

**Welcome to the ecoinvent user meeting!**

## An overview of ecoinvent v3

**Gregor Wernet**

*Executive Director*

# What is ecoinvent?



- A **not-for-profit** association of several research organizations
- Publisher of the ecoinvent database - **Life Cycle Inventory** data on many thousands of products and services
- ecoinvent is not:
  - A business
  - A provider of LCA studies

# What is ecoinvent?



- ecoinvent is a **data publisher**
  - Reviews, consistency checks, publishing services, e.g. support for users
  - Working with an established network of data providers, including governmental agencies from multiple countries, industry associations, private companies and researchers
- **Internal staff** as well as experts from **member organizations** provide the core expertise
- The **editorial board** provides additional competences on various sectors and topics
- **User and stakeholder** meetings, surveys and direct feedback also inform the development of the database

# What is ecoinvent?



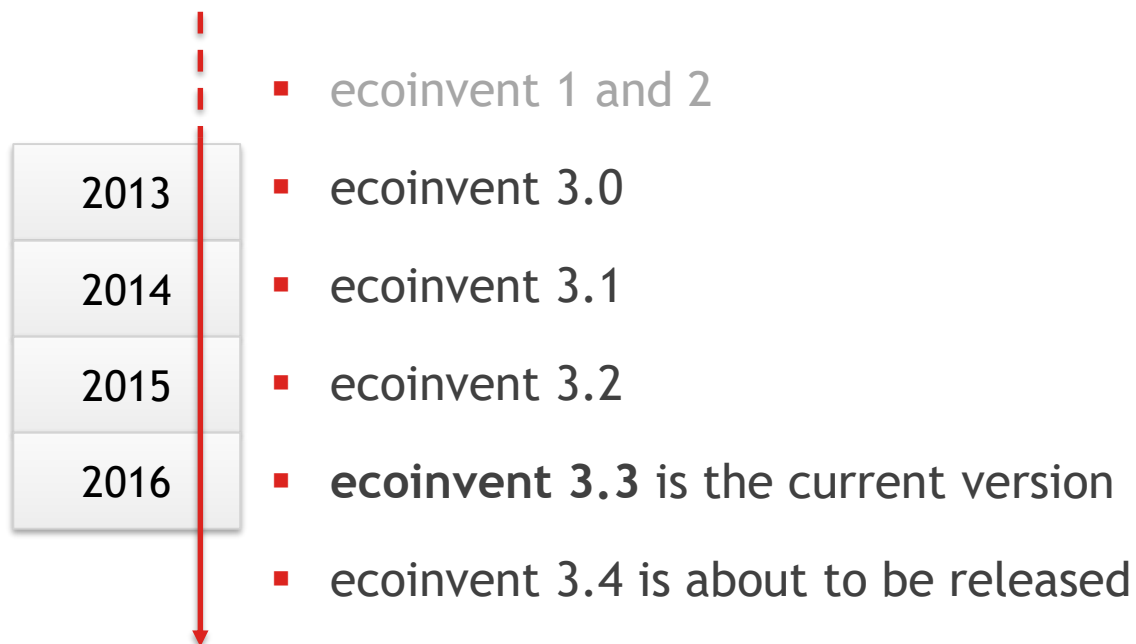
- ecoinvent is a **background database** which contains **generic data** on different materials and services
  - e.g. energy, basic materials, agriculture, transport, construction, and many more
- ecoinvent connects data providers and users
- The database provides data of a known quality
  - More than **12'500** processes
  - More than **2'700** products
  - More than **3'300** distinct technologies
  - Data from **80** countries and **157** geographies

- **Consistent**
  - Submissions are reviewed against consistent quality guidelines
  - Inconsistencies are actively addressed and corrected
- **Reliable**
  - Independent expert review for all datasets
  - Continuously developed and improved over 15 years
- **Transparent**
  - Full access to both unit process data and all calculation results
  - Individual documentation of each dataset

# Versions of the ecoinvent database



- New versions of the database are being released once a year



# What is ecoinvent?



- ecoinvent was created in Switzerland by a group of research institutes and government stakeholders
- ecoinvent **started out** as the Swiss national LCI network
  - Evolution out of several smaller, loosely connected data pools with significant additional development
  - **International** supply chains required a strong focus on European and Global data as well
  - ecoinvent has **grown** into a global database with a global userbase



# Who uses the ecoinvent database?

- The database has **many thousands of users** from over **80 countries**
- Primary users are consultants, industry, researchers, policy makers
  - Revenue from commercial and academic users supports the maintenance and development of the database
  - Research and educational use in non-OECD regions is free
- Many users in **Life Cycle Assessment (LCA)** and **carbon footprinting**
  - More and more use in EPDs (e.g. EN 15804), PEF, water footprinting, resource criticality, Social LCA, and other sustainability assessments

# Who uses the ecoinvent database?

- Included in or available for the leading LCA and eco-design software tools

SimaPro 



WRATE

thinkstep  
GaBi

carbotech 



iPoint

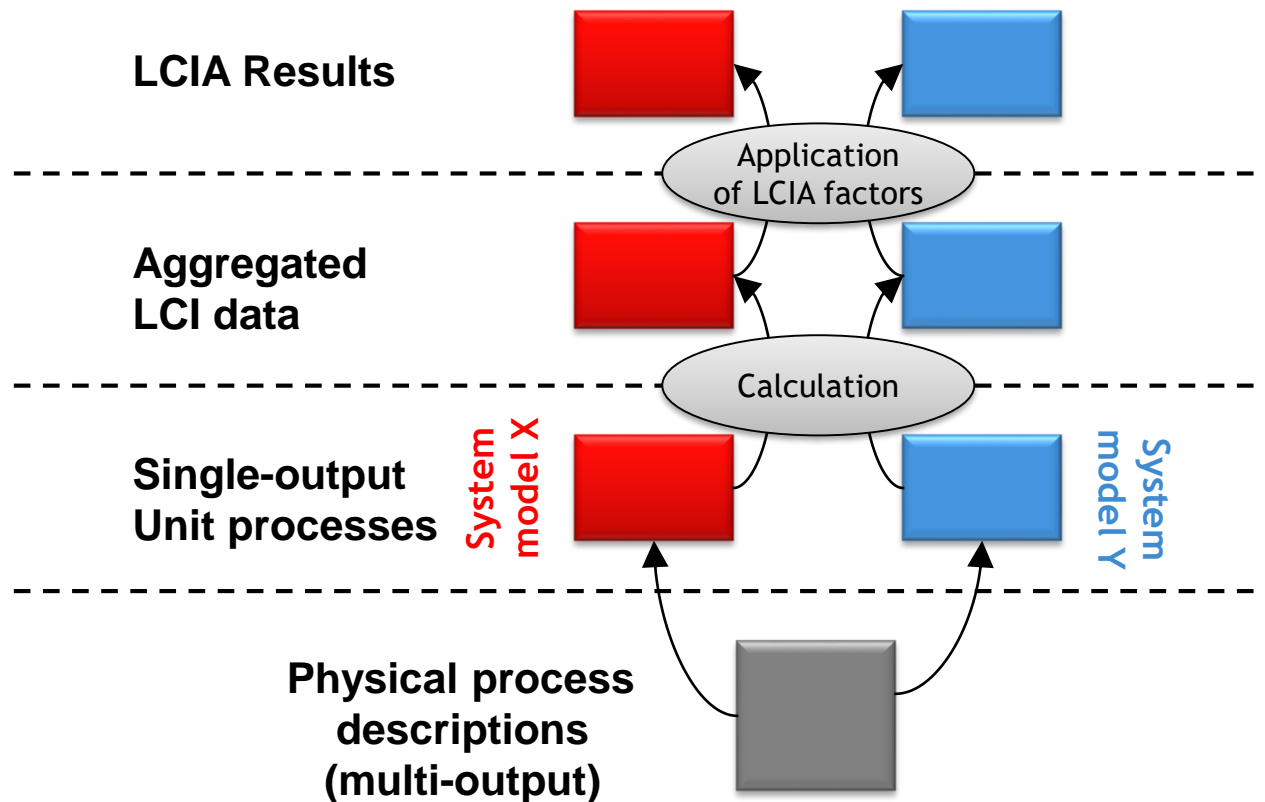
# What does the database contain?

- The database itself
  - Access to the raw process datasets
  - Access to linked, single-output unit processes (in different system models)
  - System processes/aggregated LCIs
  - Tables of Impact Assessment results
- Metadata
- Documentation

- ecoinvent publishes data at the unit process (UPR) or gate-to-gate level
  - Allows supply chain and environmental hotspot analysis
  - Easier to maintain
  - Can be updated, expanded on or modified individually by the users
- The scope of a unit process is somewhat flexible in ecoinvent
  - As little as possible, as much as necessary for use in a **background database**
  - Resolution aims at meaningful assessments of supply chain impacts
  - **Aggregation level** depends also on data availability

- A **system model** is a collection of modeling choices made for the database, e.g.
  - Allocation of by-products or substitution
  - End of Life considerations
  - Consequential and forecasting LCAs
- ecoinvent version 3 supports multiple system models
  - Certain studies and standards require specific system model choices
  - Different perspectives at the same data

# System models in version 3



- Allocation approach is based on ISO 14040/44
  - Sub-division of the system: e.g. petroleum and natural gas extraction
  - Allocation using physico-chemical properties: e.g. exergy for energy co-production
  - Allocation using revenue, mass or others: often but not always economic
- Allocation choice is confirmed for each process between the data provider and the reviewers
  - Should reflect the drivers of the impacts

# What does the database contain?

- **Supporting metadata** such as
  - Product and Process classifications
  - price information (for e.g. LCC or integration of Social LCA data)
  - Properties of products and environmental flows
    - Water content, Carbon content (fossil and biogenic), ...
  - Uncertainty and data quality information, on a flow-specific level
- **Documentation**
  - Transparency, understandability, reproducibility
    - Sources



- ecoinvent website
  - Quality Guidelines, Data submission support, FAQ, Glossary, User forum



- Dataset documentation
  - In sectorial reports and within datasets
- Individual reports for each dataset in PDF form
  - Combines documentation, unit process information, LCIA results and a contribution analysis in one overview document

# Documentation of new releases

- Activity overview

- Change report

- Change report annex

- Correspondence files

Documentation of ecoinvent  
implemented in the ecoinvent  
database v3.3  
(2016.08.15)

Moreno Ruiz E., Léková T., Reinhard J., Valasina L.,  
Bourgault G., Wernet G.

# PDF Documentation

ecoinvent

Ecoinvent 3.3 dataset documentation		
activated carbon production, granular from hard coal - RER		
<div> <div> <b>Dataset identification</b> </div> <div> <b>Table of content</b> </div> </div>		
Activity name	activated carbon production, granular from hard coal	Exchange summary
Geography	RER (Europe)	Dataset description
Time period	2005-01-01 to 2016-12-31 Valid for the entire period	Detailed information for exchanges
Synonym	None	Selected impact assessment results
ISIC 4 classification	2029: Manufacture of other chemical products n.e.c.	Sources
Reference product	activated carbon, granular	Note: This document contains only an extract of the information in the dataset. Additional data about properties of exchanges, mathematical relations, parameters, and contact information for authors and reviewers are available in the full dataset, e.g. through the ecoinvent website.
OPC classification	35499: Other chemical products n.e.c.	Link to the dataset on the ecoinvent website
Dataset type	Ordinary transforming activity	
Technology level	Current	
Version - system mode	3.3 - cut-off	
<b>Dataset authorship</b>		
Role	Date	Name, organisation
Data generator	2015-12-09	Lucia Valzasina, ecoinvent Centre
Review	2015-12-09	Ivan Muñoz Ortiz, 2-0 LCA consultants
<b>Exchange summary</b>		
Back to table of content		
Reference product	Byproduct class	Amount
activated carbon, granular	allocatable product	1.0 kg
<b>Inputs from technosphere</b>		
electricity, medium voltage	Amount	1.84 kWh
hard coal	Amount	3.0 kg
heat, district or industrial, natural gas	Amount	13.3 MJ
industrial furnace, coal, 1-10MW	Amount	3.21e-8 unit
water, completely softened, from decarbonised water, at user	Amount	12.4 kg
<b>Inputs from technosphere, wastes*</b>		
hard coal ash	Amount	0.169 kg
<b>Emissions to air</b>		
Aluminium	Amount	8.18e-4 kg
Antimony	Amount	9.13e-8 kg
Arsenic	Amount	1.45e-6 kg
Barium	Amount	7.28e-6 kg
Benzene	Amount	2.89e-5 kg
Benzotrifluoride	Amount	5.78e-10 kg
Beryllium	Amount	7.28e-8 kg
Boron	Amount	2.74e-5 kg
Bromine	Amount	5.48e-7 kg
Cadmium	Amount	9.13e-8 kg
Calcium	Amount	7.28e-5 kg

page 1

Ecoinvent 3.3 dataset documentation	
activated carbon production, granular from hard coal - RER	
<div> <div> <b>Emissions to air</b> </div> <div> <b>Amount</b> </div> </div>	
Thorium-238	3.18e-4 MBq
Thorium-232	2.02e-4 MBq
Tin	3.65e-8 kg
Titanium	2.19e-5 kg
Toluene	5.78e-5 kg
Uranium	1.45e-7 kg
Uranium-238	5.78e-4 MBq
Vanadium	2.19e-5 kg
Water	1.87e-3 m3
Xylene	5.78e-6 kg
Zinc	1.89e-7 kg
<b>Emissions to water</b>	
Water	Amount
	0.0106 m3
*A negative input indicates a by-product output of waste.	
<b>Dataset description</b>	
Back to table of content	
<b>General comments</b>	
<p>This dataset represents the production of 1 kg of granular activated carbon (GAC) from hard coal. Hard coal produced GAC is typical for Central Europe. To produce GAC, hard coal undergoes carbonisation and partial gasification (activation). Hard coal is first heated to temperatures over 700 degrees Celsius. The activation stage, in this dataset, is achieved through vaporisation at temperatures between 800 and 1000 degrees Celsius. Activation is the key step in producing GAC. The main energy requirements are 1.6 kWh electricity and 0.33 m3 of natural gas to heat 12 kg of water. The main source of data is Bayer et al. (2005) "Economic and ecological comparison of granular activated carbon (GAC) adsorbent re-fill strategies" and Munoz et al. (2007) "Life-Cycle Assessment of a Coupled Advanced Oxidation-Biological Process for Wastewater Treatment: Comparison with Granular Activated Carbon Adsorption. Environmental Engineering Science, 24(5): 638-651."</p> <p>The result of this activity is 1 kg of activated carbon from 3 kg of hard coal. To include the emissions for the carbonization of 2 kg of hard coal, the datasets for "heat production, at hard coal industrial furnace 1-10MW, GLO 1992" was taken as a reference to model emissions and energy requirements. The original datasets represented: "the production of heat from a 1-10 MW hard coal industrial furnace filled with 1 MJ of egg coal. The stoker-boiler furnace fires egg coals with hard coal quality between long-flame coal and fat coal. As there is no module for egg coal, the hard coal supply mix is used. The lifetime of the furnace is 20 years, which corresponds to 5000 fully loaded hours per year. The heating value is 28.9 MJ/kg and the efficiency factor is 80%."</p>	
<b>Included activities start</b>	
From reception of hard coal.	
<b>Included activities ends</b>	
This activity ends with produced 1 kg of granular activated carbon from 3 kg of hard coal. The datasets includes electricity consumption, the burning of natural gas for the vaporisation of water, water and the emissions from hard coal combustion.	

page 3

Ecoinvent 3.3 dataset documentation	
treatment of spent activated carbon, granular from hard coal, reactivation - RoW	
<div> <div> <b>Extrapolations</b> </div> <div> <b>Technology comments</b> </div> </div>	
<p>Extrapolated from European dataset.</p> <p>Refer to: Bayer et al. 2005. Economic and ecological comparison of granular activated carbon (GAC) adsorbent re-fill strategies. Water research (39), 1719-1728.</p> <p>Refer to: Munoz et al. 2007. Life-Cycle Assessment of a Coupled Advanced Oxidation-Biological Process for Wastewater Treatment: Comparison with Granular Activated Carbon Adsorption. Environmental Engineering Science, 24(5), 638-651.</p>	
<b>Geography comments</b>	
GAC from hard coal is common practice in Central Europe (Bayer et al. 2005).	
<b>Detailed information for exchanges</b>	
Back to table of content	
Impact contribution legend: IPCC 2007 GWP100   ecoinvent 2013   ReCiPe AF   2016, relative to dataset total score	
Reference products	Annual prod. vol.   Amount
activated carbon, granular	7.05e+8 kg   1.0 kg
Comment: Literature value, Bayer et al. (2005) estimate 10% loss during reactivation.	
Source: Bayer 2005	
<b>Inputs from technosphere</b>	
electricity, medium voltage	Amount
	7.75e-3 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	0.033 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	7.45e-3 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	8.41e-3 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	0.281 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	0.031 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	0.152 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
electricity, medium voltage	Amount
	0.0852 kWh
The comment entered by the data provider is too long to be displayed. Please refer to ecoQuery or ecoditor for more details.	
hard coal ash	Amount
	-0.31e-3 kg
Activity link: market for hard coal ash - GLO	
Comment: Estimation. Stoker-boiler furnaces emit between 100kg and 1000kg of particles per Tj if there is no particle separation. With an average of 650kg per Tj, 100kg of fly ash and 230kg of bottom ash occurs. It is assumed that 100% of the ash is disposed (worst-case scenario), in individual cases a 100% recycling rate is possible as well. Amount was scaled to the amount of reference product.	
Production volume comment: Calculated from the production volume of the reference product in proportion to the respective output amounts.	
Uncertainty distribution: lognormal; GSD: 1.23; Pedigree matrix: [3, 1, 3, 3, 3]	
Source: Bayer 2005	

page 4



- Overview of the process
  - Quick list of inputs and putputs
- Background information
  - Authorship and sourcing
  - Process and product descriptions
  - Important background data
  - etc..

## Exchange summary

### General comments

This dataset represents production of 40-foot, high-cube ISO standard container.

The intermodal shipping containers are basically metal boxes which are used for storage and transport of goods. The advantage of using these containers is, that they can be easily transferred from one type of transport to another without the necessity of unloading the goods.

There are several types and sizes of the containers mainly related to the historical development of intermodal container transport in the given region. There is a continuous effort in the standardization of the container sizes. Below see the table of the different sizes of the intermodal shipping containers as defined by the ISO standard ISO 6346:1995, ISO 1161:1984, ISO 1496-1:2013).

		20' container		40' container		40' high-cube container		45' high-cube container	
		imperial	metric	imperial	metric	imperial	metric	imperial	metric
external dimensions	length	19' 10 1/2"	6.058 m	40' 0"	12.192 m	40' 0"	12.192 m	45' 0"	13.716 m
	width	8' 0"	2.438 m	8' 0"	2.438 m	8' 0"	2.438 m	8' 0"	2.438 m
	height	8' 6"	2.591 m	8' 6"	2.591 m	9' 6"	2.896 m	9' 6"	2.896 m
interior dimensions	length	18' 8 13/16"	5.710 m	39' 5 13/16"	12.032 m	39' 4"	12.000 m	44' 4"	13.556 m
	width	7' 8 13/16"	2.352 m	7' 8 13/16"	2.352 m	7' 7"	2.311 m	7' 8 13/16"	2.352 m
	height	7' 9 17/16"	2.385 m	7' 9 17/16"	2.385 m	8' 9"	2.650 m	8' 9 17/16"	2.699 m
door aperture	width	7' 8 1/4"	2.343 m	7' 8 1/4"	2.343 m	7' 6"	2.280 m	7' 8 1/4"	2.343 m
	height	7' 5 1/4"	2.280 m	7' 5 1/4"	2.280 m	8' 5"	2.560 m	8' 5 1/4"	2.585 m
internal volume		1,169 ft³	33.1 m³	2,385 ft³	67.5 m³	2,660 ft³	75.3 m³	3,040 ft³	86.1 m³
maximum gross weight		66,139 lb	30,400 kg	66,139 lb	30,400 kg	68,008 lb	30,848 kg	66,139 lb	30,400 kg
empty weight		4,850 lb	2,200 kg	8,380 lb	3,800 kg	8,598 lb	3,900 kg	10,580 lb	4,800 kg
net load		61,289 lb	28,200 kg	57,759 lb	26,600 kg	59,410 lb	26,948 kg	55,559 lb	25,600 kg

The container is designed and constructed for the transportation of general cargo on sea (above and under deck) and on land (road or rail) throughout the world, and will be suitable for the environmental conditions imposed by those modes of transport. All materials used in the construction are able to withstand extreme temperature ranging from -40°C to 70°C without effect on container's strength and water tightness.



- Individual exchange information
  - Author comments
  - Uncertainty and quality
  - Contributions to environmental impacts
- Selected LCIA results

## Detailed information for exchanges

[Back to table of content](#)

**Impact contribution legend:** IPCC 2007 GWP100 | ecoscarcity 2013 total | ReCiPe H total, relative to dataset total score

Reference product	Annual prod.vol.	Amount
intermodal shipping container, 40-foot, high-cube	2.64e+5 unit	1.0 unit
<b>Comment:</b> Standard 40-foot, high-cube intermodal shipping container. External dimensions; length - 12.192 m, width - 2.438 m and height - 2.896 m. Interior dimensions: length - 12.000 m, width - 2.311 m and height - 2.2.650 m. Internal volume: 75.3 m3. Maximum gross weight: 30.848 tons. Empty weight: 3.9 tons. Net load: 26.58 tons.		
<b>Production volume comment:</b> Calculated value. 1.6 million TEU (Twenty-foot Equivalent unit) is newly added to the total capacity of shipping containers in the world (World Shipping Council, <a href="http://www.worldshipping.org/about-the-industry/containers/global-container-fleet">http://www.worldshipping.org/about-the-industry/containers/global-container-fleet</a> , accessed 20141014). Out of that 33% is 40-foot, high-cube containers (Containerization International Market Analysis, World Container Census 2008, <a href="http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/containerfleet.html">http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/containerfleet.html</a> , accessed 20141014).		
Inputs from technosphere	Amount impact contributions	
building, hall	0.0163 m2	
	<0.1%   <0.1%   <0.1%	
<b>Activity link:</b> market for building, hall - GLO		
<b>Comment:</b> Calculated value based on estimates. 1m2 of hall is available every day for 50 years. 1 container occupies the area of its base		

## Selected impact assessment results

[Back to table of content](#)

method	category	indicator	score
IPCC 2007	climate change	GWP 100a	1.783e+4 kg CO2-Eq
IPCC 2013	climate change	GWP 100a	1.843e+4 kg CO2-Eq
ecological scarcity 2013	total	total	8.058e+7 UBP
USEtox	human toxicity	carcinogenic	0.01033 CTU
USEtox	human toxicity	non-carcinogenic	0.03794 CTU

# Core aspects of ecoinvent v3



- How datasets are named and grouped
- Market datasets
- System models in version 3

- While version 2 had **Processes**, version 3 is organized in **Activities** and **Products**

lime production,  
hydraulic / CH

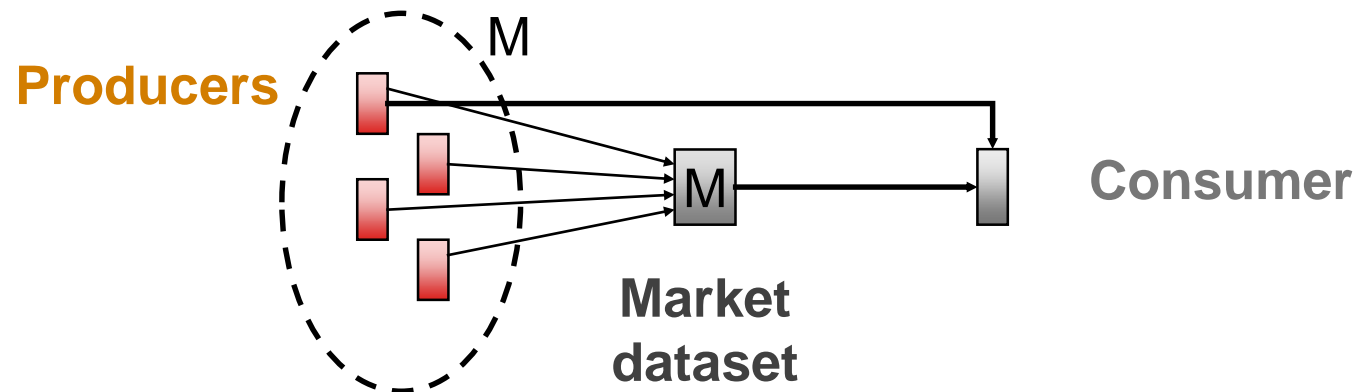
→lime, hydraulic

lime, hydraulic,  
at plant / CH

→lime, hydraulic, at  
plant / CH

- Users can search activities and products separately
- All activities with the same product can easily be identified
- Classifications provide additional structure

- Separation of product and activity names
  - More than one activity can produce the same product
- **Market datasets** are available for all products
- Markets describe the **consumption mix** for a product and region





- **Market datasets** provide convenient input mixes of a product for a region
- **Additional information** is included
  - Transport
  - Losses during transport
  - ...

# The choice remains

- As user, you can always choose between the supplying activities and the consumption mix

Search: <input type="text" value="barley grain"/>						
#		Name	Reference Product	Loc.	Time Period	S
6	<input type="checkbox"/>	barley production	barley grain [kg]	DE	01.01.2000 - 31.12.2004	
7	<input type="checkbox"/>	barley production	barley grain [kg]	ES	01.01.2000 - 31.12.2004	
8	<input type="checkbox"/>	barley production	barley grain [kg]	FR	01.01.2000 - 31.12.2004	
9	<input type="checkbox"/>	barley production	barley grain [kg]	GLO	01.01.2000 - 31.12.2004	
16	<input type="checkbox"/>	market for barley grain	barley grain [kg]	GLO	01.01.2011 - 31.12.2011	

<https://ecoquery.ecoinvent.org>

- 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

- Allocation at the point of substitution
- Allocation, Recycled Content cut-off
- Consequential (long-term, small-scale)
- Other models are possible
  - Different End of Life approaches
  - Integration with specific standards
  - ...

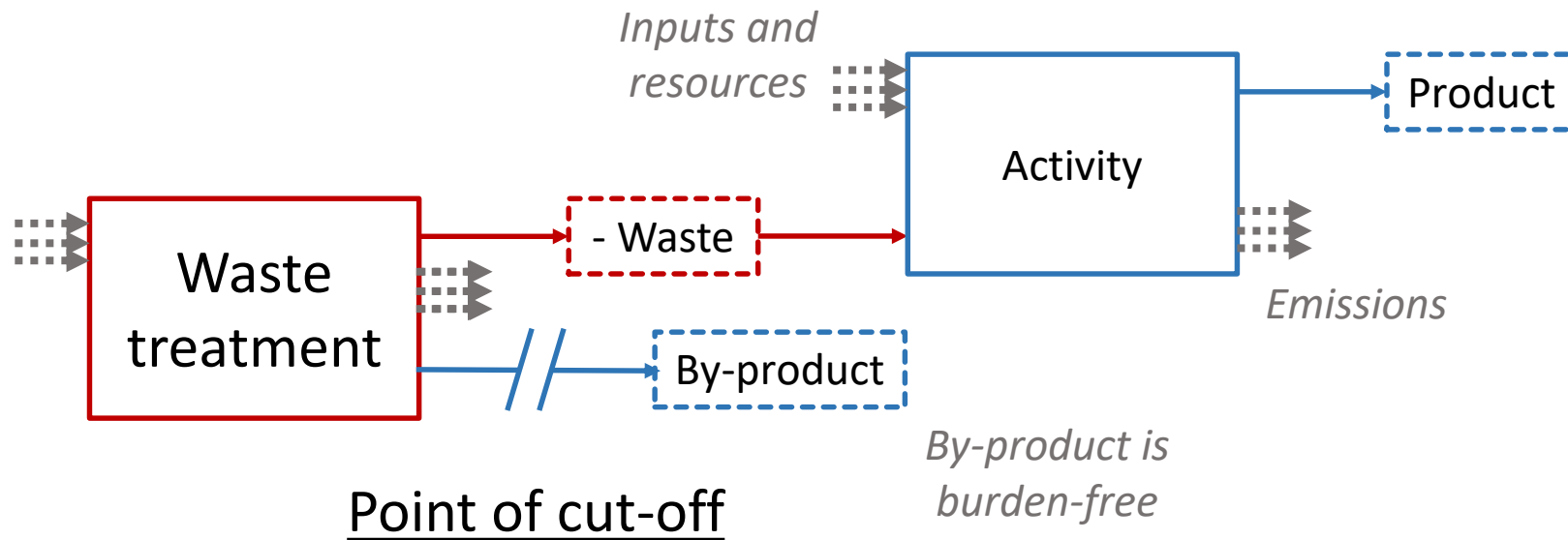
- Modeling approach of older ecoinvent versions
- Based on a **product-level** classification
  - *Ordinary, allocatable by-products*
  - *Recyclable materials*
  - *Wastes*
  - All products are **classified consistently** throughout the database

- Fundamental concept:
  - **No credit** for recycling or waste treatment by-products
  - **Full burdens** for waste treatment, but **no burdens** for recycling
- Creates a **cut** between the primary and secondary use phases
- Consequence: Burden of **primary production** is completely with the **first use** of the product
  - Use of recycled products is encouraged
  - Waste treatment with beneficial by-products is **not** encouraged

- Ordinary by-products
  - Allocated directly
  - Most products in the database
  - Allocated according to values chosen by the data provider to reflect the ISO hierarchy

# Recycled content cut-off

- Wastes

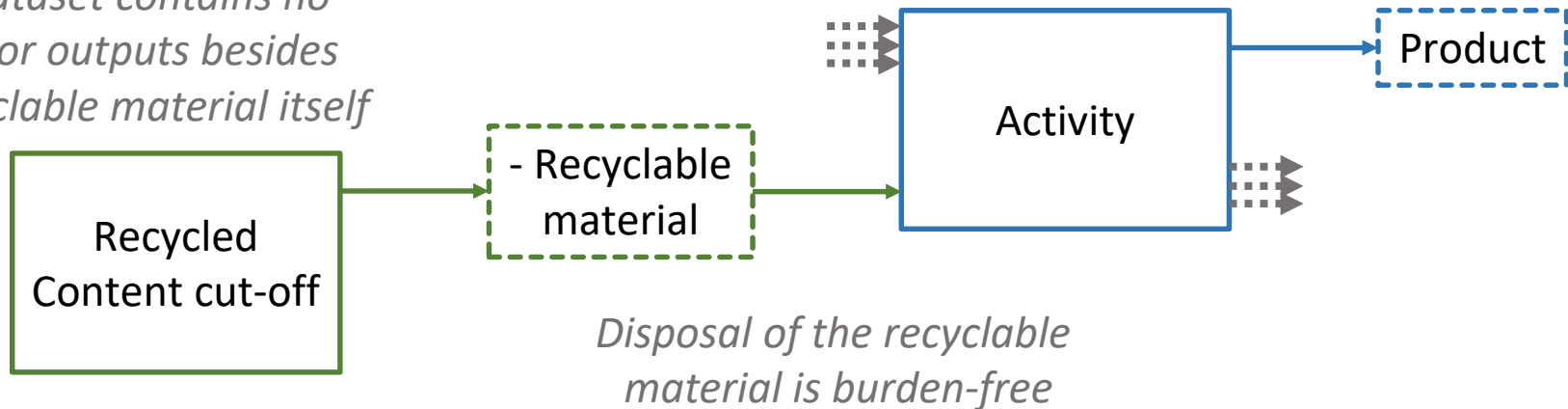




# Recycled content cut-off

- Recyclable Materials

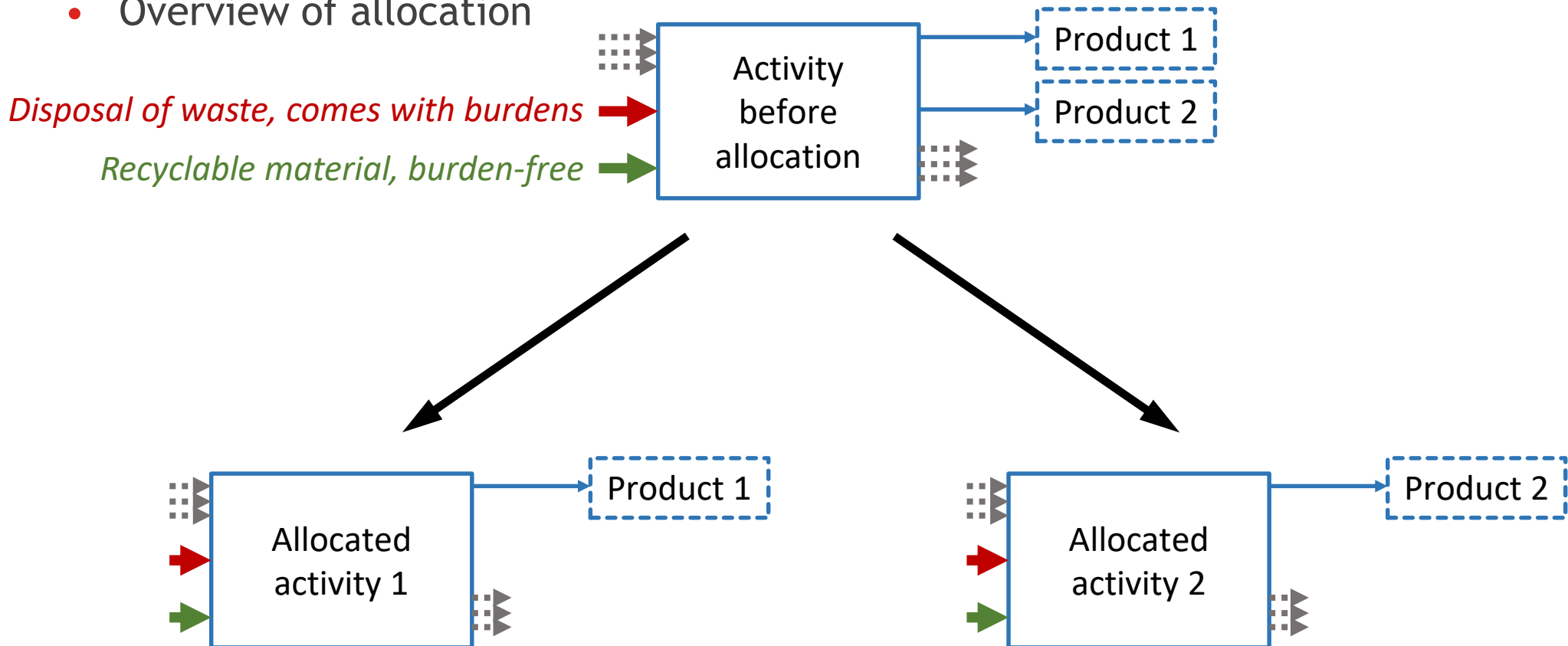
*This dataset contains no inputs or outputs besides the recyclable material itself*



Point of cut-off

# Recycled content cut-off

- Overview of allocation



# Recycled content cut-off



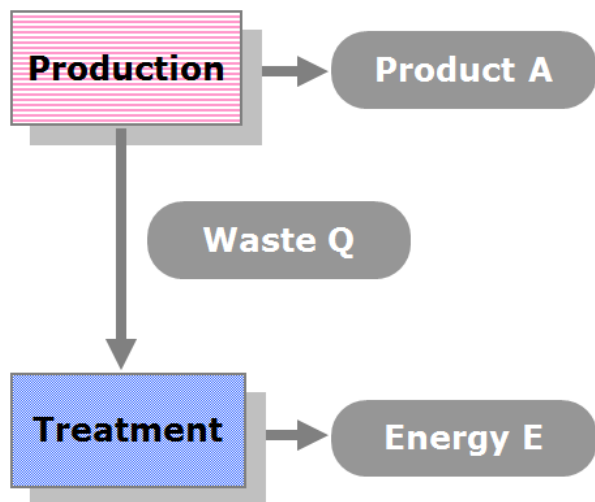
- Consistent separation of first and secondary uses based on the product classification
- Flexible application through product choice
- Simple allocation process to follow and reproduce
- Clear datasets to modify or adapt

# Allocation at the point of substitution

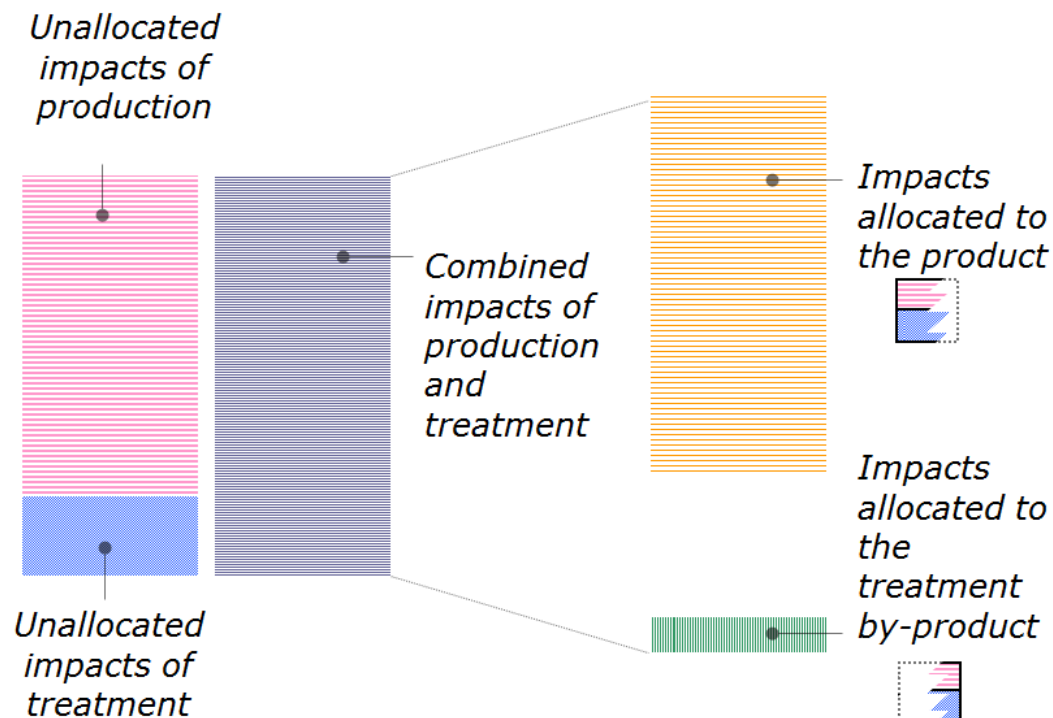
- Physical allocation where possible, otherwise **allocation at the point of substitution**
- The **point of substitution** is the point where a recycling/treatment process results in a **marketable product** (i.e. a good produced purely for economic gain)
  - At this point economic allocation is feasible

# Allocation at the point of substitution

## Process scheme



## Allocation at the point of substitution in ecoinvent v3

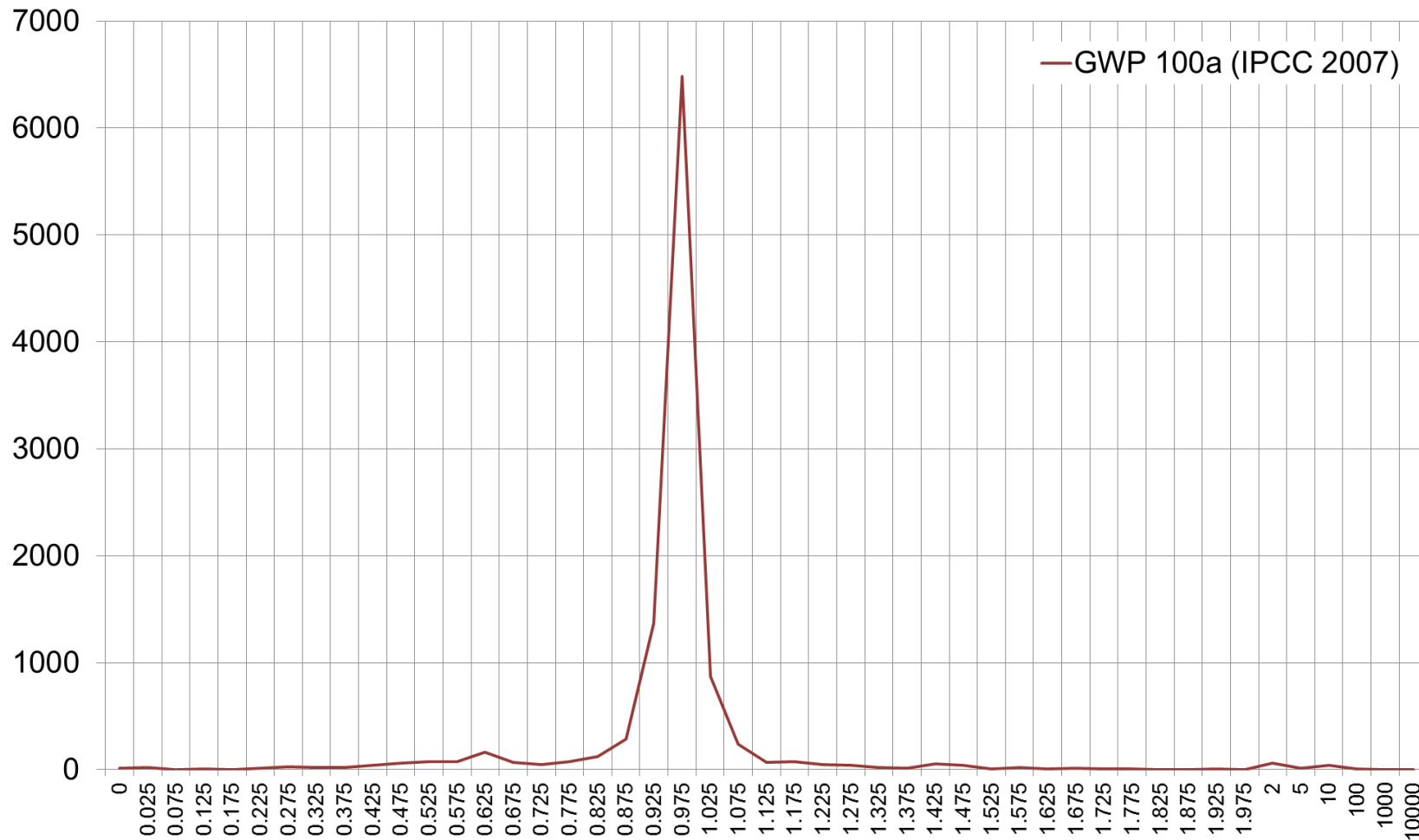


Graph: G. Doka

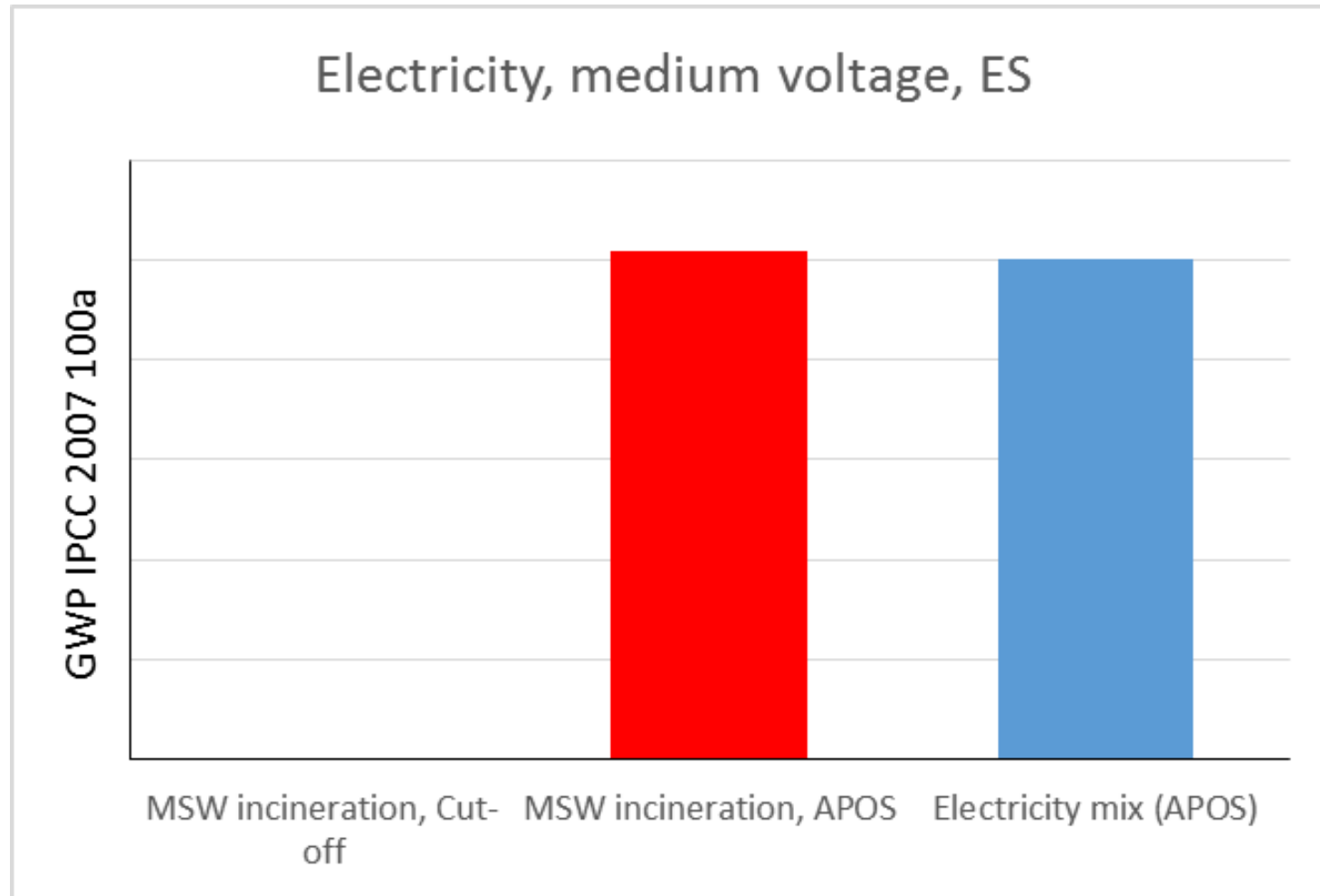
# Cut-off vs APOS

- Difference in allocation of **wastes treatment products** and **recyclable materials**
  - No other differences in the models
- Differences **only for these products**
  - Few wastes have significant by-products in treatment

# Cut-off vs APOS

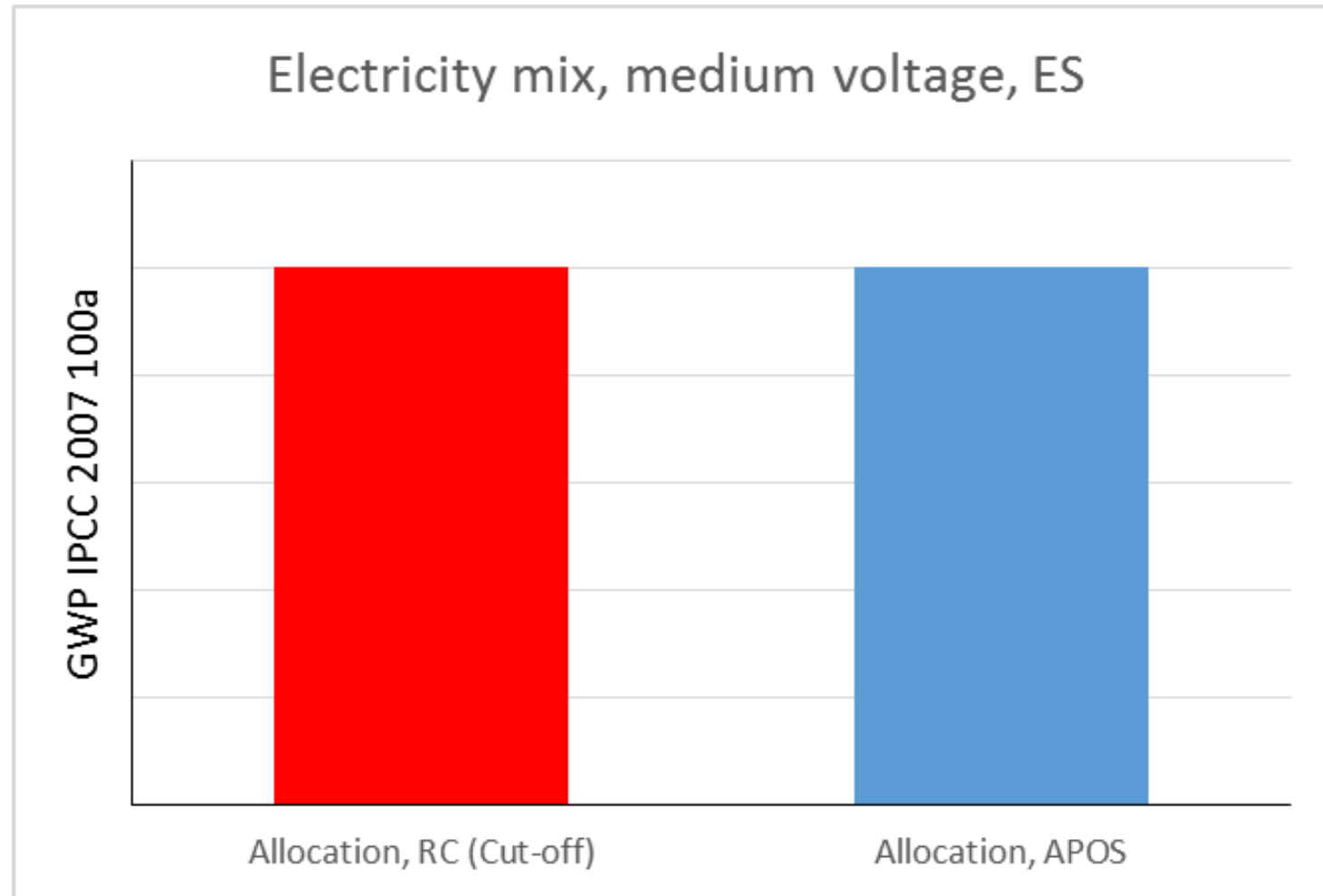


# Cut-off vs APOS

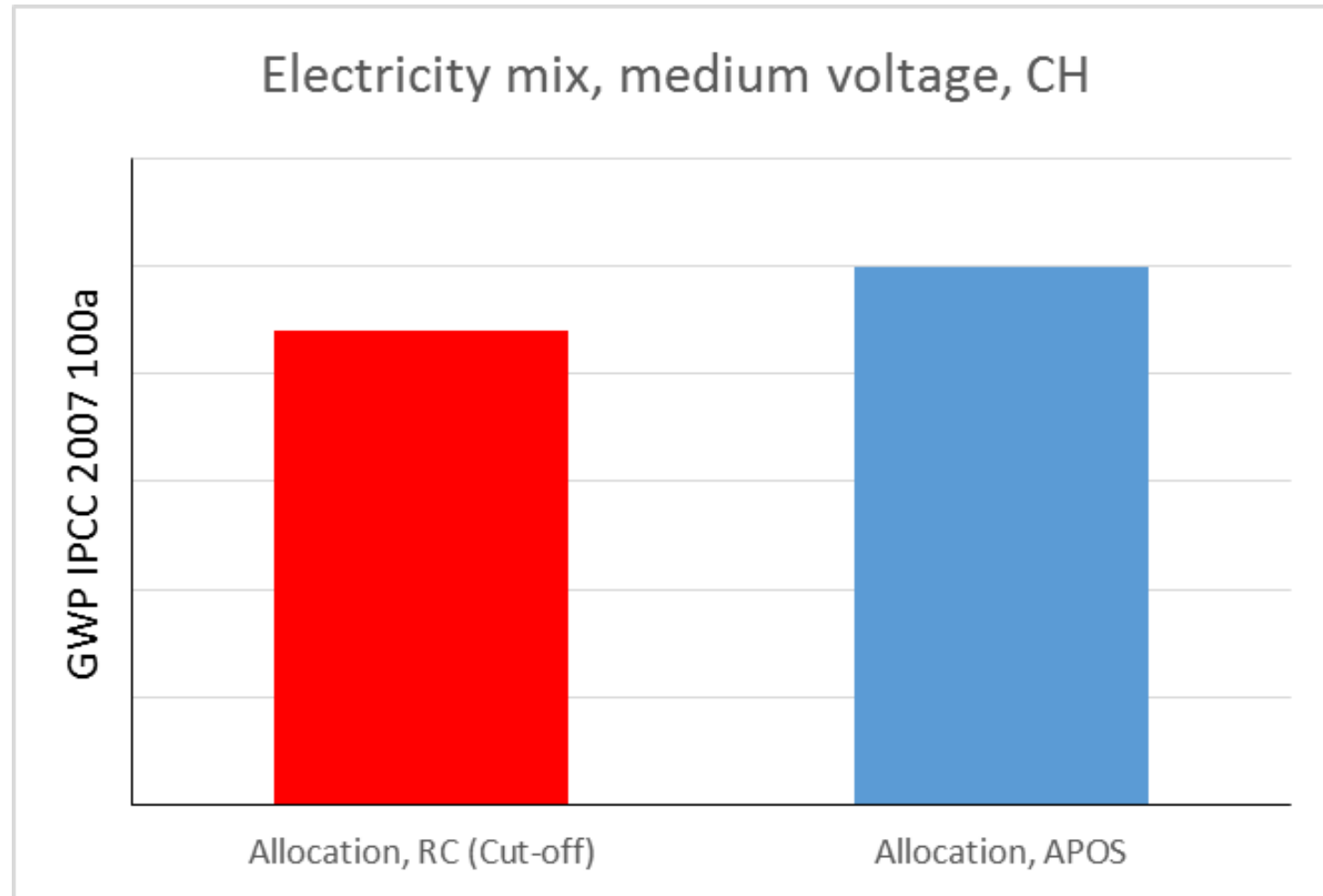




# Cut-off vs APOS



# Cut-off vs APOS



# Cut-off vs APOS

- Slightly **lower impacts** for most products in the database in **APOS**
- **Non-zero impacts** for products no longer cut off
- Impacts are **shifted** between products, but of course not created or removed
- Two available system models allow a **sensitivity analysis** in cases where recycling or cut materials are important

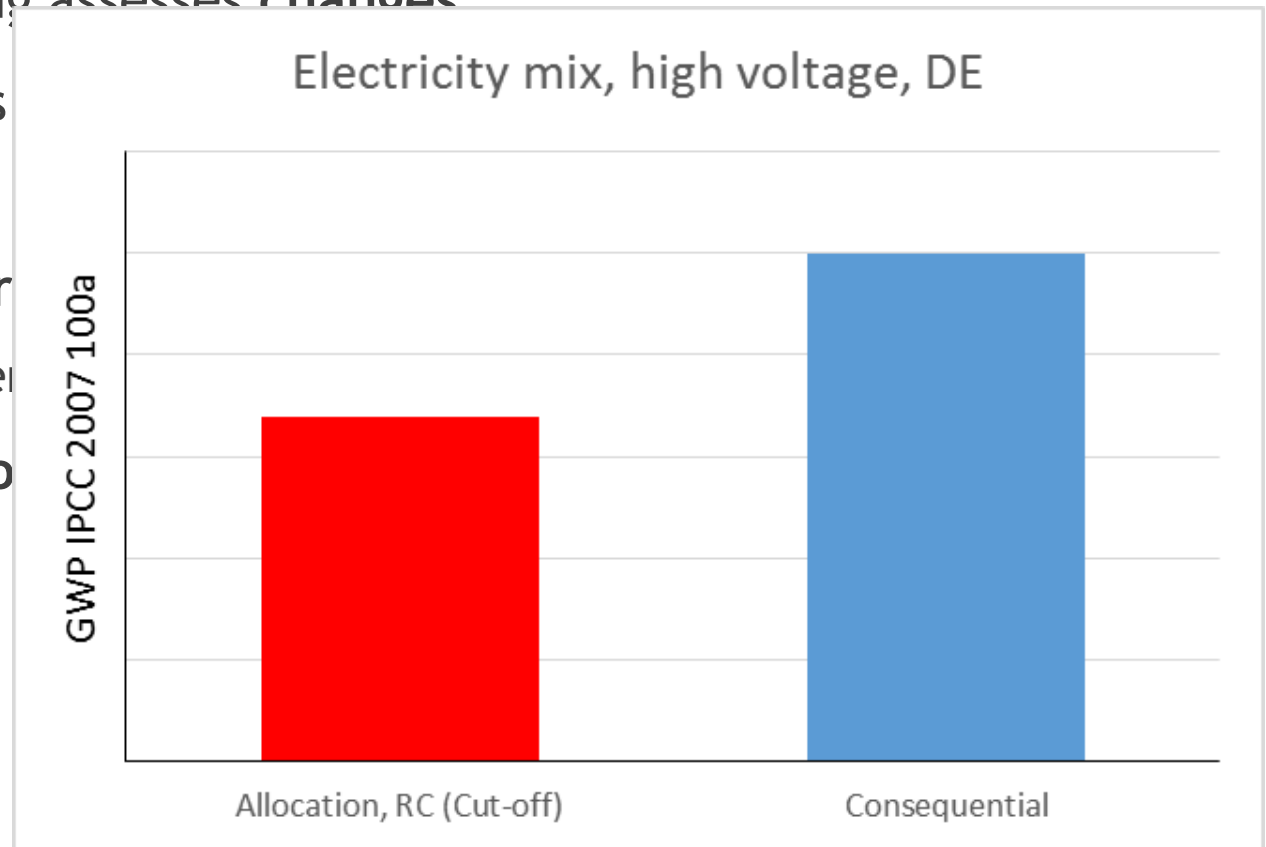
# Attributional vs Consequential

- Consequential modelling assesses changes

- Use of **Substitution** has significant by-products

- Consequential uses market prices
  - may be an improvement

- **Consumption of by-products** in consequential



# Procedure of datasets submission

## The main steps



### 1) Data collection and dataset generation

- **Data providers** collect the data and organise them into datasets
- The **ecoinvent team** provides technical support to the **data providers**, e.g. on connections to other sectors

### 2) Dataset review and correction

- The **ecoinvent team** reviews the datasets for consistency and technical quality
- **Editors** review the datasets
- **Data providers** and **reviewers** discuss and implement revisions if needed

# Procedure of datasets submission

## The main steps



### 3) Further review before publishing

- The **ecoinvent team** provides calculated LCIA results and full supply chain data to both the **data provider** and the **editor** for review
- **Data providers** and **editors** review the LCIA results and correct the datasets if necessary

### 4) After publication

- **Data providers** are listed as the data generator, with contact details if desired
- **Users** are encouraged to contact data providers with questions or comments

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



# Thank you for your attention!

# Why are v3 results different then?

- N
- C
- G
- C
- D

