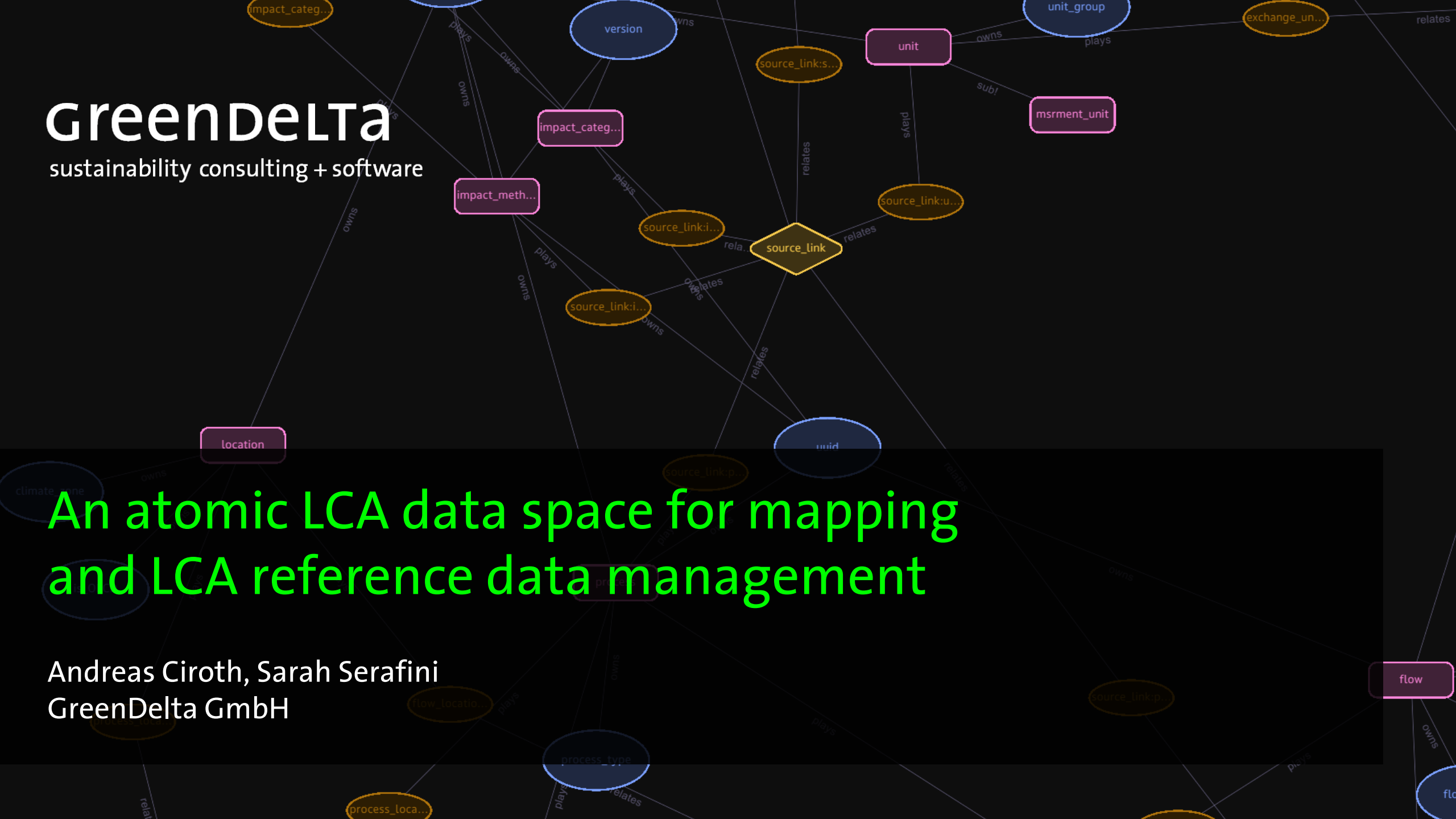


**GreenDelta**  
sustainability consulting + software

# An atomic LCA data space for mapping and LCA reference data management

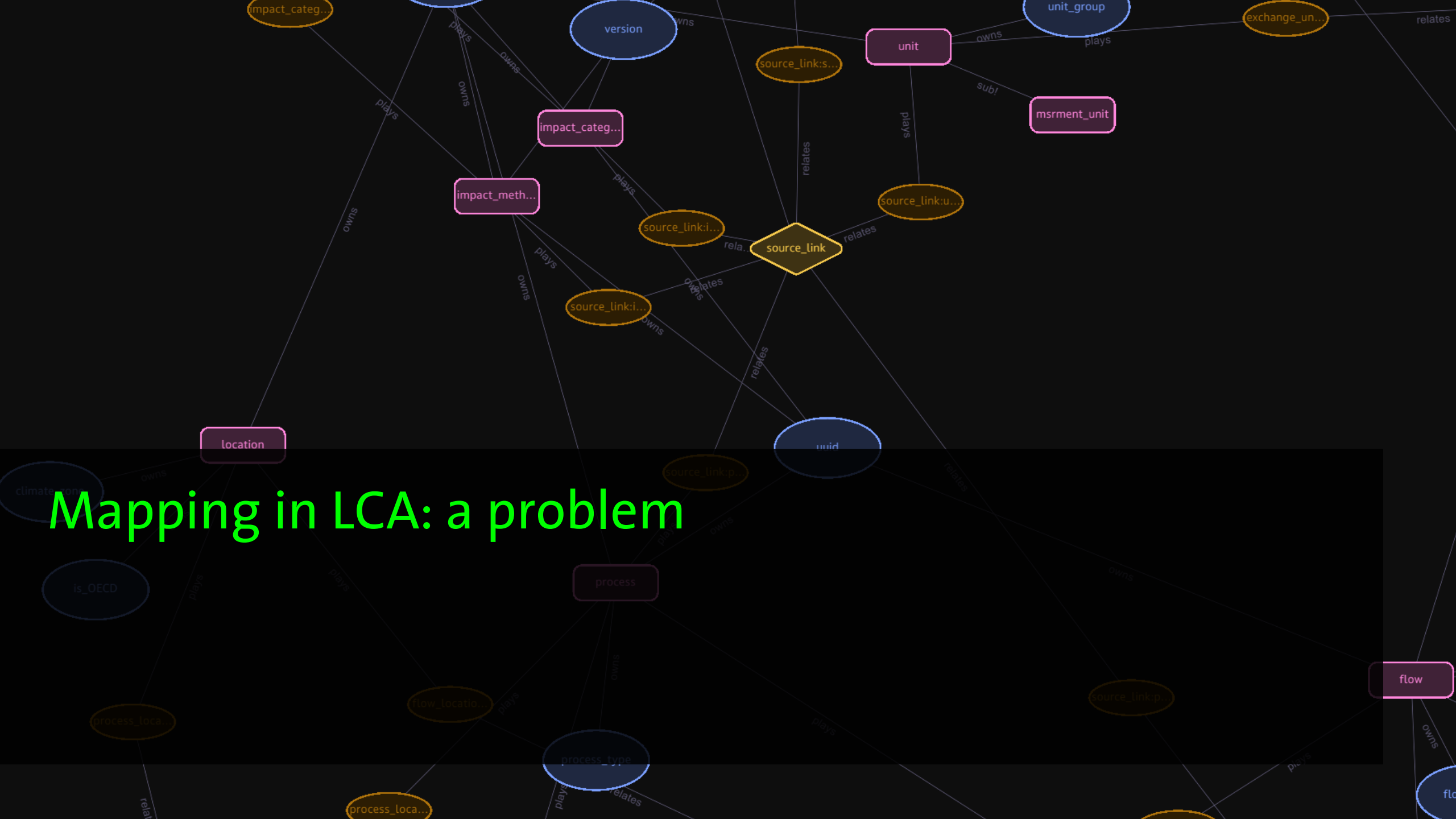
Andreas Ciroth, Sarah Serafini  
GreenDelta GmbH



# Topics

- Mapping in LCA: a problem since the start
- Related: Reference systems in LCA
- Why/ issues?
- Mapping in LCA software now: openLCA
- An 'atomic' data space for LCA
- What next

# Mapping in LCA: a problem



# Mapping in LCA

## Wörterbuch

Definitionen von [Oxford Languages](#) - [Weitere Informationen](#)



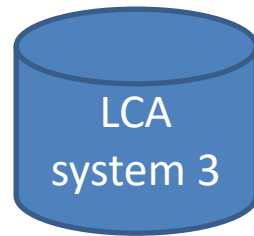
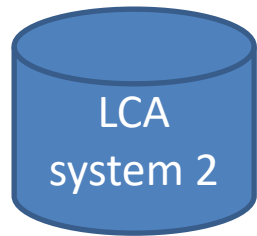
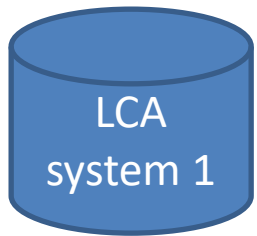
## Map·ping

/ˈmæpɪŋ/

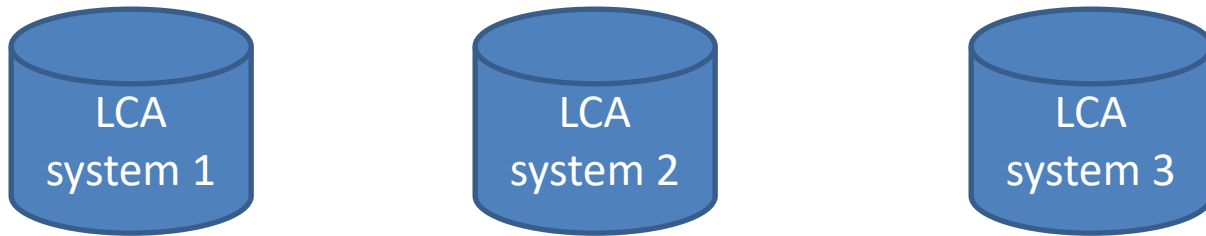
*Substantiv, Neutrum* [das]

1. **EDV**  
Verfahren zum Berechnen von [Texturen](#) (5) beim Erstellen von Computergrafiken
2. **EDV**  
**Aufeinanderabbilden von Datenelementen aus zwei verschiedenen Datenmodellen**  
"bidirektionales Mapping von Metadaten"

# Mapping in LCA

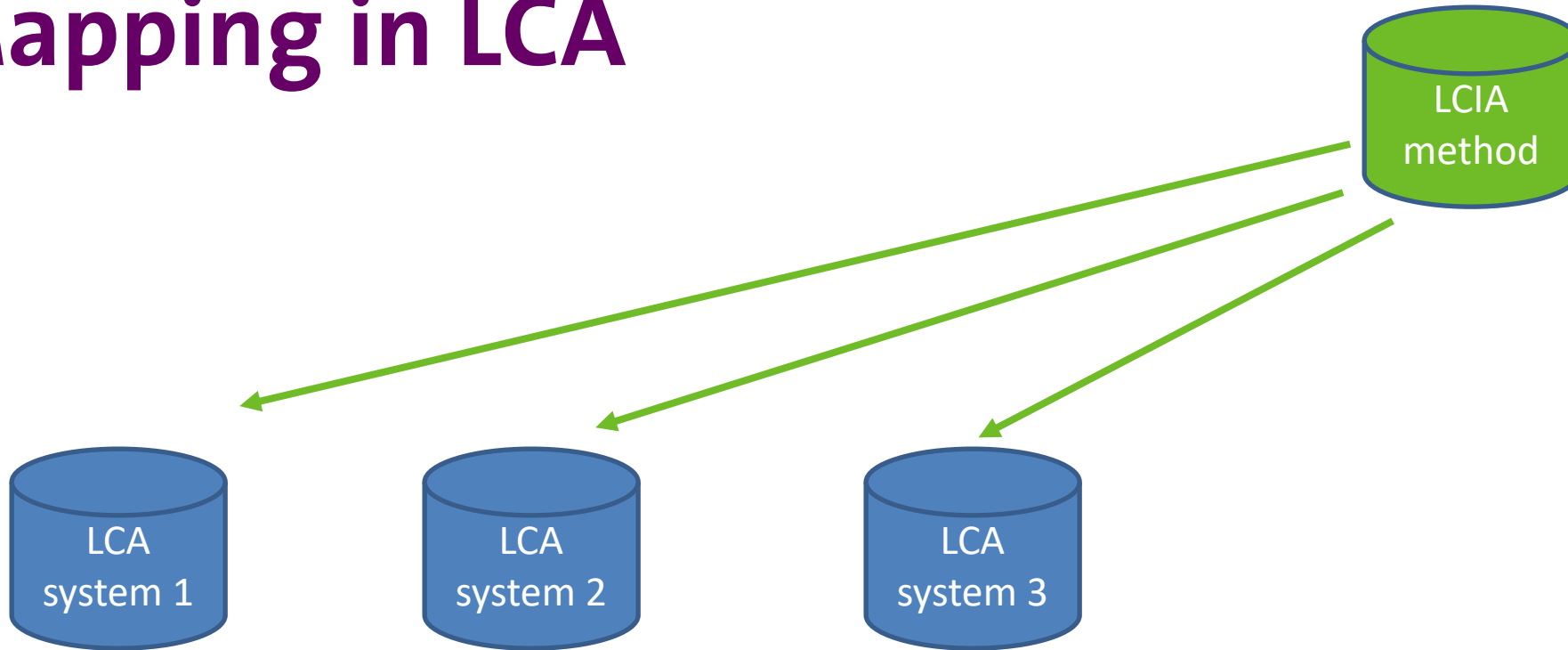


# Mapping in LCA



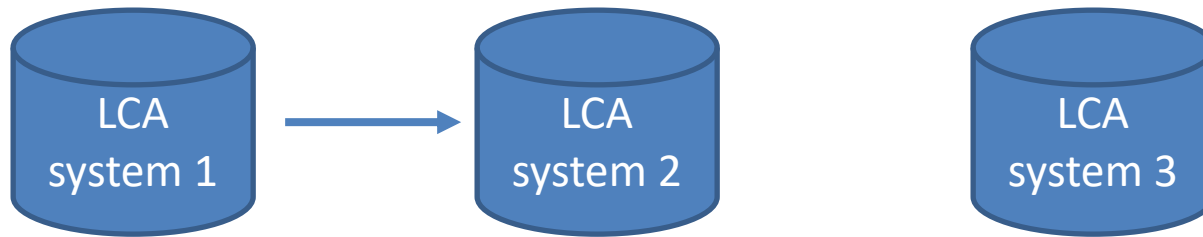
- Each of the systems has potentially different units, flows, ... for the same things.

# Mapping in LCA



- Each of the systems has potentially different units, flows, ... for the same things.
- An LCIA method has even other units, flows, for the same things, and is to be included in all three systems

# Mapping in LCA



- Each of the systems has potentially different units, flows, ... for the same things.
- Someone wants to bring data from one system to another system

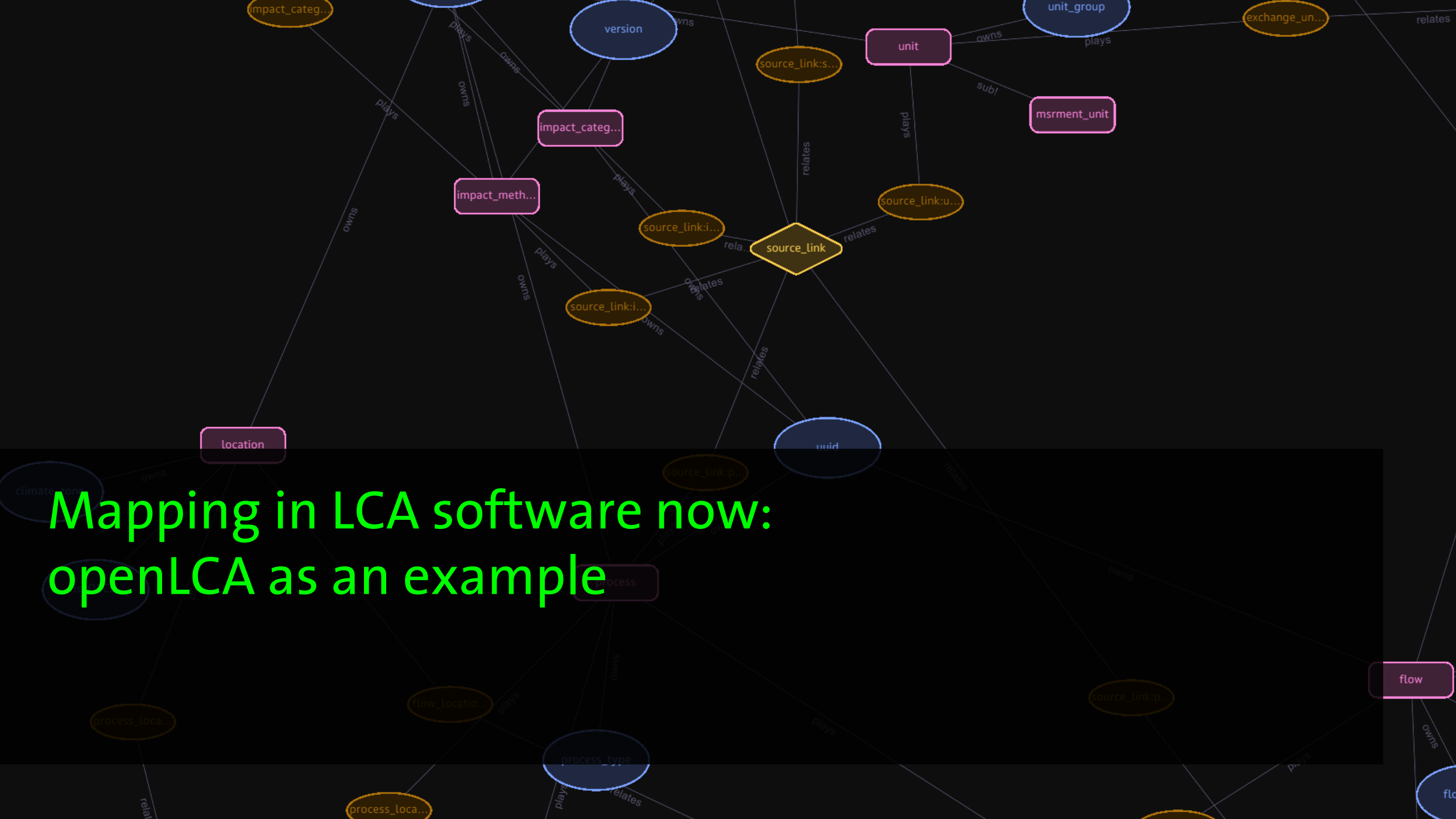
# Mapping in LCA - issues

- How are things identified:
  - Names
  - UUIDs
  - ...
- Are things clearly identified:
  - LCA systems nowadays typically messy, not well curated.
  - E.g., Environmental Footprint database of the EC: Identical UUIDs are used for different things
- Different granularity

# Mapping in LCA – issues, 2

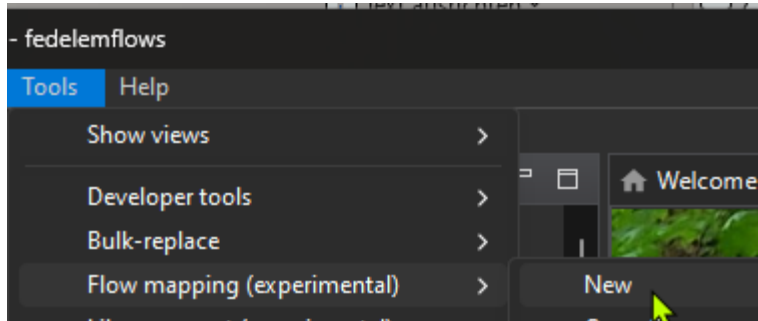
- Clusters
- Nonsense
- For flows: Need to map flow and also compartment

# Mapping in LCA software now: openLCA as an example

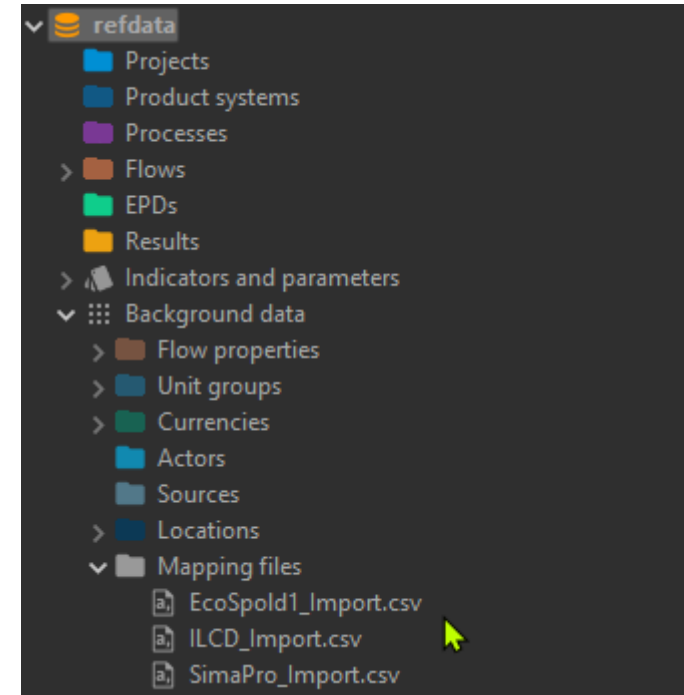


# Mapping in LCA software: openLCA

- While importing, while exporting, and within a database: it is possible to apply a mapping file



- Mapping files are provided with reference data



# Mapping in LCA software: openLCA

Flow mapping

General information

Name: ILCD\_Import.csv

Source system: db://refdata

Target system: - none -

Check mappings

Flow mapping

Status	Source flow	Source category	Target flow	Target category	Conversion factor
?	4-methylpentan-2-ol -	Emissions/Emissions to air/...	4-Methyl-2-pentanol -	Elementary flows/Emission ...	1.00000 kg/kg
?	pentan-1-ol -	Emissions/Emissions to soil...	1-Pentanol -	Elementary flows/Emission ...	1.00000 kg/kg
?	quinmerac -	Emissions/Emissions to wat...	Quinmerac -	Elementary flows/Emission ...	1.00000 kg/kg
?	chloroacetic acid -	Emissions/Emissions to air/...	Chloroacetic acid -	Elementary flows/Emission ...	1.00000 kg/kg
?	3-chloro-4-(chloromethyl)-1-[3-(trifluorom...	Emissions/Emissions to wat...	Fluorochloridone -	Elementary flows/Emission ...	1.00000 kg/kg
?	formamide -	Emissions/Emissions to wat...	Formamide -	Elementary flows/Emission ...	1.00000 kg/kg
?	-		Sodium chlorate -	Elementary flows/Emission ...	1.00000 kg/?
?	p-cymene -	Emissions/Emissions to soil...	Benzene, 1-methyl-4-(1-m...	Elementary flows/Emission ...	1.00000 kg/kg
?	formamide -	Emissions/Emissions to air/...	Formamide -	Elementary flows/Emission ...	1.00000 kg/kg
?	-		Mercury (+II) -	Elementary flows/Emission ...	1.00000 kg/?
?	2,4'-dichloro- $\alpha$ (pyrimidin-5-yl)benzhydryl a...	Emissions/Emissions to soil...	Fenarimol -	Elementary flows/Emission ...	1.00000 kg/kg
?	tert-butylamine -	Emissions/Emissions to air/...	t-Butylamine -	Elementary flows/Emission ...	1.00000 kg/kg
?	propylamine -	Emissions/Emissions to air/...	Propylamine -	Elementary flows/Emission ...	1.00000 kg/kg
?	thiophanate-methyl -	Emissions/Emissions to soil...	Thiophanat-methyl -	Elementary flows/Emission ...	1.00000 kg/kg

# Mapping in LCA software: openLCA

- This can of course be used. Issues so far:
  - Only flows addressed
  - Needs a simple flat file x is y.
  - Using in import and export and within the software is useful



# An atomic LCA data space

- Atomic modelling of flows
- Atomic modelling of compartments
- Implementation in graph database TypeDB which can infer
- Using Pubchem synonyms, CAS numbers, existing flow mappings, etc.

# An atomic LCA data space

admin@localhost:8000 > olca\_ref\_data auto

AI Support Learn

### Schema Explorer

- entities
  - compartment
  - impact\_category
  - impact\_method
  - intervention
  - location
  - primitive
  - process
  - segment
  - source
  - unit
- relations
  - compartment\_intervention
  - exchange\_unit
  - flow\_location
  - impact\_category\_flow
  - impact\_category\_method
  - is\_synonym\_to
  - process\_location
  - process\_references

### Visualiser

Search

### Graph Style

Refresh

Highlights	Themes	Editor
Kinds <span>All None</span>		
Entity	Relation	Attribute
Entity Type	Relation Type	Attribute Type
Role Type	Value	
Types <span>All None</span>		
agriculture	air	barren
biotic	commercial	
compartment	ecoinvent	economic_issue
emission	exchange	flow
forestry	grass	
ground_water	human_dominated	impact_category
impact_method	indoor	industrial
intervention	lake	LCA_reference_system
LCACommons	location	msrment_unit
non_elementary	ocean	outdoor
primitive	process	PubChem
residential	resource	river
segment		

Labels in nodes: Visible, border color

Show label on hover:

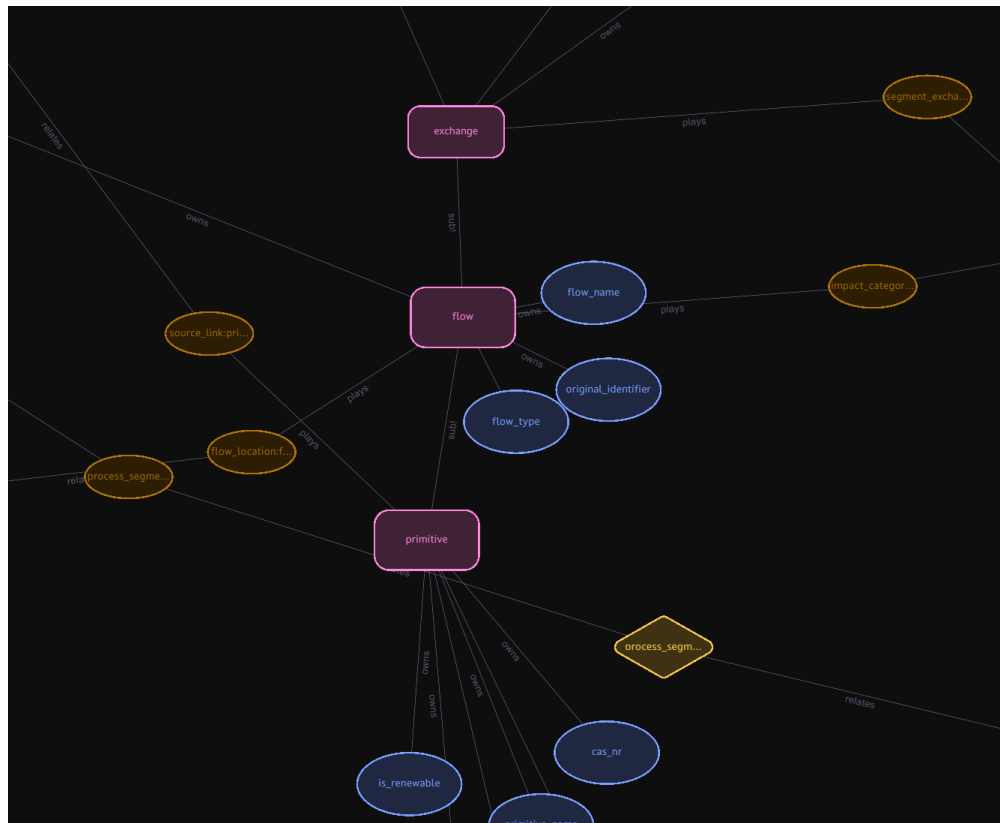
Scale nodes by connection count:

Color edges by constraint:

Redraw graph Reset all styles

# An atomic LCA data space

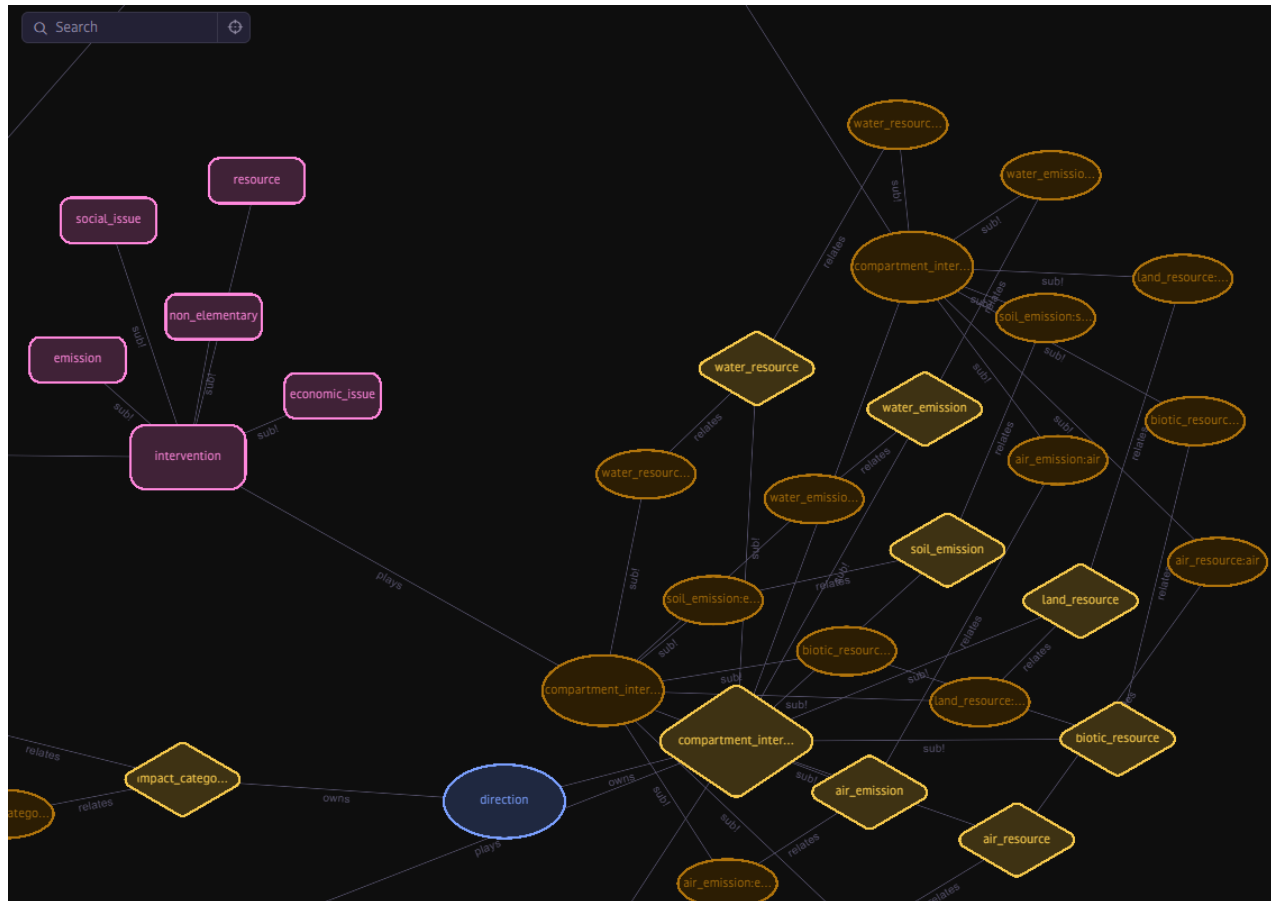
- Atomic modelling of flows: primitives, flows, exchanges



- ▼ primitive
  - ▼ exchange
    - owns cas\_nr, value string
    - owns is\_renewable, value boolean
    - owns primitive\_name, value string
    - owns primitive\_type, value string
    - owns flow\_name, value string
    - owns flow\_type, value string
    - owns original\_identifier, value string
    - owns uuid, value string
    - owns amount, value double
    - ◆ plays is\_synonym\_to:primitive
    - ◆ plays is\_synonym\_to:synonym
    - ◆ plays source\_link:primitive
    - ◆ plays flow\_location:flow
    - ◆ plays impact\_category\_flow:flow
    - ◆ plays compartment\_intervention:exchange
    - ◆ plays exchange\_unit:exchange
    - ◆ plays segment\_exchanges:exchange
  - owns cas\_nr, value string
  - owns is\_renewable, value boolean
  - owns primitive\_name, value string
  - owns primitive\_type, value string
  - owns flow\_name, value string
  - owns flow\_type, value string
  - owns original\_identifier, value string
  - owns uuid, value string
  - ◆ plays is\_synonym\_to:primitive
  - ◆ plays is\_synonym\_to:synonym
  - ◆ plays source\_link:primitive
  - ◆ plays flow\_location:flow
  - ◆ plays impact\_category\_flow:flow
- owns cas\_nr, value string
- owns is\_renewable, value boolean
- owns primitive\_name, value string

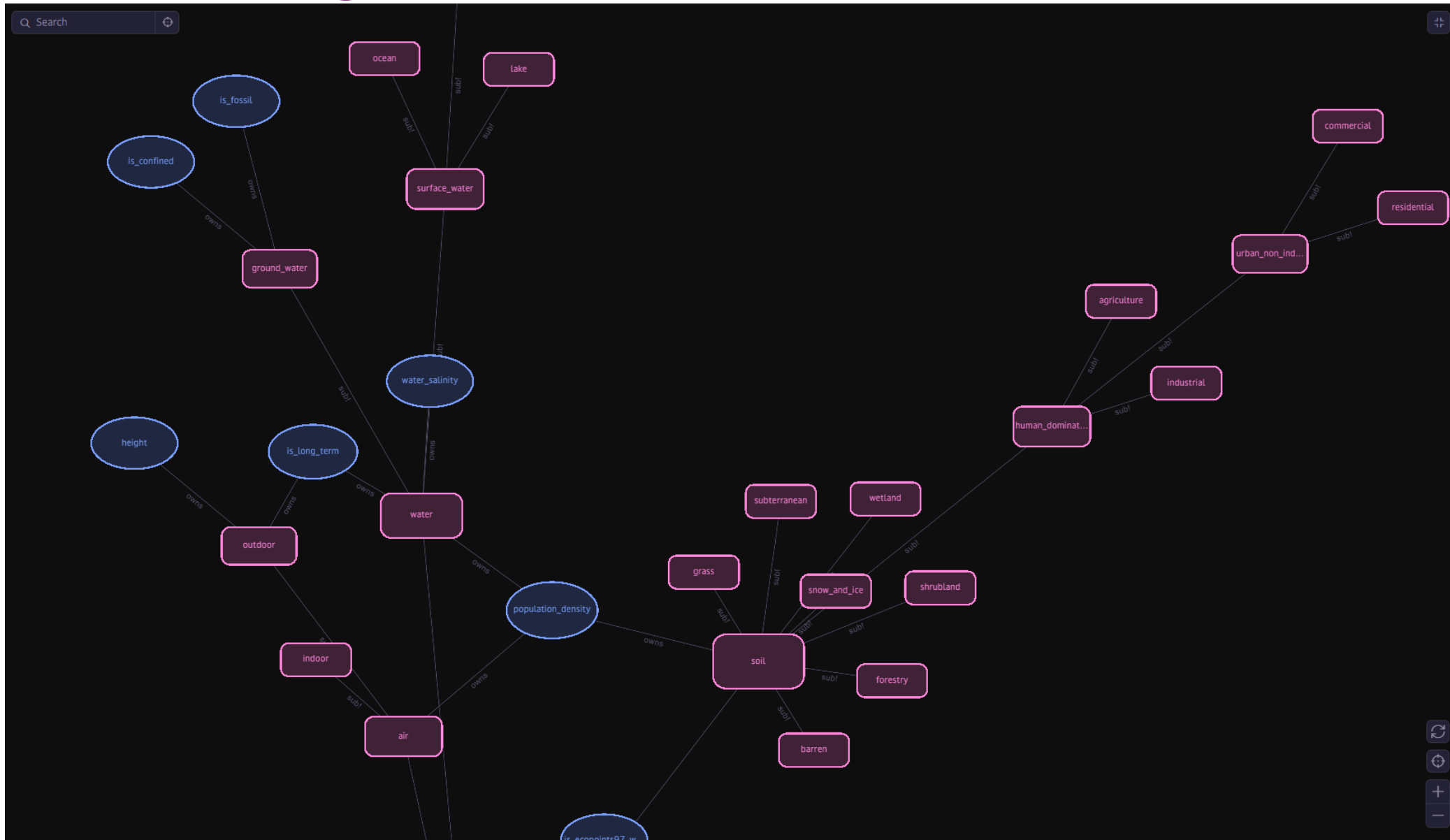
# Modelling of compartments

- Compartments (water, air, soil, with subcompartments) and interventions (emission, resource, social issue, economic issue):





# Modelling of compartments



# An atomic LCA data space

- This atomic LCA data space is able to fully capture and address all proposed LCA reference systems
- So far we are able to fully store
  - The EF3.1 system
  - LCA Commons
  - SimaPro
  - ecoinvent

(Compared to previous versions of typedb: much better performance -> now a good time to put it to real use)

# An atomic LCA data space: Next steps

- 1, use for mapping across different reference systems:
  - match Primitives via synonyms,
  - match compartments via penalty system
  - also for the MSDB database

# An atomic LCA data space: Next steps

- 2, develop an openLCA reference system
  - ! So far, openLCA was more a compilation of ecoinvent + some other databases
  - Maintaining a good link to other reference systems, it makes sense to have a good, specific reference system for openLCA
  - Not necessarily reinventing, but having a good system
  - Chris Mutel / Brightway (now: ~ hardcoded ecoinvent reference system) is also developing an own system -> collaborate
  - We have also the idea to ask for openLCA community feedback



