

Wiki on processes and products for Life Cycle Assessment (LCA) Overview

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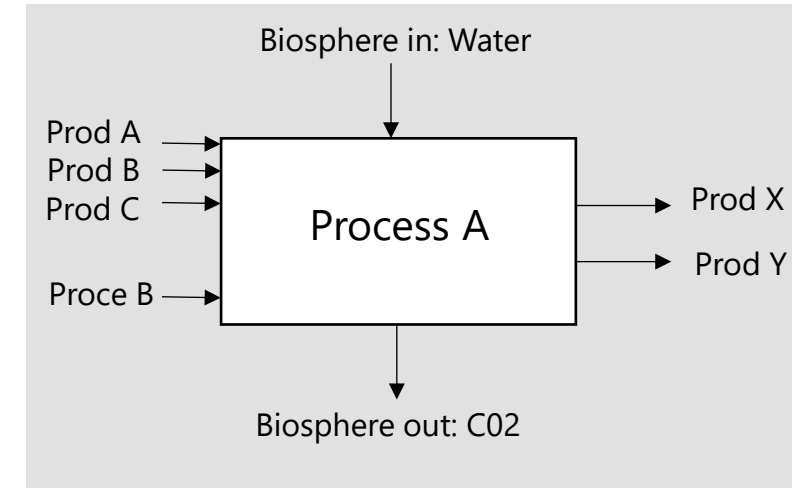
1. Some challenges in LCA – Initial motivation
2. Overview of the project
3. Current vision – two challenges addressed by the wiki
4. Data structure
5. Data import example
6. Tentative parametric approach

LCA/Impact results **without transparency on the processes** used (life cycle inventory - LCI) has **limited scientific value**.

- Impact results give **non explainable information**. Cannot be analyzed by experts.
- Given processes, one can compute and explain impact results.
- Used processes seem to be as important as methodology considered (e.g., PCR/PSR).
 - Using same methodology but different databases, one can observe up to x100 difference.
- No peer review for private databases.

However, there exist **many scientific publications in the public domain providing processes** used in the scope of LCA.

- **Proposal**: Centralize processes in a collaborative « wiki of product and processes ».
- Focus on « downstream » processes, e.g., BOMs, unlike e.g., ecoinvent which focuses on « upstream » processes.

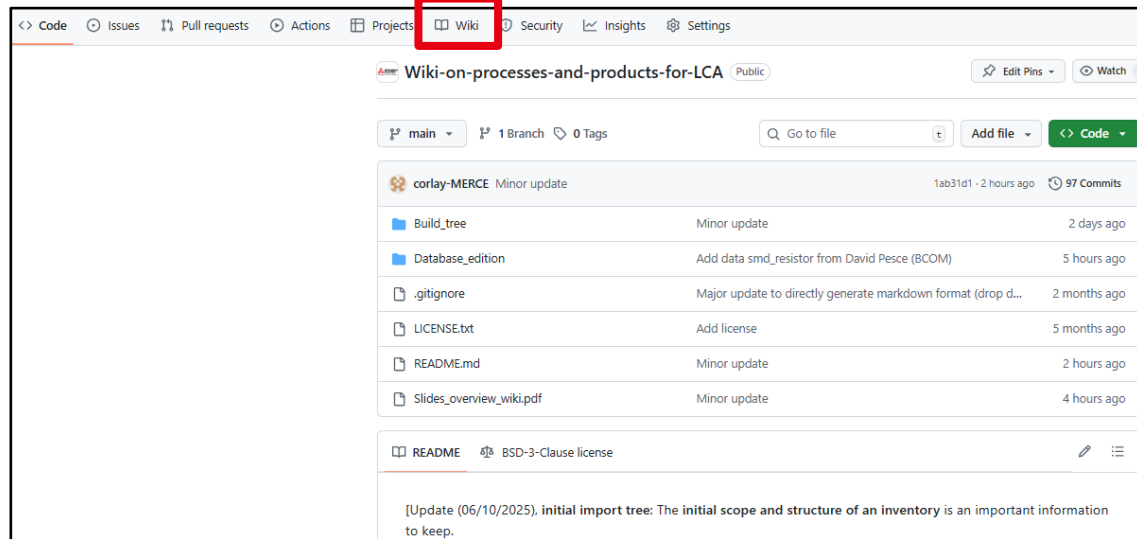


PCR: Product category rules.
PSR: Product specific rules.
BOM: Bill of materials.

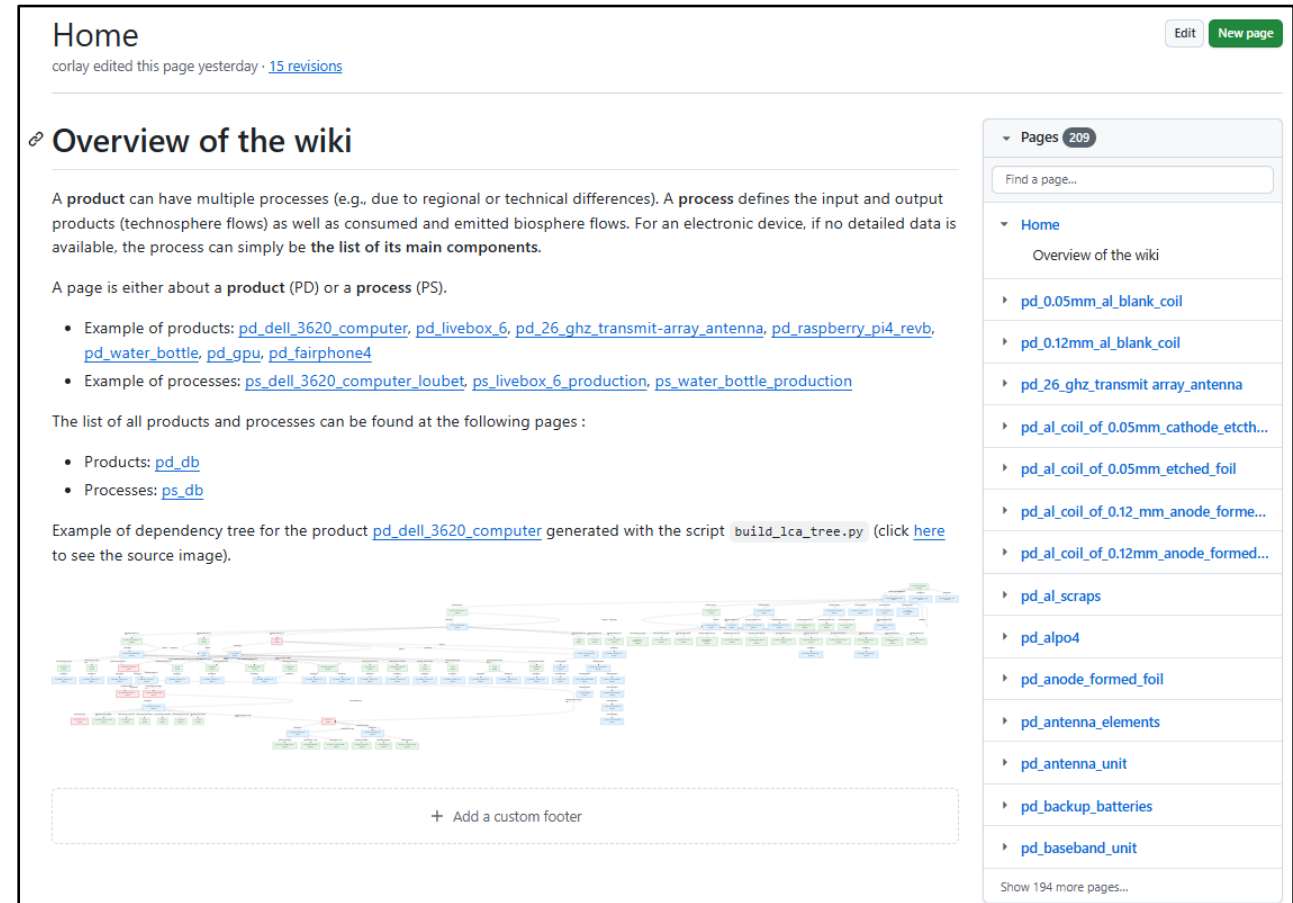
- Project link: <https://github.com/merce-fra/Wiki-on-processes-and-products-for-LCA>
 - Still at prototype stage. Goal is to illustrate approach.
- Project consists of four main parts:
 1. **The Wiki**: to organize processes and products, that can be found in the public domain, to be used for the **Life Cycle Inventory (LCI)** part of a Life Cycle Assessment (LCA) study.
 2. The **import function** for **Brightway-formatted inventory data**.
 3. **Visualization function**: automatically build a **dependency tree** starting from a chosen product or process page, **with identification of alternative process nodes**.
 4. **AI-based Wiki Edition**: AI to assist in the management of the Wiki. It automates tasks such as page generation (for not Brightway-compliant data), inconsistency detection, and product similarity analysis.

Overview of the project (2)

GitHub home page



Wiki home page

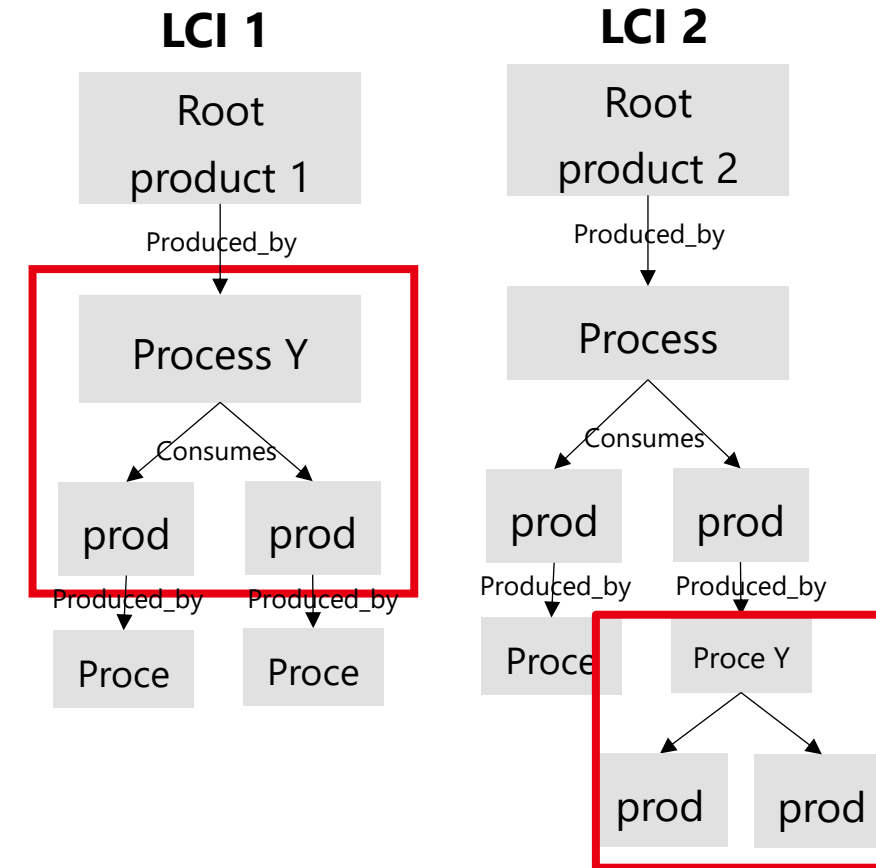


Currently, performing a LCI includes the following challenges:

1. **Several processes** may exist to produce **the same product** (not only for geographic reasons).
 2. **Scientific contributions** are often referenced by the end product, but inventory may include **sub-process data valuable for other studies**.
- This **open** wiki is designed to efficiently list and compare **multiple approaches** for performing the inventory of a product (1). It references data at the **process level** (2).
 - Easy to **compare existing options and select the most suitable approach**.

Example where LCI 1 and LCI 2 contain mutually beneficial data

(Point 2 on the left)



 Common process in LCI 1 and LCI 2

Electrolytic capacitors

- Theecoinvent reference to produce an [electrolytic capacitors](#) was originally added when importing the inventory of the [Dell computer](#).
- A second inventory was imported as data from a **research paper** dedicated to this topic. The import script automatically detected that the process produces a product already present in the wiki.
- Visualization script identifies that **two alternative processes now exist** for this node in the tree starting at the [Dell computer](#) node. **Red nodes in the graph.**
- This enables researchers studying the Dell computer to easily update their LCA with the alternative process for the electrolytic capacitors and compare the results.
- Link to the tree: raw.githubusercontent.com/wiki/merce-fra/Wiki-on-processes-and-products-for-LCA/out_tree/graph_pd_dell_3620_computer.svg

pd_electrolytic_capacitors

corlay edited this page on Jul 3 · 3 revisions

Product: pd_electrolytic_capacitors

List of processes

- Ecoinvent: market for capacitor_electrolyte_type_<2cm_height | GLO
- [ps_electrolytic_capacitors_aging_and_inspection_zhang](#)

pd_gpu

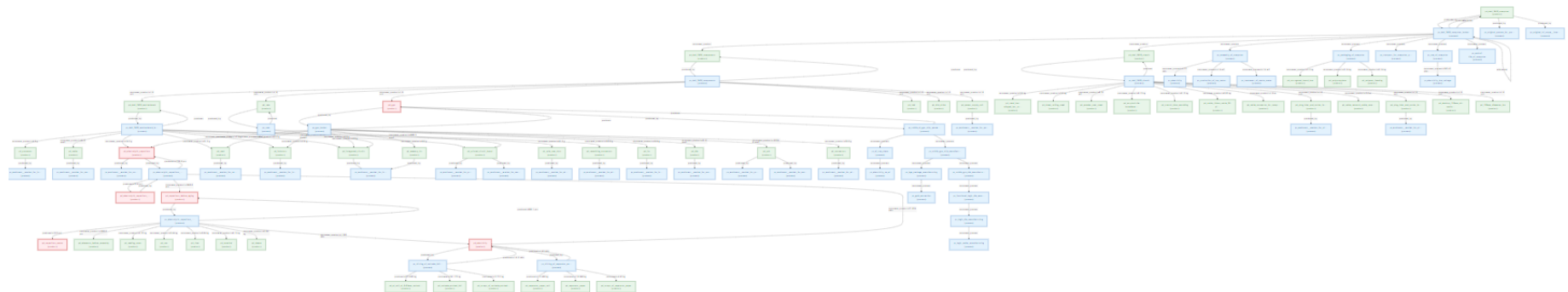
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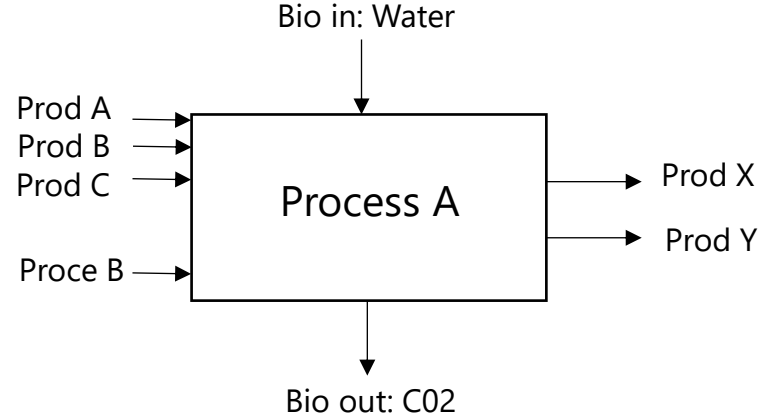
Product: pd_gpu

List of processes

- [ps_gpu_loubet](#)
- [ps_nvidia_ai_gpu_chip_parameter_appa](#)

May be similar to the following products





Product

- One product is always produced by a process.
- Several processes can be proposed for the same product (technical or geographic difference).

Process

- Process may or may not produce a product.
- It is composed of technosphere flows and biosphere flows.
- Technosphere flow:
 - Consumption of products and processes.
- Biosphere flow:
 - Consumption and emission of biosphere elements.
- Original root and process node.

Blue: clickable

Page of product X:

- [Process A](#)
- [Process B](#)
 - Original process for product as root node.
 - Original LCI scope
 - Original tree
- [Process C](#)
- Process E = Ecoinvent process (non clickable)

Example in the wiki

pd_gpu

corlay edited this page on Jul 9 · [3 revisions](#)

Product: pd_gpu

List of processes

- [ps_gpu_loubet](#)
- [ps_nvidia_ai_gpu_chip_parameter_appa](#)

Page of process A:

- Technosphere flow:
 - Production
 - [Product X](#)
 - [Product Y](#)
 - Consumption
 - [Product A](#)
 - Quantity
 - [Product B](#)
 - [Product C](#)
 - [Process B](#)
- Biosphere Flow:
 - Emission
 - [CO2](#)
 - Consumption
 - [water](#)
- Original root product and process nodes
 - Product: [XXX](#)
 - Process: [XXX](#)
- Information:

Publi ref...

Example in the wiki

Process: ps_gpu_loubet

Characteristics

- Added by: Vincent Corlay (v.corlay@fr.mercedes-mee.com)

Technosphere Flow

Production

- [pd_gpu](#) - Quantity: None unit

Consumption

Product:

- [pd_electrolytic_capacitors](#) - Quantity: 5.2 g - Amount: 4 - Database: Not s
- [pd_smd](#) - Quantity: 22.2 g - Amount: 258 - Database: Not s
- [pd_inductors](#) - Quantity: 3.8 g - Amount: 2 - Database: Not s
- [pd_ics](#) - Quantity: 10.0 g - Amount: 24 - Database: Not s
- [pd_memory_ics](#) - Quantity: 8.0 g - Amount: 4 - Database: Not s
- [pd_die](#) - Quantity: 81.0 mm2 - Amount: 1 - Database: Not s
- [pd_pcb](#) - Quantity: 10336.0 mm2 - Amount: 1 - Database: Not s
- [pd_connectors](#) - Quantity: 20.0 g - Amount: 3 - Database: Not s
- [pd_integrated_circuits](#) - Quantity: 8.0 g - Amount: 1 - Database: Not s

Note: this example does not include parametric approach

The **original scope and structure of an inventory** is an important information to keep.

- For instance, the quantity used in a sub-process are often established with respect to the root product LCI scope.
- New processes may be added under an existing product → lose track of original path in tree.

Page structure (see [pd_smd_thin_resistor](#), [pd_livebox_6](#), [Dell computer](#) for examples):

- When importing an inventory, the **LCI scope should be specified**.
- The root process of a root product is **clearly indicated**.
- This LCI scope is added under the **original process of the root product of the inventory**.
- The **original tree path is computed and added under the original process of the root product of the inventory (link to rn_ file)**.
- **A link** to the original root product and process nodes is added in **each child process page**.

pd_dell_3620_computer
corlay edited this page 3 hours ago · [2 revisions](#)

🔗 **Product:** pd_dell_3620_computer

🔗 **List of processes**

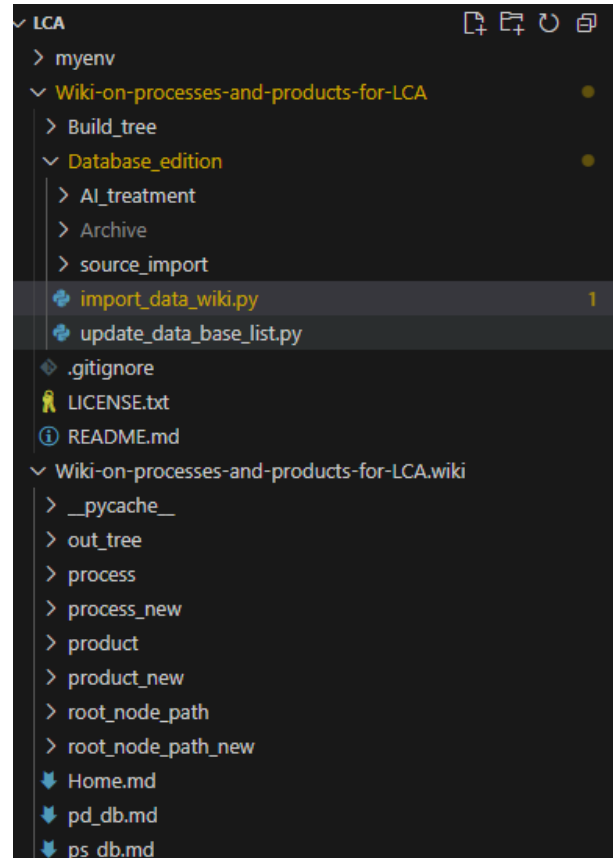
- [ps_dell_3620_computer_loubet](#)
 - Original process for product as root node.
 - Original LCI scope: Inventory of one computer for one year.
 - Original tree path: [rn_pd_dell_3620_computer_ps_dell_3620_computer_loubet](#)

🔗 **Original root product and process nodes**

- Product: [pd_livebox_6](#)
- Process: [ps_livebox_6_production](#)

GitHub Project

with code to
import/edit pages



```
Wiki-on-processes-and-products-for-LCA > Database_edition > import_data_wiki.py > ...
1  # -----
2  # Description: [python code to import data (create product and process pages) from Excel files that are
3  # compatible with the Brightway format]
4  # [Directly generates GitHub Wiki markdown pages (.md) for product and process]
5  # Author: [Vincent Corlay - Mitsubishi Electric R&D Centre Europe]
6  # -----
7  from brightway2 import *
8  import os
9
10 # Define paths for database files
11 base_path_source = "../Wiki-on-processes-and-products-for-LCA/" # EDIT THIS PATH IF NEEDED, parent folder
12 # for source files
13 base_path_target = "../Wiki-on-processes-and-products-for-LCA.wiki/" # Parent folder for generated wiki
14 # markdown files
15 source_file_path = "Database_edition\\source_import\\Example_bw\\Livebox_6.xlsx"
16
17 #Define some meta data
18 root_node_LCI_scope = "Inventory of one livebox 6" # Functional unit for the processes
19
20 General_information = "From Youtube videoby Deux Ex Silicium: Dans les entrailles de la LIVEBOX 6 :
21 analyses, mesures et décorticage de son électronique, link: https://www.youtube.com/watch?v=VryPNmlxxas :
22 added_by = "Vincent Corlay (v.corlay@fr.mercede.mee.com)"
23 source_file = "Livebox_6.xlsx"
24
25 path = base_path_source + source_file_path
26 imp = ExcelImporter(path) #Brightway import function to import data from Excel files
```

Wiki Project

Markdown pages located in
process & product folders.

New pages created in
process_new &
product_new folders.

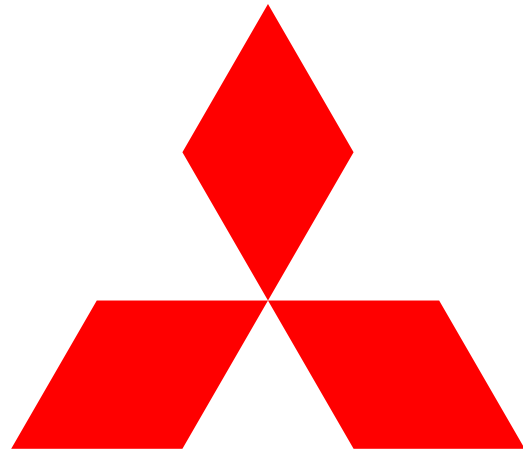
The example of **Appa's parametric GPU model** has been added to the wiki to help identify necessary adaptations. This process is now listed under the [GPU product page](#) of the wiki.

In the [Appa GPU process branch](#), the wiki page structure updated as follow to handle the parametric model.

- New **"Parameters" section**: List of the input parameter names.
- New **"parameters" field**: Added to the metadata following a process name in the "Consumption" section.
- **Models** (based on Appa's "Parameter Matching"):
 - If a model is used by a single process, it is added as a local model under that process.
 - If a model is used by multiple processes, consider creating a Global Model section to avoid duplication.
- New **"Impact Flow"** section: Allows for impact formulas based on parameters (e.g., see [logic wafer](#)).

Process: ps_nvidia_ai_gpu_chip_parameter_appa
Characteristics
Parameters
<ul style="list-style-type: none">• cuda_core• architecture• energy_per_inference• inference_per_day• lifespan• usage_location
Global Models (used by several process)
Technosphere Flow
Production
<ul style="list-style-type: none">• pd_gpu - Quantity: None unit
Consumption
Process:
<ul style="list-style-type: none">• ps_ai_use_phase<ul style="list-style-type: none">◦ Local model:<ul style="list-style-type: none">▪ inference = f(inference_per_day,lifespan)◦ Parameters: energy_per_inference, inference, usage_location◦ Quantity: None◦ Database: Not specified• ps_nvidia_gpu_chip_manufacturing - parameters: architecture, cuda_core - Quantity: None - Da

Process: ps_logic_wafer_manufacturing
Characteristics
Parameters
<ul style="list-style-type: none">• fab_location• masks
Global Models (used by several process)
Technosphere Flow
Production
Consumption
Process:
Chimaera (to be classified - put in process by default):
Biosphere Flow
Impact Flow
<ul style="list-style-type: none">• Category: "(EF v3.0, 'climate change', 'global warming potential (GWP100)')_tec◦ Amount: (0.049*masks + 0.3623) * 3.14159 * pow(15, 2) #impact originally iwafer



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Changes for the Better