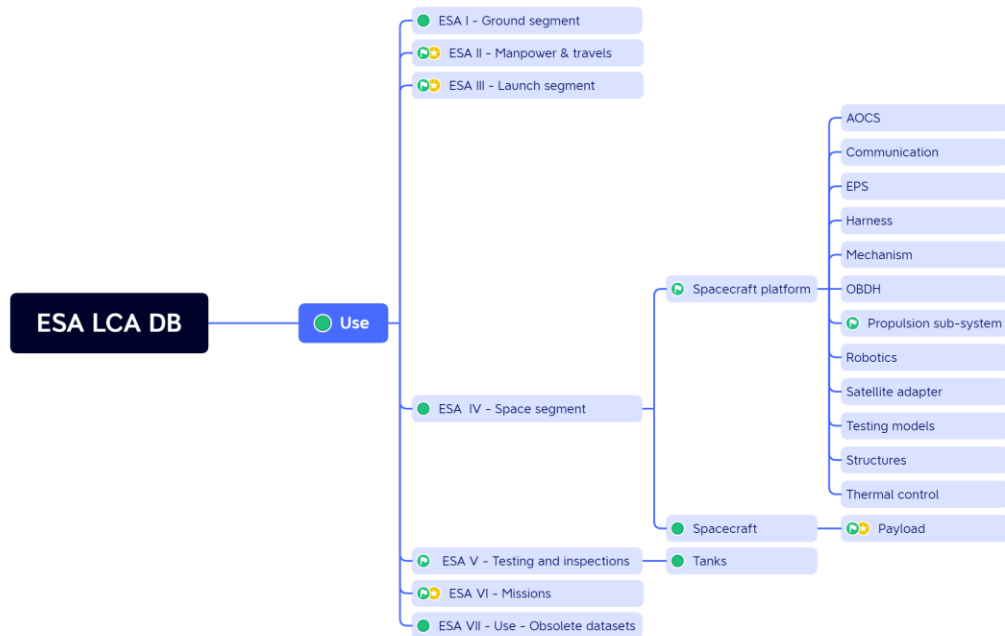
ESA LCA DB End-User Experience Structure changes

- ❑ The sub-categories of the “Materials” and “Processing” categories have been re-adapted to the nomenclature of the **ECSS-Q-ST-70C Rev.2**, “Space product assurance - Materials, mechanical parts and processes”



ESA LCA DB End-User Experience Structure changes

- ❑ The Category “Use” has been added, to reflect the space segments:
 - ❑ Ground segment
 - ❑ Launch segment
 - ❑ Space segment



Some datasets representing testing activities performed in ETS (European Test Services) have been added to the DB.

- ❑ Data are collected in 2022 from ETS (ESA/ESTEC) and provided by ESA HIF.
- ❑ The datasets are under the folder *USE - ESA V - Testing and inspections*.

The list of the datasets is the following:

- ❑ Vibration test, {RER} | Testing | Cut-off, U
- ❑ Thermal Vacuum Chamber, PHENIX infrared, {RER} | Testing | Cut-off, U
- ❑ Thermal Vacuum Chamber, LSS, Sun simulation ON, {RER} | Testing | Cut-off, U
- ❑ Thermal Vacuum Chamber, LSS, Sun simulation OFF, {RER} | Testing | Cut-off, U
- ❑ ISO8 Clean Room, {RER} | Testing | Cut-off, U
- ❑ Acoustic [LEAF], {RER} | Testing | Cut-off, U



Example of AIT in ETS dataset:

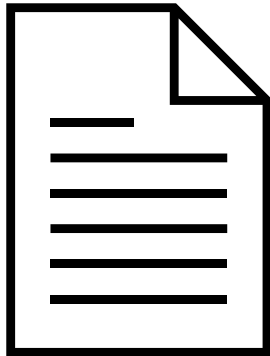
Vibration test, {RER} Testing Cut-off, U	min	ESA LCA External 1.2.0f e3.9.1
<p>< [Progress Bar]</p>		
<p>This dataset describes a vibration test (sinusoidal or random load) of 1 minute duration in a shaker (MVS and Quad Shaker 4x160kN).</p> <p>The preparation time on the shaker shall be accounted for, thus 30 minutes operations shall be considered in total per each run.</p> <p>The dataset refers only to the test itself (clean room impacts are not included and shall be added separately).</p> <p>This dataset can be used for SM (structural model) and/or PFM (Proto-Flight model) test campaign.</p> <p>Data are collected in 2022 from ETS (ESA/ESTEC) and provided by ESA HIF.</p> <p>Assumption: European energy mix</p> <p>The dataset is modelled by RINA.</p> <p>Exclusion & Justification</p> <ol style="list-style-type: none">1) Emissions and waste: Negligible2) Infrastructure: Not included		

ESA LCIA - EF 3.0 Method (Adapted)

- ❑ **adapted from EF 3.0**, used in the European Commission's Environmental Footprint transition phase
- ❑ includes **normalization** and **weighting factors** from November 2019
- ❑ impact categories haven't been adapted to space applications
- ❑ flow indicators not included (to be calculated using ESA LCA handbook)
- ❑ potential supply chain risks against REACH, RoHS, and CRM directives

Impact Categories & Space Applications

- ❑ EF-Climate Change (GWP)
- ❑ EF-Ozone depletion (ODEPL)
- ❑ EF-Ionising radiation (IORAD)
- ❑ EF-Photochemical ozone formation (PCHEM)
- ❑ EF-Particulate matter (PMAT)
- ❑ EF-Human toxicity, non-cancer (HTOXnc)
- ❑ Human toxicity, cancer (HTOXc)
- ❑ EF-Acidification (ACIDef)
- ❑ EF-Eutrophication freshwater (FWEUT)
- ❑ EF-Eutrophication marine (MWEUT)
- ❑ EF-Eutrophication terrestrial (TEUT)
- ❑ EF-Ecotoxicity freshwater (FWTOX)
- ❑ EF-Land Use (LUP)
- ❑ EF-Water use (WDEPL)
- ❑ EF-Resource use, energy carriers (ADEPLf)
- ❑ EF-Resource use, mineral and metals (ADEPLmu)
- ❑ CML-Acidification (ACIDcml)
- ❑ CML-Resource use, mineral and metals (ADEPLmr)
- ❑ CML-Ecotoxicity marine aquatic (MWTOX)
- ❑ CED-Primary energy consumption (PRENE)



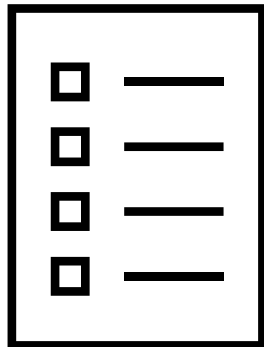
ESA LCA DB Public User Manual

- aligned for External v1.2.0f e3.9.1
- dedicated document for each DB release
- new structure presented
- procedures focusing on usage, based on “lessons learned”
- SimaPro procedures
- openLCA procedures
- available on ESA Platform



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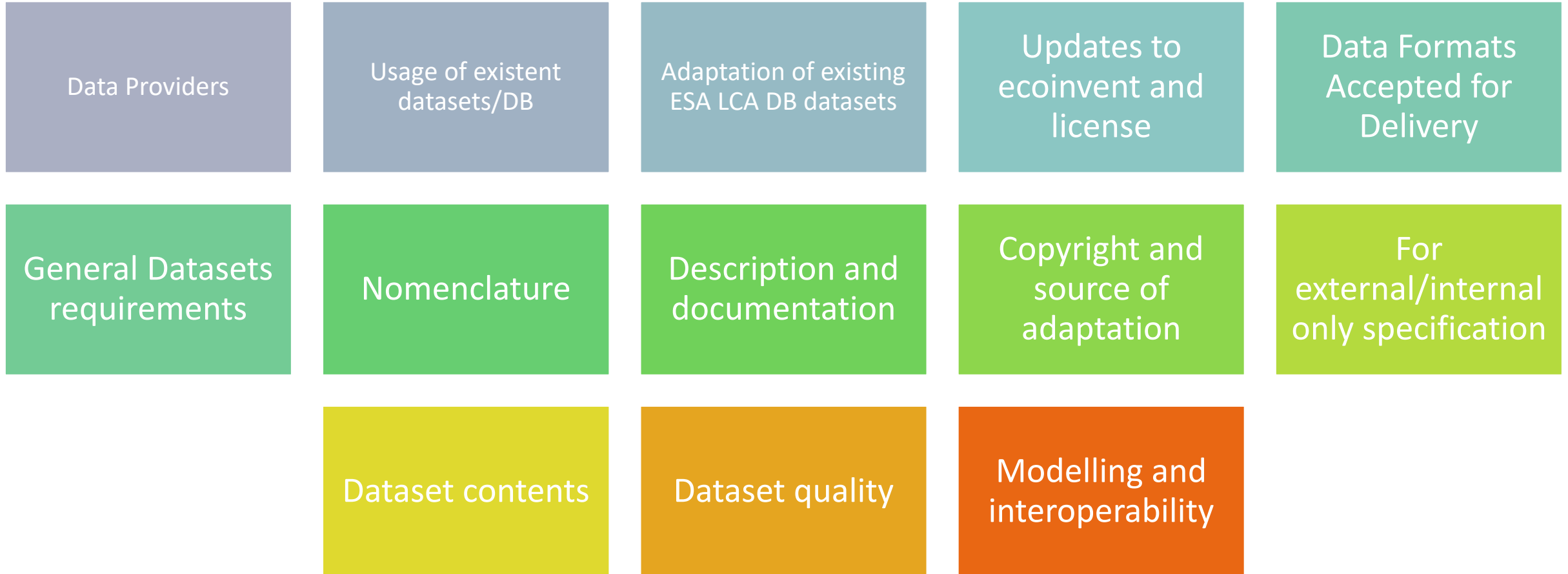
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Guidelines for Datasets delivered to ESA

- Based on “lessons learned” in dataset integration and conversion
- Work in progress
- Nomenclature
- Format
- Documentation and details
- Interoperability

ESA LCA DB End-User Experience Guidelines for Datasets Delivered to ESA



ESA LCA DB End-User Experience Guidelines for Datasets Delivered to ESA

In order to receive and use the ESA LCA DB SimaPro version, the data provider shall have a SimaPro license equal or higher than the ESA LCA DB version.

In order to receive and use the ESA LCA DB, the data provider shall have an ecoinvent license equal or higher than the ESA LCA DB version.

When different datasets for the same material, product or process are available, the contractor shall select the one that better fits the actual material, product, or process, with justification.

The user shall not modify the ESA LCA DB datasets directly. Any change will be done in copies of said datasets.

When using the ESA LCA DB, it is the responsibility of each LCA Project Contractor to ensure that no obsolete ecoinvent datasets are being used in the modelling of datasets during the LCA Activity.

- SimaPro .nx1
- SimaPro .csv
- openLCA JSON-LD, .zolca
- Questionnaire
- Gabi ILCD (currently not available)

All datasets provided to ESA shall be modelled as **unit processes**.

The dataset name shall follow the nomenclature considerations, containing 5 sections: Product name, Geographical location, Activity name, Allocation, Proprietary tag. Abbreviations shall be avoided.

The datasets delivered shall contain a minimal set of information on object, functional unit, exclusions, methodological choices, etc.

The dataset description shall include, in case of adaptation, the source of adaptation and modification performed.

The dataset description shall contain a copyright statement.

The dataset description shall contain the explicit specification on integration inside the ESA LCA DB external version.

ESA shall have access to all the foreground datasets created/developed/used in the LCA model.

The required allocation criteria is cut-off.

The dataset shall follow the dataset quality considerations, including the minimal contents expected per dataset type.

For a dataset the mass and energy balances shall be consistent.

The dataset modelling shall take into account the interoperability between LCA software considerations.

ESA LCA DB – Gaps

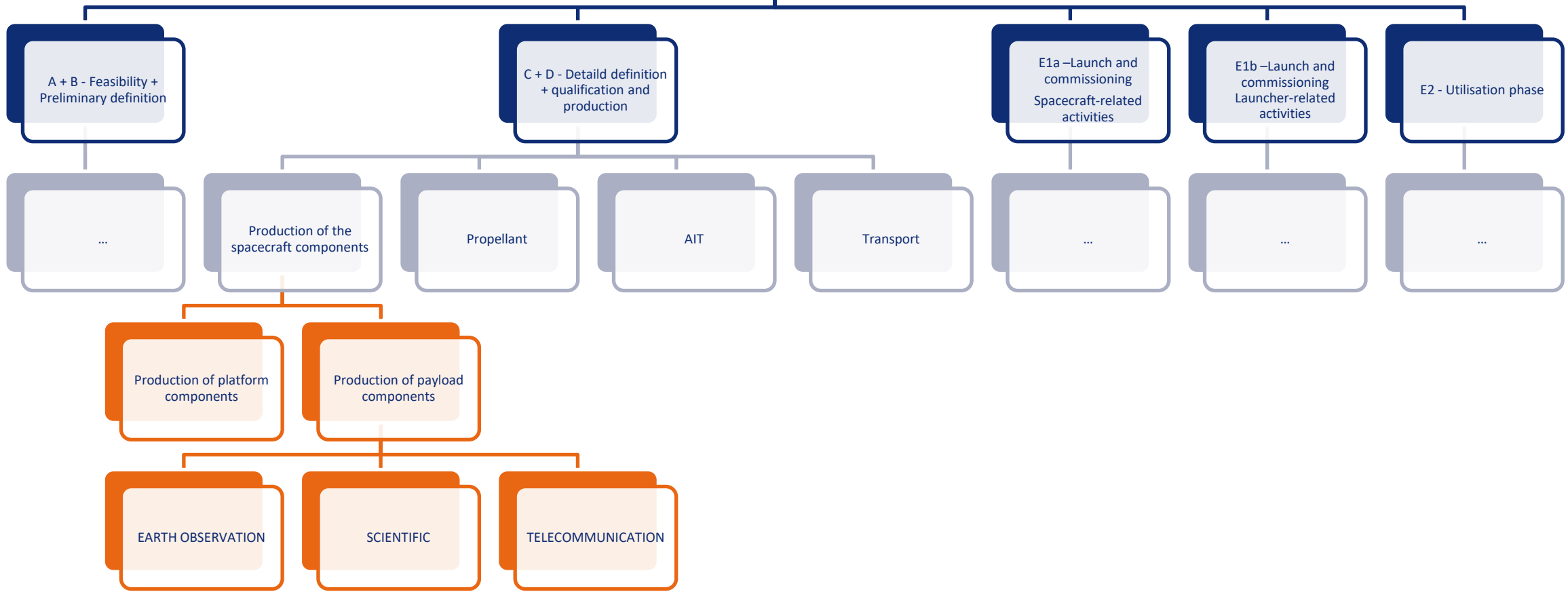
- ❑ One of the objectives of our work is to identify gaps in the ESA LCA DB (missing datasets) so that we can add them, thus facilitating the modelling of specific missions.



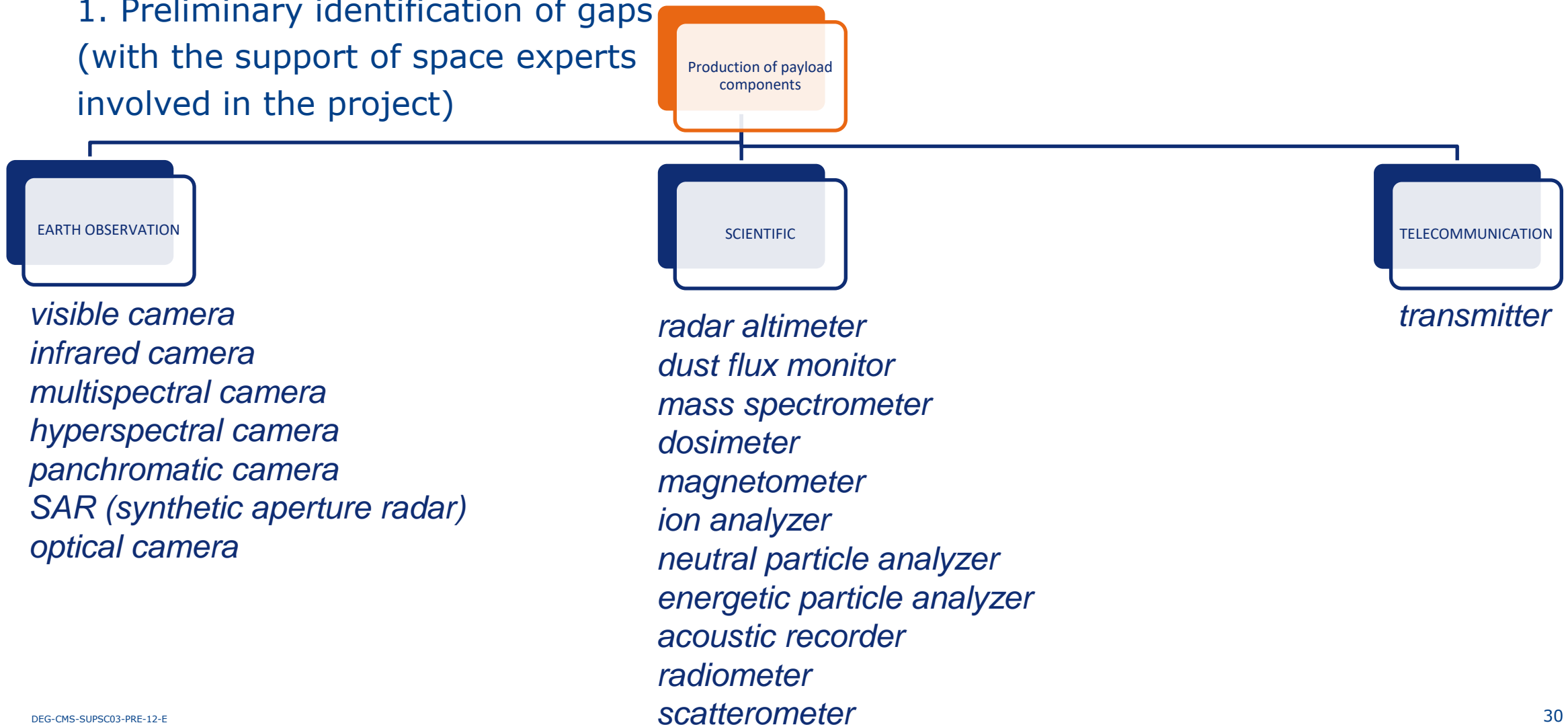
ESA LCA DB End-User Experience

ESA LCA DB – Gaps


Elements needed to model a generic

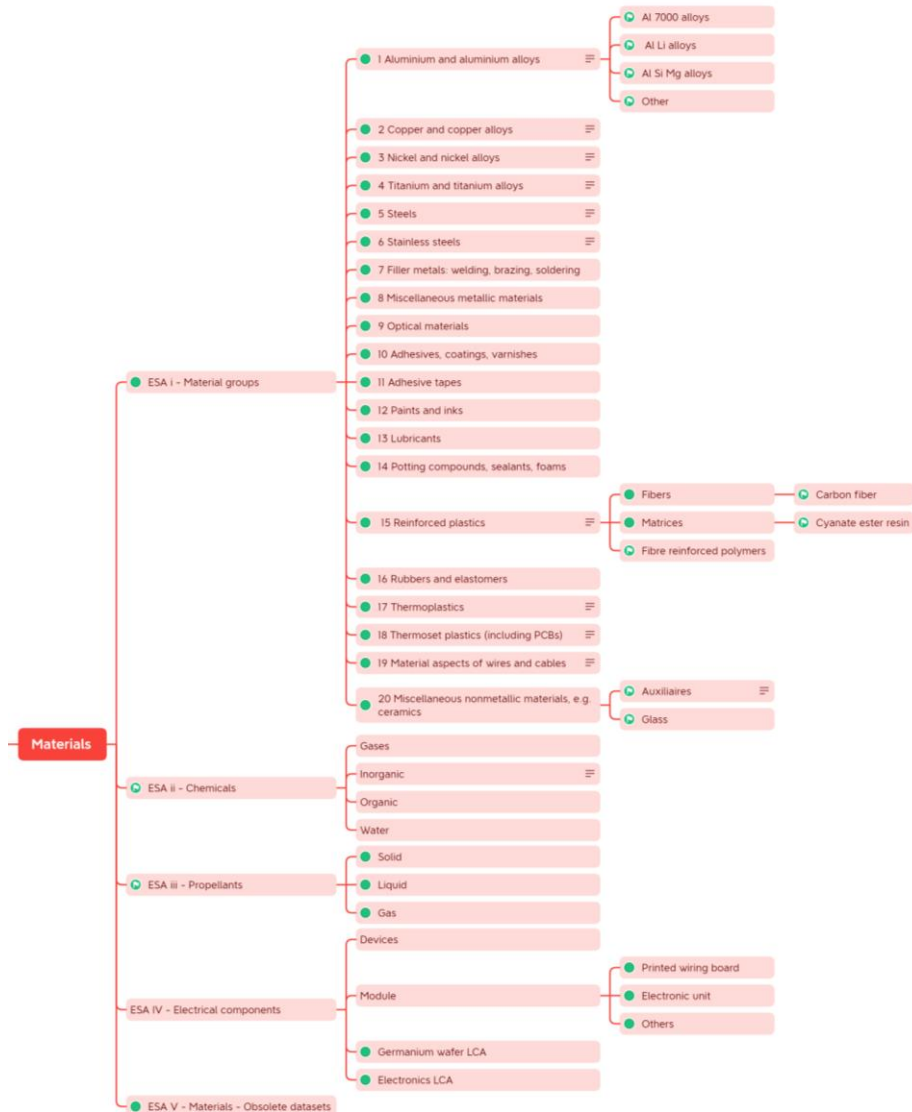


1. Preliminary identification of gaps (with the support of space experts involved in the project)



2. Other gaps identified during dedicated meeting with other space experts:

- Data on launch and use phase ★ only in the internal DB
- Standard recurrent materials specific for space applications - *in order to ensure that different primers are using the same modelling*
- Propellants
- Data regarding different types of tests and test equipment, and also data for energy to keep cleanroom in correct atmosphere 
- Data for office manhours (generic or if possible distinguishing between types of activities e.g. design and development, groundstation)
- Data for different manufacturing processes of subsystems and parts (mainly related to auxiliaries and energy, waste, ...)
- Data for ground support equipment
- Data for different types of infrastructure: cleanroom, groundstation ★ only in the internal DB
- Data about Cubesat



3. Additionally, the new ESA LCA DB structure can help in the identification of gaps by examining the empty folders, e.g.:

- 07. Filler metals: welding, brazing, soldering
- 09. Optical materials
- 11. Adhesive tapes
- 12. Paints and inks
- 13. Lubricants
- 14. Potting compounds, sealants, foams
- 16. Rubbers and elastomers

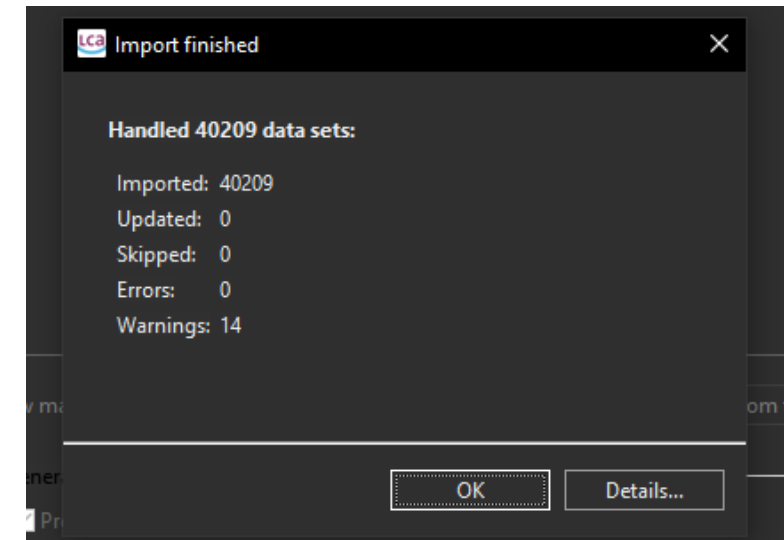
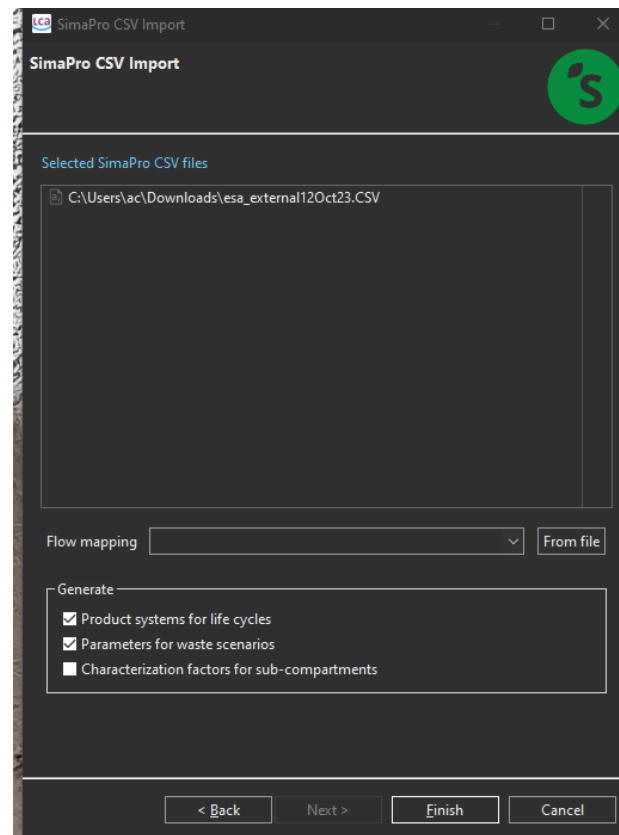
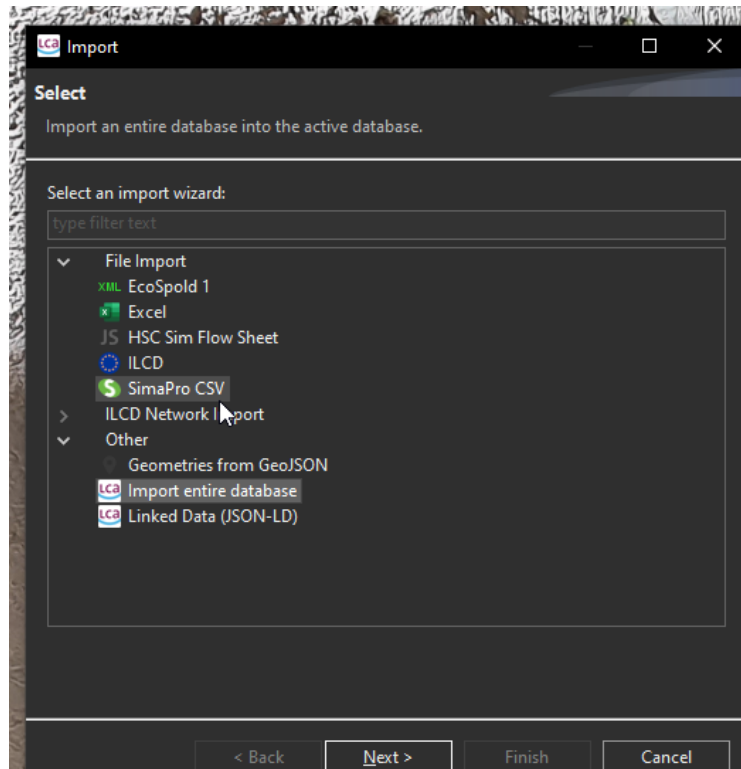
openLCA Converter Tool

- openLCA used as data converter, data management platform and LCA software in the project

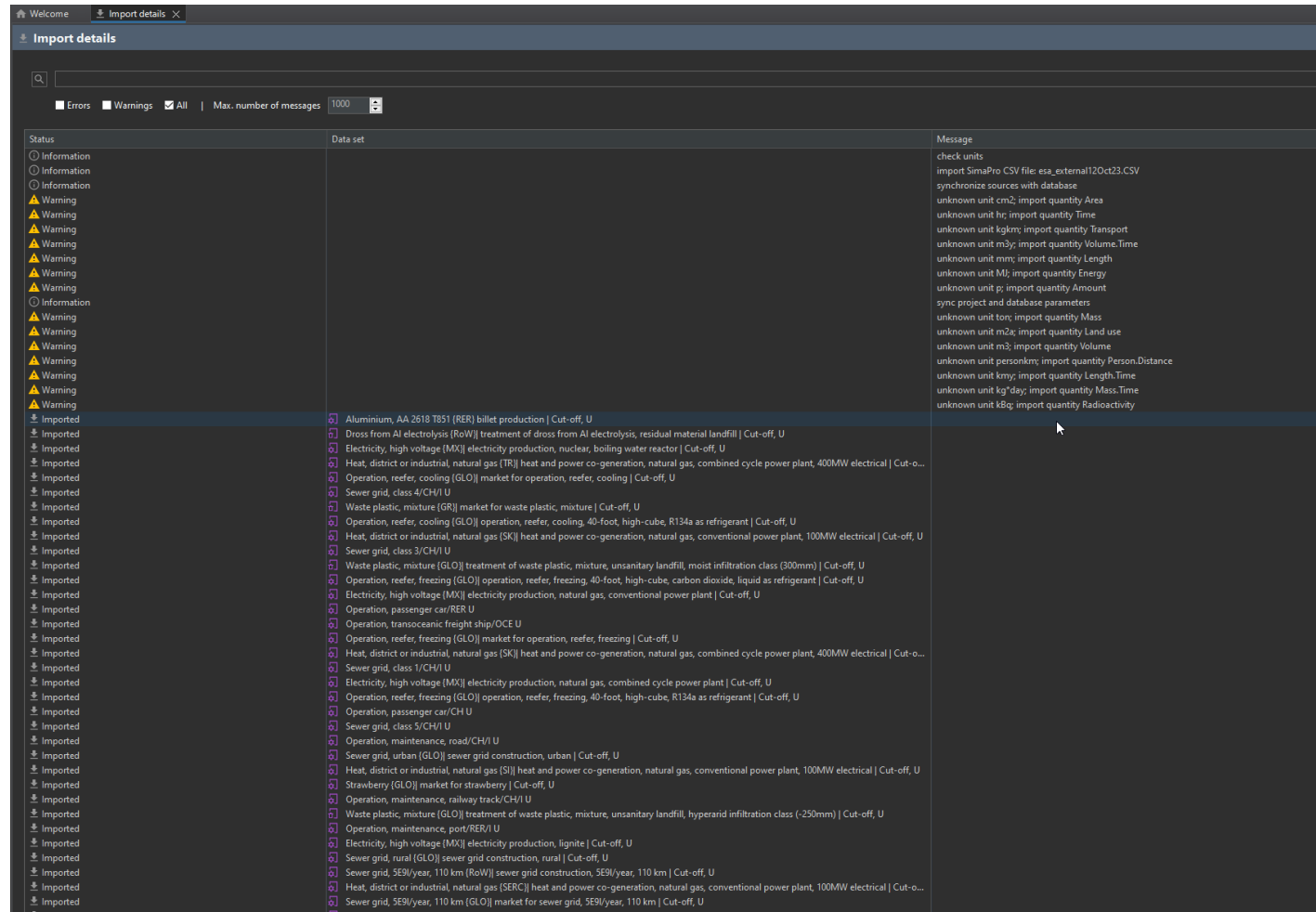


- ❑ „Full fledged“ LCA software, like SimaPro or GaBi
- ❑ open source and free, developed by GreenDelta since ~ 15 years
- ❑ > 100,000 users worldwide, flexible and powerful
- ❑ Latest release 2.0.2 two weeks ago
- ❑ Ecoinvent, GaBi, .. other databases can be used in openLCA
- ❑ Script support, flexible, powerful -> better suited for data management

❑ SimaPro import



❏ SimaPro import



The screenshot displays the 'Import details' window in openLCA. At the top, there are tabs for 'Welcome' and 'Import details'. Below the tabs, there is a search bar and a filter section with checkboxes for 'Errors' and 'Warnings', and a dropdown menu set to 'All'. A 'Max. number of messages' field is set to '1000'. The main area is a table with three columns: 'Status', 'Data set', and 'Message'.

Status	Data set	Message
Information		check units
Information		import SimaPro CSV file: esa_external12Oct23.CSV
Information		synchronize sources with database
Warning		unknown unit cm2; import quantity Area
Warning		unknown unit hr; import quantity Time
Warning		unknown unit kgkm; import quantity Transport
Warning		unknown unit m3; import quantity Volume.Time
Warning		unknown unit m; import quantity Length
Warning		unknown unit MJ; import quantity Energy
Warning		unknown unit ps; import quantity Amount
Warning		sync project and database parameters
Warning		unknown unit ton; import quantity Mass
Warning		unknown unit m2a; import quantity Land use
Warning		unknown unit m3; import quantity Volume
Warning		unknown unit personkm; import quantity Person.Distance
Warning		unknown unit km; import quantity Length.Time
Warning		unknown unit kg/day; import quantity Mass.Time
Warning		unknown unit kBq; import quantity Radioactivity
Imported	Aluminium, AA 2618 T851 (RER) billet production Cut-off, U	
Imported	Dross from Al electrolysis (RoW) treatment of dross from Al electrolysis, residual material landfill Cut-off, U	
Imported	Electricity, high voltage (MX) electricity production, nuclear, boiling water reactor Cut-off, U	
Imported	Heat, district or industrial, natural gas (TR) heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical Cut-off, U	
Imported	Operation, reefer, cooling (GLO) market for operation, reefer, cooling Cut-off, U	
Imported	Sewer grid, class 4/CH/I U	
Imported	Waste plastic, mixture (GR) market for waste plastic, mixture Cut-off, U	
Imported	Operation, reefer, cooling (GLO) operation, reefer, cooling, 40-foot, high-cube, R134a as refrigerant Cut-off, U	
Imported	Heat, district or industrial, natural gas (SK) heat and power co-generation, natural gas, conventional power plant, 100MW electrical Cut-off, U	
Imported	Sewer grid, class 3/CH/I U	
Imported	Waste plastic, mixture (GLO) treatment of waste plastic, mixture, unsanitary landfill, moist infiltration class (300mm) Cut-off, U	
Imported	Operation, reefer, freezing (GLO) operation, reefer, freezing, 40-foot, high-cube, carbon dioxide, liquid as refrigerant Cut-off, U	
Imported	Electricity, high voltage (MX) electricity production, natural gas, conventional power plant Cut-off, U	
Imported	Operation, passenger car/RER U	
Imported	Operation, transoceanic freight ship/OCE U	
Imported	Operation, reefer, freezing (GLO) market for operation, reefer, freezing Cut-off, U	
Imported	Heat, district or industrial, natural gas (SK) heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical Cut-off, U	
Imported	Sewer grid, class 1/CH/I U	
Imported	Electricity, high voltage (MX) electricity production, natural gas, combined cycle power plant Cut-off, U	
Imported	Operation, reefer, freezing (GLO) operation, reefer, freezing, 40-foot, high-cube, R134a as refrigerant Cut-off, U	
Imported	Operation, passenger car/CH U	
Imported	Sewer grid, class 5/CH/I U	
Imported	Operation, maintenance, road/CH/I U	
Imported	Sewer grid, urban (GLO) sewer grid construction, urban Cut-off, U	
Imported	Heat, district or industrial, natural gas (SI) heat and power co-generation, natural gas, conventional power plant, 100MW electrical Cut-off, U	
Imported	Strawberry (GLO) market for strawberry Cut-off, U	
Imported	Operation, maintenance, railway track/CH/I U	
Imported	Waste plastic, mixture (GLO) treatment of waste plastic, mixture, unsanitary landfill, hyperarid infiltration class (-250mm) Cut-off, U	
Imported	Operation, maintenance, port/RER/I U	
Imported	Electricity, high voltage (MX) electricity production, lignite Cut-off, U	
Imported	Sewer grid, rural (GLO) sewer grid construction, rural Cut-off, U	
Imported	Sewer grid, SE9/year, 110 km (RoW) sewer grid construction, SE9/year, 110 km Cut-off, U	
Imported	Heat, district or industrial, natural gas (SERC) heat and power co-generation, natural gas, conventional power plant, 100MW electrical Cut-off, U	
Imported	Sewer grid, SE9/year, 110 km (GLO) market for sewer grid, SE9/year, 110 km Cut-off, U	
Imported	Electricity, high voltage (MX) electricity production, hydro, conventional Cut-off, U	

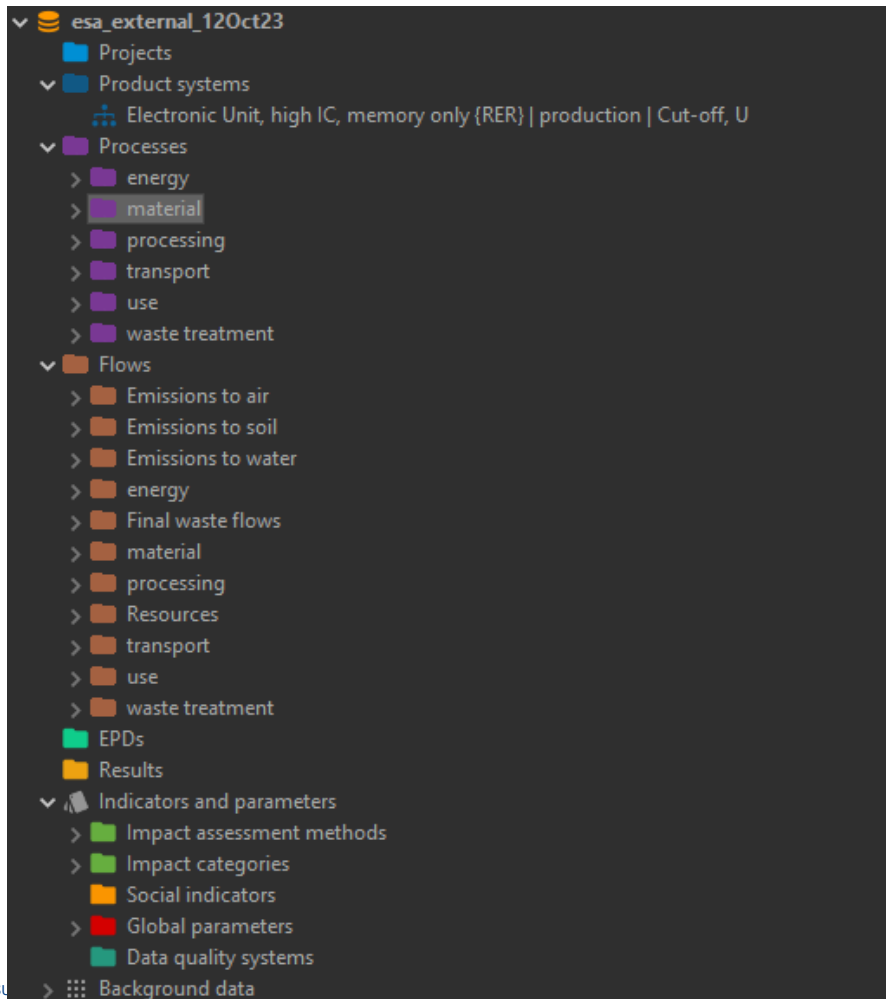
❑ SimaPro import

Message
check units
import SimaPro CSV file: esa_external12Oct23.CSV
synchronize sources with database
unknown unit cm2; import quantity Area
unknown unit hr; import quantity Time
unknown unit kgkm; import quantity Transport
unknown unit m3y; import quantity Volume.Time
unknown unit mm; import quantity Length
unknown unit MJ; import quantity Energy
unknown unit p; import quantity Amount
sync project and database parameters
unknown unit ton; import quantity Mass
unknown unit m2a; import quantity Land use
unknown unit m3; import quantity Volume
unknown unit personkm; import quantity Person.Distance
unknown unit kmy; import quantity Length.Time
unknown unit kg*day; import quantity Mass.Time
unknown unit kBq; import quantity Radioactivity

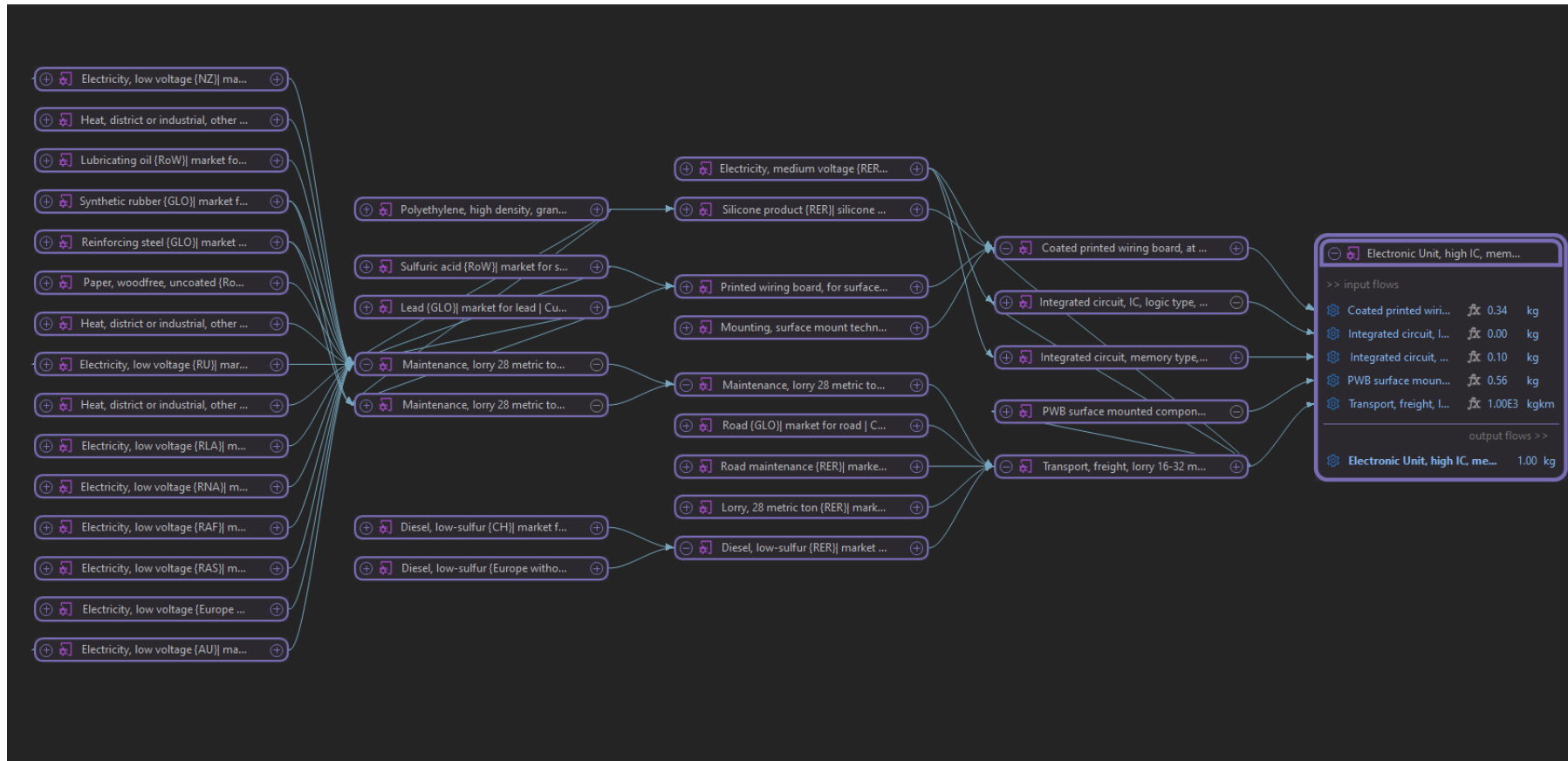
□ SimaPro import

↓ Imported	⚙ Aluminium, AA 2618 T851 {RER} billet production Cut-off, U
↓ Imported	⚙ Dross from Al electrolysis {RoW} treatment of dross from Al electrolysis, residual material landfill Cut-off, U
↓ Imported	⚙ Electricity, high voltage {MX} electricity production, nuclear, boiling water reactor Cut-off, U
↓ Imported	⚙ Heat, district or industrial, natural gas {TR} heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical Cut-off, U
↓ Imported	⚙ Operation, reefer, cooling {GLO} market for operation, reefer, cooling Cut-off, U
↓ Imported	⚙ Sewer grid, class 4/CH/I U
↓ Imported	⚙ Waste plastic, mixture {GR} market for waste plastic, mixture Cut-off, U
↓ Imported	⚙ Operation, reefer, cooling {GLO} operation, reefer, cooling, 40-foot, high-cube, R134a as refrigerant Cut-off, U
↓ Imported	⚙ Heat, district or industrial, natural gas {SK} heat and power co-generation, natural gas, conventional power plant, 100MW electrical Cut-off, U
↓ Imported	⚙ Sewer grid, class 3/CH/I U
↓ Imported	⚙ Waste plastic, mixture {GLO} treatment of waste plastic, mixture, unsanitary landfill, moist infiltration class (300mm) Cut-off, U
↓ Imported	⚙ Operation, reefer, freezing {GLO} operation, reefer, freezing, 40-foot, high-cube, carbon dioxide, liquid as refrigerant Cut-off, U
↓ Imported	⚙ Electricity, high voltage {MX} electricity production, natural gas, conventional power plant Cut-off, U
↓ Imported	⚙ Operation, passenger car/RER U
↓ Imported	⚙ Operation, transoceanic freight ship/OCE U
↓ Imported	⚙ Operation, reefer, freezing {GLO} market for operation, reefer, freezing Cut-off, U
↓ Imported	⚙ Heat, district or industrial, natural gas {SK} heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical Cut-off, U
↓ Imported	⚙ Sewer grid, class 1/CH/I U
↓ Imported	⚙ Electricity, high voltage {MX} electricity production, natural gas, combined cycle power plant Cut-off, U
↓ Imported	⚙ Operation, reefer, freezing {GLO} operation, reefer, freezing, 40-foot, high-cube, R134a as refrigerant Cut-off, U
↓ Imported	⚙ Operation, passenger car/CH U
↓ Imported	⚙ Sewer grid, class 5/CH/I U
↓ Imported	⚙ Operation, maintenance, road/CH/I U
↓ Imported	⚙ Sewer grid, urban {GLO} sewer grid construction, urban Cut-off, U
↓ Imported	⚙ Heat, district or industrial, natural gas {SI} heat and power co-generation, natural gas, conventional power plant, 100MW electrical Cut-off, U
↓ Imported	⚙ Strawberry {GLO} market for strawberry Cut-off, U
↓ Imported	⚙ Operation, maintenance, railway track/CH/I U

❑ Completed database and LCIA methods



❑ Product systems can be created in the database..



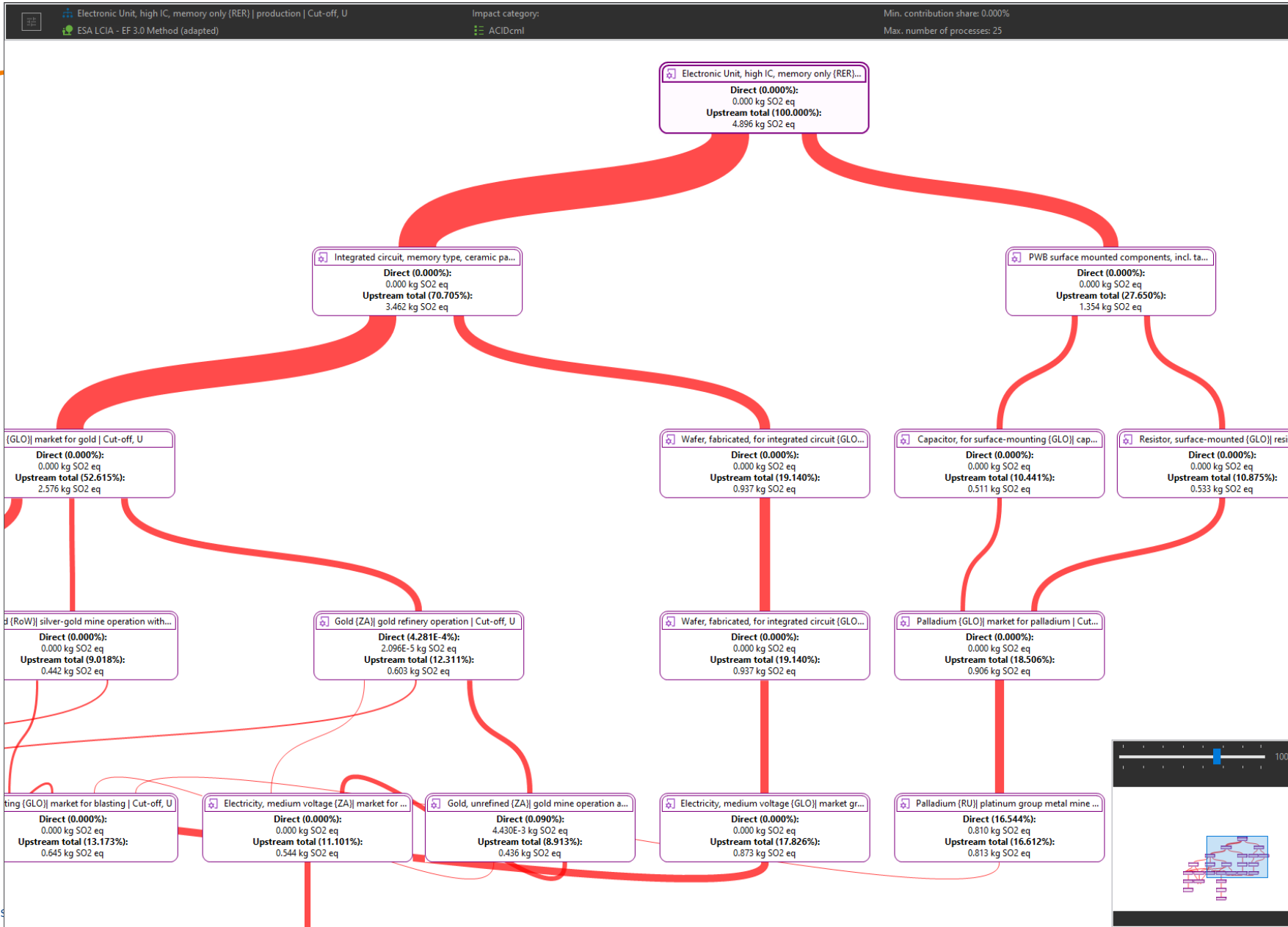
□ ..and evidently be calculated

Electronic Unit, high IC, memory only (RER) | production | Cut-off, U

Impact analysis: ESA LCIA - EF 3.0 Method (adapted)

Sub-group by: Flows Processes | Don't show < 1 %

Name	Category	Inventory result	Characterization factor	Impact assessment result
> ACIDcml	ESA LCIA - EF 3.0 Method (adapted)			4.89642 kg SO2 eq
> ACIDef	ESA LCIA - EF 3.0 Method (adapted)			6.22103 mol H+ eq
> Sulfur dioxide	Emissions to air/low. pop.	2.40286 kg	1.31000 mol H+ eq/kg	3.14775 mol H+ eq
> Nitrogen oxides	Emissions to air/low. pop.	1.51641 kg	0.74000 mol H+ eq/kg	1.12214 mol H+ eq
> Nitrogen oxides	Emissions to air	1.14672 kg	0.74000 mol H+ eq/kg	0.84857 mol H+ eq
> Ammonia	Emissions to air	0.13875 kg	3.02000 mol H+ eq/kg	0.41901 mol H+ eq
> Sulfur dioxide	Emissions to air/high. pop.	0.23489 kg	1.31000 mol H+ eq/kg	0.30771 mol H+ eq
> Sulfur oxides	Emissions to air	0.10440 kg	1.31000 mol H+ eq/kg	0.13677 mol H+ eq
> Nitrogen oxides	Emissions to air/high. pop.	0.14632 kg	0.74000 mol H+ eq/kg	0.10828 mol H+ eq
> Sulfur dioxide	Emissions to air	0.06870 kg	1.31000 mol H+ eq/kg	0.09000 mol H+ eq
> ADEPLf	ESA LCIA - EF 3.0 Method (adapted)			9042.41701 MJ
> ADEPLmr	ESA LCIA - EF 3.0 Method (adapted)			1.20476 kg Sb eq
> Tantalum	Resources/in ground	0.04078 kg	11.50000 kg Sb eq/kg	0.46900 kg Sb eq
> Tantalum concentrate, 30% Ta2O5 (RoW) tantalum mine operation and beneficiati	material/Metals/Non ferro/Transformation	0.01657 kg		0.19050 kg Sb eq
> Tantalum concentrate, 30% Ta2O5 (CD) tantalum mine operation and beneficiati	material/Metals/Non ferro/Transformation	0.01614 kg		0.18566 kg Sb eq
> Tantalum concentrate, 30% Ta2O5 (RW) tantalum mine operation and beneficiati	material/Metals/Non ferro/Transformation	0.00807 kg		0.09283 kg Sb eq
> Silver	Resources/in ground	0.04576 kg	8.42000 kg Sb eq/kg	0.38526 kg Sb eq
> Gold	Resources/in ground	0.00862 kg	36.00000 kg Sb eq/kg	0.31033 kg Sb eq
> ADEPLmu	ESA LCIA - EF 3.0 Method (adapted)			0.51247 kg Sb eq
> FWLUT	ESA LCIA - EF 3.0 Method (adapted)			1.57034 kg P eq
> FWTOX	ESA LCIA - EF 3.0 Method (adapted)			2.09235E4 CTUe
> GWP	ESA LCIA - EF 3.0 Method (adapted)			716.96441 kg CO2 eq
> Carbon dioxide, fossil	Emissions to air/low. pop.	512.31346 kg	1.00000 kg CO2 eq/kg	512.31346 kg CO2 eq
> Methane, fossil	Emissions to air/low. pop.	2.03574 kg	36.80000 kg CO2 eq/kg	74.91515 kg CO2 eq
> Hard coal (CN) hard coal mine operation and hard coal preparation Cut-off, U	material/Fuels/Coal/Transformation	1.13047 kg		41.60119 kg CO2 eq
> Natural gas, vented (GLO) natural gas venting from petroleum/natural gas prod	material/Fuels/Natural gas/Transformation	0.59554 kg		21.91569 kg CO2 eq
> Carbon dioxide, fossil	Emissions to air/high. pop.	57.79911 kg	1.00000 kg CO2 eq/kg	57.79911 kg CO2 eq
> Carbon dioxide, fossil	Emissions to air	37.09886 kg	1.00000 kg CO2 eq/kg	37.09886 kg CO2 eq
> Diesel, burned in building machine (GLO) diesel, burned in building machine C	energy/Mechanical/Transformation	19.54499 kg		19.54499 kg CO2 eq
> Ethane, hexafluoro-, HFC-116	Emissions to air/high. pop.	0.00111 kg	1.23000E4 kg CO2 eq/kg	13.69150 kg CO2 eq
> Wafer, fabricated, for integrated circuit (GLO) wafer production, fabricated, for i	material/Electronics/Component/Transformation	0.00111 kg		13.69146 kg CO2 eq
> HTOXc	ESA LCIA - EF 3.0 Method (adapted)			7.06790E-7 CTUh
> HTOXnc	ESA LCIA - EF 3.0 Method (adapted)			4.05109E-5 CTUh
> IORAD	ESA LCIA - EF 3.0 Method (adapted)			84.48112 kBq U-235 eq
> LUP	ESA LCIA - EF 3.0 Method (adapted)			4906.80996 Pt
> MWEUT	ESA LCIA - EF 3.0 Method (adapted)			1.25318 kg N eq
> MWTOX	ESA LCIA - EF 3.0 Method (adapted)			1.03293E7 kg 1,4-DB eq
> ODEPL	ESA LCIA - EF 3.0 Method (adapted)			5.80971E-5 kg CFC11 eq
> PCHEM	ESA LCIA - EF 3.0 Method (adapted)			3.74720 kg NMVOC eq
> PMAT	ESA LCIA - EF 3.0 Method (adapted)			4.12966E-5 disease inc.

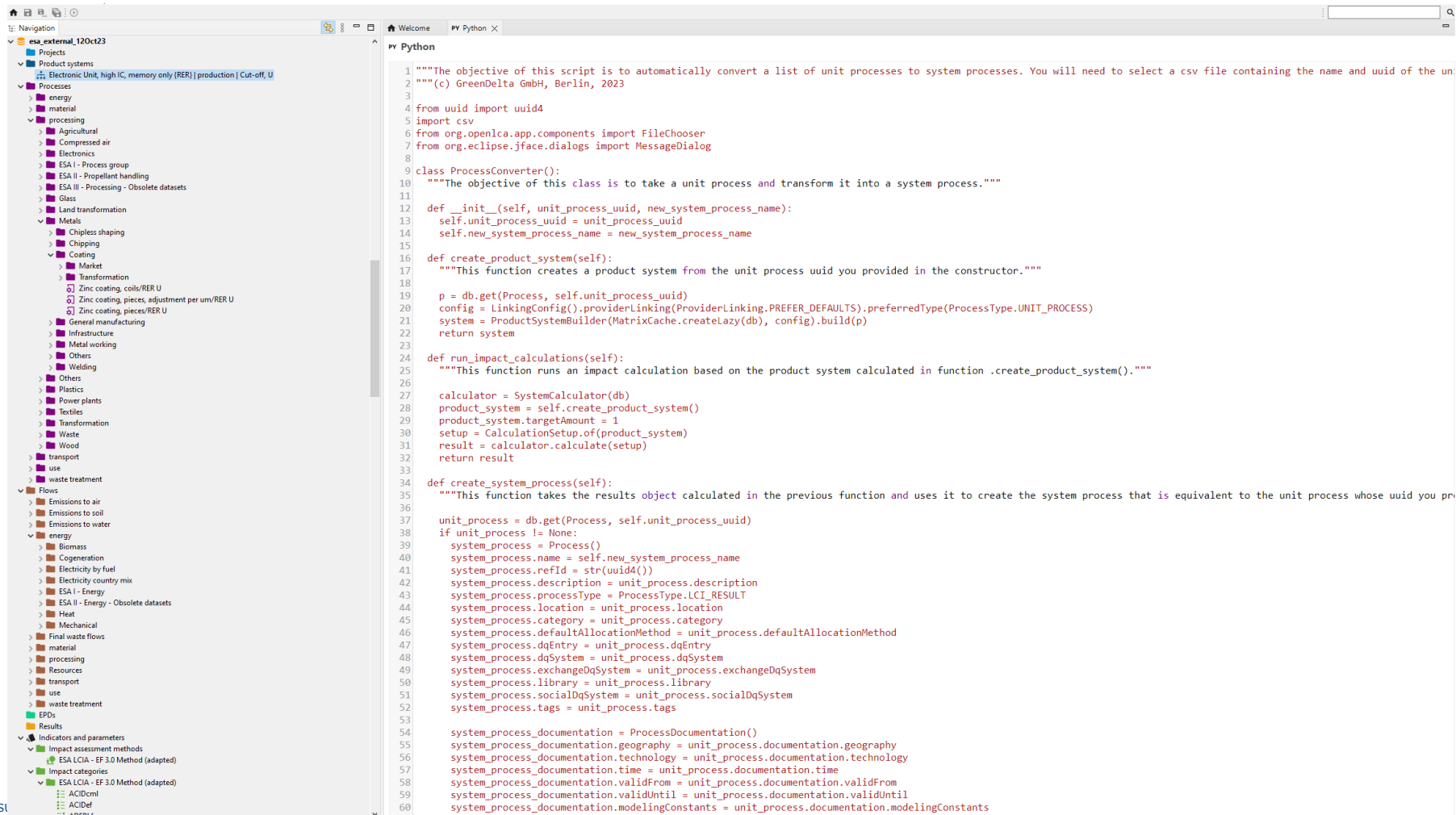


openLCA:SimaPro result comparison (external database, Electronic Unit, high IC, memory only {RER} | production | Cut-off, U)



Name	Category	openLCA Impact assessment result	SimaPro Total	Unit	o/SP
ACIDcml	ESA LCIA - EF 3.0 Method (adapted)	4.896418114	4.89641806	kg SO2 eq	1.00000001
ACIDef	ESA LCIA - EF 3.0 Method (adapted)	6.221032012	6.22103194	mol H+ eq	1.00000001
ADEPLf	ESA LCIA - EF 3.0 Method (adapted)	9042.417009	9042.41684	MJ	1.00000002
ADEPLmr	ESA LCIA - EF 3.0 Method (adapted)	1.204761963	1.20476196	kg Sb eq	1
ADEPLmu	ESA LCIA - EF 3.0 Method (adapted)	0.512473244	0.51247324	kg Sb eq	1
FWEUT	ESA LCIA - EF 3.0 Method (adapted)	1.570335308	1.5703353	kg P eq	1.00000001
FWTOX	ESA LCIA - EF 3.0 Method (adapted)	20923.53852	20923.5384	CTUe	1.00000001
GWP	ESA LCIA - EF 3.0 Method (adapted)	717.0323484	716.964395	kg CO2 eq	1.00009478
HTOXc	ESA LCIA - EF 3.0 Method (adapted)	7.07E-07	7.07E-07	CTUh	1.00000045
HTOXnc	ESA LCIA - EF 3.0 Method (adapted)	4.05E-05	4.05E-05	CTUh	0.99999994
IORAD	ESA LCIA - EF 3.0 Method (adapted)	84.48111987	84.4811184	kBq U-235 ec	1.00000002
LUP	ESA LCIA - EF 3.0 Method (adapted)	4906.809957	4906.80991	Pt	1.00000001
MWEUT	ESA LCIA - EF 3.0 Method (adapted)	1.253184875	1.25318486	kg N eq	1.00000001
MWTOX	ESA LCIA - EF 3.0 Method (adapted)	1.03E+07	10329272.5	kg 1,4-DB eq	1.00000001
ODEPL	ESA LCIA - EF 3.0 Method (adapted)	5.81E-05	5.81E-05	kg CFC11 eq	1.00000082
PCHEM	ESA LCIA - EF 3.0 Method (adapted)	3.747196498	3.74719645	kg NMVOC e	1.00000001
PMAT	ESA LCIA - EF 3.0 Method (adapted)	4.13E-05	4.13E-05	disease inc.	1.00000016
PRENE	ESA LCIA - EF 3.0 Method (adapted)	10613.48955	10613.4894	MJ	1.00000002
TEUT	ESA LCIA - EF 3.0 Method (adapted)	14.01649413	14.016494	mol N eq	1.00000001
WDEPL	ESA LCIA - EF 3.0 Method (adapted)	141.1528113	141.152809	m3 depriv.	1.00000002

❑ Datasets could be modified with scripts



The screenshot shows the openLCA interface. On the left is a navigation tree for a project named 'esa_external_12Oct23'. The tree is expanded to show 'Product systems' and 'Processes'. Under 'Processes', there are categories like 'energy', 'material', and 'processing'. The 'processing' category is further expanded to show various sub-processes such as 'Agricultural', 'Compressed air', 'Electronics', 'ESA I - Process group', 'ESA II - Propellant handling', 'ESA III - Processing - Obsolete datasets', 'Glass', 'Land transformation', 'Metals', 'Chipless shaping', 'Chipping', 'Coating', 'Market', 'Transformation', 'Zinc coating, coils/RER U', 'Zinc coating, pieces, adjustment per um/RER U', 'Zinc coating, pieces/RER U', 'General manufacturing', 'Infrastructure', 'Metal working', 'Others', 'Welding', 'Plastics', 'Power plants', 'Textiles', 'Transformation', 'Waste', 'Wood', 'transport', 'use', and 'waste treatment'. The 'Flows' category is also expanded to show 'Emissions to air', 'Emissions to soil', 'Emissions to water', 'energy', 'Biomass', 'Cogeneration', 'Electricity by fuel', 'Electricity country mix', 'ESA I - Energy', 'ESA II - Energy - Obsolete datasets', 'Heat', 'Mechanical', 'Final waste flows', 'material', 'processing', 'Resources', 'transport', 'use', and 'waste treatment'. The 'Results' category is expanded to show 'Indicators and parameters', 'Impact assessment methods', and 'Impact categories'. The 'Impact categories' are further expanded to show 'ESA LCIA - EF 3.0 Method (adapted)', 'ACIDcmI', and 'ACIDef'.

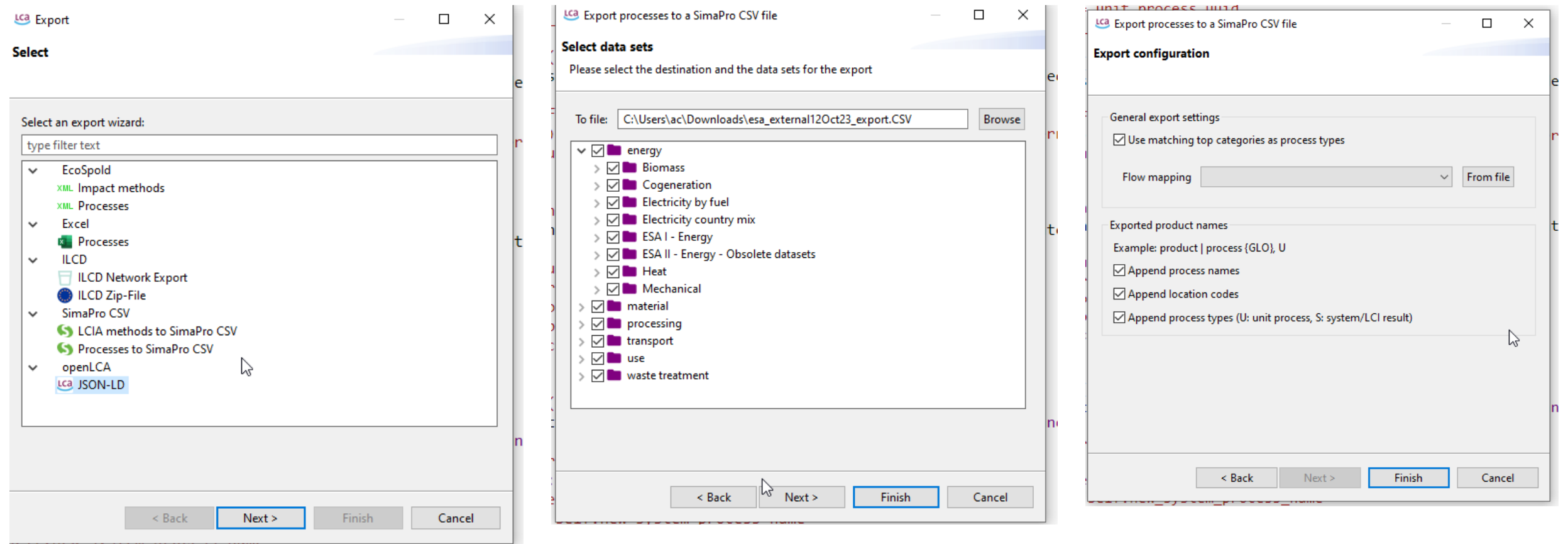
On the right, a Python script is shown in a code editor. The script is titled 'pv Python' and contains the following code:

```

1 """The objective of this script is to automatically convert a list of unit processes to system processes. You will need to select a csv file containing the name and uuid of the un
2 """(c) GreenDelta GmbH, Berlin, 2023
3
4 from uuid import uuid4
5 import csv
6 from org.openlca.app.components import FileChooser
7 from org.eclipse.jface.dialogs import MessageDialog
8
9 class ProcessConverter():
10     """The objective of this class is to take a unit process and transform it into a system process."""
11
12     def __init__(self, unit_process_uuid, new_system_process_name):
13         self.unit_process_uuid = unit_process_uuid
14         self.new_system_process_name = new_system_process_name
15
16     def create_product_system(self):
17         """This function creates a product system from the unit process uuid you provided in the constructor."""
18
19         p = db.get(Process, self.unit_process_uuid)
20         config = LinkingConfig().providerLinking(ProviderLinking.PREFER_DEFAULTS).preferredType(ProcessType.UNIT_PROCESS)
21         system = ProductSystemBuilder(MatrixCache.createLazy(db), config).build(p)
22         return system
23
24     def run_impact_calculations(self):
25         """This function runs an impact calculation based on the product system calculated in function .create_product_system()."""
26
27         calculator = SystemCalculator(db)
28         product_system = self.create_product_system()
29         product_system.targetAmount = 1
30         setup = CalculationSetup.of(product_system)
31         result = calculator.calculate(setup)
32         return result
33
34     def create_system_process(self):
35         """This function takes the results object calculated in the previous function and uses it to create the system process that is equivalent to the unit process whose uuid you pr
36
37         unit_process = db.get(Process, self.unit_process_uuid)
38         if unit_process != None:
39             system_process = Process()
40             system_process.name = self.new_system_process_name
41             system_process.refId = str(uuid4())
42             system_process.description = unit_process.description
43             system_process.processType = ProcessType.LCI_RESULT
44             system_process.location = unit_process.location
45             system_process.category = unit_process.category
46             system_process.defaultAllocationMethod = unit_process.defaultAllocationMethod
47             system_process.dqEntry = unit_process.dqEntry
48             system_process.dqSystem = unit_process.dqSystem
49             system_process.exchangeDqSystem = unit_process.exchangeDqSystem
50             system_process.library = unit_process.library
51             system_process.socialDqSystem = unit_process.socialDqSystem
52             system_process.tags = unit_process.tags
53
54             system_process_documentation = ProcessDocumentation()
55             system_process_documentation.geography = unit_process.documentation.geography
56             system_process_documentation.technology = unit_process.documentation.technology
57             system_process_documentation.time = unit_process.documentation.time
58             system_process_documentation.validFrom = unit_process.documentation.validFrom
59             system_process_documentation.validUntil = unit_process.documentation.validUntil
60             system_process_documentation.modelingConstants = unit_process.documentation.modelingConstants

```

- ❑ Export is possible to various platforms and LCA Tools (but: devil is in the detail)



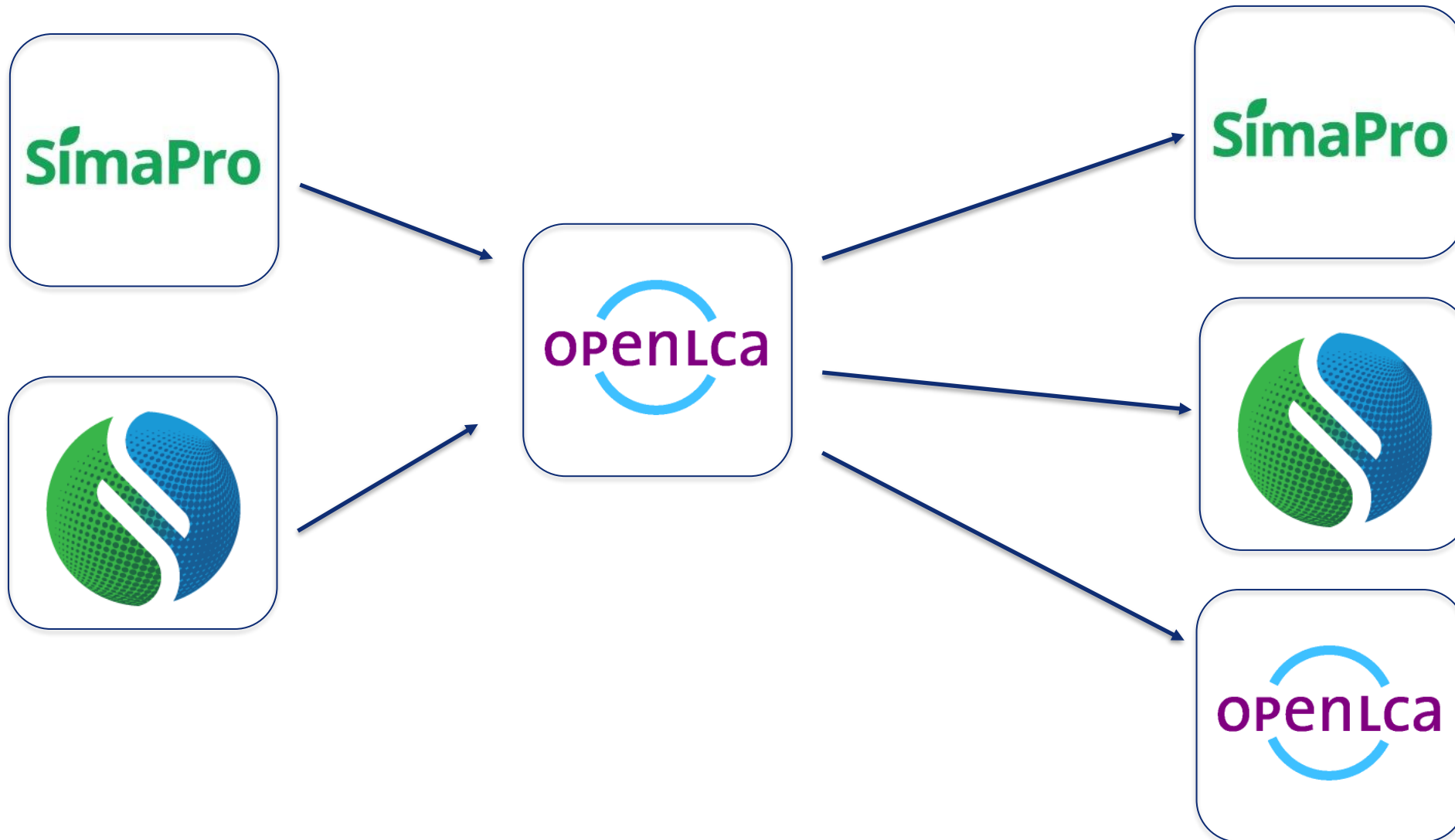
The image displays three sequential screenshots of the openLCA export wizard, illustrating the process of exporting data to a SimaPro CSV file.

Screenshot 1: Select
 The first window, titled "LCA Export", shows a "Select" dialog. It prompts the user to "Select an export wizard:" and provides a search filter "type filter text". A list of export options is shown, including EcoSpold, Excel, ILCD, SimaPro CSV, and openLCA. The "openLCA" option is highlighted, and the "Next >" button is active.

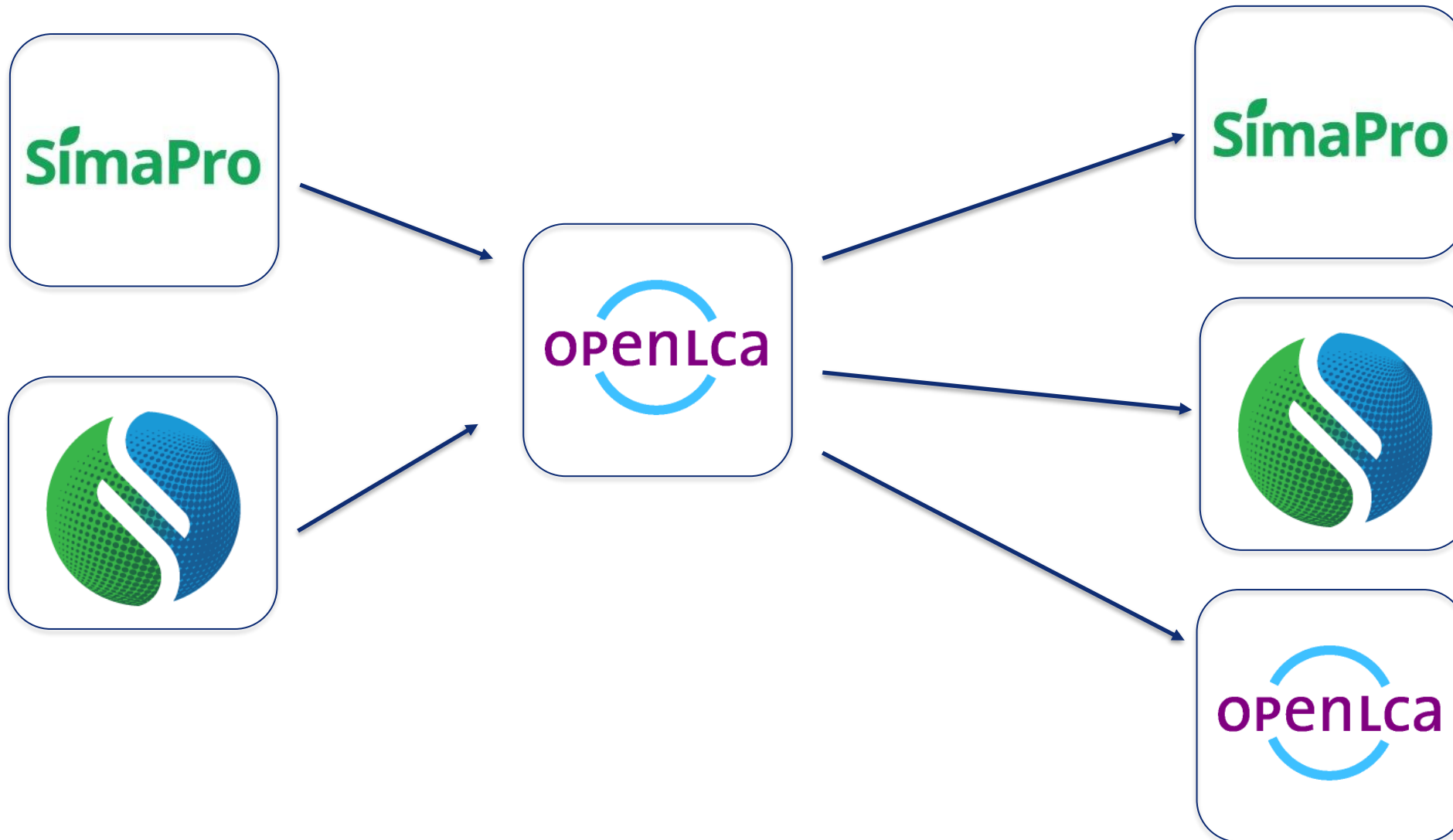
Screenshot 2: Select data sets
 The second window, titled "LCA Export processes to a SimaPro CSV file", shows the "Select data sets" dialog. It prompts the user to "Please select the destination and the data sets for the export". The "To file:" field is set to "C:\Users\ac\Downloads\esa_external12Oct23_export.CSV". A list of data sets is shown, including energy, material, processing, transport, use, and waste treatment. All data sets are checked, and the "Next >" button is active.

Screenshot 3: Export configuration
 The third window, titled "LCA Export processes to a SimaPro CSV file", shows the "Export configuration" dialog. It prompts the user to configure the export settings. The "General export settings" section includes a checked option for "Use matching top categories as process types" and a "Flow mapping" dropdown set to "From file". The "Exported product names" section includes checked options for "Append process names", "Append location codes", and "Append process types (U: unit process, S: system/LCI result)". The "Finish" button is active.

- ❑ Data conversion / import from GaBi into openLCA, from projects
- ❑ Export to SimaPro (entire esa database)
- ❑ Import from SimaPro (entire esa database and „pieces“, single datasets)
- ❑ Modification of datasets in the esa database
- ❑ Provision of the esa database (openLCA users)



openLCA: role in the project: an LCA data platform



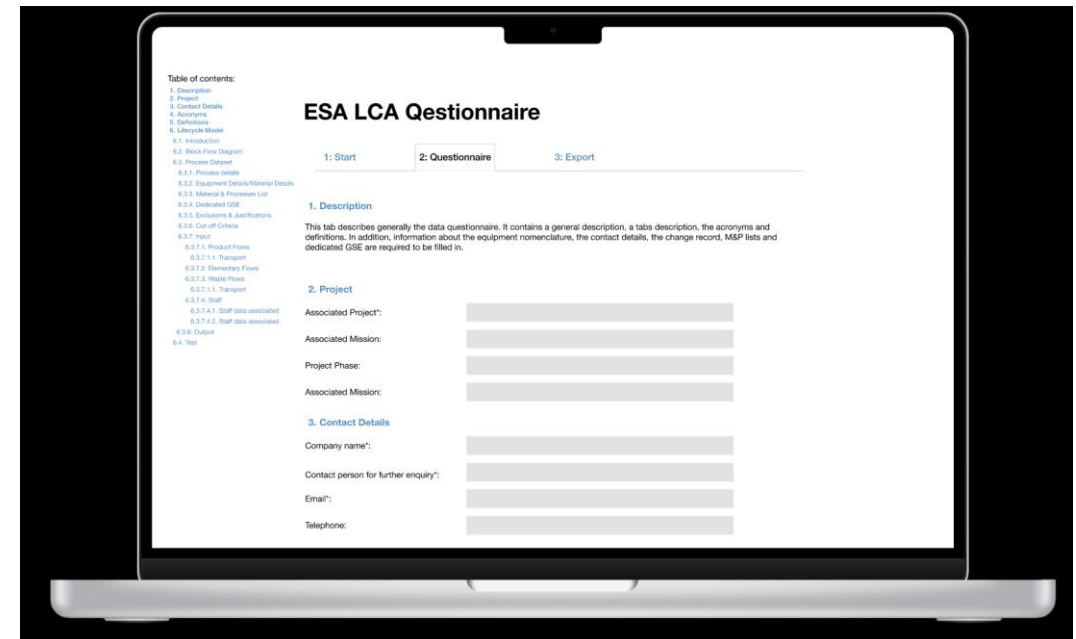
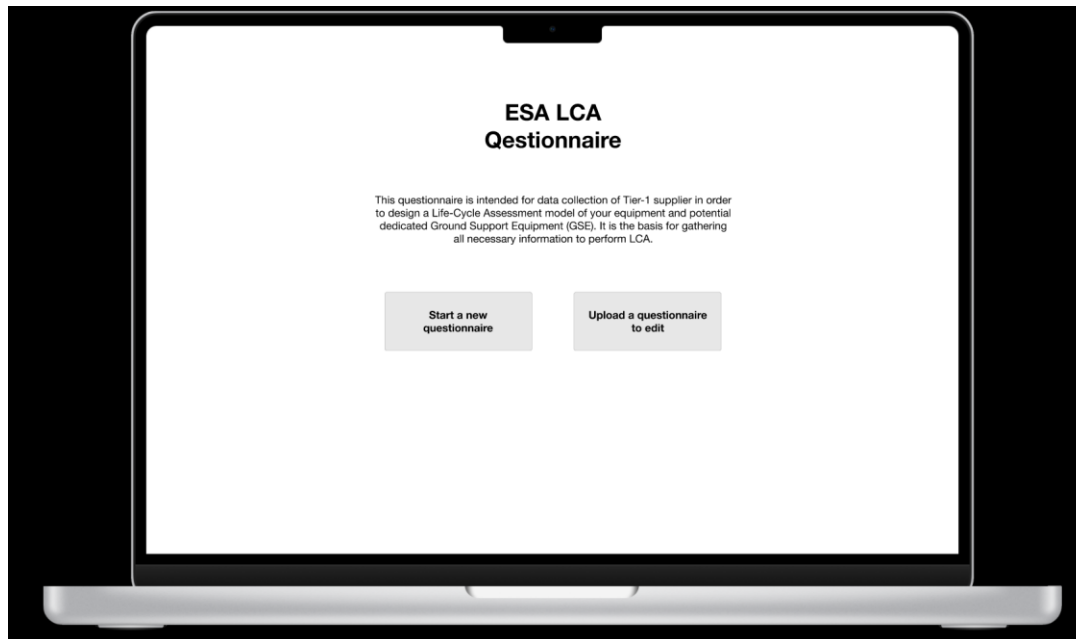
- ❑ Every data conversion in LCA is challenging (tools with limitations and different modeling concepts; different interpretation and different support of LCA data exchange formats across LCA software)
- ❑ There will be some information loss (-> language translation)
- ❑ We will provide a coordinated user support manual for the conversion (idea: make users understand basic concepts and avoid things in own models and datasets that cause issues)
- ❑ Quality assurance: various tests, one e.g. results in SimaPro and openLCA identical, looking good so far
- ❑ On the bright side: import of the entire SimaPro esa internal database in openLCA works with clicking a few buttons, export as well (e.g.)
- ❑ We look forward to expanding and improving the data platform and conversion capabilities and usability in the project, also based on your input & feedback

ESA LCA DB – Next Steps

1. WebTool Questionnaire
2. ESA LCA DB next versions
3. Workshops (round 2), wishlists, lessons learned

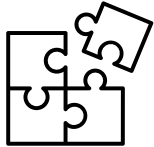
WebTool Questionnaire

- ❑ Currently in development
- ❑ Targeted end of 2023
- ❑ Web Tool alternative for the .xls Questionnaire



External DB – 2023

- ❑ Add datasets



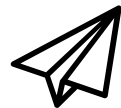
User feedback



- ❑ ESA LCA DB user on-point feedback (DB/Documentation)

User Wishlist

- ❑ Compiling user wish lists on missing/incomplete datasets



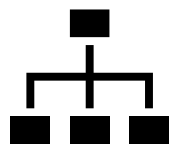
Lessons Learned

- ❑ Need for standardization and harmonization



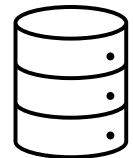
ESA LCA DB analysis

- ❑ Top-down approach
- ❑ Bottom-up approach



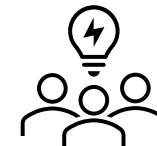
External DB – long Term

- ❑ Existent Dataset quality improvements
- ❑ New project datasets integration
- ❑ Priority on missing datasets needed by users
- ❑ Gaps addressed



ESA LCA DB Workshops (II)

- ❑ Dedicated meetings with Prime contractors/ ESA LCA DB users to understand the needs of the industry and prioritize updates accordingly



Why update to the new ESA LCA DB?

- ❑ Easy to export and deliver content (full DB and single processes)
- ❑ Access to the latest ESA LCA DB and datasets
- ❑ Access to the latest LCIA methods
- ❑ Access to updated documentation
- ❑ Possibility for support
- ❑ Feedback



Thank you

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