Input-output modelling
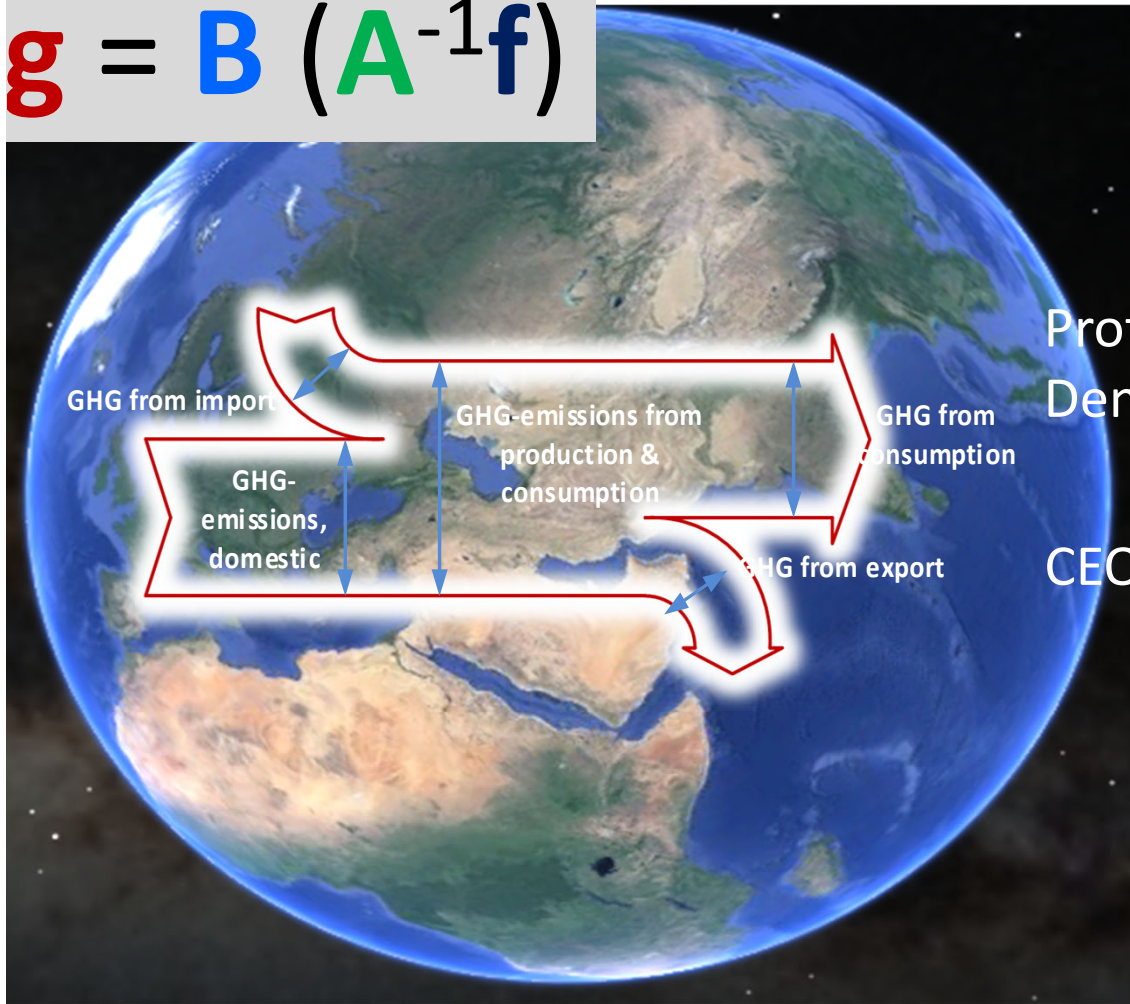
Disaggregating/detailing supply-use tables and IO models
Hybrid-LCA in practice – tips & tricks

$$g = B(A^{-1}f)$$

GHG from import

GHG-emissions from production & consumption

GHG from consumption

GHG-emissions, domestic

GHG from export

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DCEA | THE DANISH CENTRE FOR ENVIRONMENTAL ASSESSMENT

CEO, 2.-0 LCA consultants

LCA consultants

AALBORG UNIVERSITY
DENMARK

Agenda

- Disaggregating/detailing supply-use tables and IO models
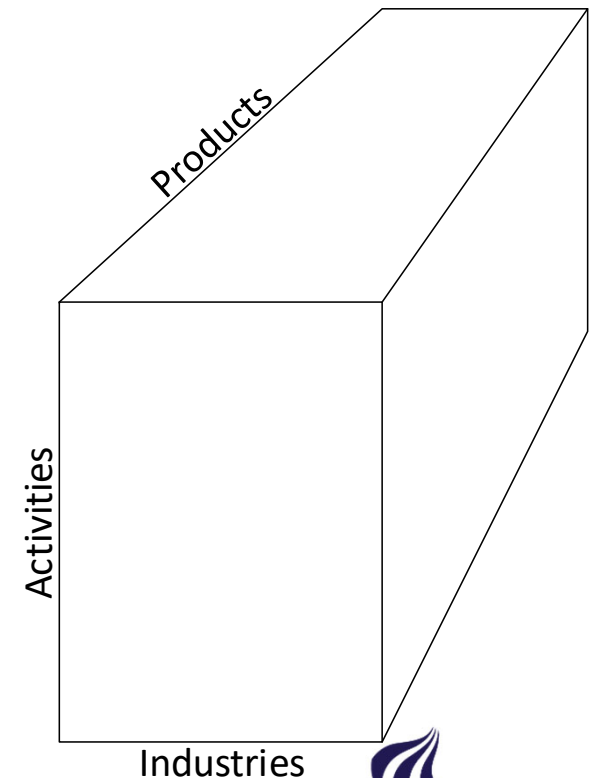- Hybrid LCA in practice – tips & tricks

Detailing aggregated SUTs

- Why disaggregate?
  - Large difference on products within products group ⇨ uncertainties in analysis.
  - Focus on special sector in industry, e.g. copper production in metals industry.
  - Most often IO-tables are blamed for being too aggregated for LCA purposes.
  - Recycling aggregated with virgin production.

Classification
- Challenges

- Comparing with LCA, typical industry classification systems have limitations:
  - Agriculture: Farms are aggregated.
  - Waste treatment (incin, landfill): All fractions are aggregated.
  - Recycling: The service to recycle waste is classified based on the by-product from the recycling process.
  - Aggregation of recycling with virgin production
- Activity versus industry based classification
  - Analytical purposes versus accounting purposes
- How to solve the problem?
  - Make bridge to go from industries to activities
  - Bridge = Three dimensional SUTs

Products

Activities

Industries

Detailing aggregated SUTs

"Getting the Data Right"

⇨ ~2000 products and >200,000 datasets

https://www.en.plan.aau.dk/getting-the-data-right/

Ecoinvent (3100 products, 18,000 datasets)

Name
Apple {GLO}| production	Conseq, U
Aubergine {GLO}| production	Conseq, U
Avocado {GLO}| production	Conseq, U
Banana {GLO}| production	Conseq, U
Barley grain {DE}| barley production	Conseq, U
Barley grain {ES}| barley production	Conseq, U
Barley grain {FR}| barley production	Conseq, U
Barley grain {RoW}| barley production	Conseq, U
Barley grain, organic {CH}| barley production, organic	Conseq, U
Barley grain, organic {RoW}| barley production, organic	Conseq
Barley grain, Swiss integrated production {CH}| barley production
Barley grain, Swiss integrated production {CH}| barley production
Broccoli {GLO}| production	Conseq, U
Cabbage red {GLO}| production	Conseq, U
Cabbage white {GLO}| production	Conseq, U
Carrot {GLO}| 335 production	Conseq, U
Cauliflower {GLO}| production	Conseq, U
Celery {GLO}| 675 production	Conseq, U
Citrus {GLO}| production	Conseq, U
Coconut, husked {PH}| production	Conseq, U
Coconut, husked {RoW}| production	Conseq, U
Cucumber {GLO}| production	Conseq, U
Fava bean, organic {CH}| production	Conseq, U
Fava bean, organic {RoW}| production	Conseq, U
Fava bean, Swiss integrated production {CH}| fava bean product
Fava bean, Swiss integrated production {RoW}| fava bean produ
Fennel {GLO}| production	Conseq, U
Grape {GLO}| production	Conseq, U
Green asparagus {GLO}| production	Conseq, U
Green bell pepper {GLO}| production	Conseq, U
Iceberg lettuce {GLO}| production	Conseq, U
Kiwi {GLO}| production	Conseq, U
Lettuce {GLO}| 360 production	Conseq, U
Lettuce {GLO}| 361 production	Conseq, U
Maize grain {RoW}| production	Conseq, U
Maize grain {US}| production	Conseq, U

Exiobase (164 products, 16,000 datasets)

Name
EU27_NO __1 Cultivation of paddy rice
EU27_NO __2 Cultivation of wheat
EU27_NO __3 Cultivation of cereal grains nec
EU27_NO __4 Cultivation of vegetables, fruit, nuts
EU27_NO __5 Cultivation of oil seeds
EU27_NO __6 Cultivation of sugar cane, sugar beet
EU27_NO __7 Cultivation of plant-based fibers
EU27_NO __8 Cultivation of crops nec
EU27_NO __9 Cattle farming
EU27_NO _10 Pigs farming
EU27_NO _11 Poultry farming
EU27_NO _12 Meat animals nec
EU27_NO _13 Animal products nec
EU27_NO _14 Raw milk
EU27_NO _15 Wool, silk-worm cocoons
EU27_NO _16 Manure treatment (conventional), storage and land applic
EU27_NO _17 Manure treatment (biogas), storage and land application
EU27_NO _18 Forestry, logging and related service activities (02)
EU27_NO _19 Fishing, operating of fish hatcheries and fish farms; servi

Eurostat (60 products)

INDUSTRIES (NACE)	Agriculture, hunting and related service activities	Forestry, logging and related service activities			
			fishing		exclud survey
PRODUCTS (CPA)	01	02	05	10	11
	1	2	3	4	5
Products of agriculture, hunting	6 386	109	0	0	
Products of forestry, logging an	23	1 311	0	0	
Fish and other fishing products;	6	0	0	0	
Coal and lignite; peat	545	0	0	112	
Crude petroleum and natural ga	0	0	0	0	
Uranium and thorium ores	0	0	0	0	
Metal ores	132	0	0	4	24
Other mining and quarrying products

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Detailing aggregated SUTs
## - How can it be done?

- More detailed economic SUTs

  - Ex use US (600) to disaggregate Canada.

- Detailed economic satellite accounts

  - Ex AgriSAM to detail agr industry in Eurostat SUTs in Exiobase.

- Specific costs functions for detailed industries within industry group.

  - Ex Energy cost of alu and steel manufacturing.

- Engineering and physical coefficient information.

  - Ex LCI data for specific industries.

Agenda

- Disaggregating/detailing supply-use tables and IO models
- Hybrid LCA in practice – tips & tricks

Making new activities
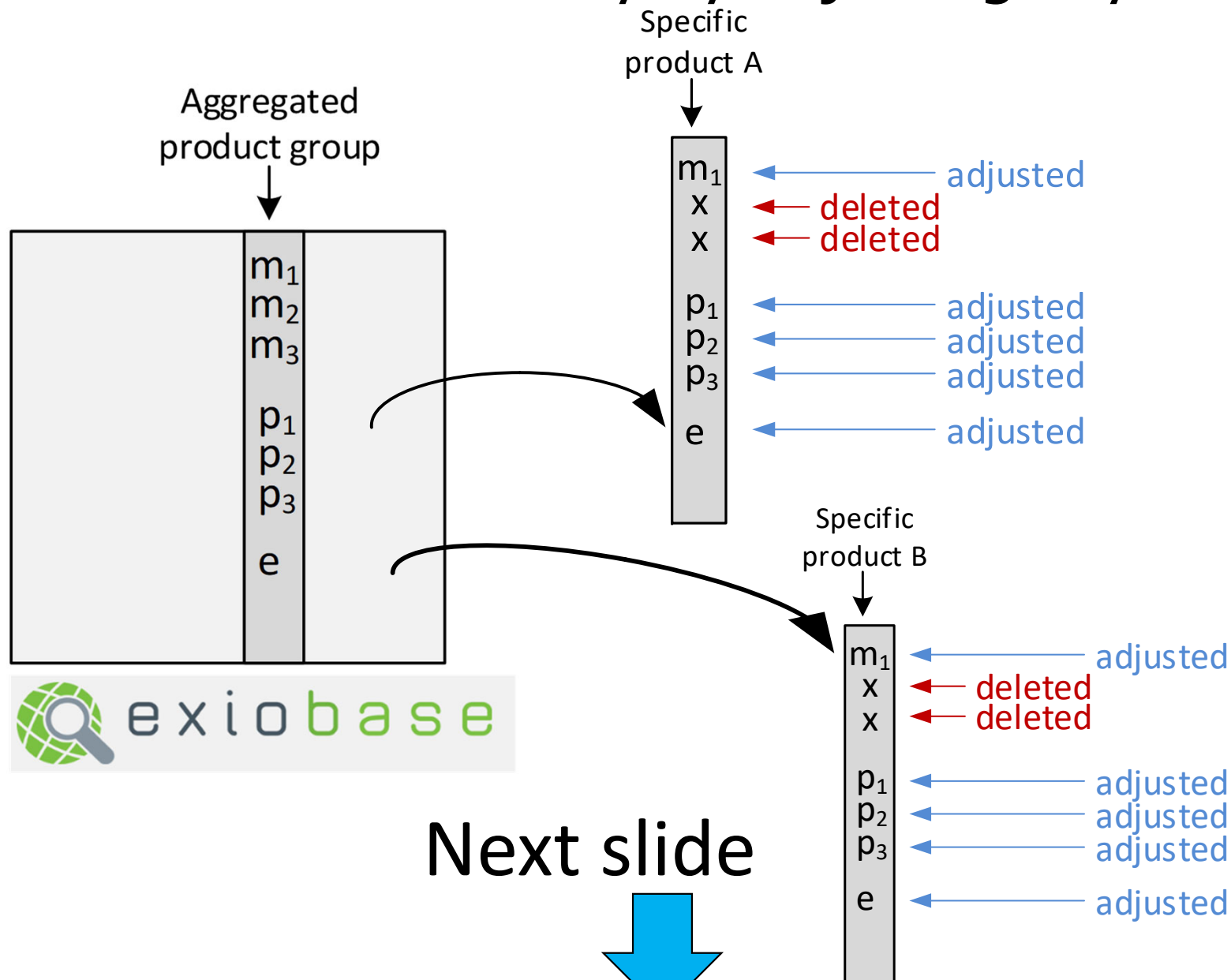## - Creation of IO-activity by adjusting key data inputs
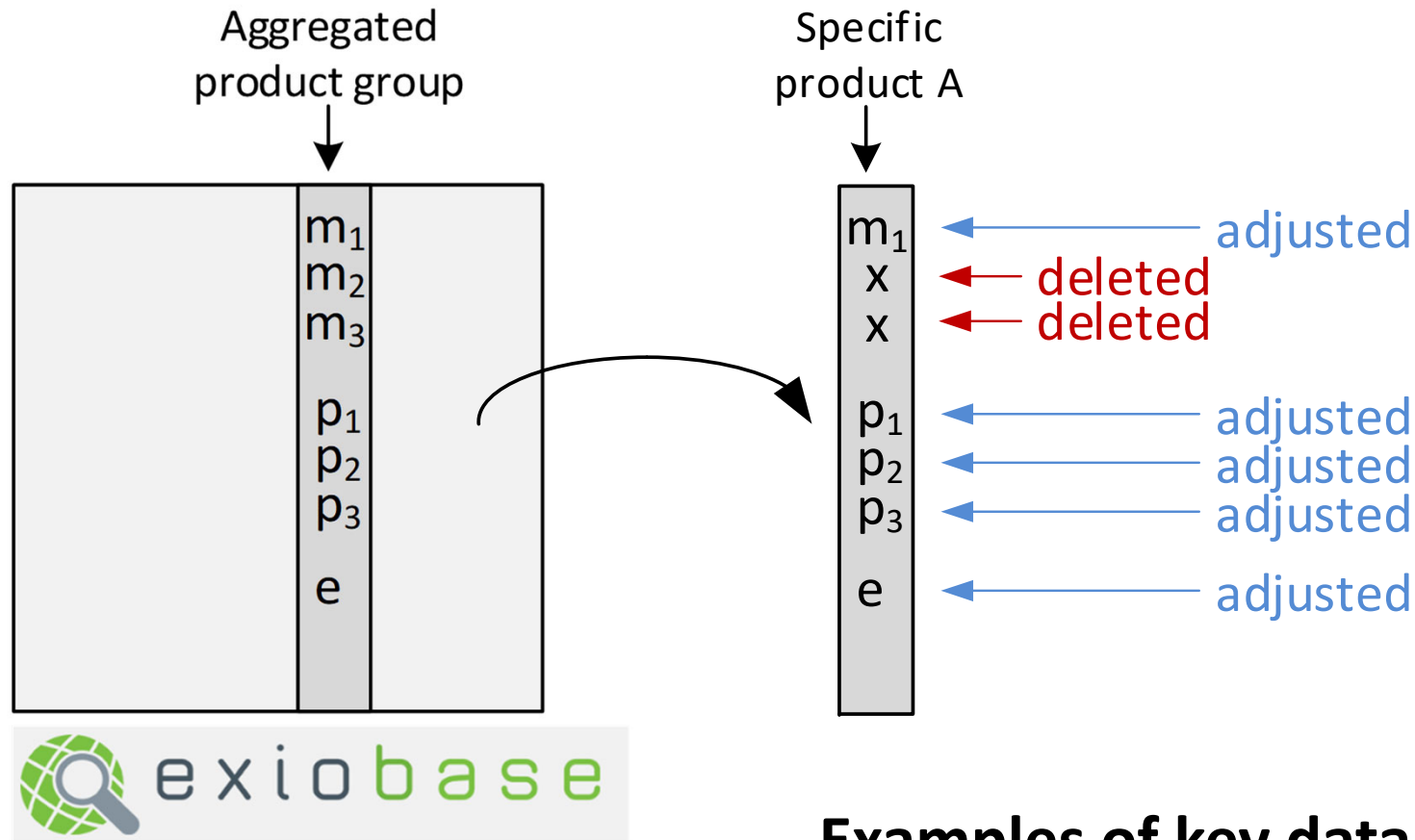
N.B. Remember emissions

Examples of key data points
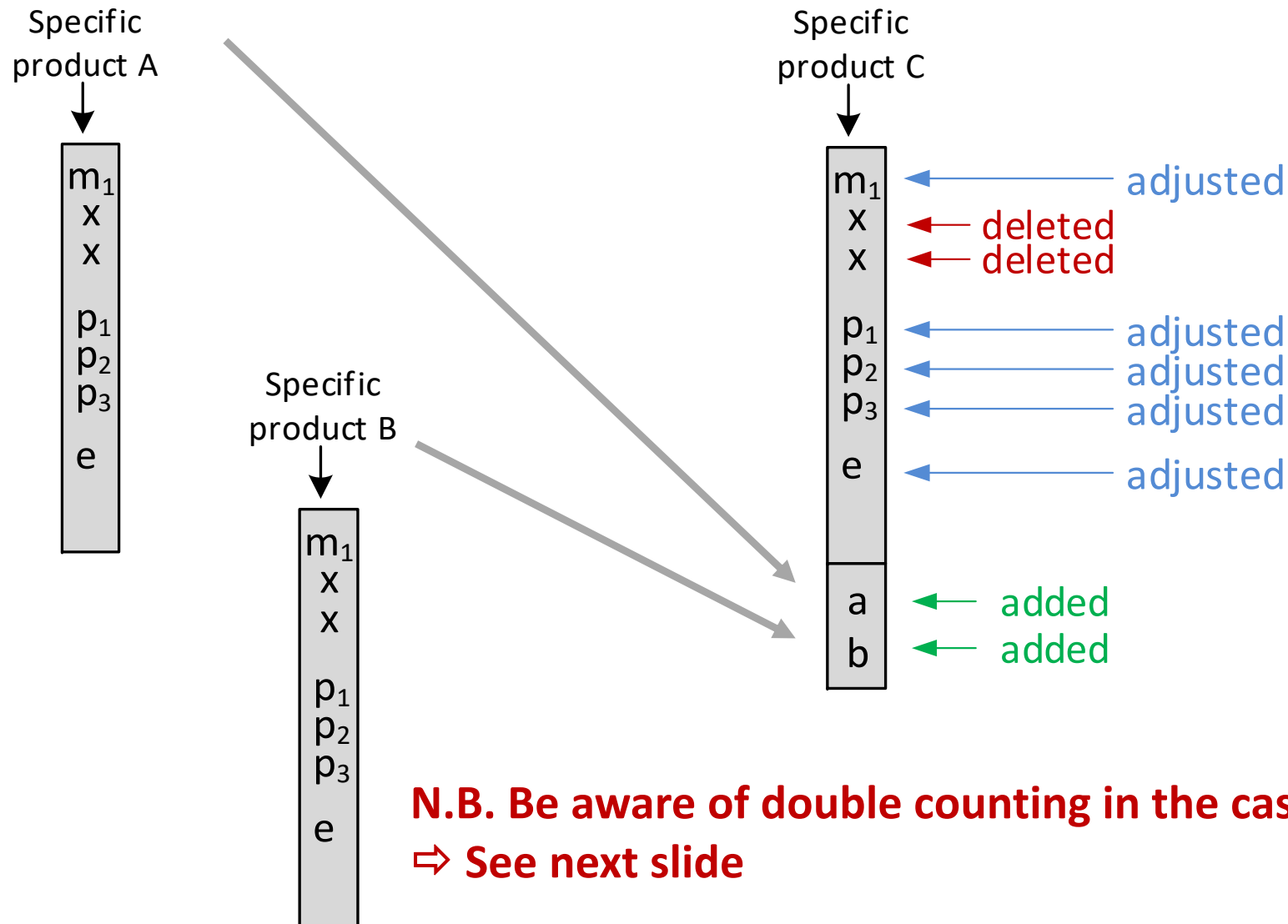
- Materials (m)
- Packaging (p)
- Energy (e)

Making more activities (1 of 2)
## - Creation of IO-activity by adjusting key data inputs

Making more activities (2 of 2)
- Creation of IO-activity by adjusting key data inputs

Specific product A

Specific product B

Specific product C

m_1 — adjusted
x — deleted
x — deleted
p_1 — adjusted
p_2 — adjusted
p_3 — adjusted
e — adjusted
a — added
b — added

N.B. Be aware of double counting in the case of internal flows
⇨ See next slide

How to handle a situation with several linked new activities

Aggregated product group

product b

copy

copy

product a

a

Double counting must be avoided
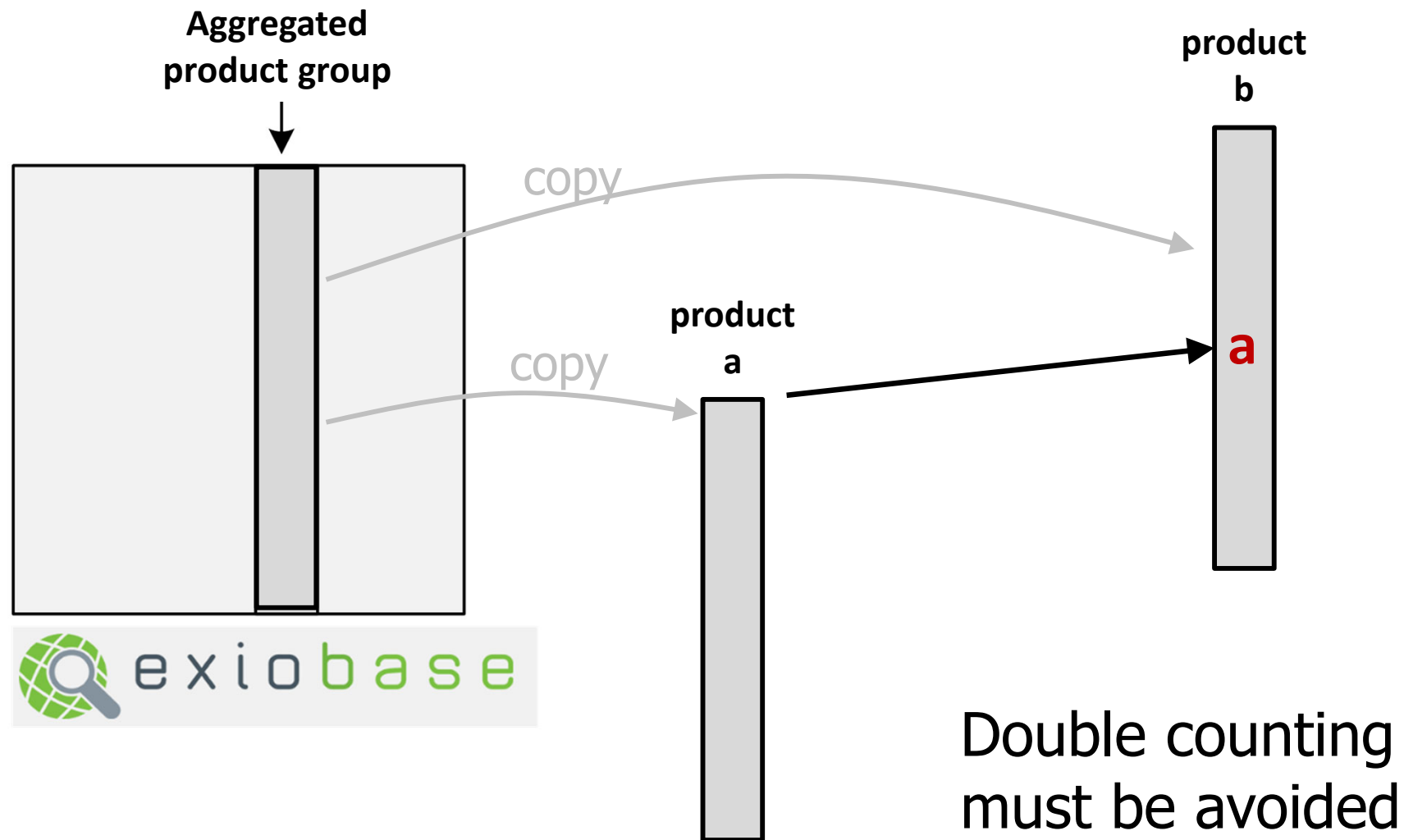
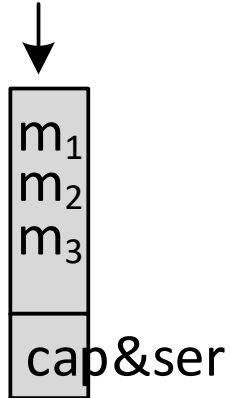Internally linked activities: Modify inputs (reduce proportionally to internal flow) to avoid double counting

Working in two tracks:
- Detailed foreground + rough of "the rest"
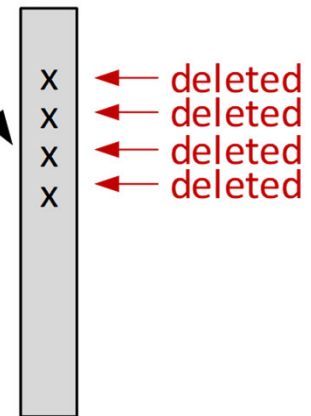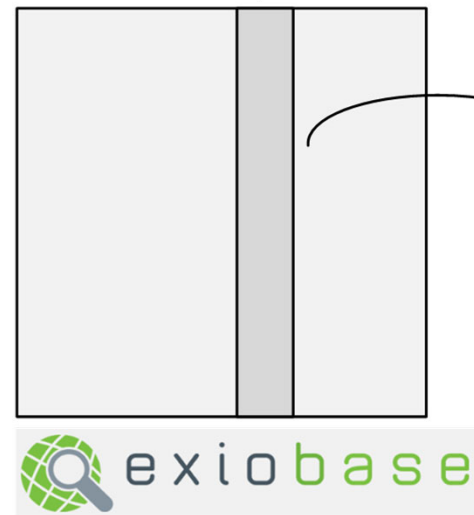
Detailed foreground

Rough of "the rest"

Product X

m_1
m_2
m_3

cap&ser

Aggregated product group

Capital goods and services

x ← deleted
x ← deleted
x ← deleted
x ← deleted
x

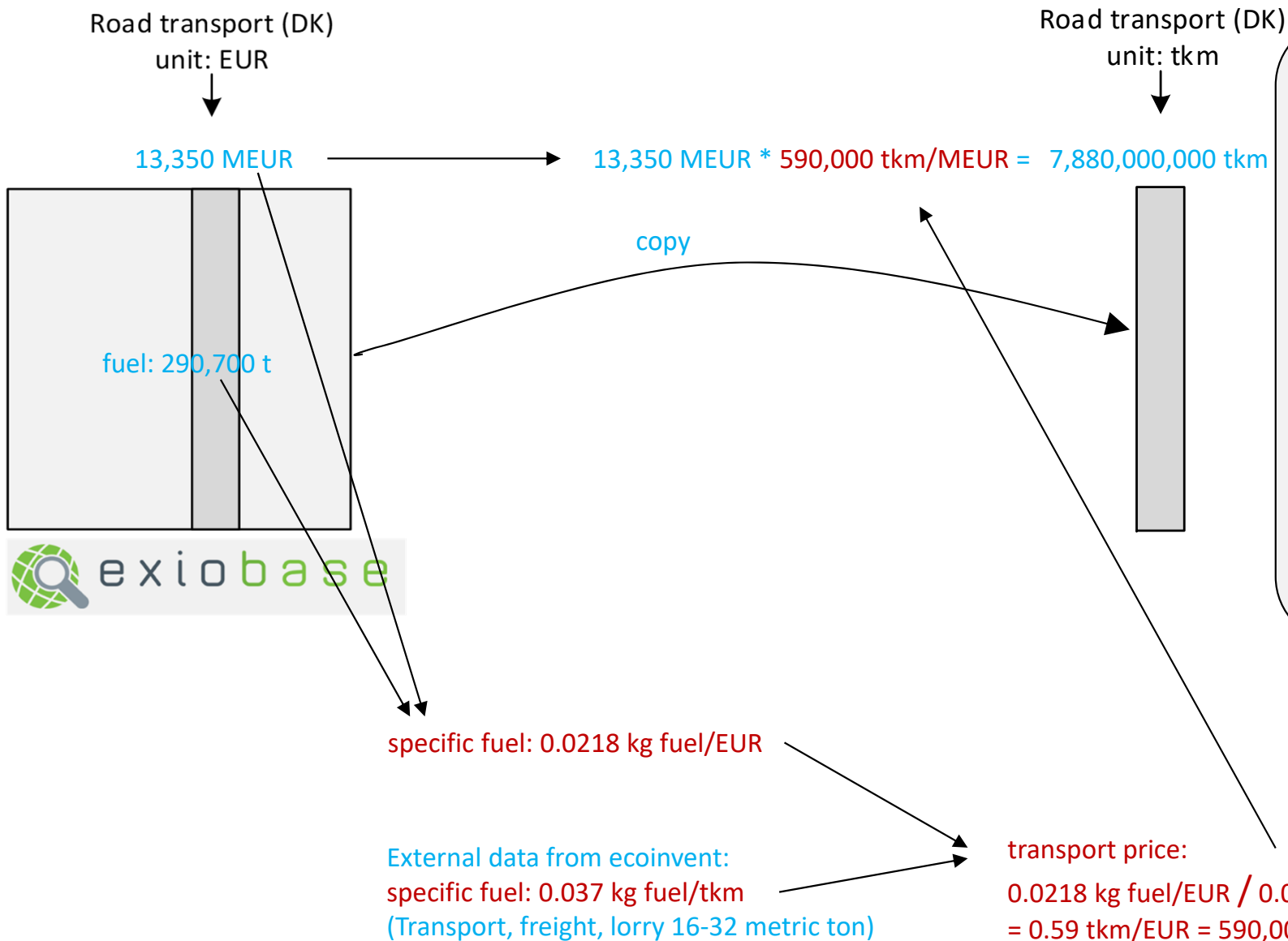exiobase

N.B. Be aware of double counting for "the rest"

Making transport datasets:
- Changing unit from EUR to tkm

Road transport (DK)
unit: EUR

Road transport (DK)
unit: tkm

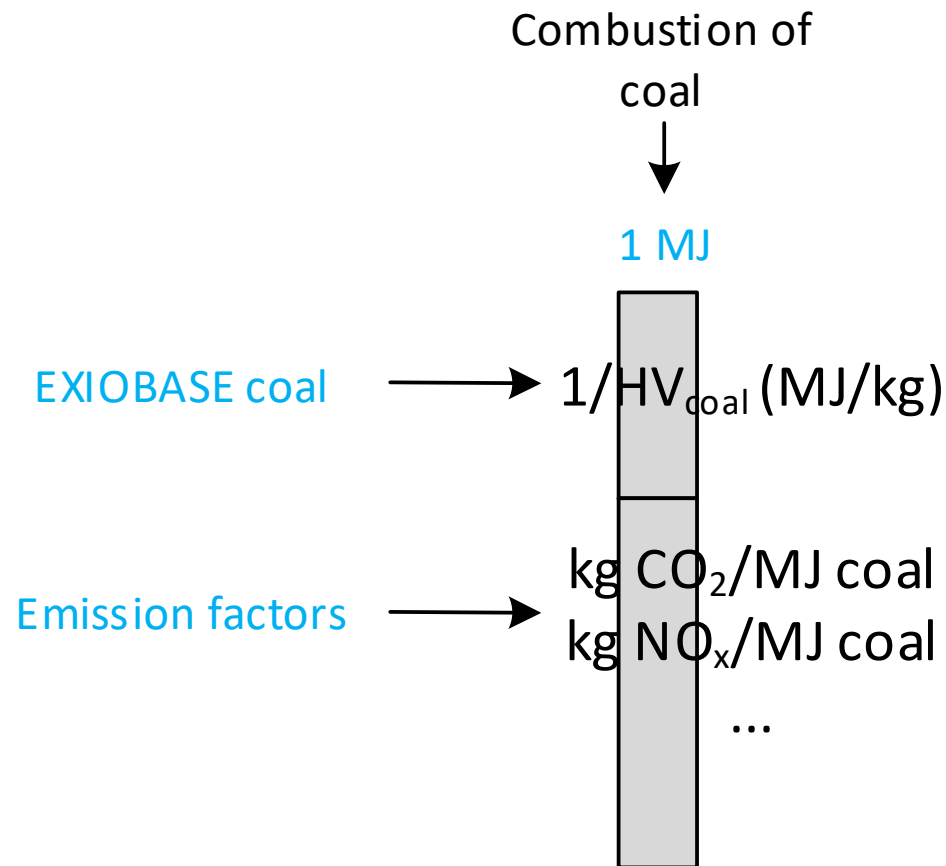13,350 MEUR → 13,350 MEUR * 590,000 tkm/MEUR = 7,880,000,000 tkm

copy

fuel: 290,700 t

exiobase

Note: Road transport in EXIO has inputs of ship transport => logistics companies sell full logistics services. Hence, they sell more than road transport. Therefore inputs of e.g. ship transport needs to be deleted.

specific fuel: 0.0218 kg fuel/EUR

External data from ecoinvent:
specific fuel: 0.037 kg fuel/tkm
(Transport, freight, lorry 16-32 metric ton)

transport price:
0.0218 kg fuel/EUR / 0.037 kg fuel/tkm
= 0.59 tkm/EUR = 590,000 tkm/MEUR

Making combustion datasets:
- Adding emissions

Combustion of
coal

↓

1 MJ

EXIOBASE coal ⟶ $1/HV_{coal}$ (MJ/kg)

Emission factors ⟶ kg CO_2/MJ coal
kg NO_x/MJ coal
...

... if you want to know more

- The International Life Cycle Academy (https://ilca.es/)
- Consequential LCA (https://consequential-lca.org/)