



Energistyrelsen  
Danish Energy Agency

# IntERACT

## - An Integrated Energy and Economic Model

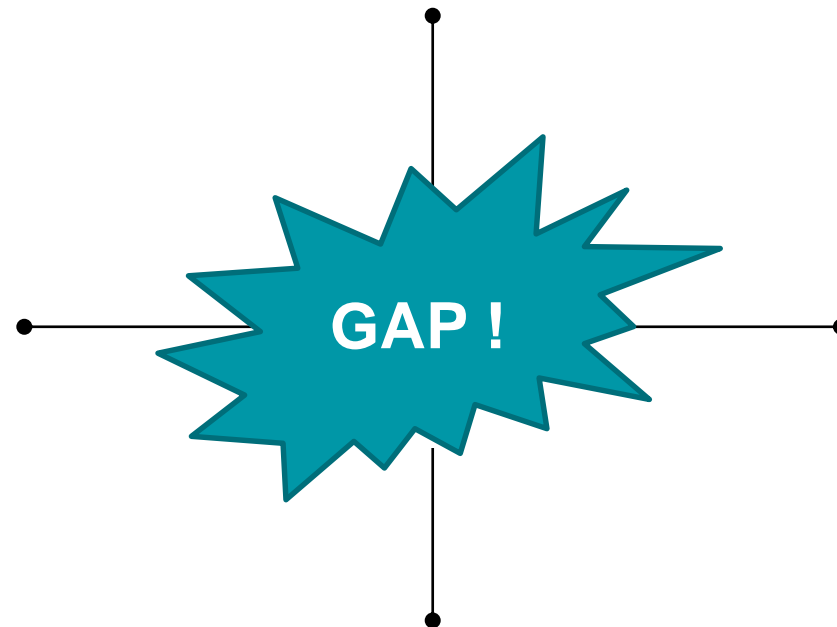
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# Motivation



**Policymakers:**  
*"We want to ban this technology by year 2035, what is the exact impact?"*

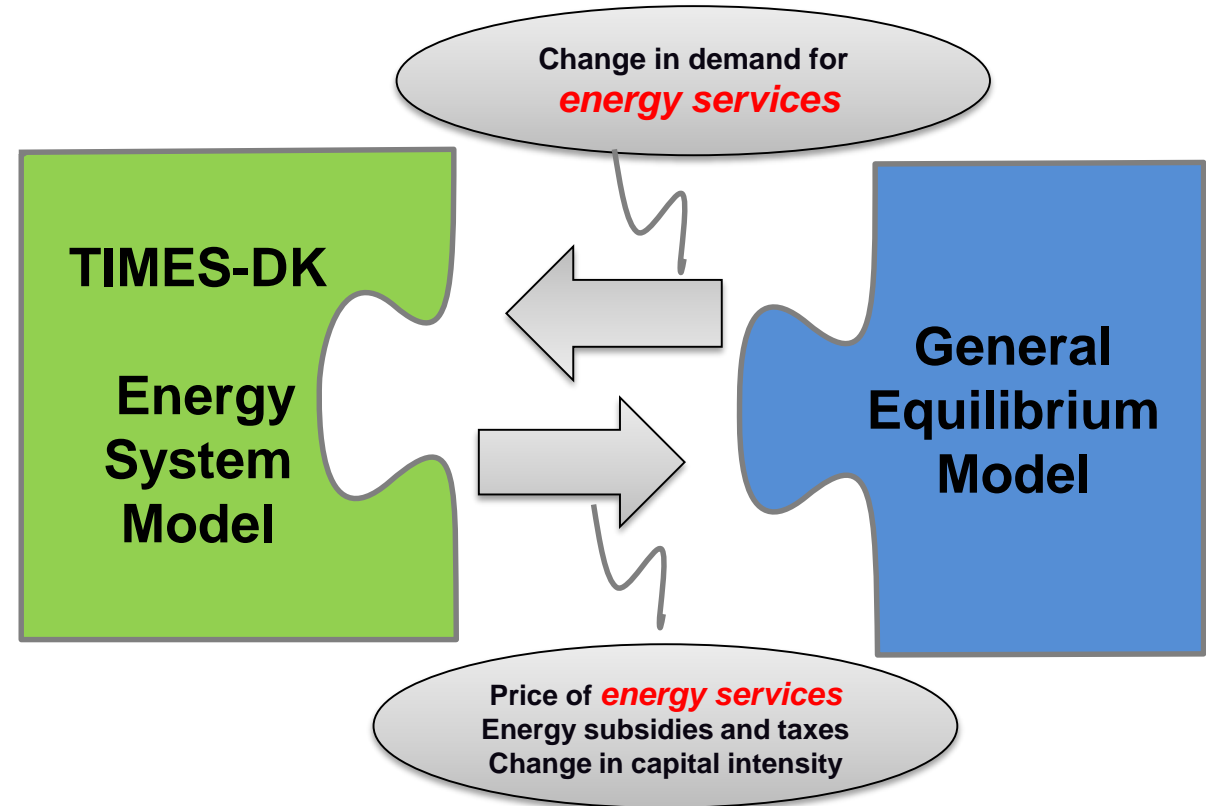
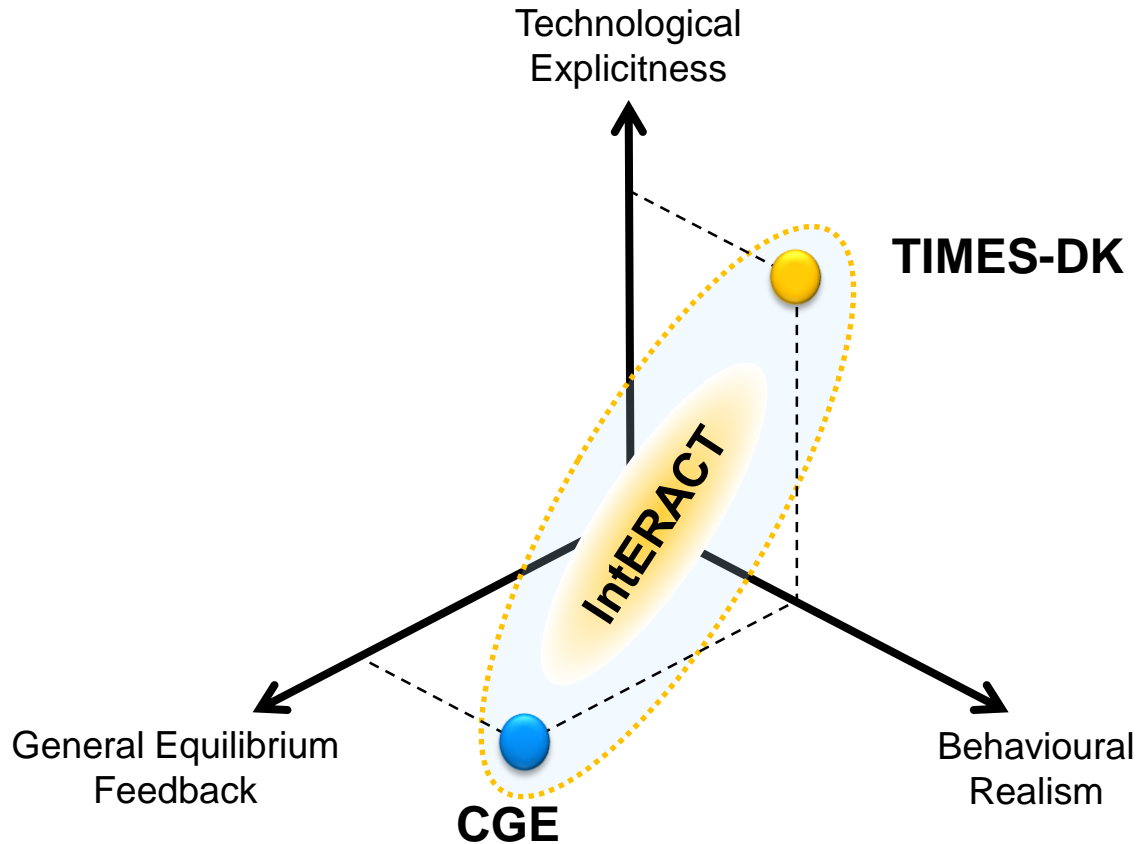
**Engineers:**  
*"Design the optimal system!"*



**Academic research:**  
*"We provide insights..."*

**Economists:**  
*"Uniform CO<sub>2</sub>-price across sectors and countries!"*

# Model concept



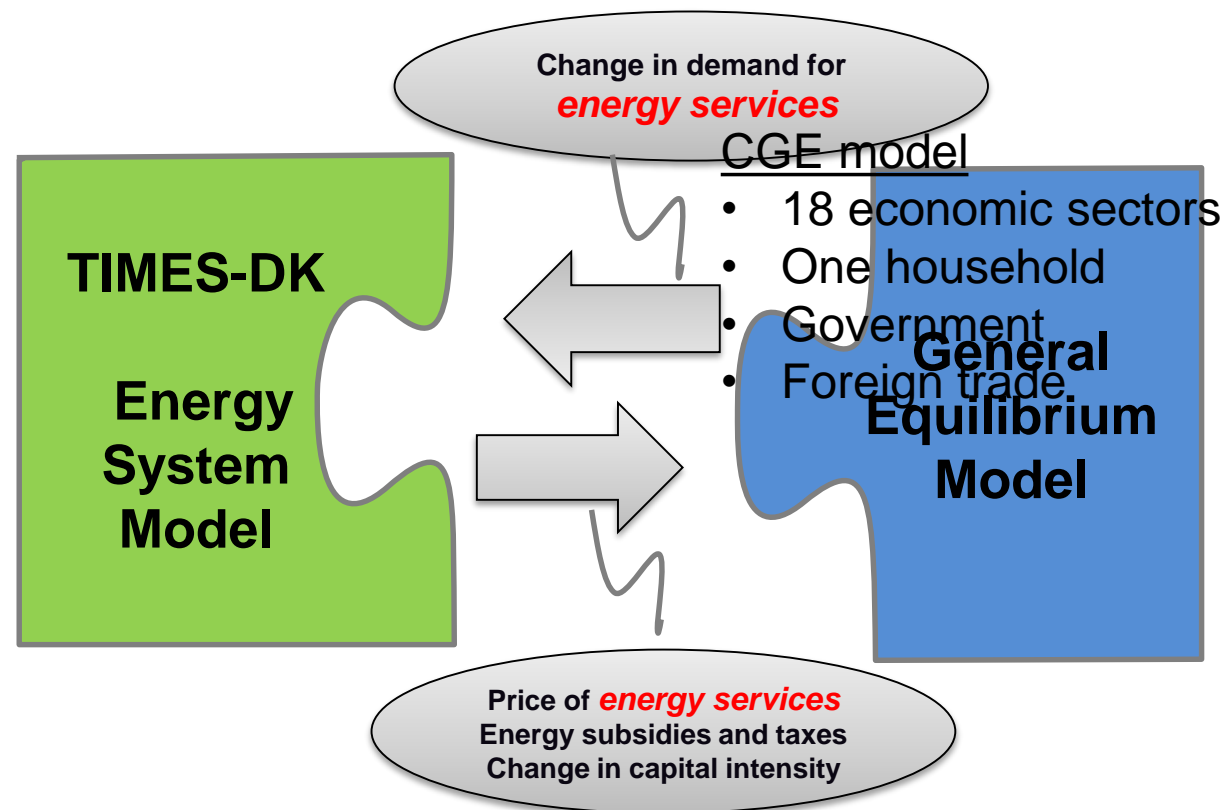
# What's included?

## TIMES-DK

- Optimizes Danish energy system towards 2050
- 10 Economic sectors
- Power and district heat sector
- Residential sector
- Transport sector
- Electricity exchange with neighbouring countries
- 32 time slices

## Soft-link

- 10 Economic sectors
- Power and district heating sector
- Residential sector



# Application of IntERACT

- Danish Energy Outlook
  - Frozen policy scenario
- Analysis Assumptions for Energinet (TSO)
  - Best estimate for future energy system
- Energy agreement 2021-2030
  - Assessment of policy changes



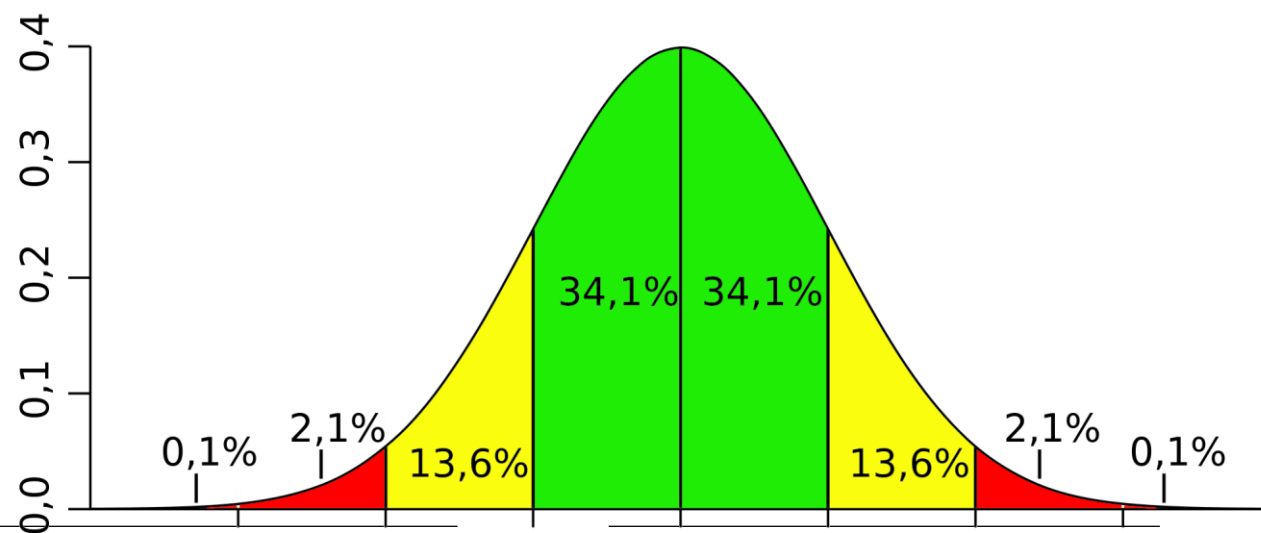
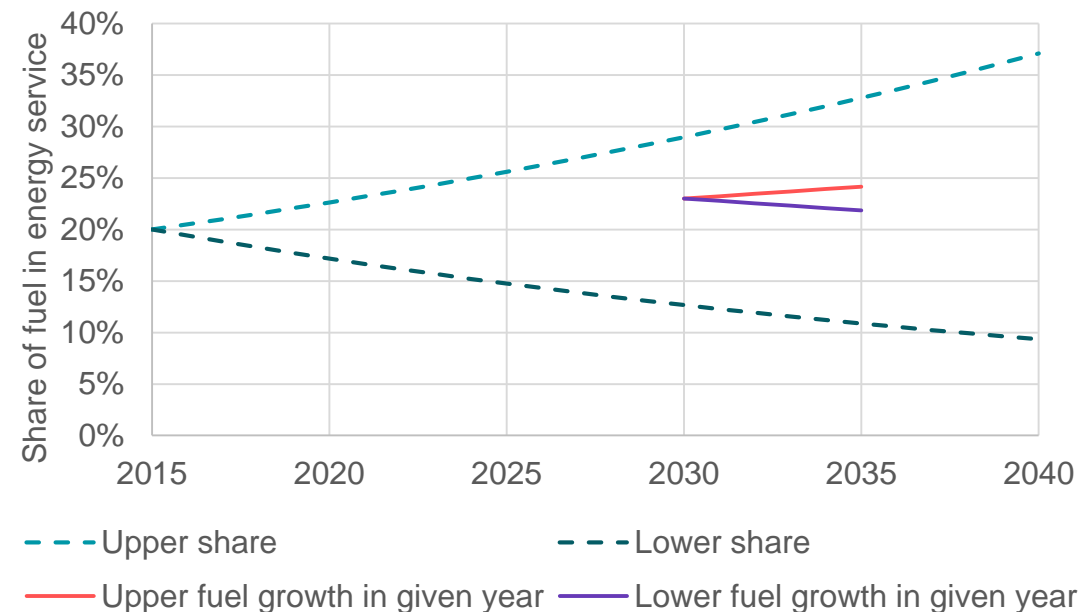
# Controlling the model

Linear modelling → Winner takes all!

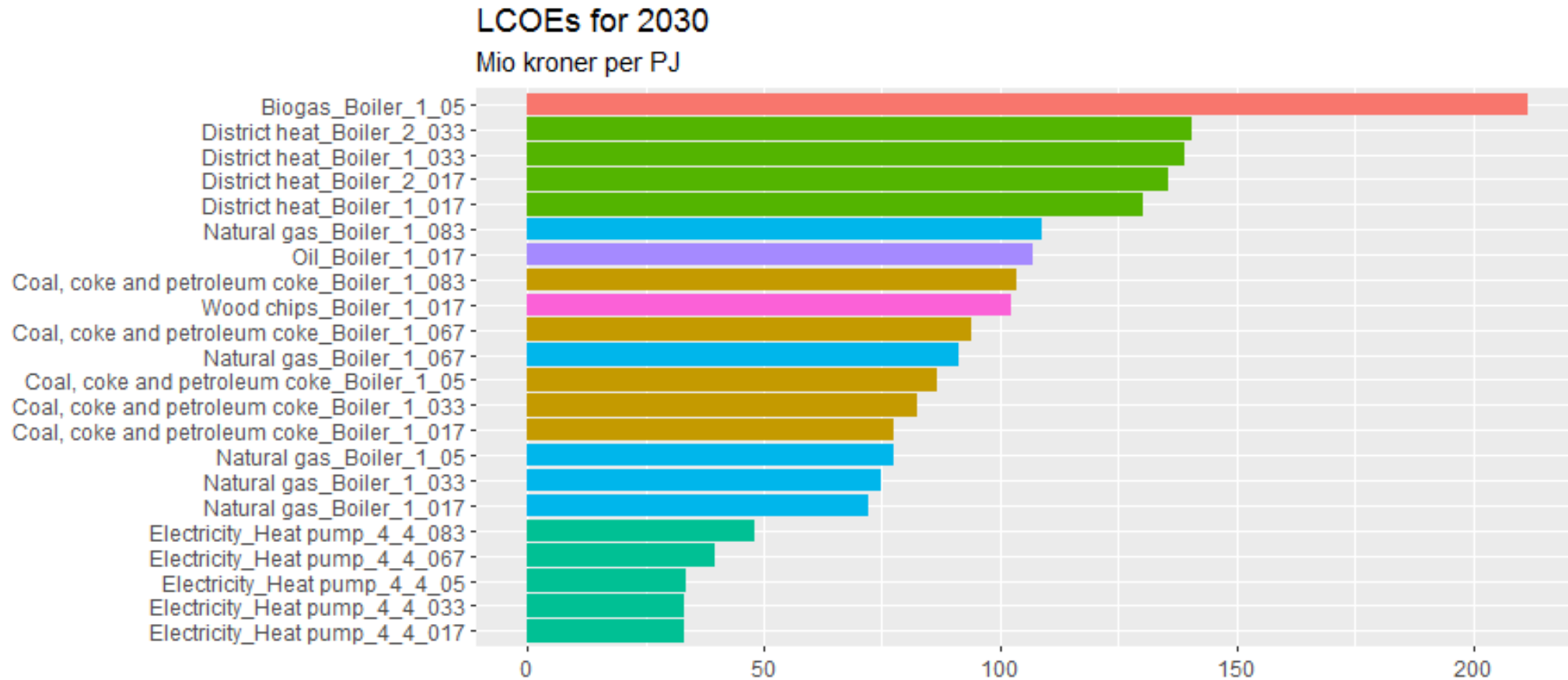
Different approaches:

- Growth limitations
- Share constraints
- Technical limitations (e.g. direct firing for industrial processes)
- Distributed technologies  
Variations over price, efficiency etc.
- Hurdle rate for energy efficiency

Illustration of share and fuel growth constraints



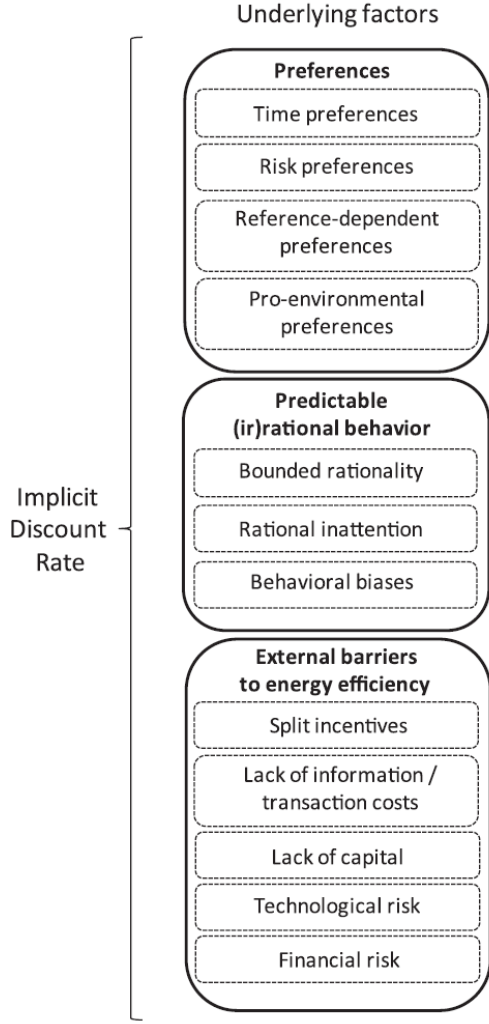
# Distributed technologies



# Modelling energy efficiency policies

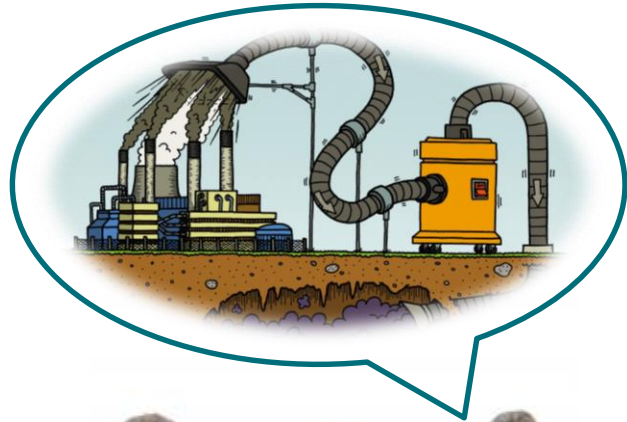
- Households largely fail to adopt energy efficiency investments that are cost-effective under market conditions!
- Hurdle rate to cover many different risks/barriers, to catch real-world behavior.
- So what happens if we change the substitution parameter in the CGE model?

Final energy demand (PJ)		Saving potential (PJ)
HurdleRate 25%	HurdleRate 4%	
146.5	121.2	25.3



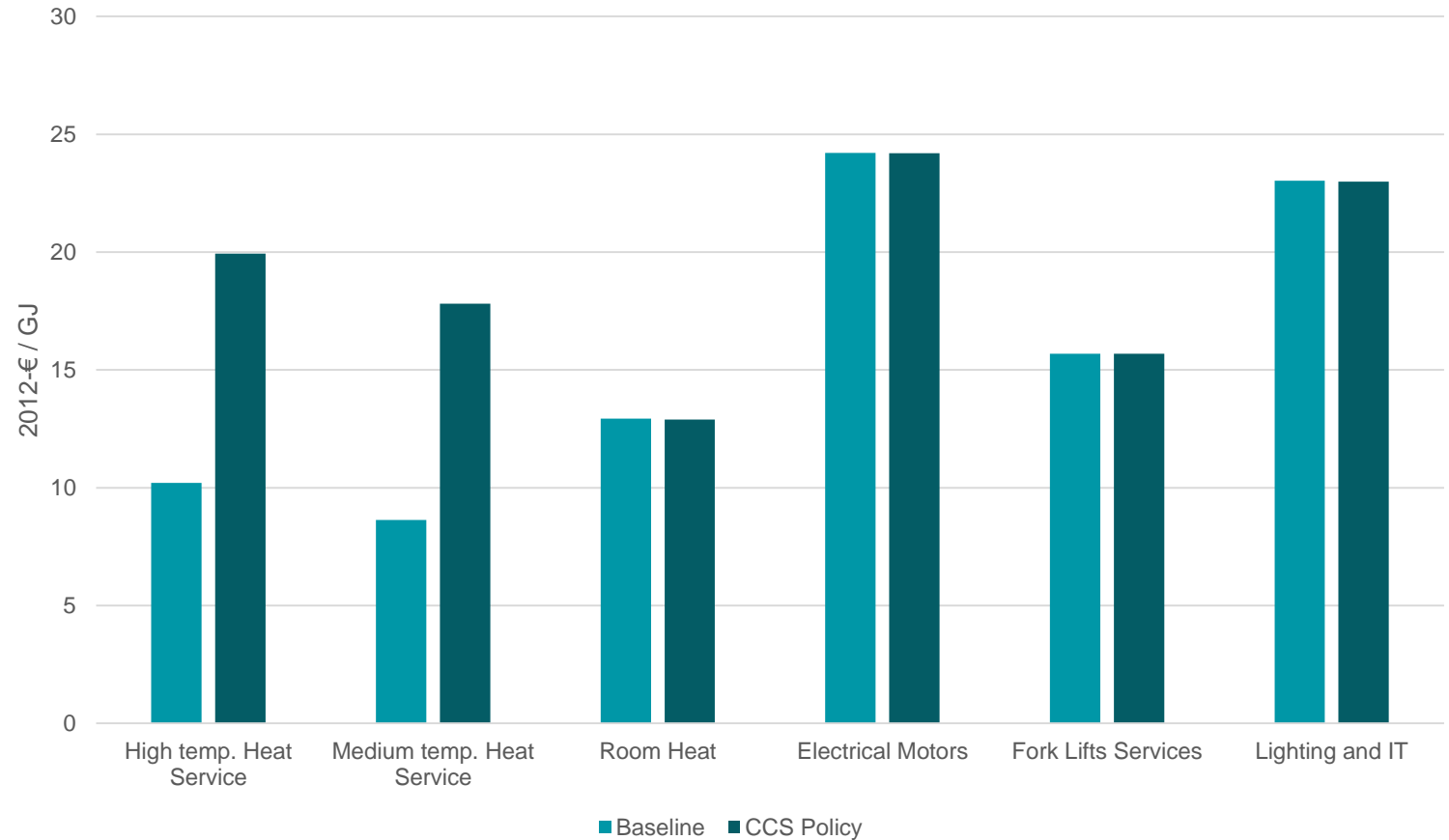


# What is the effect of the link?



**Policymakers:**  
*"Cement production must use CCS to limit CO2 emissions!"*

Effect on energy service prices by 2035

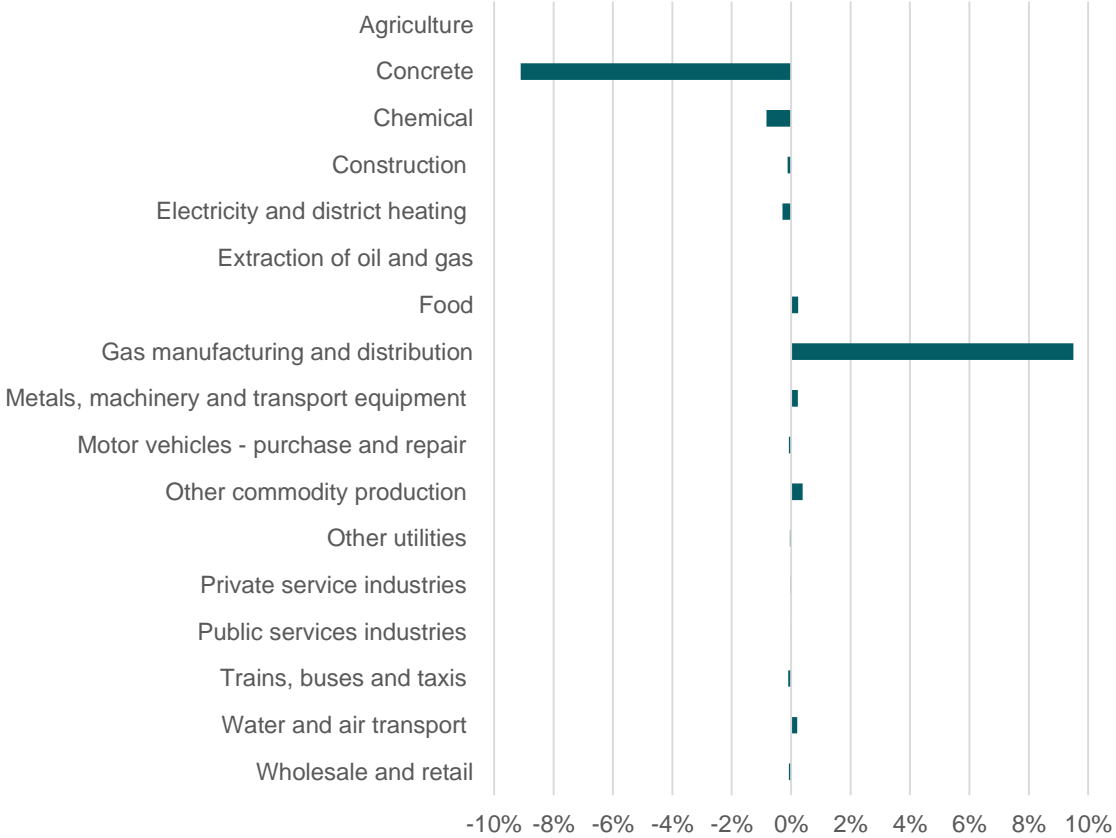


# Economy effect of CCS policy

- The coal CCS policy reduces domestic production from the cement sector by €357 million in 2035, whereas net import increases by €316 million.
- This suggest a **carbon leakage of around 88 percent**. It may be higher or lower depending on the CO2 emission associated with foreign concrete production.
- So now the policymaker can make an informed decision.



Relative change in sectoral activity relative to baseline across the 20 sectors in the CGE model



**Policymakers:**  
*"Thank you IntERACT!"*



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# Thank you for your attention

Learn more:

<https://ens.dk/en/our-services/projections-and-models/models/documentation-interact>