

Activity Browser Advanced Tutorial

Marc van der Meide | Brightoncon 2022

- Master of Industrial Ecology at Leiden U.
- Have been developing for AB since 2018
- PhD at Leiden U. since Oct 2020



Plan for today → Interactive tutorial

1. Making sure AB is working for all of you
2. Flow scenarios
3. Live demo
4. Break!
5. Uncertainty + Monte Carlo
6. Live demo
7. Break + Playing around
8. Reporting problems/asking for help & Wrapping up

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Setting up

1. Installing Miniconda3

<https://docs.conda.io/en/latest/miniconda.html>

2. Installing Activity Browser

<https://github.com/LCA-ActivityBrowser/activity-browser>

1. Most OS:

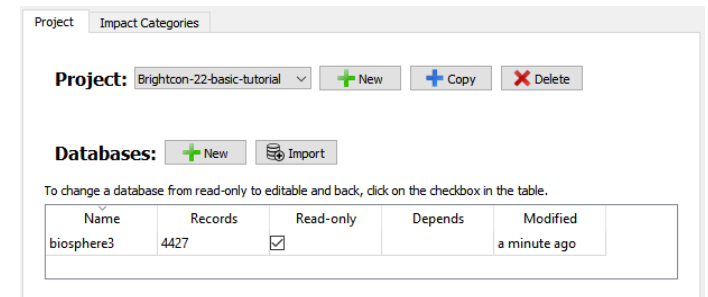
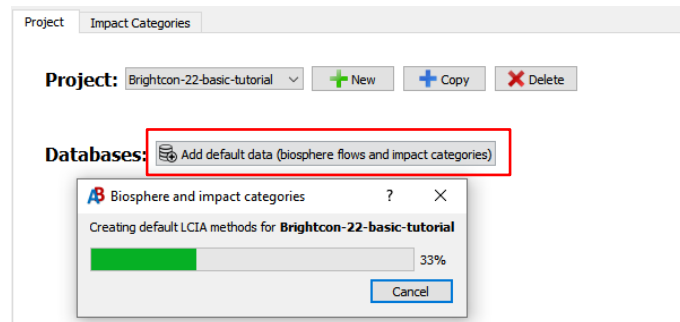
```
conda create -n ab -c conda-forge -c cmutel -c bsteubing activity-browser
conda activate ab
activity-browser
```

2. Apple M1 Mac

```
conda create -n ab -c conda-forge -c cmutel -c bsteubing activity-browser-arm
conda activate ab
activity-browser
```

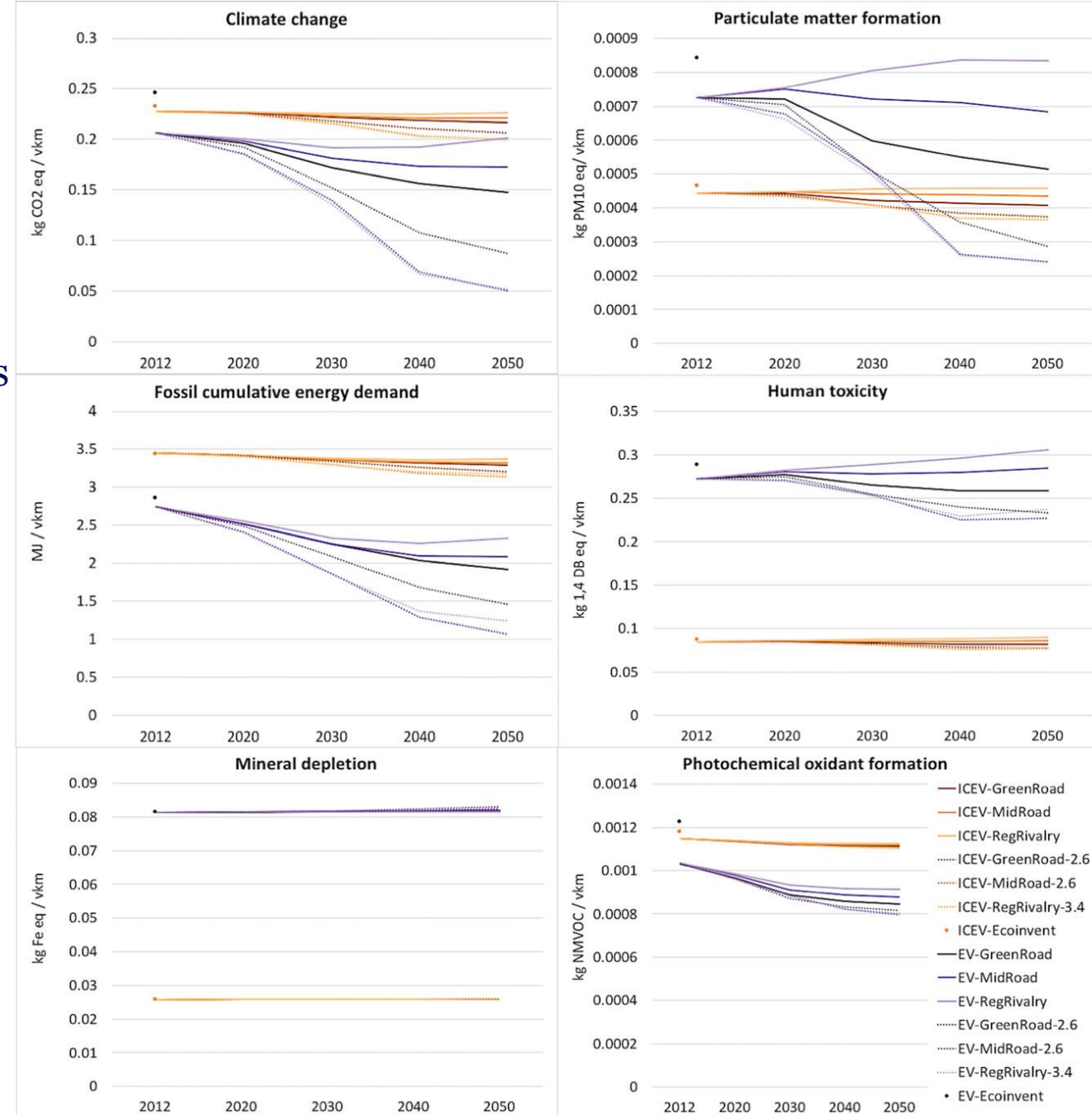
3. Add default data

Do it now, this takes some time



What scenarios are

- Very simply:
 - Different representations of (possible) reality
- Often used for exploration of future possible realities
- Can easily be used as 'sensitivity analysis'
- Some further scenario reading:
 - [A talk by Dr. Bernhard Steubing](#) tonight (18:30-19:30 CEST) at the LCA network (free, requires sign-up)
 - Framework for scenario development in LCA ([Pesonen et al. 2000](#))
 - When the background matters ([Mendoza Beltran et al. 2018](#))



Flow scenarios & AB

- Flow scenarios represent changes in flows

☒ Products:

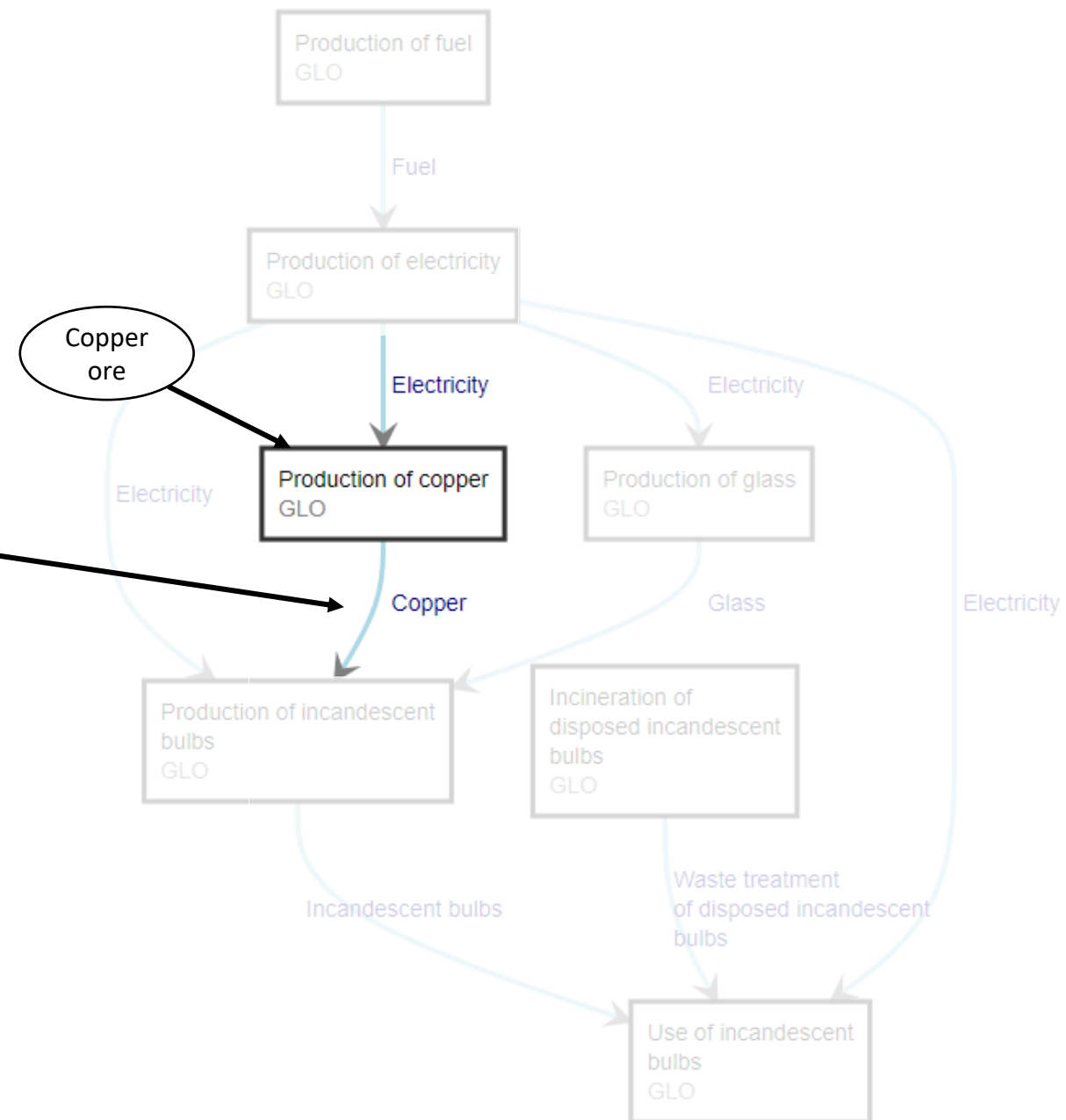
	Amount	Unit	Product	Formula
0	100	kilogram	Copper	

☒ Technosphere Flows:

	Amount	Unit	Product	Activity	Location	Database
0	10000	megajoule	Electricity	Production of electricity	GLO	background_database

☒ Biosphere Flows:

	Amount	Unit	Flow Name	Compartments	Database	Formula
0	1000	kilogram	Copper, in ground	natural resource - in ground	biosphere3	



Flow scenarios & AB

- Flow scenarios represent changes in flows

☒ Products:

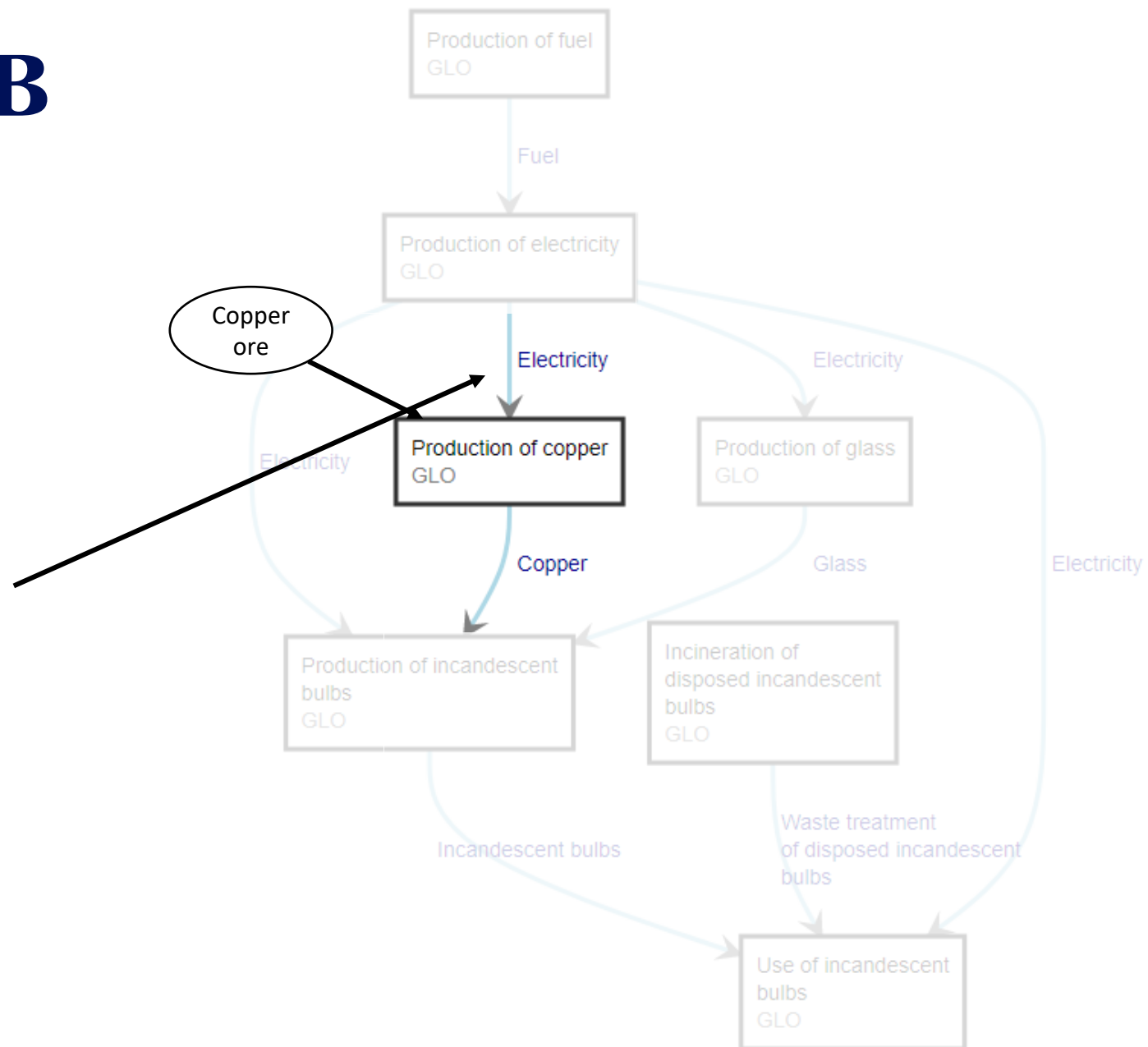
	Amount	Unit	Product	Formula
0	100	kilogram	Copper	

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Flow scenarios & AB

- Flow scenarios represent changes in flows

☒ Products:

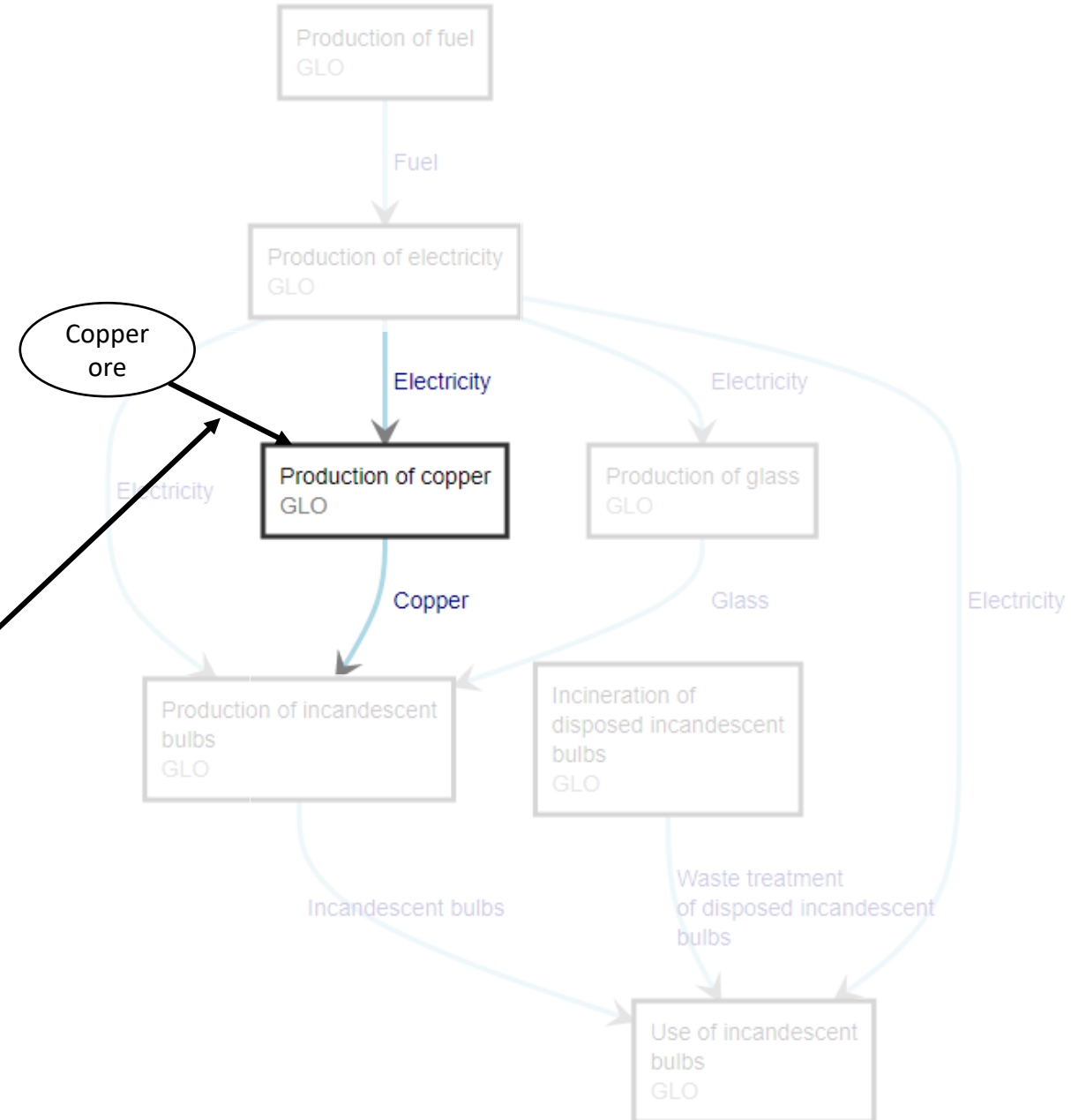
	Amount	Unit	Product	Formula
0	100	kilogram	Copper	

☒ Technosphere Flows:

	Amount	Unit	Product	Activity	Location	Database
0	10000	megajoule	Electricity	Production of electricity	GLO	background_database

☒ Biosphere Flows:

	Amount	Unit	Flow Name	Compartments	Database	Formula
0	1000	kilogram	Copper, in ground	natural resource - in ground	biosphere3	



Flow scenarios & AB

- Flow scenarios represent changes in flows
- Flows are represented by a ``from`` and ``to``

☒ Products:

	Amount	Unit	Product	Formula
0	100	kilogram	Copper	

☒ Technosphere Flows:

	Amount	Unit	Product	Activity	Location	Database	
0	10000	megajoule	Electricity	Production of electricity	GLO	background_database	1

☒ Biosphere Flows:

	Amount	Unit	Flow Name	Compartments	Database	Formula
0	1000	kilogram	Copper, in ground	natural resource - in ground	biosphere3	

from activity name	from reference product	from location	from categories	from database	from key	to activity name	to reference product	to location	to categories	to database	to key	flow type	amount
Copper, in ground			('natural resource - in ground	biosphere3	('biosphere3	Production of copper	Copper	GLO		background_database	('background_database	biosphere	1000
Production of copper	Copper	GLO		background_database	('background_database	Production of copper	Copper	GLO		background_database	('background_database	production	100
Production of electricity	Electricity	GLO		background_database	('background_database	Production of electricity	Copper	GLO		background_database	('background_database	technosphere	10000

Working with flow data

- From Activities table to within an activity
- You can copy flow data from AB through right-click
 - Copies all related flows
 - You can also select multiple rows
- You can then paste to Excel
- Add columns for new scenarios

Databases: + New Import

To change a database from read-only to editable and back, click on the checkbox in the table.

Name	Records	Read-only	Depends	
background_da...	4	<input type="checkbox"/>	biosphere3	53 mi
biosphere3	4427	<input checked="" type="checkbox"/>		2 wee
fluorescent_bulb	3	<input checked="" type="checkbox"/>	background_da...	an hc
incandescent_b...	3	<input checked="" type="checkbox"/>	background_da...	an hc

Activities: [background_d...] Filter b... AND Filter by... Q X

Product	Activity	Location	Unit	
0 Copper	Open activity		kilogram	('back
1 Electricity	Open in Graph Explorer		megajoule	('back
2 Fuel	Add new activity		kilogram	('back
3 Glass	Duplicate activity/-ies		kilogram	('back

Copy to clipboard Exchanges for scenario difference file

Name: Production of copper

Location: GLO

Database: background_database

☒ Products:

Amount	Unit	Product	Formula
0 100	kilogram	Copper	

☒ Technosphere Flows:

Amount	Unit	Product	Activity	Location	Database	Formula
0 10000	megajoule	Electricity	Production of electricity	GLO	background_database	

☒ Biosphere Flows:

Amount	Unit	Flow Name	Compartments	Database	Formula
0 1000	kilogram	Copper, in ground		biosphere3	

☐ Downstream Consumers:

Modify uncertainty

Delete exchange(s)

Clear formula(s)

Remove uncertainty/-ies

Copy to clipboard Exchanges for scenario difference file

Calculating flow scenarios

- Choose the `Scenario LCA` option and load a file

Calculation Setup: light + New + Copy 📄 Rename ✖ Delete

📄 Calculate Scenario LCA Standard LCA Scenario LCA Presamples LCA

Reference flows:

	Amount	Unit	Product	Activity	Location	Database
0	1	unit	Use of incandescent bulb	Use of incandescent bulbs	GLO	incandescent_bulb
1	1	unit	Use of fluorescent bulb	Use of fluorescent bulbs	GLO	fluorescent_bulb

Impact categories:

	Name	Unit	# CFs
0	IPCC 2013, climate change, GWP 100a	kg CO2-Eq	211
1	ecological scarcity 2013, energy resources, total	UBP	12
2	ecological scarcity 2013, mineral resources, total	UBP	153

Scenarios: ? + Add

examples_1-gb.xlsx 📄 Load ✖ Delete

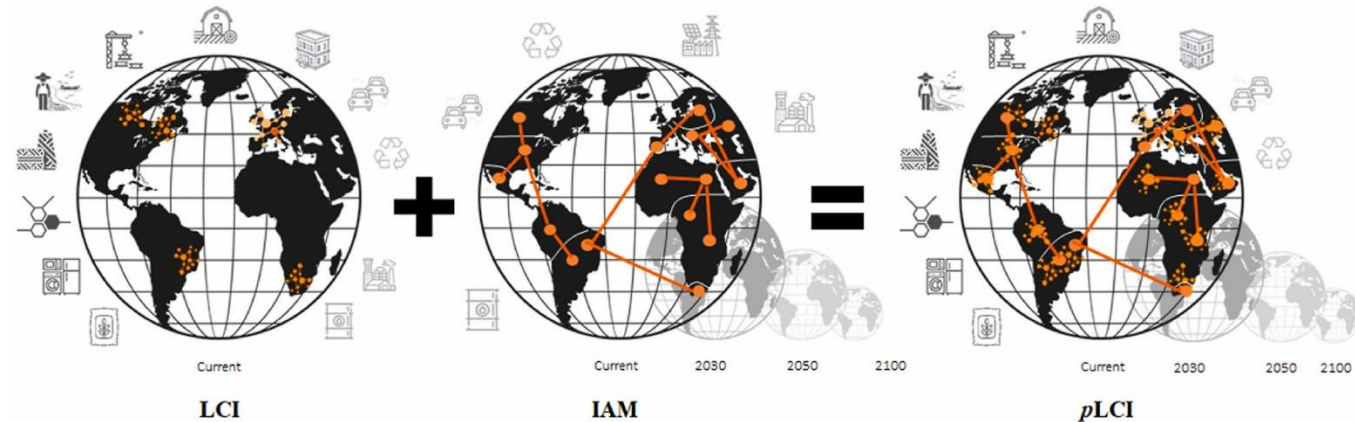
	Scenario name
0	default_bg
1	better elec
2	CCS
3	better copper

Flow scenarios, but cooler:

- Change *many* processes in ecoinvent background?
- Couple Integrated Assessment Models to ecoinvent?
- Generate files with >> 100'000 flows changed?
- Consider different scenarios into the deep future?

- Premise ([Sacchi et al. 2022](#))
- Superstructure ([Steubing & de Koning 2021](#))

- More info? Come to the talk by Romain Sacchi tomorrow



Live demo

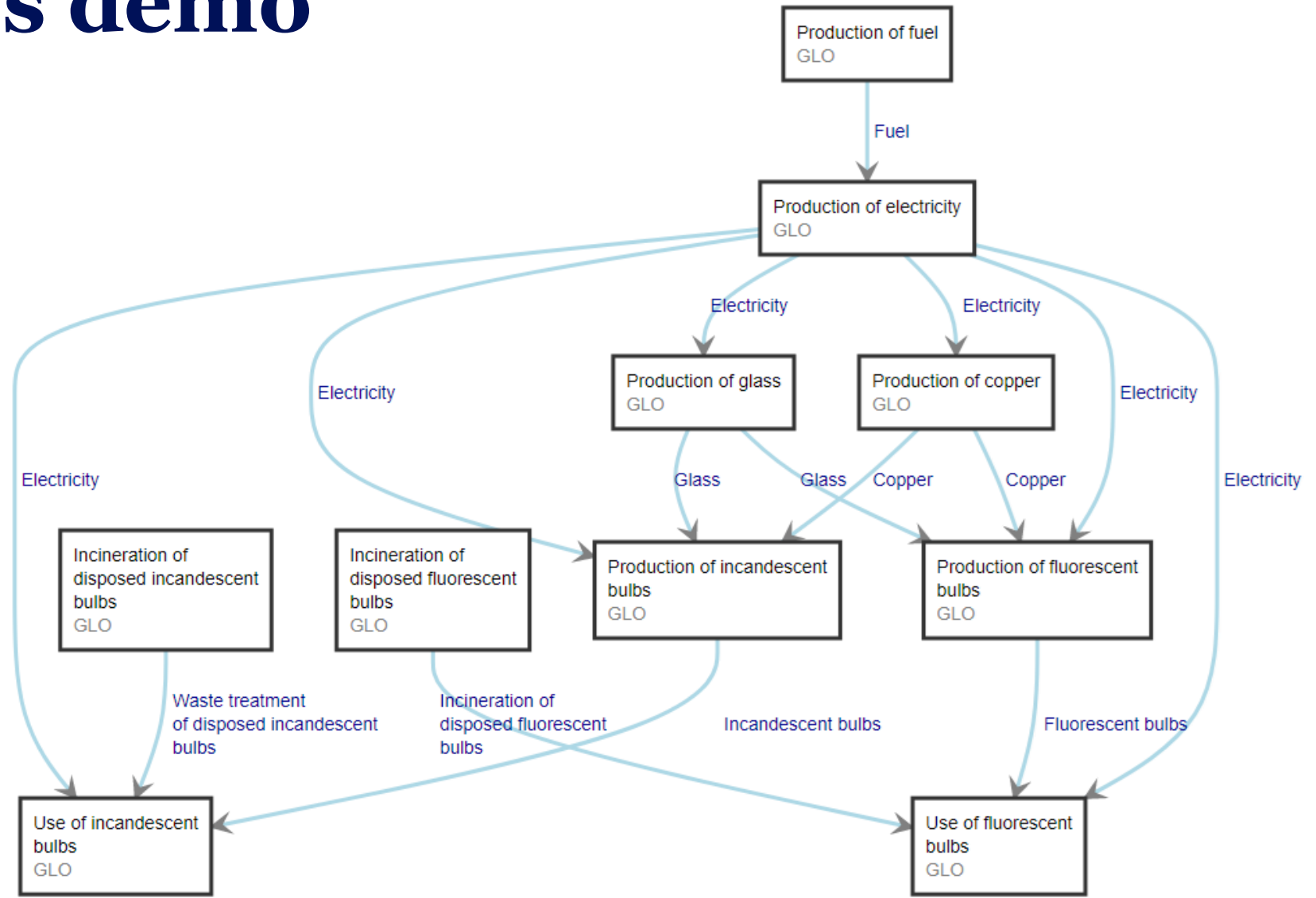


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Flow scenarios demo

I will:

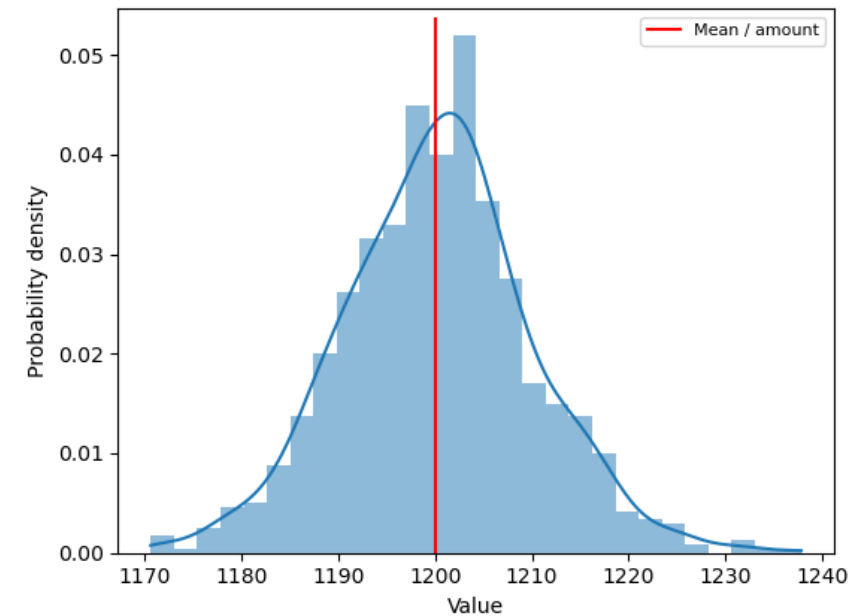
- Introduce the system
- Generate flow scenario file
- Run calculations
- Assess results
 - General results
 - Process contributions
- Use multiple flow scenarios



This example is based on [Chapter 17A](#) of Principles of Environmental Sciences (Heijungs; 2009).

What are uncertainties in LCA

- We never know a number with perfect precision
- We can assume a distribution of results



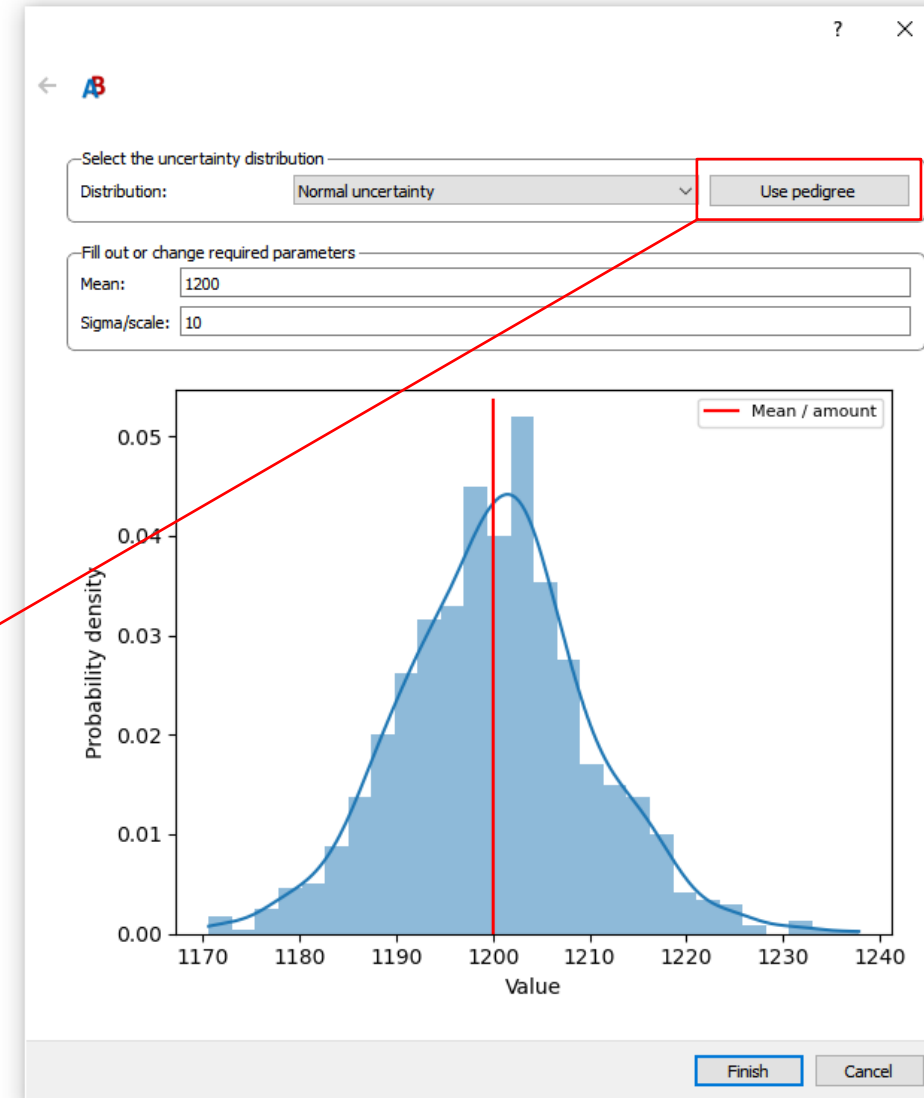
Uncertainties & AB

- You can set uncertainty distributions for every flow, parameter and characterization factor in AB
- Many different distributions can be set in AB (see [statsarrays](#) documentation)
- You can also use pedigree distributions ([Ciroth et al. 2013](#))
 - 5 categories that get a score 1-5
- Ecoinvent also uses this for uncertainty data

Select pedigree values

Reliability	1) Verified data based on measurements
Completeness	1) Representative relevant data from all sites, over an adequate period
Temporal correlation	1) Representative relevant data from all sites, over an adequate period
Geographical correlation	2) Representative relevant data from >50% sites, over an adequate period
Further technological correlation	3) Representative relevant data from <50% sites OR >50%, but over shorter period
	4) Representative relevant data from one site OR some sites but over shorter period
	5) Representativeness unknown
	1) Data from enterprises, processes and materials under study

- Though not without criticism ([Heijungs 2020](#))



Setting uncertainty in AB

- Right-click a flow and choose Modify uncertainty

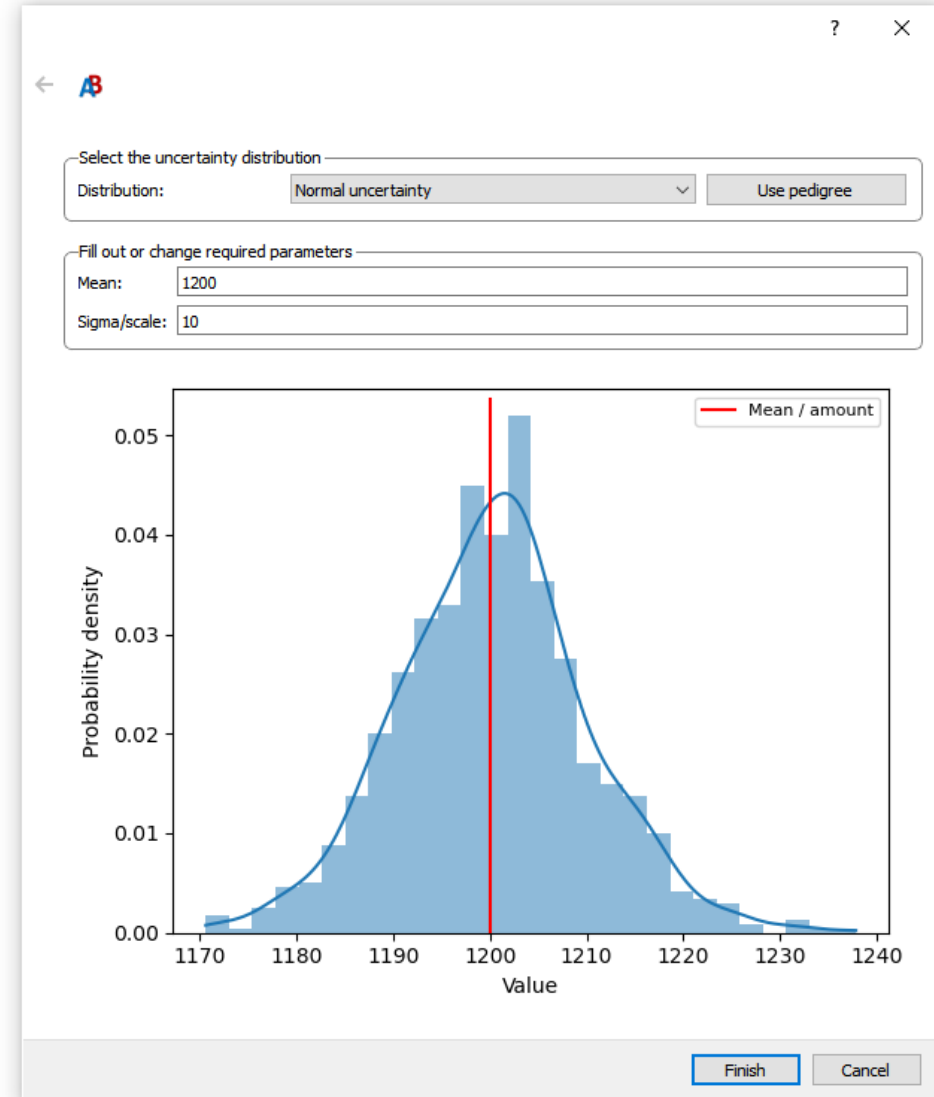
☒ Biosphere Flows:

	Amount	Unit	Flow Name	Compartments	Database
0	200	kilogram	Carbon dioxide, fossil	air	biosphere
1	1200	kilogram	Oil, crude, in ground	natural resource, in ground	biosphere
2	5	kilogram	Sulfur dioxide		

☐ Downstream Consumers:

Context menu for flow 1 (Oil, crude, in ground):

- Modify uncertainty
- Delete exchange(s)
- Clear formula(s)
- Remove uncertainty/-ies
- Copy to clipboard



Calculating with uncertainty in AB

- Do a normal calculation

light ×

Inventory LCA Results EF Contributions Process Contributions Sankey Monte Carlo Sensitivity Analysis

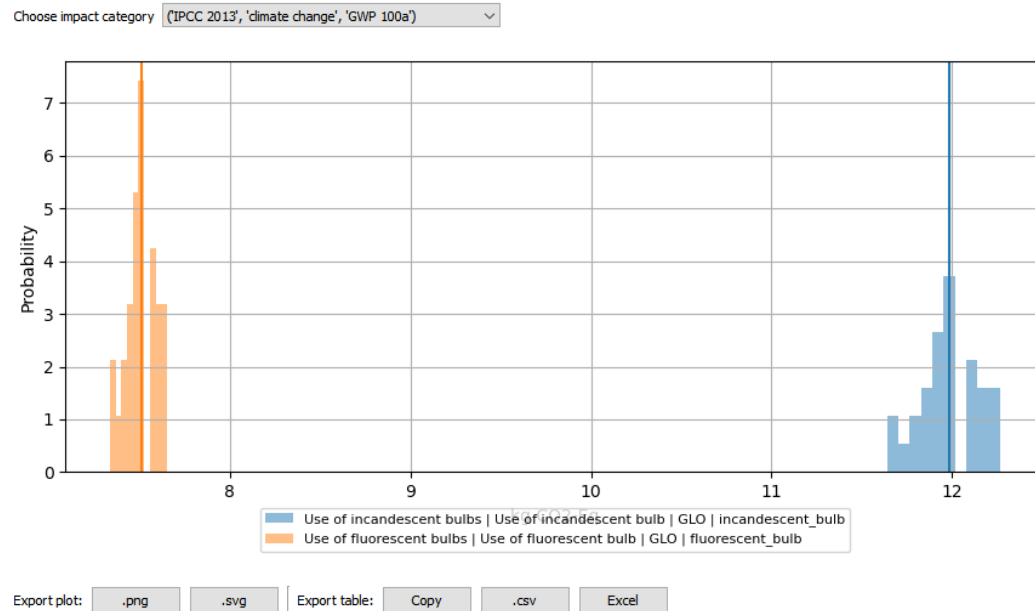
Monte Carlo Simulation

Run Iterations: Random seed:

Include uncertainty for:

- ☒ Technosphere ☒ Biosphere
- ☒ Characterization Factors ☒ Parameters

- Then go to Monte Carlo and run



Live demo

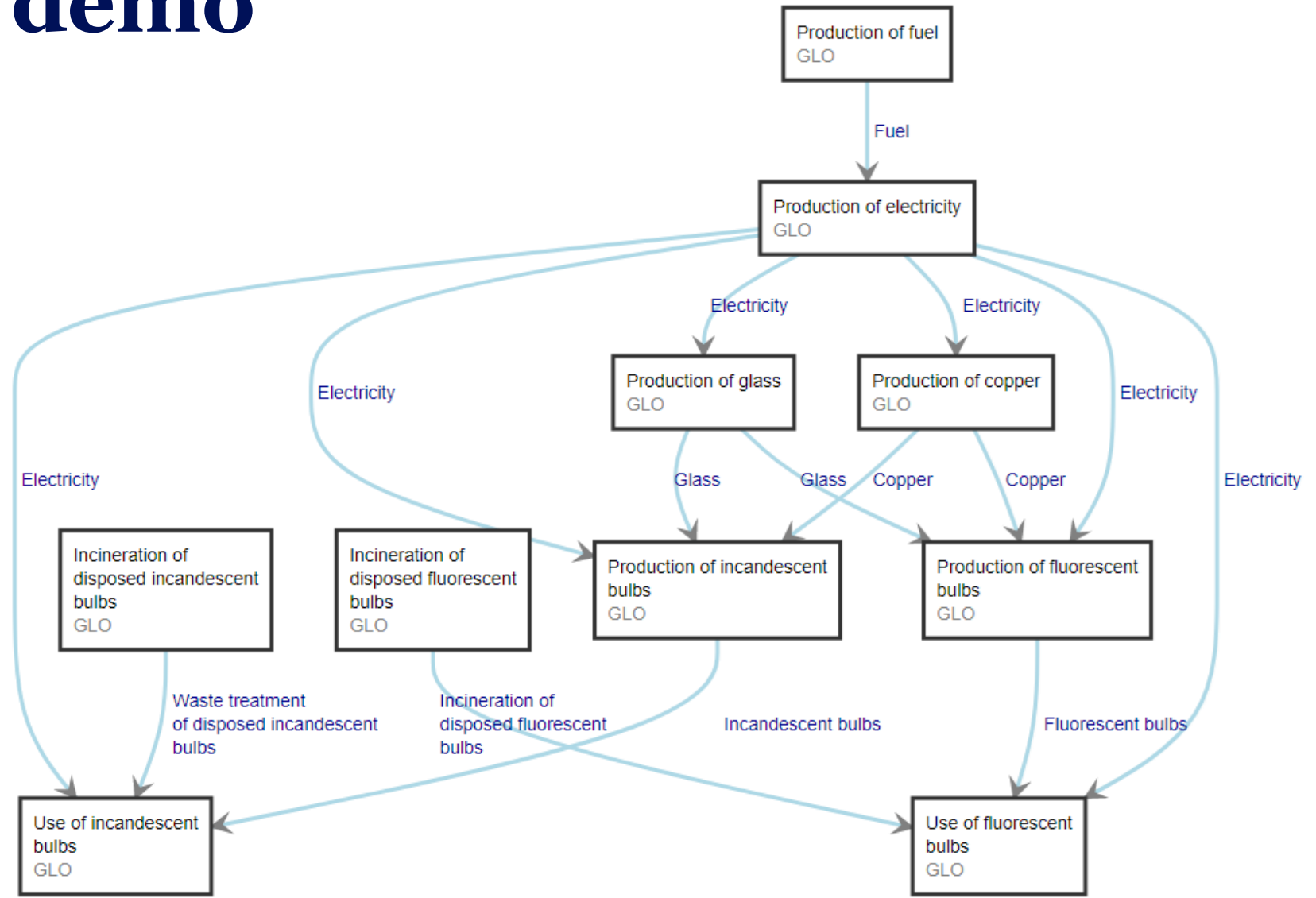


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Uncertainties demo

I will:

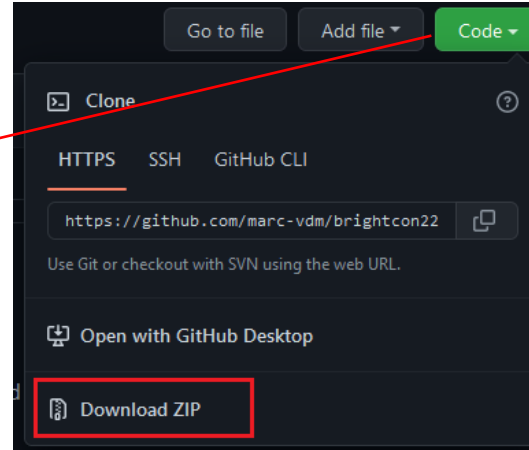
- Use the same system
- Demonstrate some uncertainties
- Calculate results



This example is based on [Chapter 17A](#) of Principles of Environmental Sciences (Heijungs; 2009).

Playing around

1. Take a break, grab a drink
2. Go to:
tinyurl.com/bcon22-AB102
3. Download all files
 - Optional: Import the databases
4. Use the slides as a guide to play around
 - Create some flow scenarios
 - And/or add uncertainty data
5. Either use the provided databases or your own system to try things out



Ready to continue?



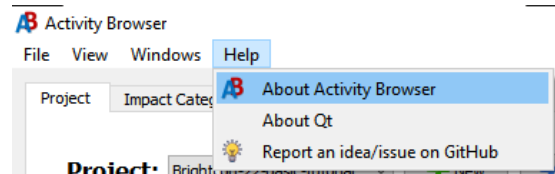
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Reporting problems and asking for help

- Are you having problems or did you find a bug?
- Don't know how to do something?
- Do you have ideas for improvements or totally new features?

Report it on our [github-issues page](#)

- Reporting a problem?
Provide the following for quicker help:
 - What were you trying to do/expecting?
 - What did happen?
 - If relevant share extra information:
 - Screenshots
 - Error messages from the terminal
 - The version of your Activity Browser →

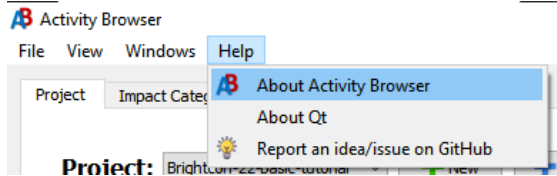


Wrapping up

1. You can now develop your own flow scenarios and assess results
2. You can now add uncertainty data and use Monte Carlo simulations

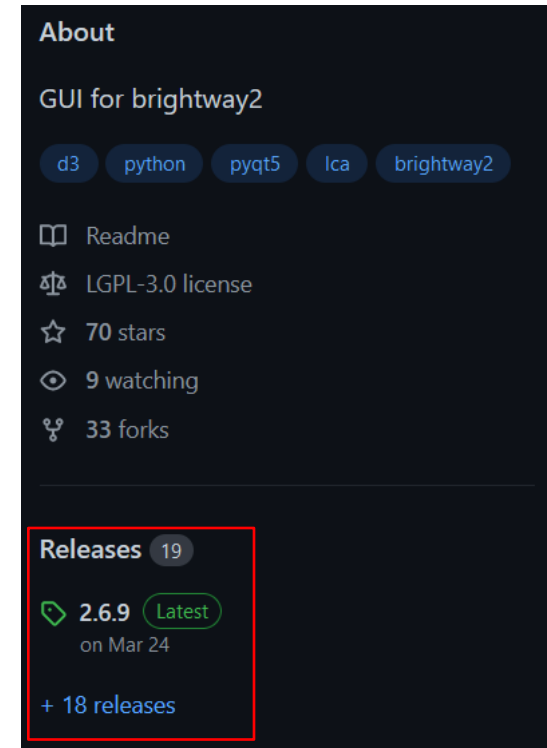
Updating AB

- Updating will never remove data in your projects/databases
- You can check what version of AB you're on under: Help → About Activity Browser



- You can see what version is the latest release on our github under releases
- You can update activity browser with:
`conda activate ab`
`conda update activity-browser`

- Want to be on the cutting edge?
 - You can download the development version [here](#)
 - You can have both versions side-by-side and both will have access to the same projects/databases etc
 - The development version gets more updates, but things may break more often



General tips

- **Tooltips:** Hover over a button/slider/item with your mouse to get a popup for more information.
- **Excel format:** While AB supports the excel format, please don't make databases in excel, only edit them there, it's *very* easy to make mistakes and break your file.
- **Modeling waste treatment:** Be aware that ecoinvent considers waste treatment a service that an activity needs as 'input', not as an output product. This is modeled by having a negative value for production and the input into a process.

Q&A



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