The world's most consistent and transparent Life Cycle Inventory database

ecoinvent

Consequential LCA system model: implementation in ecoinvent version 3 and illustration of consequences on selected supply chains

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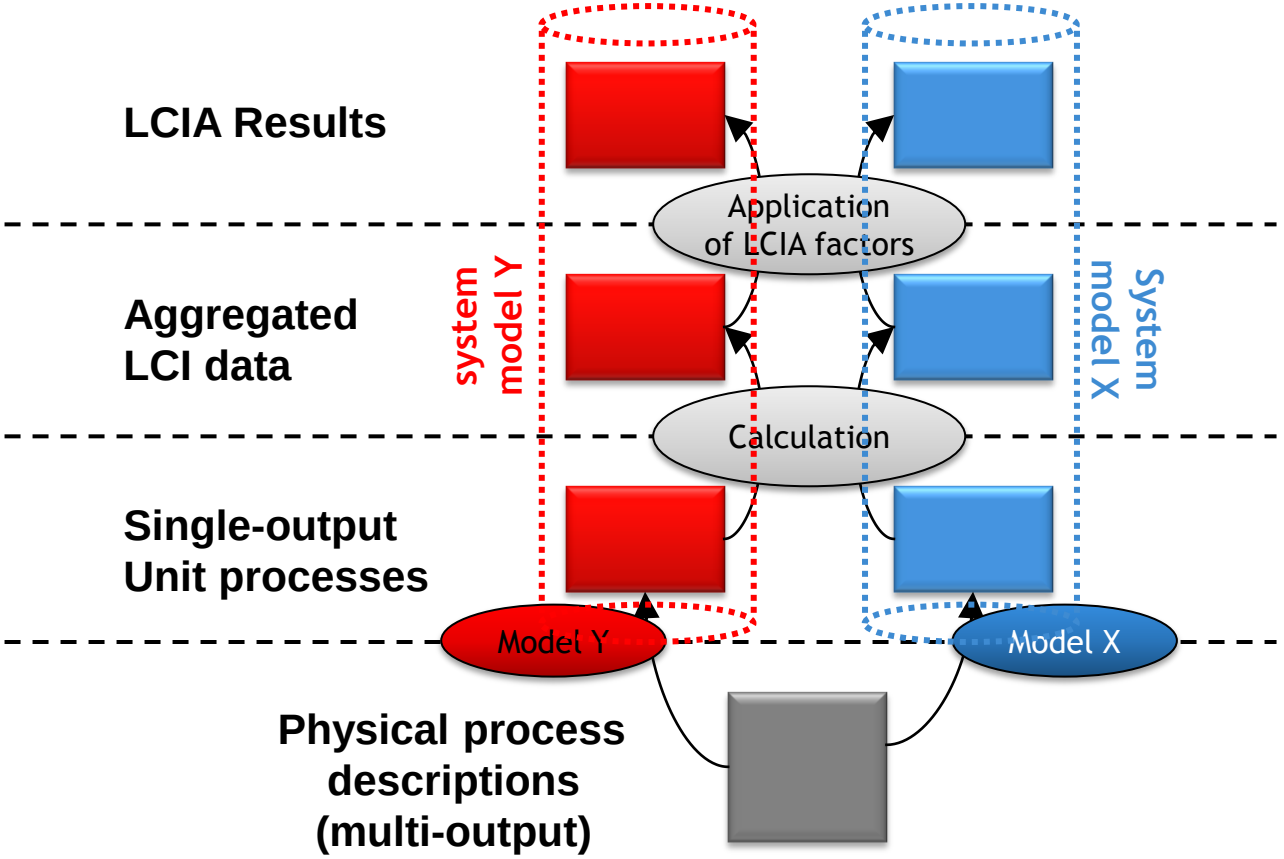
System models in version 3

- A **system model** is a collection of modeling choices made for the database
  - Solving the allocation problem
  - Recycling and waste streams
  - Handling constraints in suppliers
- In version 3, **multiple system models** are possible
  - Different perspectives at the same database

System models in version 3



System models in ecoinvent v3

- Allocation at the point of substitution
- Allocation, Recycled Content cut-off
- Consequential (long-term, small-scale)
- Other models possible
  - Waste/Recycling system models
  - Other allocation choices
  - Integration with specific standards
  - Complete mass- or carbon-based allocation (Mass Flow Analysis)

The Consequential SM in ecoinvent v3

- Offering a consequential system model was an ambition in version 3 as the use of attributional background data introduced errors of unknown impact in consequential studies

- Implementation in version 3 is a basic version of the consequential approach
  - Foreground systems can and should show more specificity
  - Important parts of the background supply chain can be checked and adapted if necessary
- A basic consequential ecoinvent version allows research and work on consequential database development

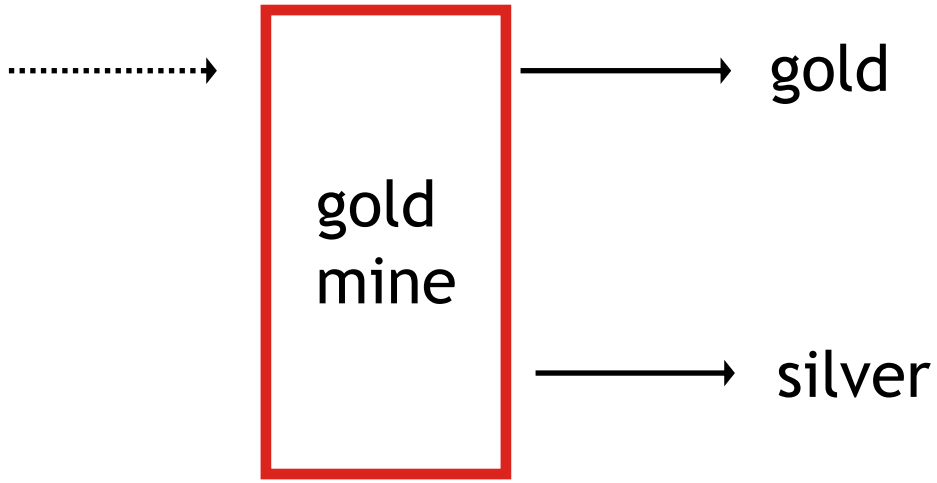
The Consequential SM in ecoinvent v3

- Use of **Substitution** for by-products to avoid allocation

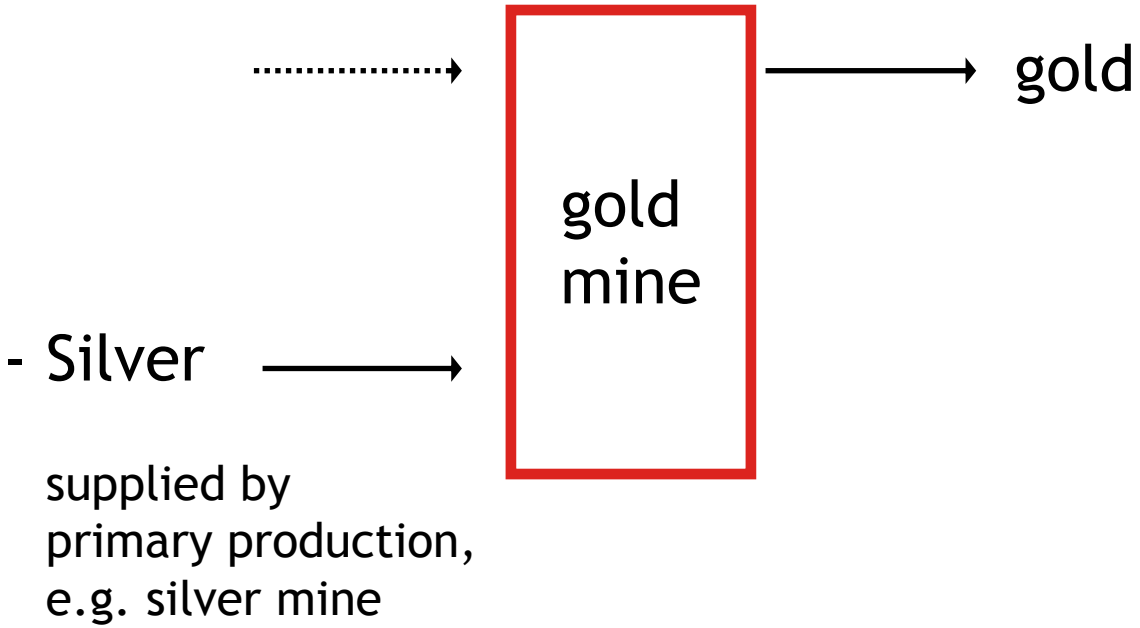
- Use of **marginal suppliers** only
  - Constraints of by-product production
  - Constraints due to technology

- **Consumption of by-products** creates demand for **primary production**
  - **Alternative production routes**
  - **Constrained markets** identify the marginal consumer of constrained products

Substitution in the ecoinvent v3



Substitution in the ecoinvent v3

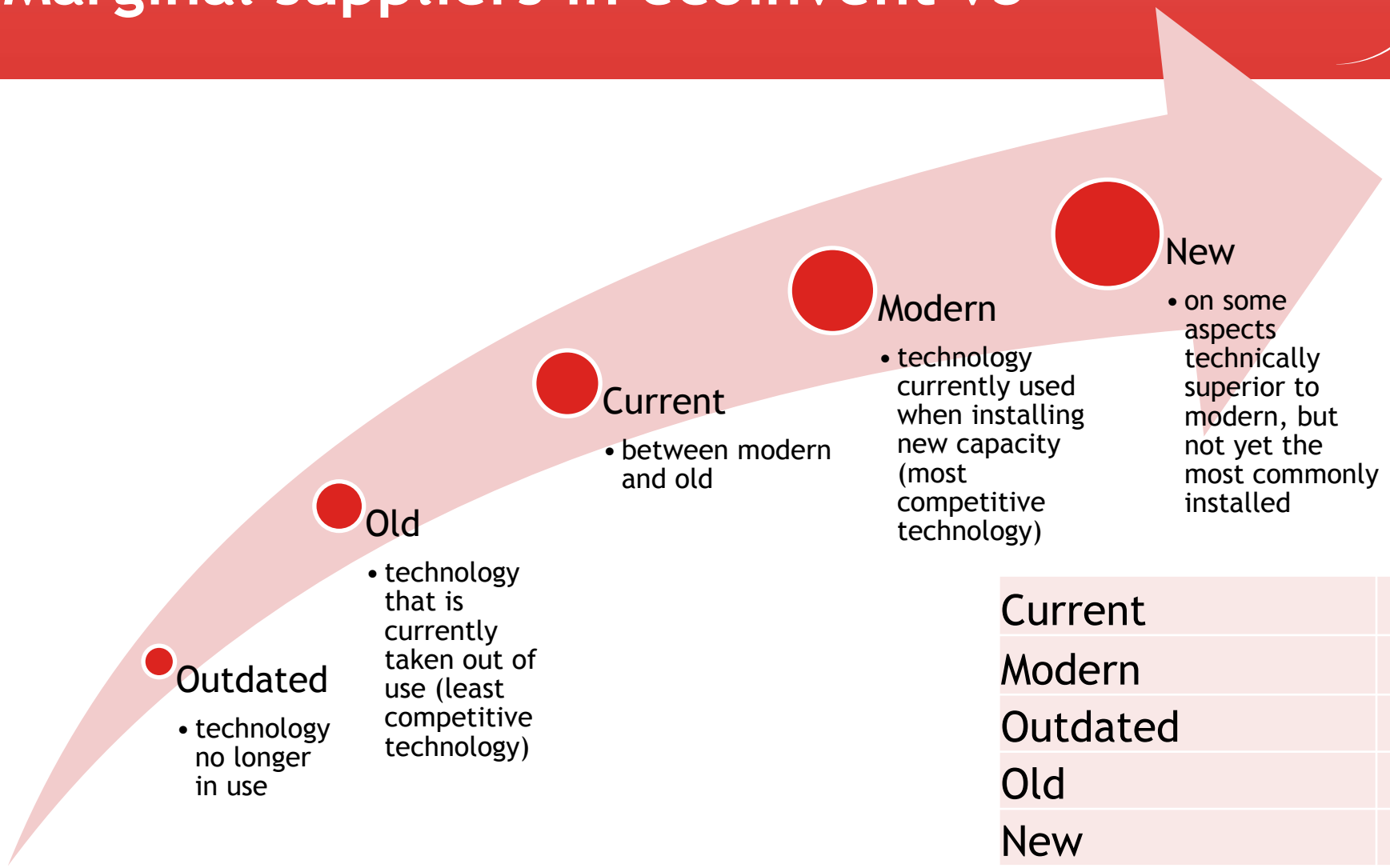


Marginal suppliers in ecoinvent v3

- **By-products** are generally constrained and therefore not available to supply activities
  - Many datasets that exist in the allocation-based models do not exist in the consequential model

- Products are also constrained based on the **technology level** of the producing activity

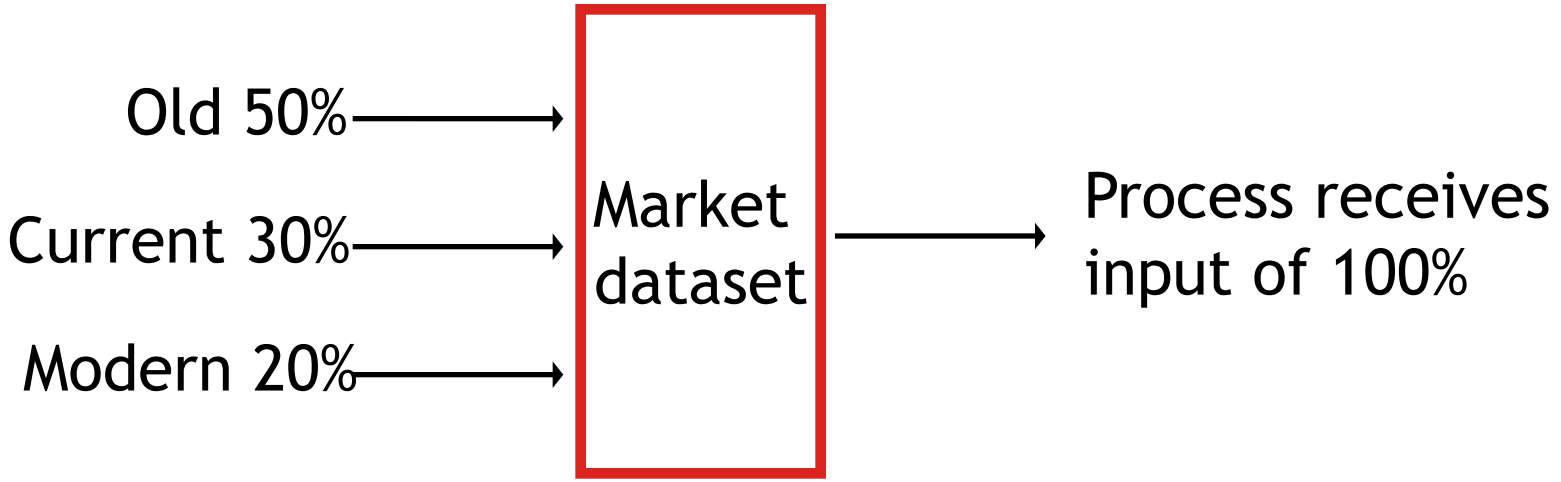
Marginal suppliers in ecoinvent v3



Current	81.4%
Modern	17.2%
Outdated	0.6%
Old	0.5%
New	0.4%

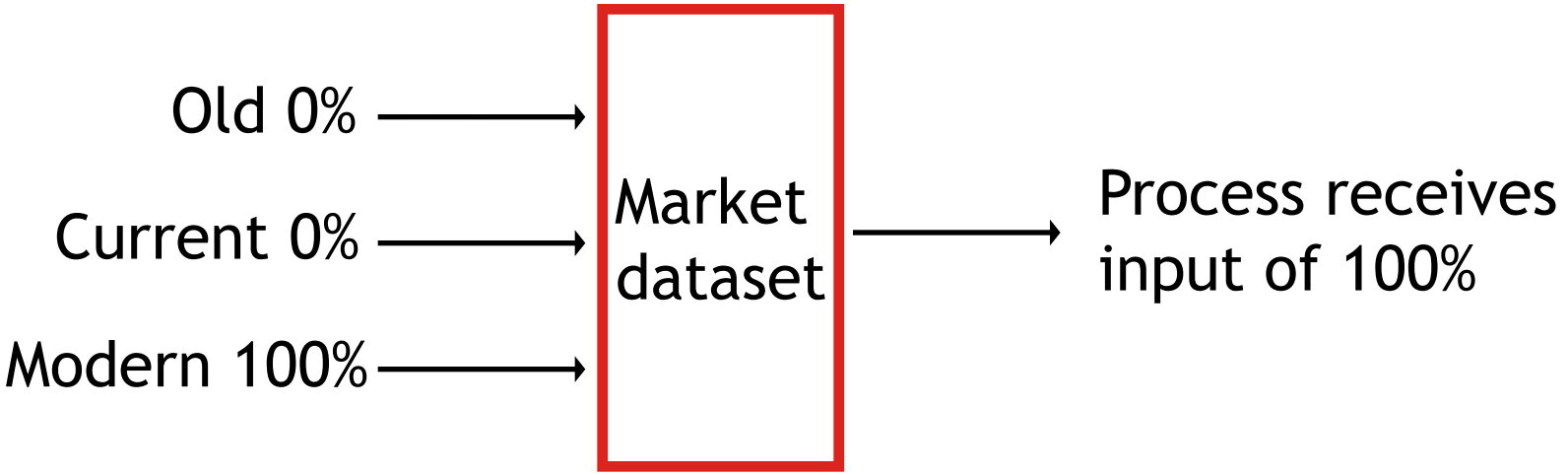
Marginal suppliers in ecoinvent v3

Attributional model

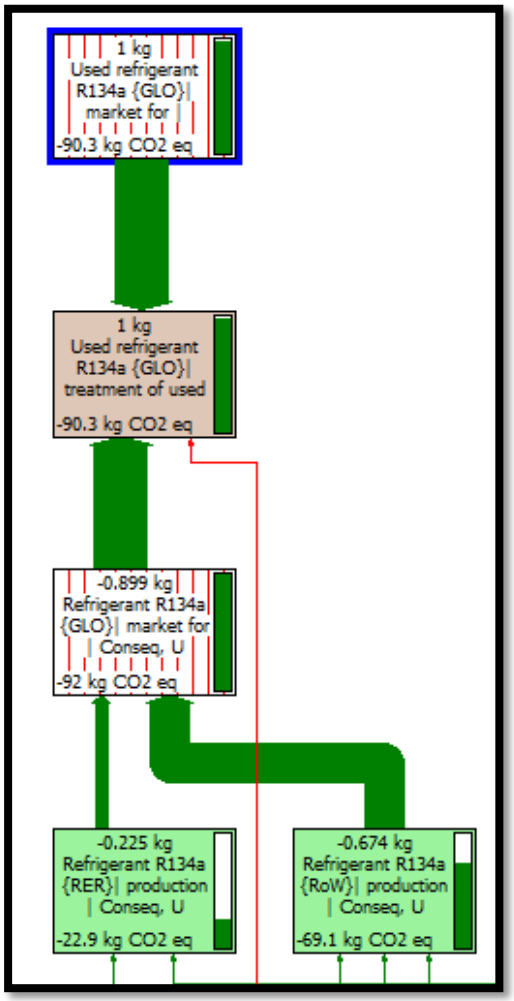


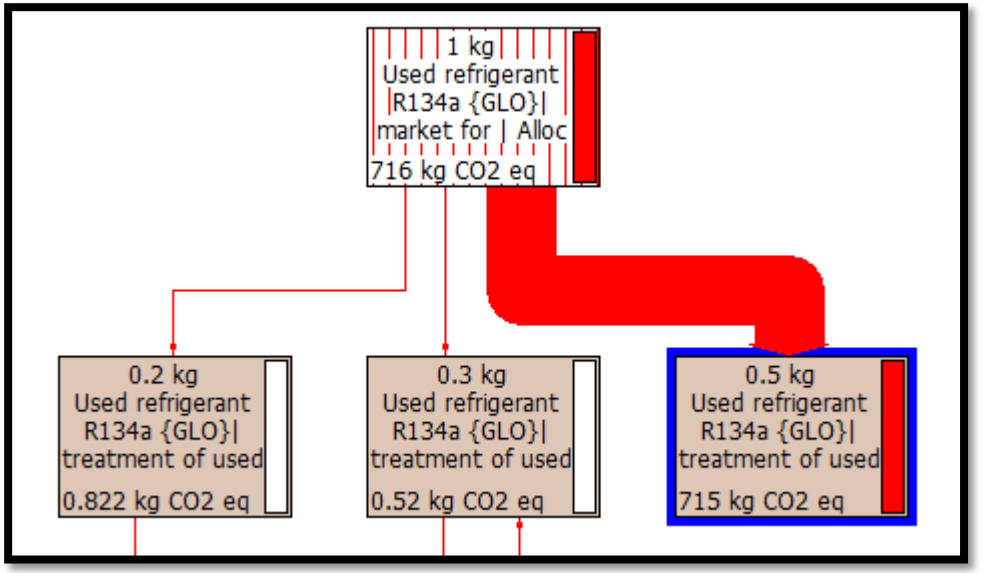
Marginal suppliers in ecoinvent v3

Consequential model



Marginal suppliers in ecoinvent v3





final disposal

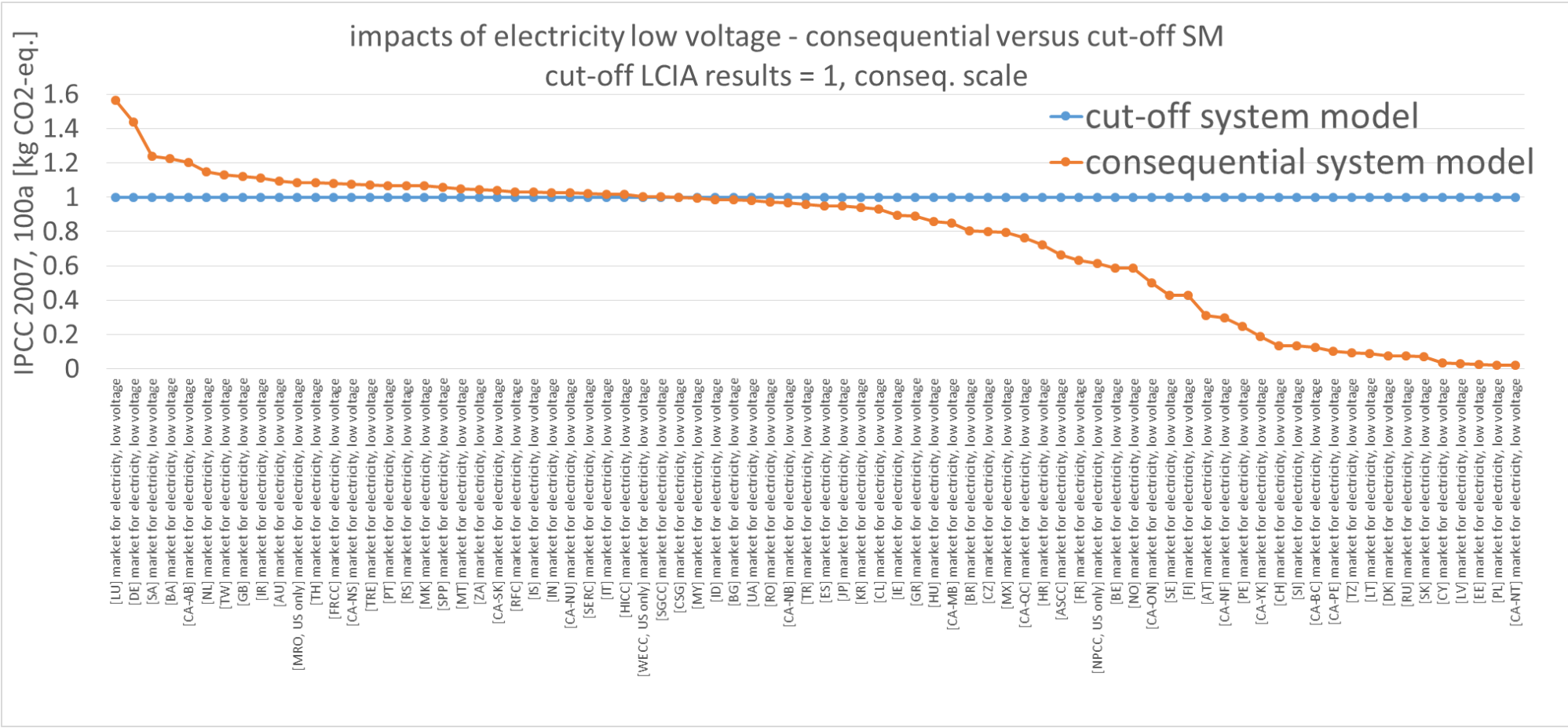
reclamation

venting

Marginal suppliers in ecoinvent v3

- Determination of constraints via technology levels is a basic approach
  - Application to many thousands of datasets requires an efficient solution
- Data providers are looking to improve on these models
  - Integration of advanced forecasting data in the works

Marginal suppliers in ecoinvent v3

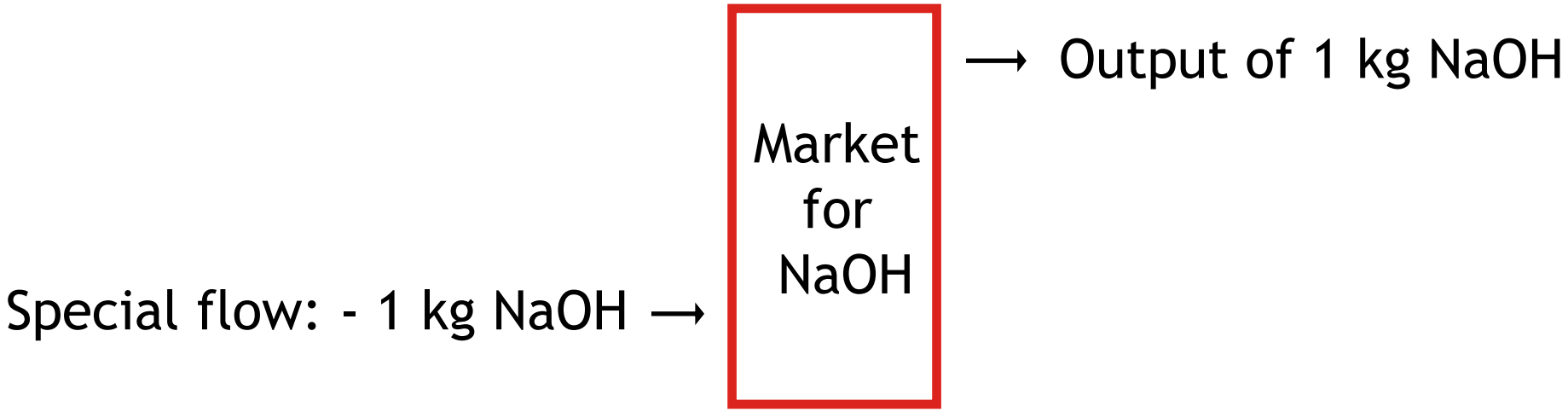


Constrained markets

- Constrained markets occur when by-product cannot be substituted by primary production
- Chlorine production is an example of a constrained by-product
  - Sodium hydroxide is a by-product of chlorine production
  - Constrained market for NaOH

- Use of NaOH leads not to excess Chlorine production but to reduced use of NaOH elsewhere, requiring a substitute defined by the **marginal consumption activity**

Constrained markets

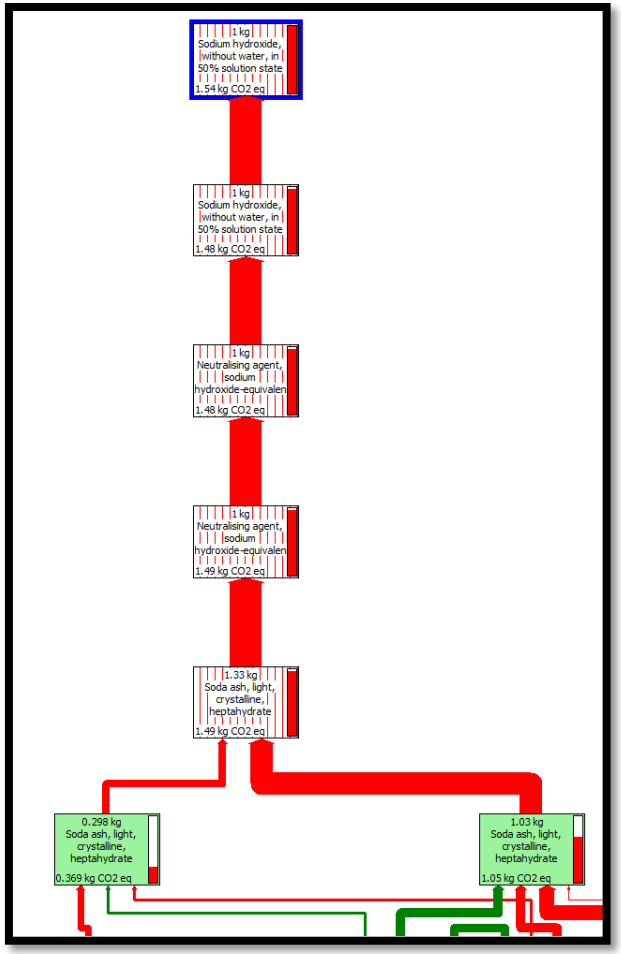


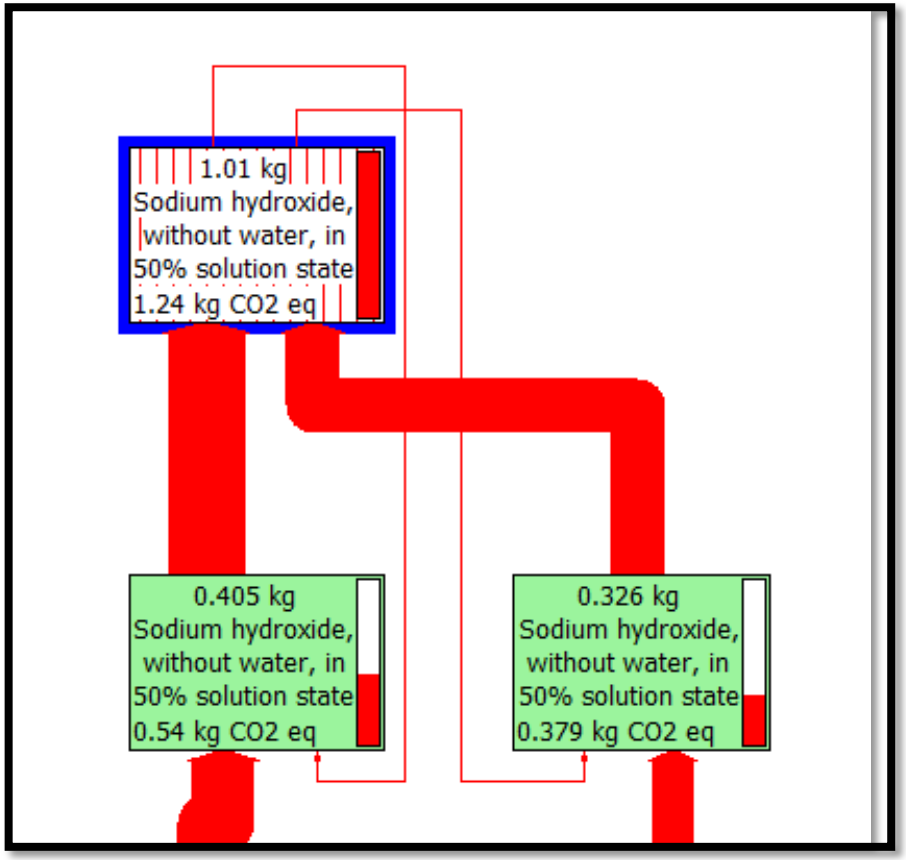
- **ignored** by linking algorithm in other system models
- **direct link** to marginal consumption
- **property tag** which defines the level of constraint and which system models use this special flow

Constrained markets

- Link to marginal consumption activity: NaOH as a neutralising agent
- Market for neutralising agents defines substitution
  - In this case: Sodium Carbonate
- In the consequential model, using NaOH results in adding the burden of the equivalent amount of Sodium Carbonate due to the displacement of the marginal consumption
- Stored in the same database, but does not affect other system models

Constrained markets





Conclusions

- The consequential model follows the core tenets of consequential modelling
  - Limited to small-scale, long-term
- Implementation rather basic to address poor data situation
- Adaptations possible in the unit process structure
- Improvements on important markets such as electricity foreseen