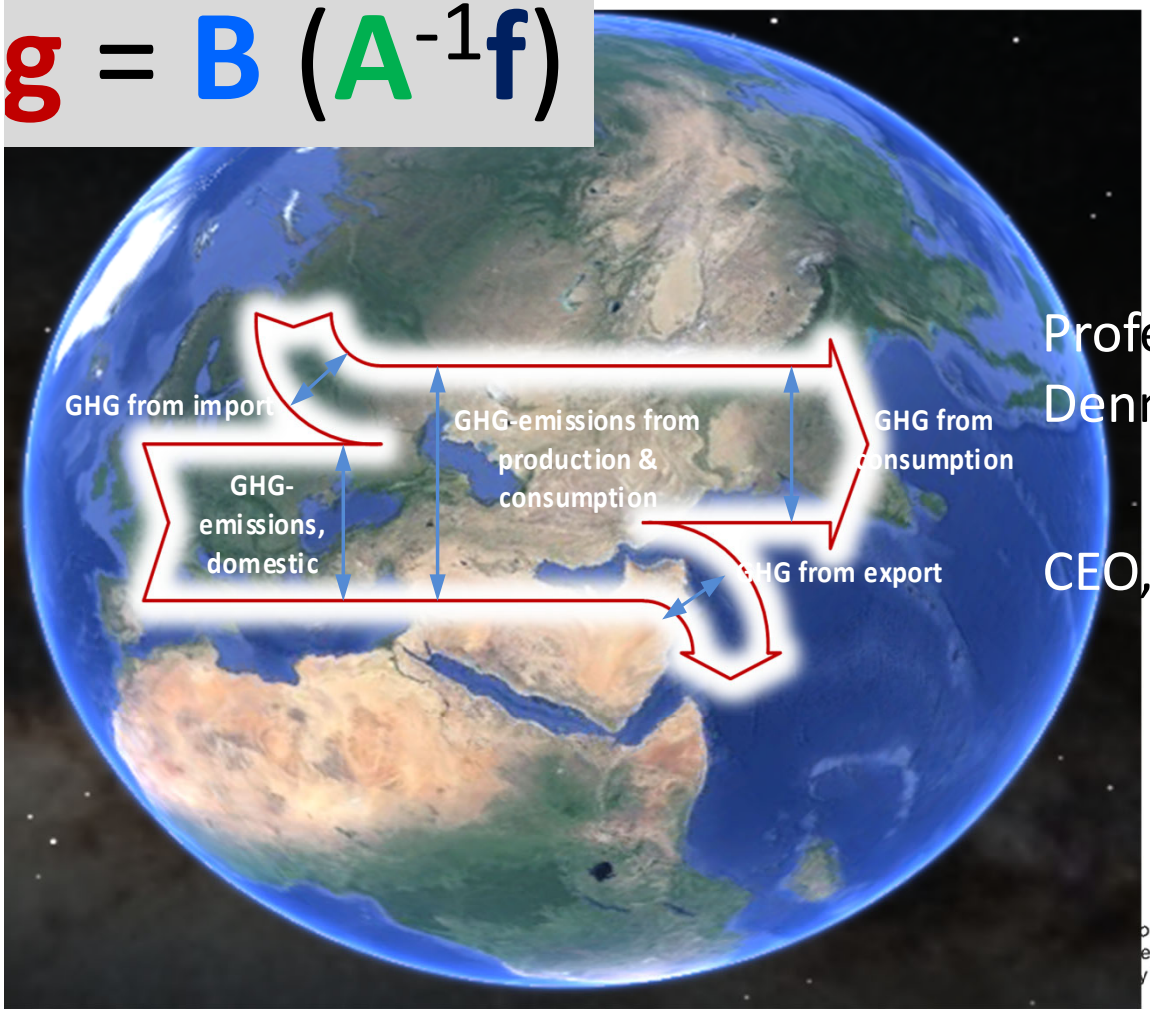
Input-output modelling

Consequential modelling in an IO database

Example of electricity markets

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



Jannick Schmidt

Professor, PhD, Aalborg University, Denmark

DCEA | THE DANISH CENTRE FOR ENVIRONMENTAL ASSESSMENT

CEO, 2.-0 LCA consultants

Updated: 28th April 2022

Agenda

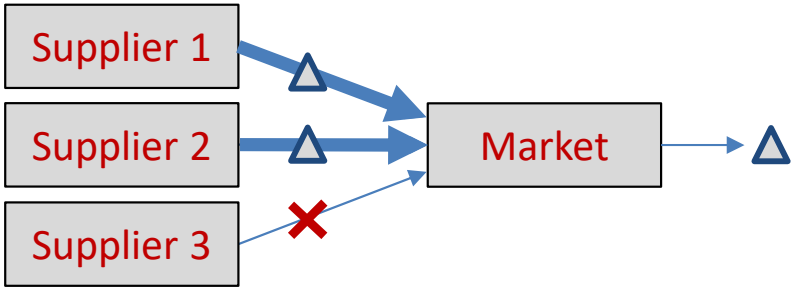
- Consequential modelling in an IO database
- Example of electricity markets

SUT framework for consequential modelling

Markets

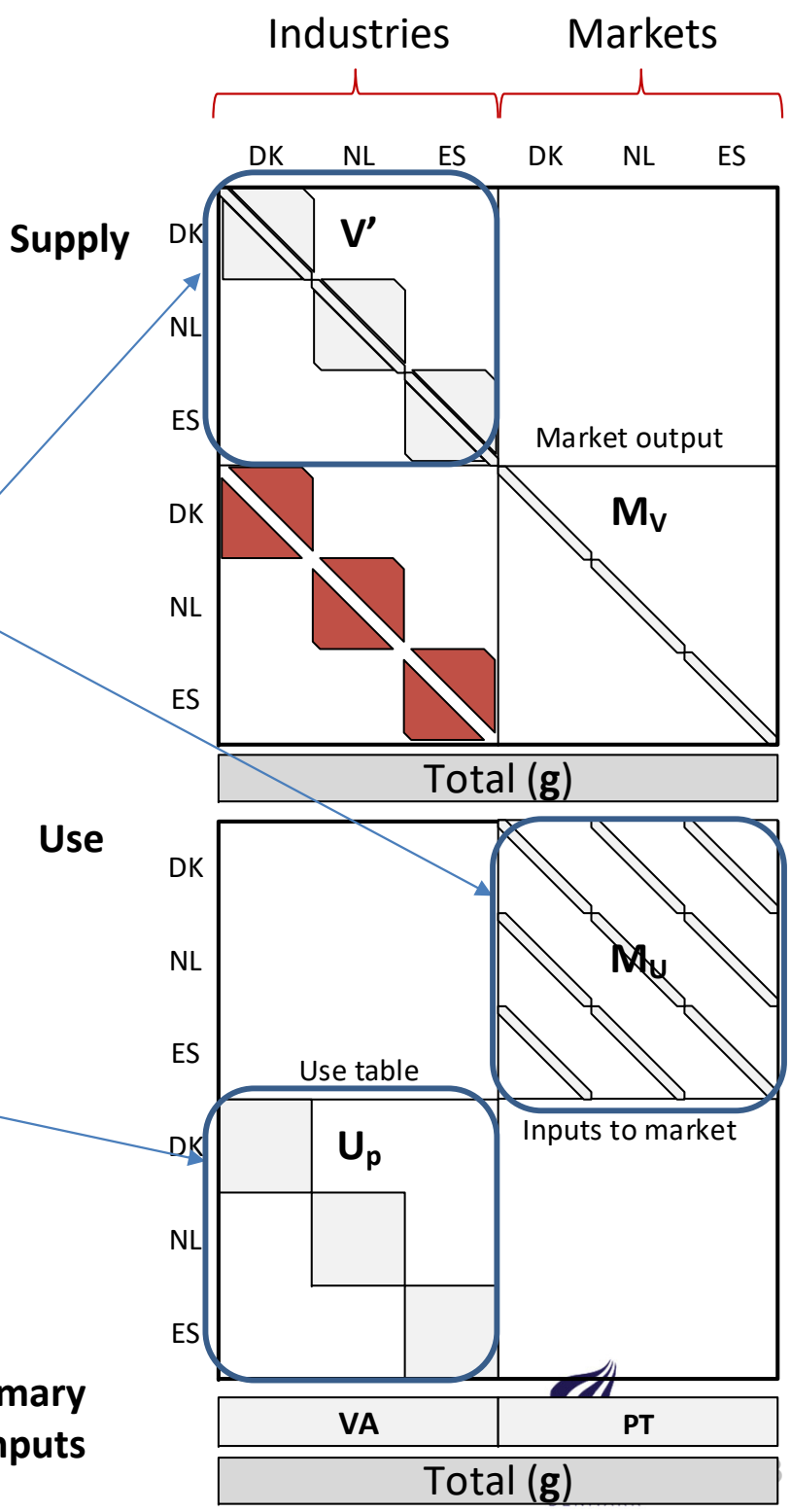
Marginal supply mixes

- Geographically
- Technological



By-products

Substitution modelled by moving by-products to input side with negative sign



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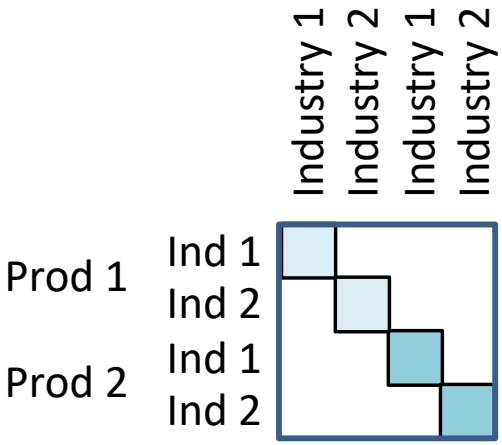
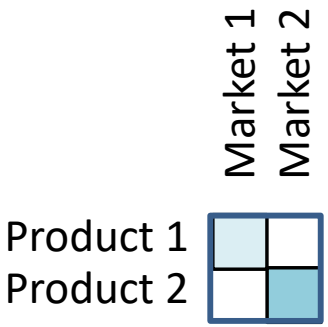
ILCA International Life Cycle Academy

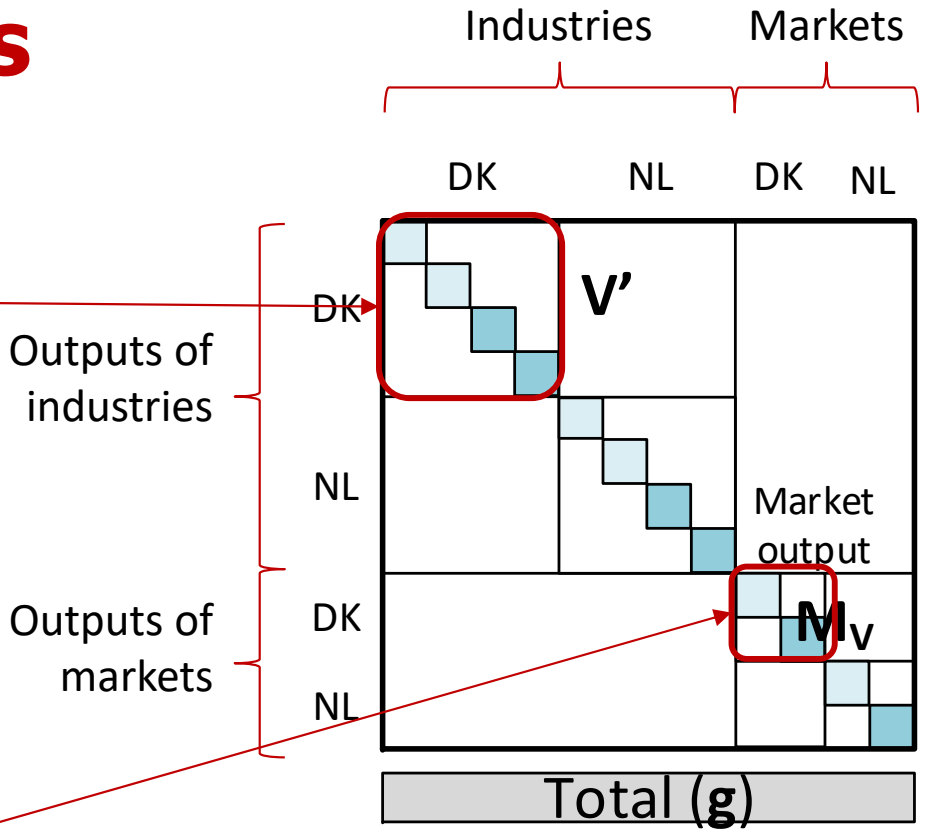
Marginal supply mixes
- Supply table

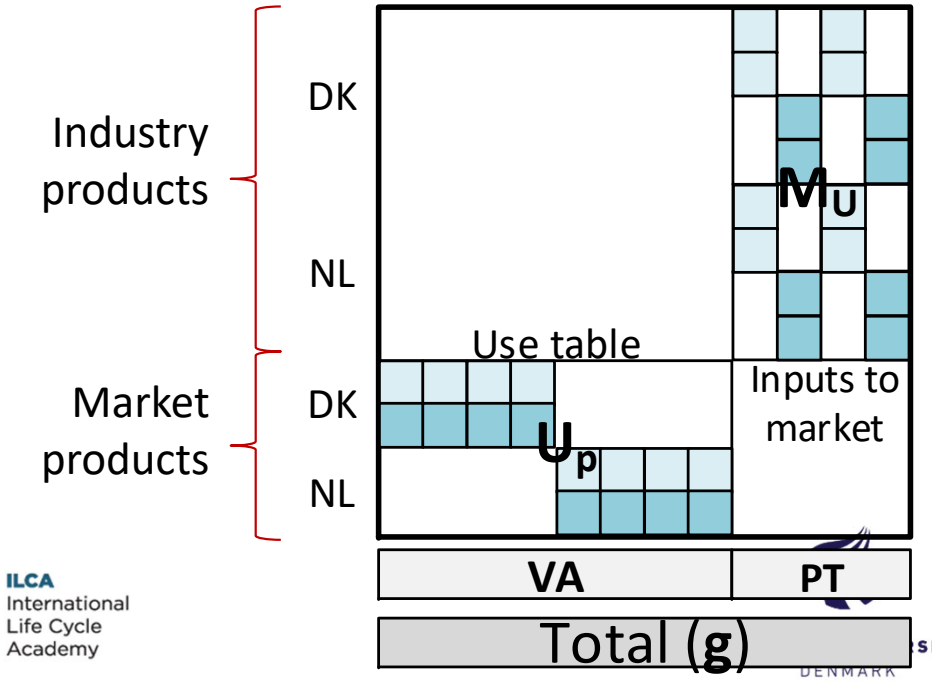
Industry supply



Market supply

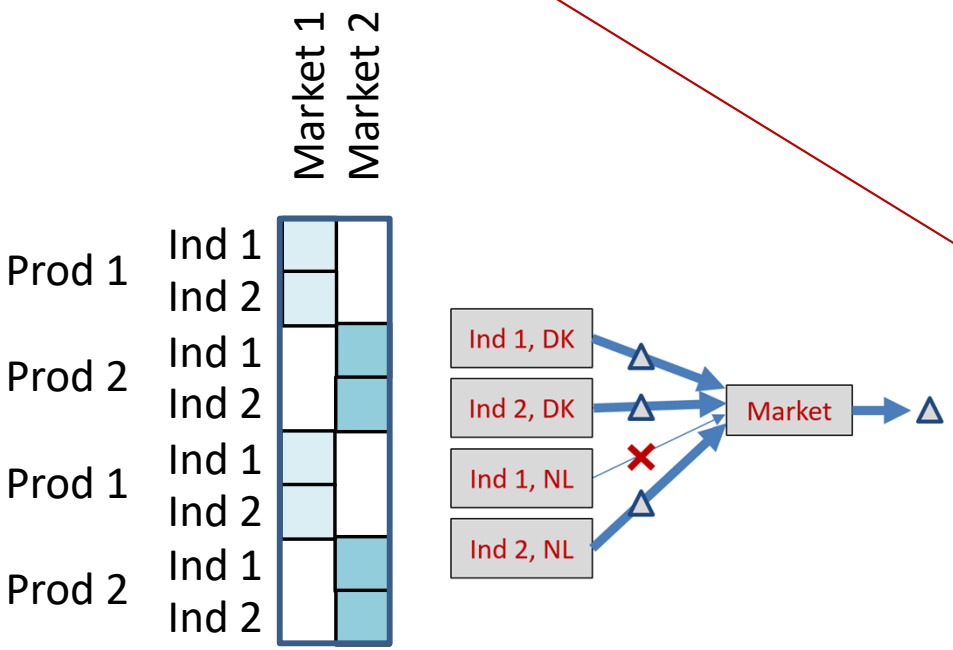




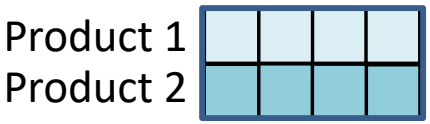


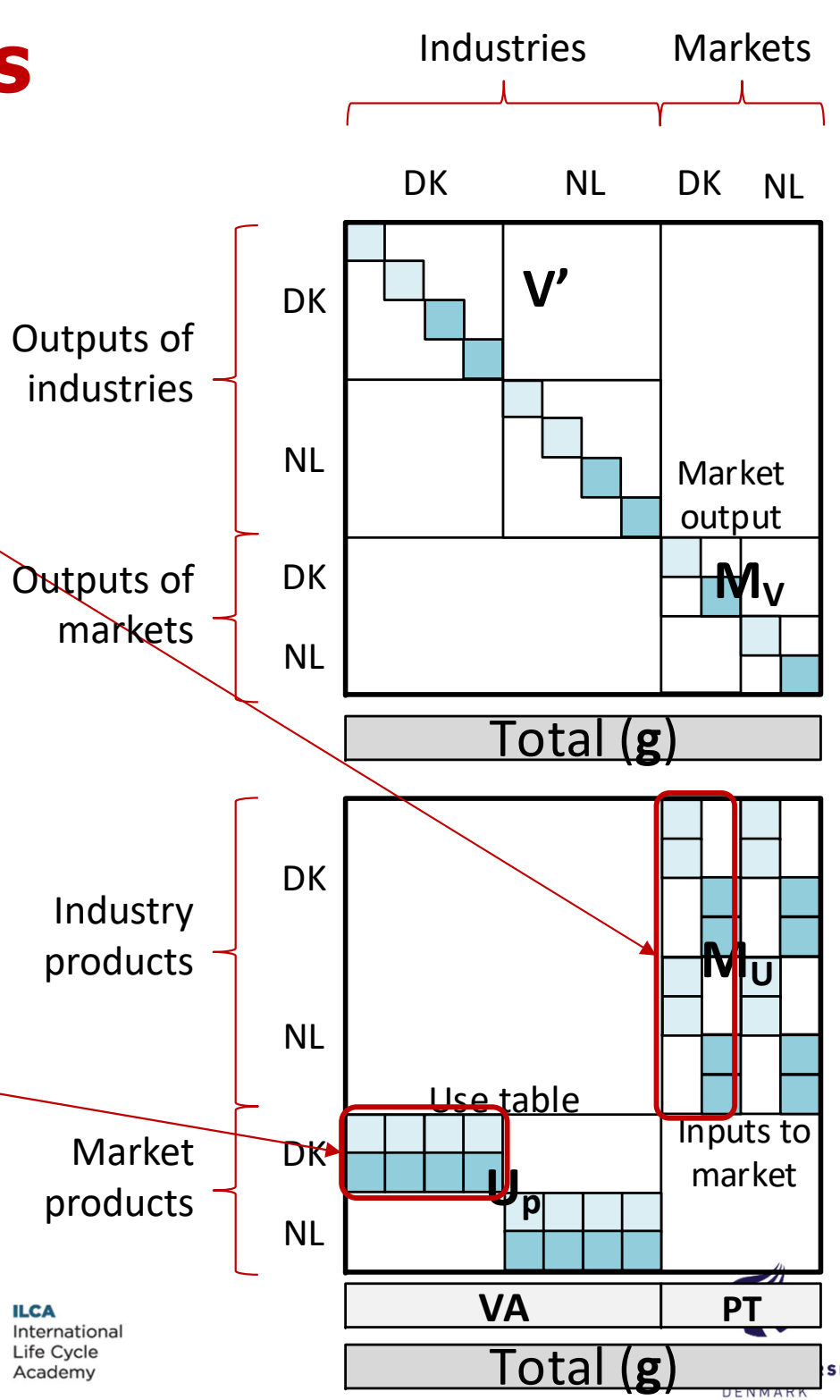
Marginal supply mixes
- Use table

Inputs to markets:



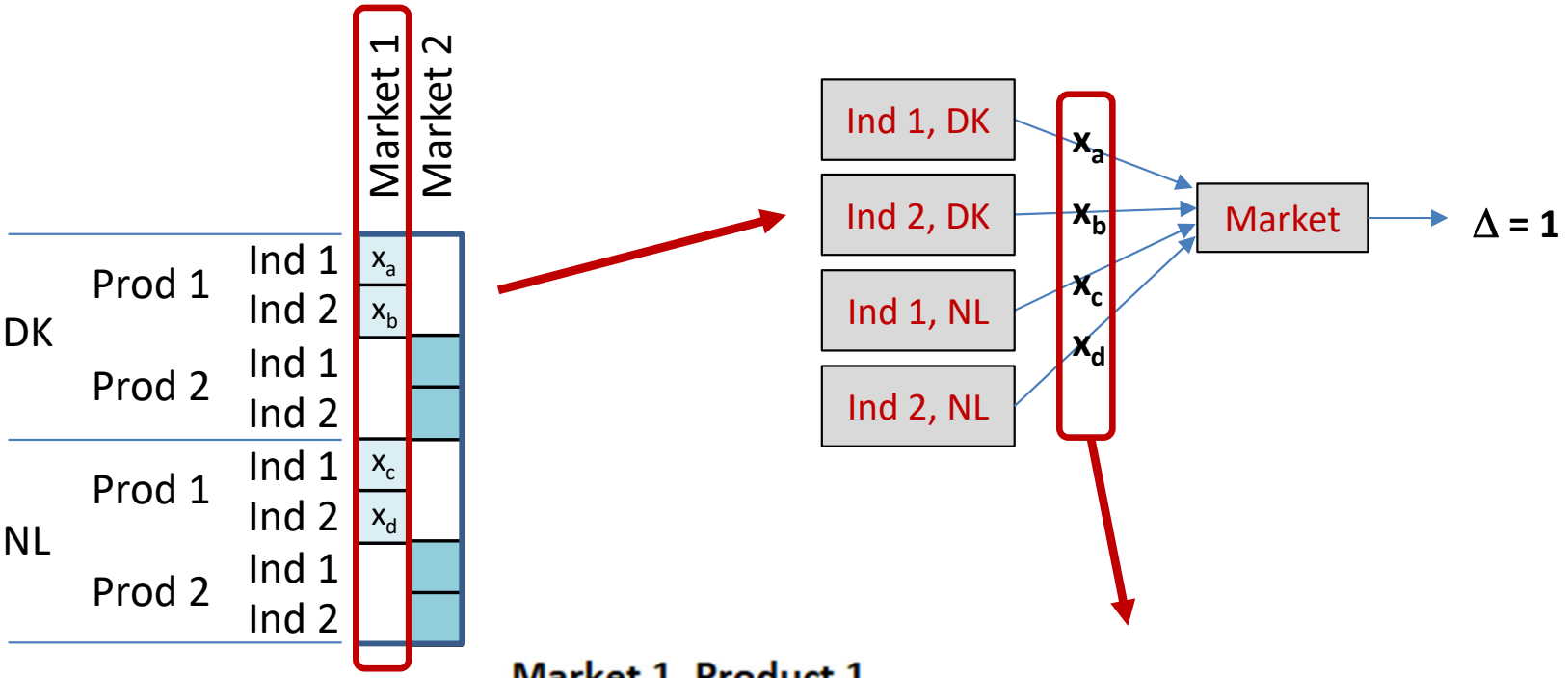
Inputs to industries:





Marginal supply mix

- How to compose?



Market 1, Product 1

Suppliers	Year 1	Year 2	Δ	Δ > 0	Market share
Ind 1, DK	a_1	a_2	$a_2 - a_1$	$a_2 - a_1$	$x_a = (a_2 - a_1) / \Sigma$
Ind 2, DK	b_1	b_2	$b_2 - b_1$	$b_2 - b_1$	$x_b = (b_2 - b_1) / \Sigma$
Ind 1, NL	c_1	c_2	$c_2 - c_1$		$x_c = 0$
Ind 2, NL	d_1	d_2	$d_2 - d_1$	$d_2 - d_1$	$x_d = (d_2 - d_1) / \Sigma$
Sum				**Σ**	**1**

Agenda

- Consequential modelling in an IO database
- Example of electricity markets

Example: Electricity mix

- Marginal mix for Denmark

Data

Source of electricity	GWh in 2014	GWh in 2019
Domestic production		
Coal	11,064	3,246
Oil	316	237
Natural gas	2,096	1,852
Biofuels[a]	3,409	5,094
Waste	1,609	1,720
Hydro	15	16
Solar PV	596	963
Wind	13,079	16,150
Total production	32,184	29,278
Imports		
Imports from Germany	3,566	6,168
Imports from Norway	4,120	3,384
Imports from Sweden	4,165	4,995
Total imports	11,851	14,548
Production + imports	**44,035**	**43,826**

https://consequential-lca.org/clca/marginal-suppliers/the-special-case-of-electricity/example-marginal-electricity-in-denmark/

Example: Electricity mix

- Marginal mix for Denmark

Calculations

Generation	Annual growth 2014-2019 (%)[1]	Plant lifetime (years)[2]	Capital replacement (%)[3]	Net annual growth 2014-2019 (%)[4]	Classification[5]	Net annual growth 2014-2019 (GWh/yr)[6]	Long-term marginal mix, including import by country (%)
Coal	-14.10%	60	-1.70%	-12.50%	Old	0	0%
Oil	-5.00%	60	-1.70%	-3.30%	Old	0	0%
Gas	-2.30%	30	-3.30%	1.00%	Modern	19	1%
Wind	4.70%	20	-5.00%	9.70%	Modern	1,566	45%
Biofuels	9.90%	45	-2.20%	12.10%	Modern	617	18%
Hydro	1.30%	100	-1.00%	2.30%	Modern	0.4	0%
Solar PV	12.30%	30	-3.30%	15.60%	Modern	151	4%
Imports from Germany	14.60%	n.a.	n.a.	14.60%	n.a.	901	26%
Imports from Sweden	4.00%	n.a.	n.a.	4.00%	n.a.	199	6%
Total						3,452	100%

https://consequential-lca.org/clca/marginal-suppliers/the-special-case-of-electricity/example-marginal-electricity-in-denmark/