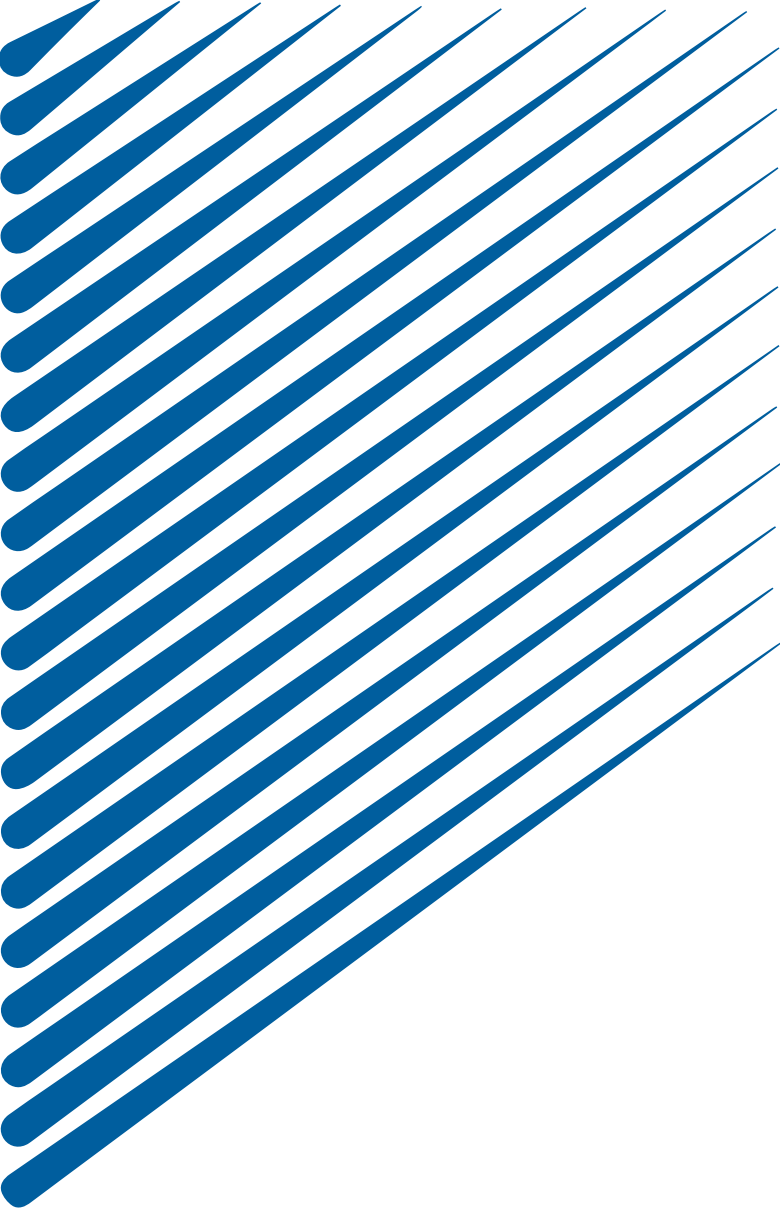




lca_supplymat

A new brightway LCIA method
to quantify manufactured
materials from inventory data

Joanna SCHLESINGER-MARTINAT, Raphaël JOLIVET,
Cécile BEGASSAT-PIQUET, Alejandra CUE-GONZALEZ, Mathilde MARCHAND-LASSERRE



SUMMARY

- The need
- The solution
- Principle
- Setup
- Live demo on **Activity Browser**

THE NEED

Context :

- **RTE** : French Transmission System Operator
- **Project** : Prospective LCA of the french electricity mix

Need : Evaluate gross usage of materials (metals, concrete, ...)

Constraints :

- Not only metals / biosphere extraction :
Can't use Relics
- Compatibility with legacy *Brightway* / *Ica_algebraic* / *Activity Browser* :
Can't use EDGES

THE SOLUTION

Create a **pseudo** LCIA method for Brightway, for each material.

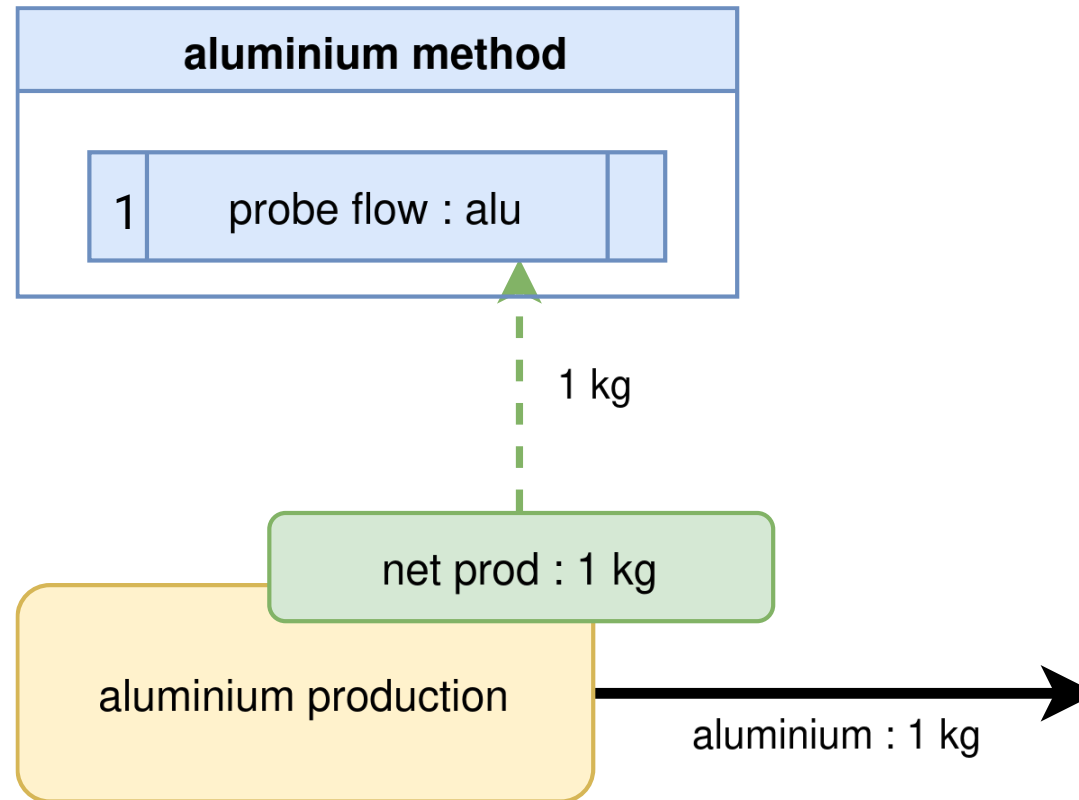
Matching on *reference products*, not activity name.

Add a "biosphere" database with **pseudo probe elementary** flows.

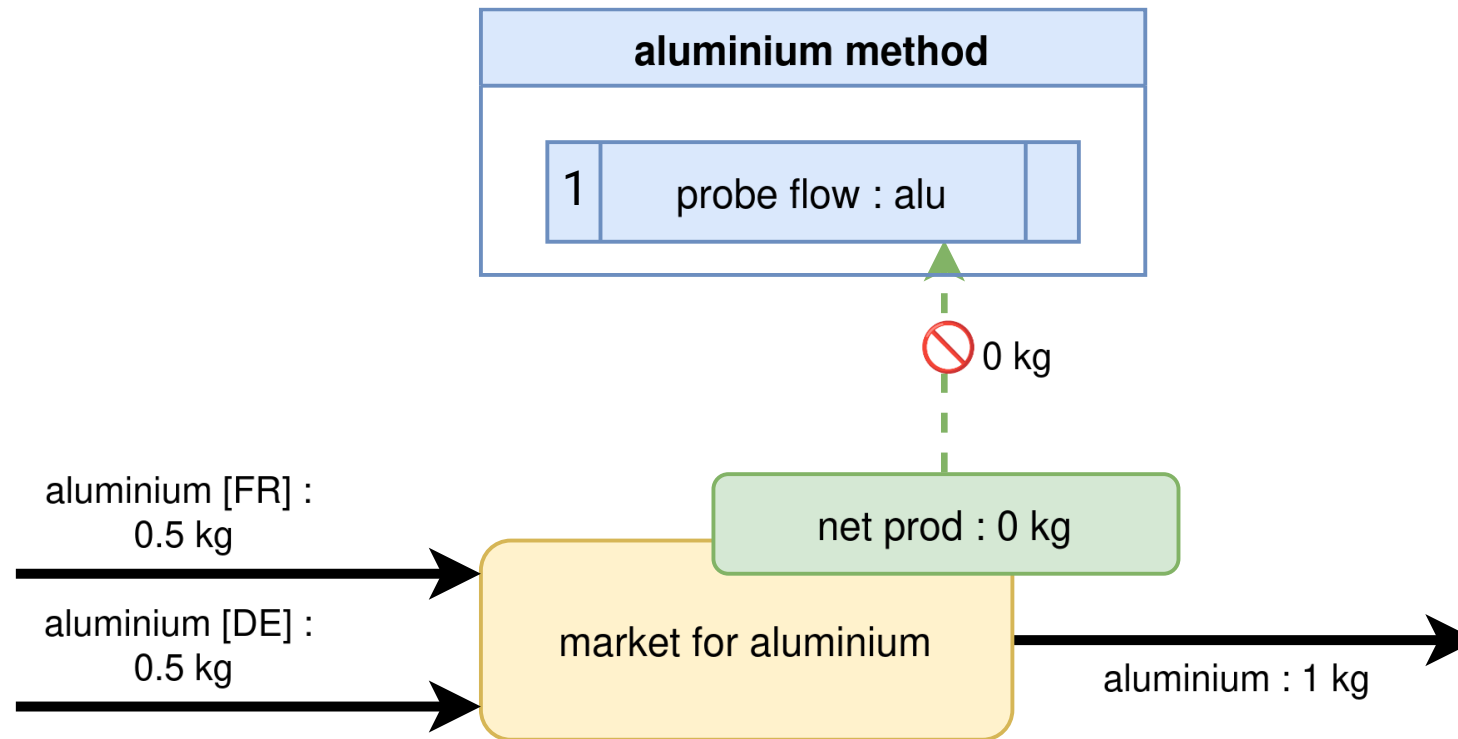
Add **custom exchanges** targeting **pseudo biosphere flows**, on each matching activity.

Terminology : *pseudo* LCIA and biosphere flows

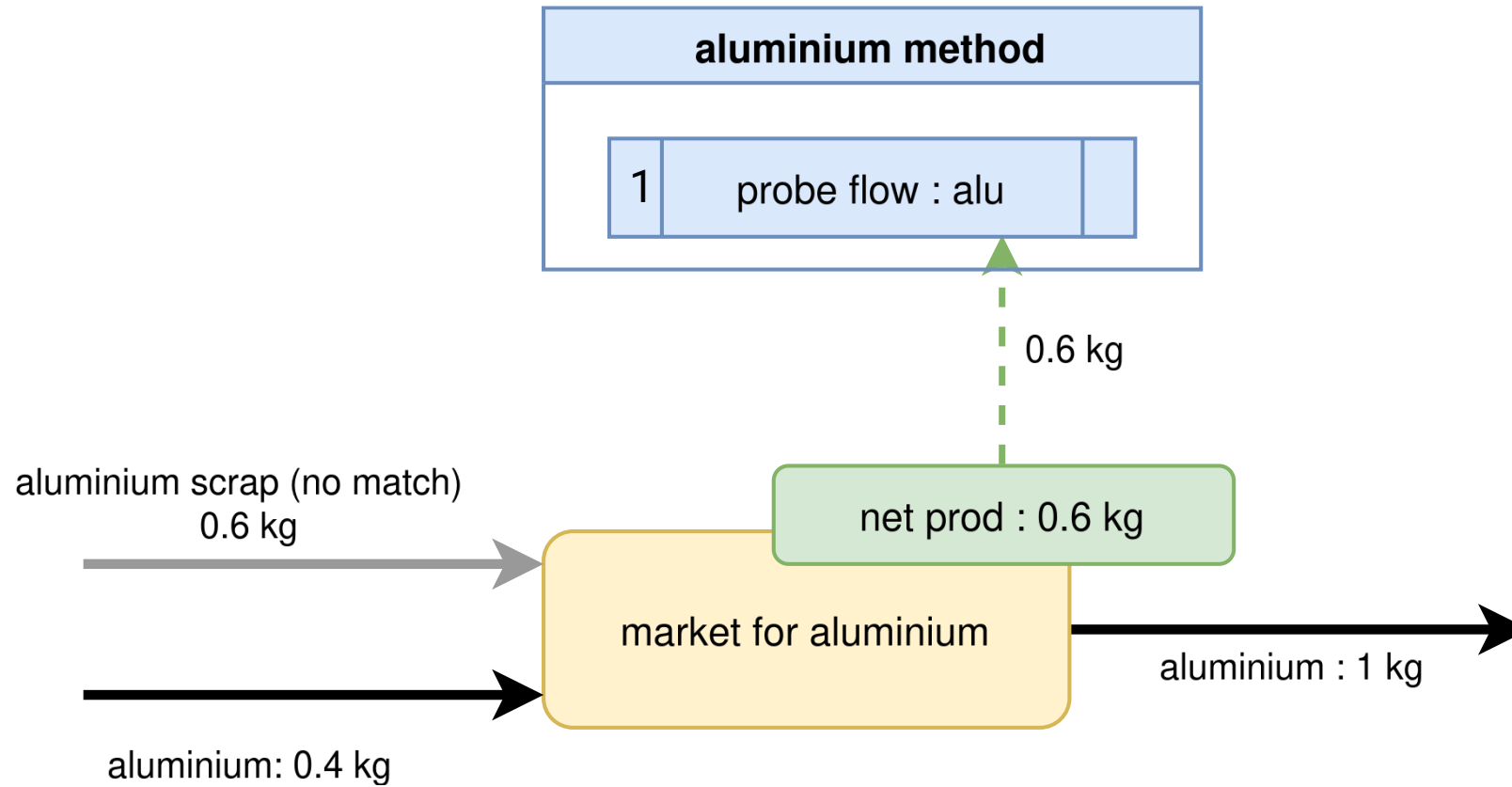
PRINCIPLE



PRINCIPLE



PRINCIPLE



PRINCIPLE

- Matching on **reference product & unit** rather than activity name
 - **Net production** prevents double counting
 - Basic regionalization
 - The setup checks "impacts" of matching activities ≈ 1.0
-
- Principle similar to **T-reX**.
Matching on **ref products + net production** = more generic



SETUP

Requirements

Python 3.12, Brightway 2.5

A project with ecoinvent (tested on 3.11)

Published [on pypi](#) :

> pip install lca_supplymat

```
from lca_supplymat import setup_lca_supply_mat

setup_lca_supply_mat(
    target_db="ecoinvent-3.11-cutoff",
    yaml_file="path.yaml",      # optionnal: load 23 definition from the package by default
)
```

Full notebook [here](#)

HOW TO DEFINE A METHOD ?

By default lca_supplymat installs [23 pre defined methods](#).

You may also provide your own **YAML file** with **custom definitions** with patterns :

```
concrete:
  matchings: ["*concrete*"]
  excludes: ["*wastewater*", "waste*"]
  unit: cubic meter
```

DEMO



CONCLUSION

RESULTS

- A new (pseudo) LCIA method integrated in the Brightway & ActBr framework > fast set-up & user-friendly
- A set of 23 available methods + easy implementation of new user-defined methods

Potential uses of this new metric on background/foreground inventories

Extract material quantity from LCI > **WARNING !!** The quality of the results is representative of the foreground and background inventory datasets > **use results with caution !**

- New lens to explore LCI data to compare them not only on LCI data / traditional impacts
- Helper to build foreground LCI data to quickly assess material quantities
- Compare material consumption from foreground vs background

THANK YOU FOR YOUR ATTENTION

THANK YOU TO BRIGHTCON AMAZING ORGANIZERS !

Raphaël.jolivet@minesparis.psl.eu
Joanna.schlesinger@minesparis.psl.eu

BACK UP SLIDES DEMO



Databases

	name	records	depends
	ecoinvent-3.11-biosphere	9795	
	ecoinvent-3.11-cutoff	25412	ecoinvent-3.11-biosphere
	lca_supplymat	110	ecoinvent-3.11-biosphere lca_supplymat

Welcome

Parameters

Settings

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Activity Browser - lca_supplymat_test

Project Database Impact categories Calculate View Help

Databases

name	records	depends
ecoinvent-3.11-biosphere	9795	
ecoinvent-3.11-cutoff	25412	ecoinvent-3.11-biosphere, lca_supplymat
lca_supplymat	110	

Databases Impact Categories Calculation Setups

lca_supplymat

concrete

name	categories	unit
concrete [CH]	lca_supplymat > concrete	cubic meter
concrete [BR]	lca_supplymat > concrete	cubic meter
concrete [CA-QC]	lca_supplymat > concrete	cubic meter
concrete [GLO]	lca_supplymat > concrete	cubic meter
concrete [PE]	lca_supplymat > concrete	cubic meter
concrete [CO]	lca_supplymat > concrete	cubic meter
concrete [RoW]	lca_supplymat > concrete	cubic meter
concrete [AT]	lca_supplymat > concrete	cubic meter
concrete [ZA]	lca_supplymat > concrete	cubic meter
concrete [IN]	lca_supplymat > concrete	cubic meter
concrete [North America witho...	lca_supplymat > concrete	cubic meter

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The Activity Browser



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Project Database Impact categories Calculate View Help

Impact Categories

Quick Search

	name	unit	num_cfs
▶	ecoinvent-3.11		
▼	lca_supplymat		
▼	total		
▼	concrete		
	concrete	cubic meter	11.0
▶	cement		
▶	gravel		
▶	steel-iron		
▶	aluminium		
▶	copper		
▶	rare-earths-oxide		
▶	titanium		
▶	zirconium-oxide		
▶	platinum		
▶	iridium		
▶	nickel-class1		
▶	silicon-metal		
▶	silver		
▶	lithium-carbonate		
▶	lithium-hydroxide		
▶	cobalt-sulfate		
▶	nickel-sulfate		
▶	manganese-sulfate		
▶	graphite		
▶	graphite-nat		
▶	zirconium-sponge		
▶	iron-scrap		

Databases Impact Categories Calculation Setups

Welcome - Parameters - Settings -

Welcome to

The Activity Browser

AB

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[default](#)

[name-project](#)

[RTE eolien](#)

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Activity Browser - lca_supplymat_test

ProjectDatabaseImpact categoriesCalculateViewHelp

Impact Categories

Quick Search

	name	unit	num_cfs
▶	ecoinvent-3.11		
▼	lca_supplymat		
▼	total		
▼	concrete		
	concrete	cubic meter	11.0
▶	cement		
▶	gravel		
▶	steel-iron		
▶	aluminium		
▶	copper		
▶	rare-earths-oxide		
▶	titanium		
▶	zirconium-oxide		
▶	platinum		
▶	iridium		
▶	nickel-class1		
▶	silicon-metal		
▶	silver		
▶	lithium-carbonate		
▶	lithium-hydroxide		
▶	cobalt-sulfate		
▶	nickel-sulfate		
▶	manganese-sulfate		
▶	graphite		
▶	graphite-nat		
▶	zirconium-sponge		
▶	iron-scrap		

WelcomeParametersSettingsCharacterization Factors

lca_supplymat | total | concrete

Name: lca_supplymat | total | concrete

Unit: cubic meter

Edit Impact Category

name	categories	database	amount	unit	uncertain
🌐 concrete [AT]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [BR]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [CA-QC]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [CH]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [CO]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [GLO]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [IN]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [North America without Quebec]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [PE]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [RoW]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	
🌐 concrete [ZA]	lca_supplymat > concrete	lca_supplymat	1.0	cubic meter	

1concrete:

2matchings: ["*concrete*"]

3excludes: ["*wastewater*", "waste*"]

4unit: cubic meter

DatabasesImpact CategoriesCalculation Setups

Databases			
name	records	depends	def
ecoinvent-3.11-biosphere	9795		uns
ecoinvent-3.11-cutoff	25412	ecoinvent-3.11-biosphere, lca_supplymat	uns
lca_supplymat	110		uns

Databases Impact Categories Calculation Setups		
ecoinvent-3.11-cutoff		
Quick Search		
name	product	unit
concrete production, 25MPa, for building construction, with...	concrete, 2...	cubic

concrete production, 25MPa, for building construction, with cement, CP III

BR ecoinvent-3.11-cutoff

Flows Description Graph Parameters Consumers Data

Output:

amount	unit	product	producer	location	database	categories
1.0	cubic meter		concrete [BR]	GLO	lca_supplymat	lca_supplymat, concrete
89.946	kilogram	waste concrete	market for waste concrete	RoW	ecoinvent-3.11-cutoff	
0.161	cubic meter	wastewater from concrete prod...	market for wastewater from concrete production	RoW	ecoinvent-3.11-cutoff	
0.0499	kilogram	waste mineral oil	market for waste mineral oil	RoW	ecoinvent-3.11-cutoff	
0.0345	kilogram	waste rubber, unspecified	market for waste rubber, unspecified	RoW	ecoinvent-3.11-cutoff	
0.0238	kilogram	waste steel	market for waste steel	RoW	ecoinvent-3.11-cutoff	
1.0	cubic meter	concrete, 25MPa	concrete production, 25MPa, for building constru...	BR	ecoinvent-3.11-cutoff	

Input:

amount	unit	product	producer	location	categories	database	formula
4.57e-07	unit	concrete mixing factory	market for concrete mixing factory	GLO		ecoinvent-3.11-...	
0.0238	kilogram	steel, low-alloyed, hot rolled	market for steel, low-alloyed, hot rolled	GLO		ecoinvent-3.11-...	
0.0345	kilogram	synthetic rubber	market for synthetic rubber	GLO		ecoinvent-3.11-...	
0.0499	kilogram	lubricating oil	market for lubricating oil	RoW		ecoinvent-3.11-...	
0.161	cubic meter		Water, unspecified natural origin		natural resourc...	ecoinvent-3.11-...	
1.85802	kilogram	chemical, organic	market for chemical, organic	GLO		ecoinvent-3.11-...	$1,79 \cdot (1 + \text{loss})$
2.99	kilowatt hour	electricity, medium voltage	market group for electricity, medium voltage	BR		ecoinvent-3.11-...	
5.01	megajoule	diesel, burned in building machine	market for diesel, burned in building machine	GLO		ecoinvent-3.11-...	
190.992	kilogram	tap water	market for tap water	BR		ecoinvent-3.11-...	$184 \cdot (1 + \text{loss})$
316.59	kilogram	cement, CP III	market for cement, CP III	BR		ecoinvent-3.11-...	$\text{cement} \cdot (1 + \text{loss})$
746.322	kilogram	sand	market for sand	BR		ecoinvent-3.11-...	$\text{sand} \cdot (1 + \text{loss})$
1230.03	kilogram	gravel, crushed	market for gravel, crushed	BR		ecoinvent-3.11-...	$\text{gravel} \cdot (1 + \text{loss})$

Databases

name	records	depends	def
ecoinvent-3.11-biosphere	9795		uns
ecoinvent-3.11-cutoff	25412	ecoinvent-3.11-biosphere, lca_supplymat	uns
lca_supplymat	110		uns

Databases Impact Categories Calculation Setups

ecoinvent-3.11-cutoff

Quick Search

name	product	unit
concrete production, 25MPa, for building construction, with...	concrete, 2...	cubic

Welcome Parameters Settings LCA Setup x Activity Details x LCA Results x

concrete production, 25MPa, for building construction, with cement, CP III x market for concrete, 25MPa x

market for concrete, 25MPa

BR ecoinvent-3.11-cutoff

Flows Description Graph Parameters Consumers Data

Output:

amount	unit	product	producer	location	database	categories	formula	comment	uncert
1.0	cubic meter	concrete, 25MPa	market for concrete, 25MPa	BR	ecoinvent-3.11-cutoff				

No concrete biosphere flow thanks to the algorithm

Input:

amount	unit	product	producer	location	database	category
0.03208607023...	cubic meter	concrete, 25MPa	concrete production, 25MPa, for building construction, with cement, CP-II-F	BR	ecoinvent-3.11-cutoff	
0.06622287093...	cubic meter	concrete, 25MPa	concrete production, 25MPa, for building construction, with cement, CP-II-E	BR	ecoinvent-3.11-cutoff	
0.90169105883...	cubic meter	concrete, 25MPa	concrete production, 25MPa, for building construction, with cement, CP III	BR	ecoinvent-3.11-cutoff	
57.9465	ton kilometer	transport, freight, lorry, >32 metric ...	market for transport, freight, lorry, >32 metric ton, diesel, EURO 3	BR	ecoinvent-3.11-cutoff	

Impact Categories

Quick Search

name	unit	num_cfs
ecoinvent-3.11		
lca_supplymat		
total		
concrete		
concrete	cubic meter	11.0
cement		
gravel		
steel-iron		
steel-iron	kilogram	8.0
aluminium		
copper		
rare-earths-oxide		
titanium		
zirconium-oxide		
platinum		
iridium		
nickel-class1		
silicon-metal		
silver		
lithium-carbonate		
lithium-hydroxide		
cobalt-sulfate		
nickel-sulfate		
manganese-sulfate		
graphite		
graphite-nat		
zirconium-sponge		
iron-scrap		

Welcome - Parameters - Settings - LCA Setup x Activity Details x LCA Results x Characterization Factors x

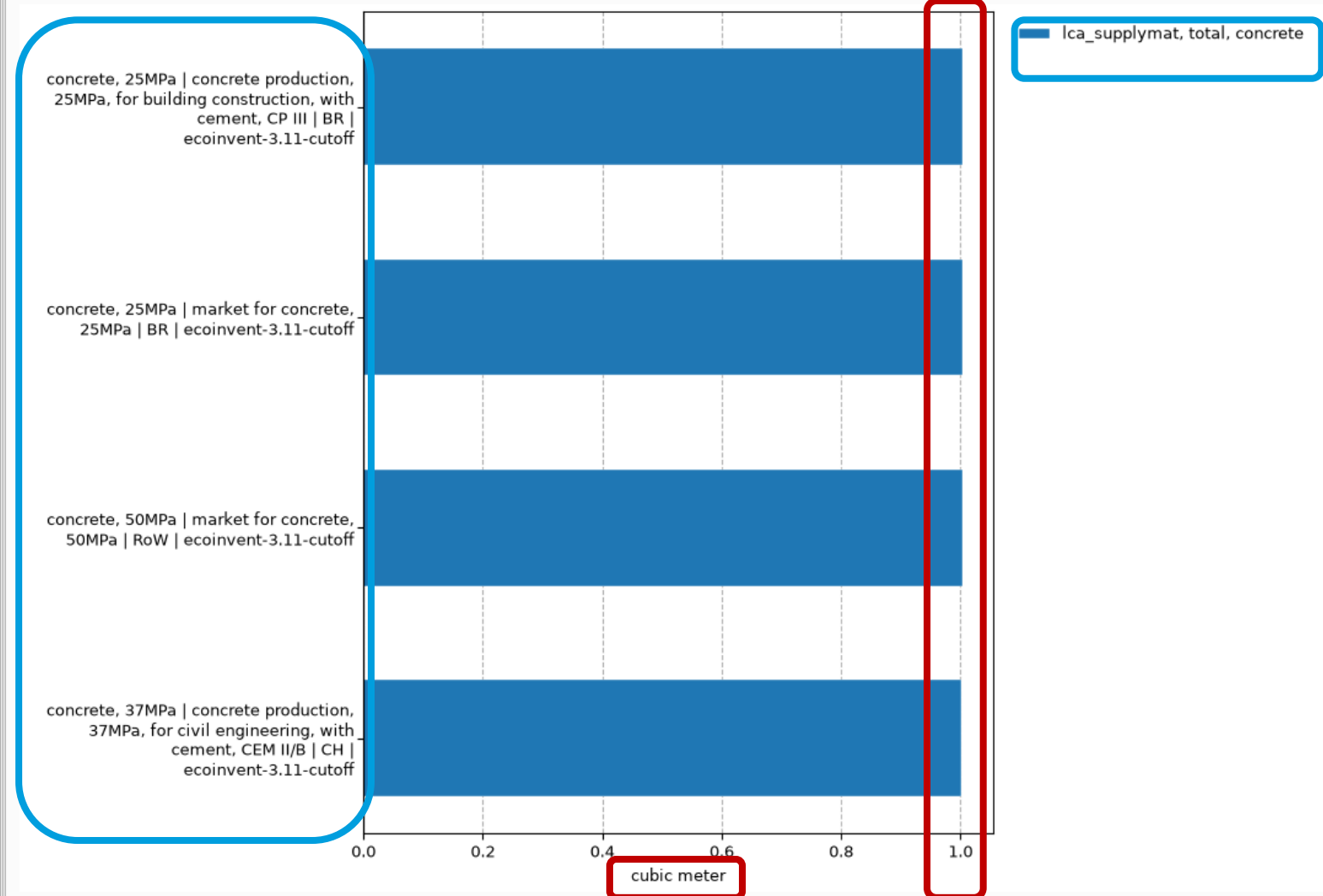
concrete [14:26] x elec [14:12] x steel [14:22] x copper [14:20] x transport [14:42] x concrete [16:15] x

Inventory LCA scores EF Contributions Process Contributions Tree Sankey Monte Carlo Sensitivity Analysis

LCA scores

Compare: Reference Flows

Impact Category: ('lca_supplymat', 'tc')

☒ Plot ☐ Table ☐ Relative ☒ Absolute ☒ Horizontal ☒ Full labels

Plot:

Copy

.png

.svg

Table:

Copy

.csv

.xlsx

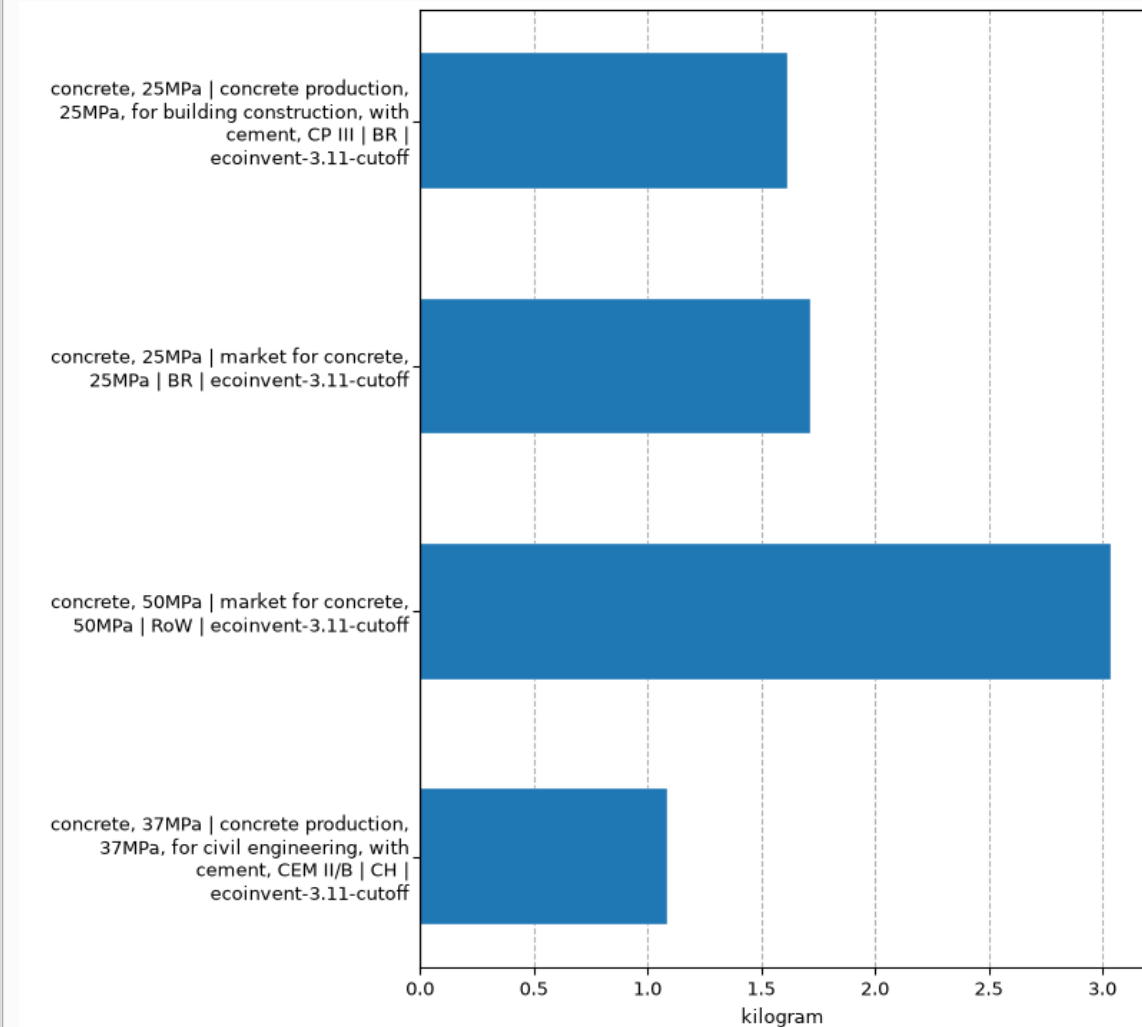
Impact Categories

Quick Search

name	unit	num_cfs
ecoinvent-3.11		
lca_supplymat		
total		
concrete		
concrete	cubic meter	11.0
cement		
gravel		
steel-iron		
steel-iron	kilogram	8.0
aluminium		
copper		
rare-earths-oxide		
titanium		
zirconium-oxide		
platinum		
iridium		
nickel-class1		
silicon-metal		
silver		
lithium-carbonate		
lithium-hydroxide		
cobalt-sulfate		
nickel-sulfate		
manganese-sulfate		
graphite		
graphite-nat		
zirconium-sponge		
iron-scrap		

LCA scores

Compare: Reference Flows | Impact Category: ('lca_supplymat', 'tc')

☒ Plot ☐ Table ☐ Relative ☒ Absolute ☒ Horizontal ☒ Full labels

Impact Categories

Quick Search

name	unit	num_cfs
ecoinvent-3.11		
lca_supplymat		
total		
concrete		
concrete	cubic meter	11.0
cement		
gravel		
steel-iron		
steel-iron	kilogram	8.0
aluminium		
copper		
rare-earths-oxide		
titanium		
zirconium-oxide		
platinum		
iridium		
nickel-class1		
silicon-metal		
silver		
lithium-carbonate		
lithium-hydroxide		
cobalt-sulfate		
nickel-sulfate		
manganese-sulfate		
graphite		
graphite-nat		
zirconium-sponge		
iron-scrap		

Welcome - Parameters - Settings - LCA Setup x Activity Details x LCA Results x Characterization Factors x

concrete [14:26] x elec [14:12] x steel [14:22] x copper [14:20] x transport [14:42] x concrete [16:15] x

Inventory LCA scores EF Contributions Process Contributions Tree Sankey Monte Carlo Sensitivity Analysis

LCA scores

Compare: Reference Flows

Impact Category: ('lca_supplymat', 'tc')

☒ Plot ☐ Table ☐ Relative ☒ Absolute ☒ Horizontal ☒ Full labelssteel, unalloyed | market for steel,
unalloyed | GLO | ecoinvent-3.11-cutoff

STEEL

1,01 kg

lca_supplymat, total, steel-iron

It also includes the steel in the upstream supply
chain = the steel that is used to produce steel

steel, low-alloyed | steel production,
electric, low-alloyed | AT |
ecoinvent-3.11-cutoffsteel, unalloyed | steel production,
converter, unalloyed | RoW |
ecoinvent-3.11-cutoff0.0 0.2 0.4 0.6 0.8 1.0
kilogram

Plot:

Copy

.png

.svg

Table:

Copy

.csv

.xlsx

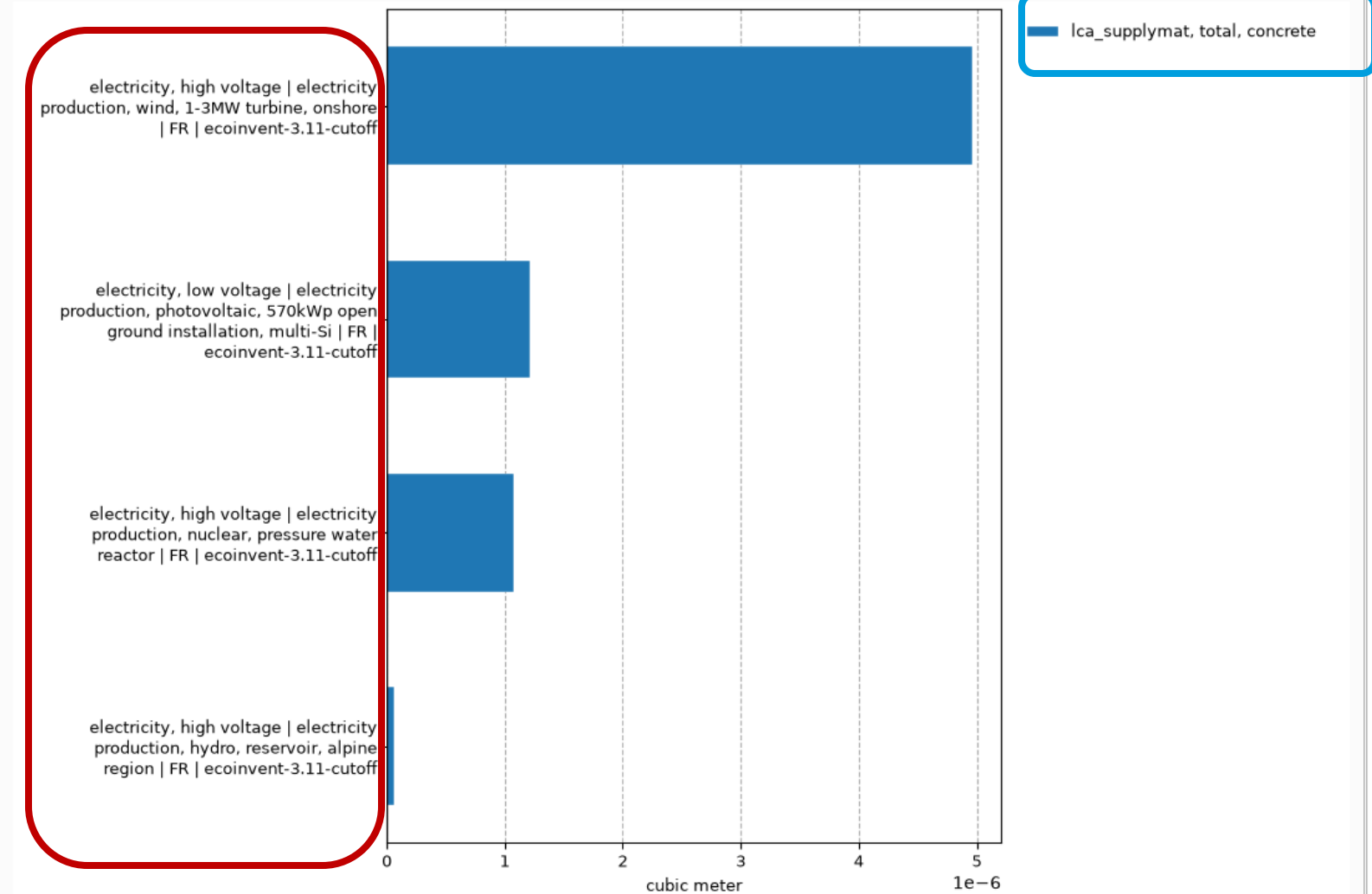
Calculation Setups

name	functional_units	impact_categories
elec	4	4
transport	6	5
concrete	4	4
copper	3	3
steel	3	3

LCA scores

Compare: Reference Flows Impact Category: ('lca_supplymat', 'tc')

☒ Plot ☐ Table ☐ Relative ☒ Absolute ☒ Horizontal ☐ Full labels

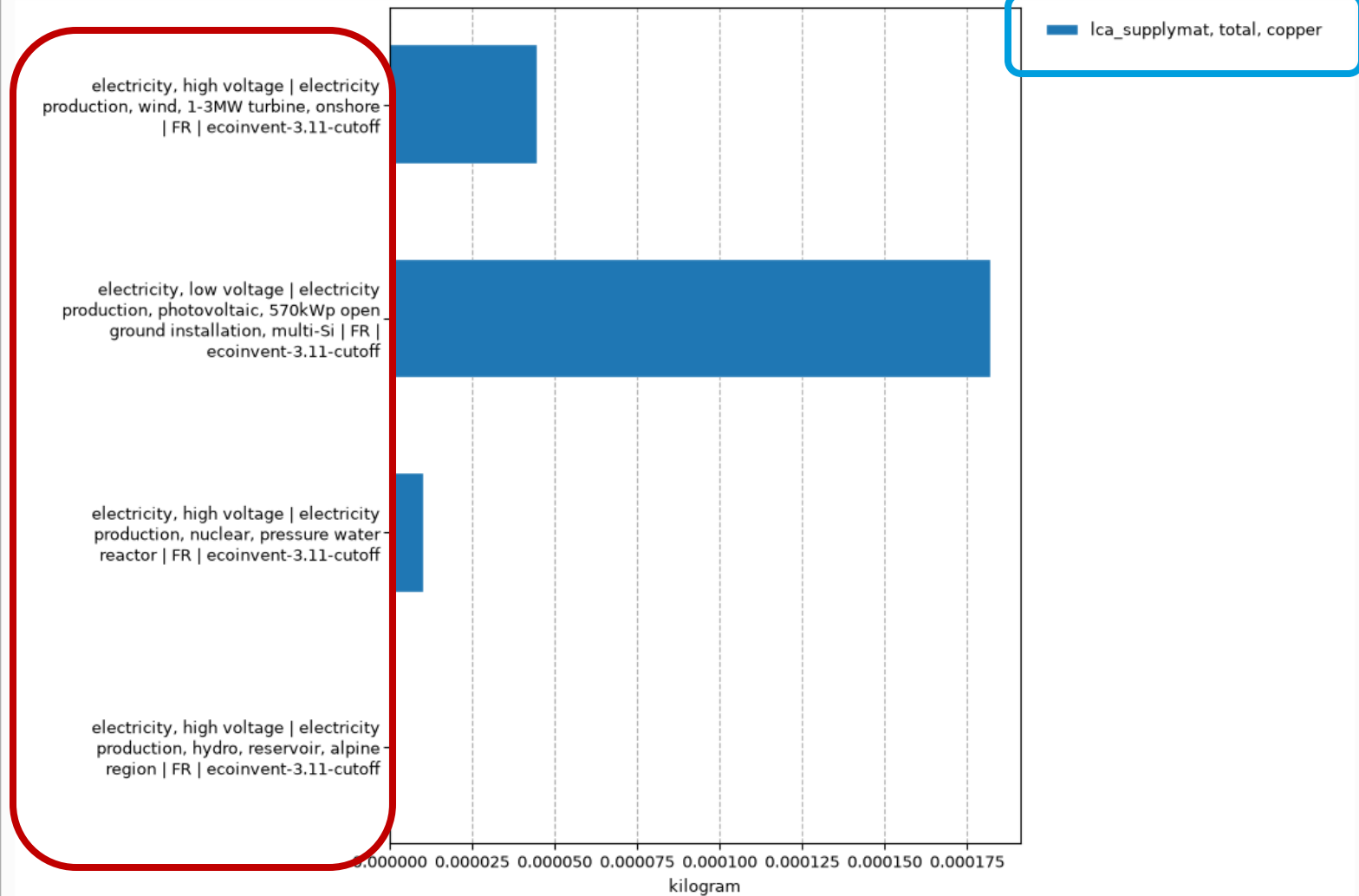


Calculation Setups

name	functional_units	impact_categories
elec	4	4
transport	6	5
concrete	4	4
copper	3	3
steel	3	3

LCA scores

Compare: Reference Flows Impact Category: ('lca_supplymat', 'tc')

☒ Plot ☐ Table ☐ Relative ☒ Absolute ☒ Horizontal ☐ Full labels

Calculation Setups

name	functional_units	impact_categories
elec	4	4
transport	6	5
concrete	4	4
copper	3	3
steel	3	3

- Electricity production, PV
- Concrete method

Sankey

Reference flow: electricity, low volta Impact category: ('lca_supplymat', 'tc')

Cutoff: 6.000 %

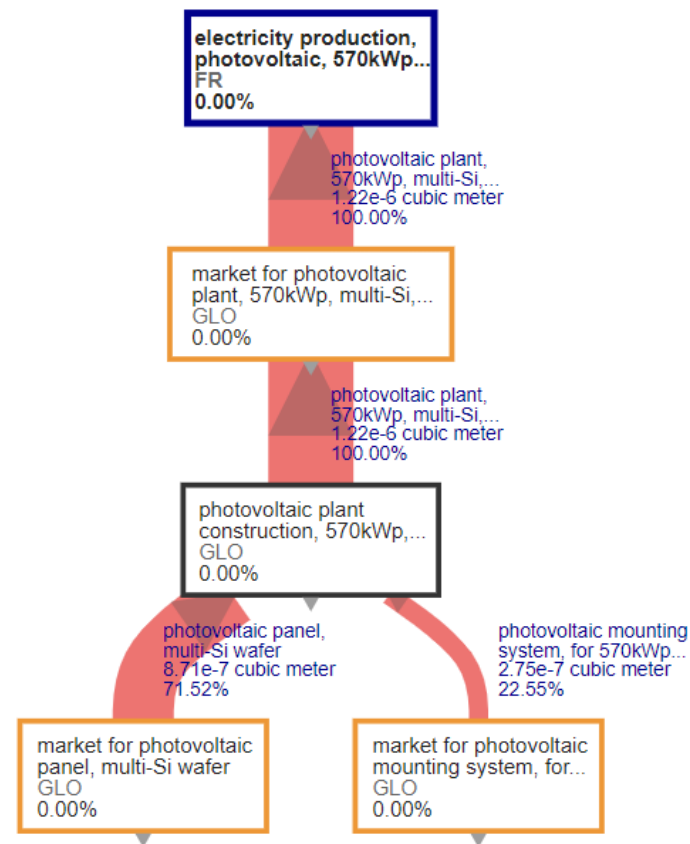
Adjust to: Tier

2

Adjust

Aggregate by: None

Color by: Direct impact

Layout Top to bottom ☐ Minimap ☒ Flows ☒ absolute ☒ relative

Shown: 5 processes, 0.0% of direct impacts, max tier 3, 4 flows | Calculated: 5 processes, 0.0% of direct impacts, max tier 3

Show all

Plot:

Copy

.png

.svg