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# Can Nuclear Power be Part of a Sustainable Future?

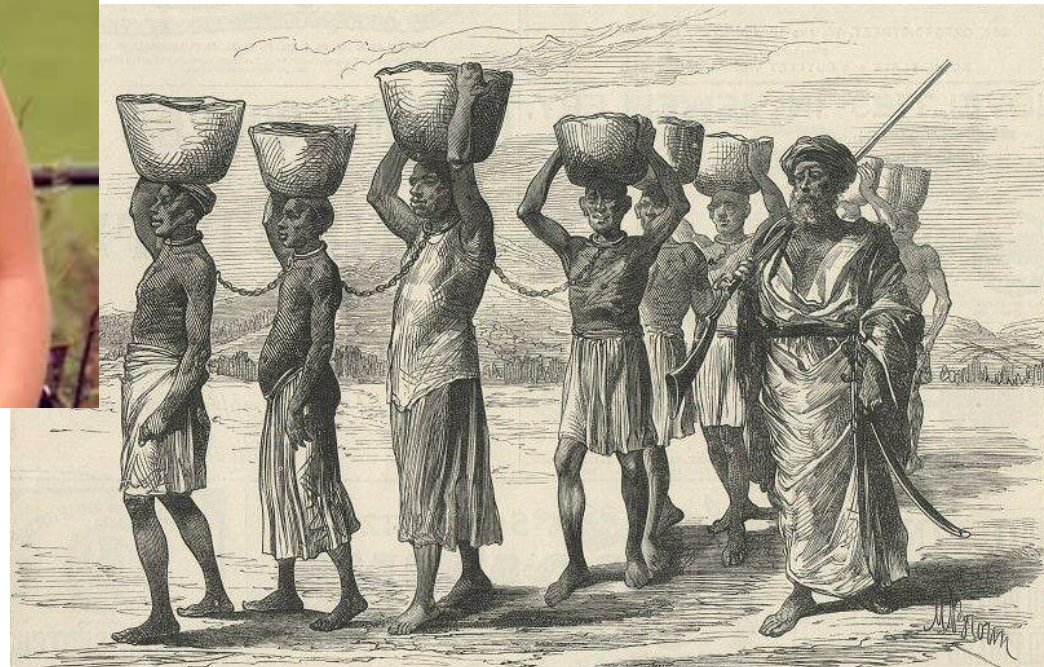
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Fredrik Hedenus, Associate Professor

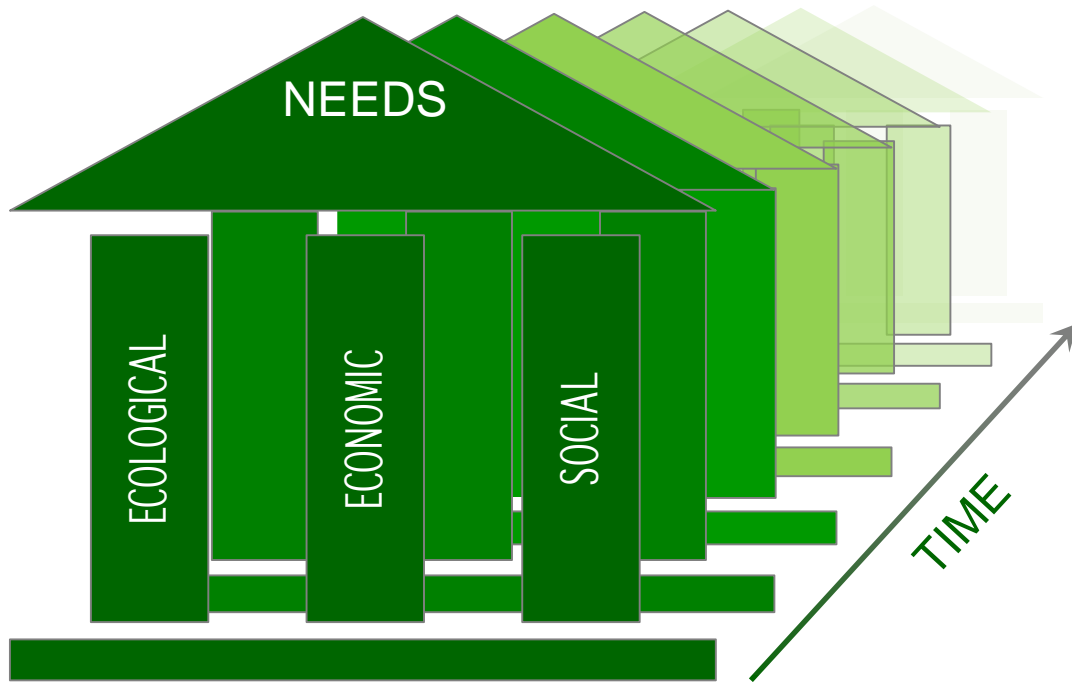
Fysisk resursteori, Chalmers

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Some things are sustainable but does not lead to development and vice versa



# The three dimensions of sustainable development



Distinction between goal,  
means and prerequisites

# Ecological dimension

Preserving a living environment that is necessary to sustain a human population

Production capacity

- Agricultural land
- Ecosystem services
- Hydrological cycle

Assimilation capacity

- Acidification
- Carbon dioxide



# Economic dimension

Efficient use and allocation of resources

Extraction of non-renewable resources

- Metals, fossil fuels, phosphorous

Capital Stock

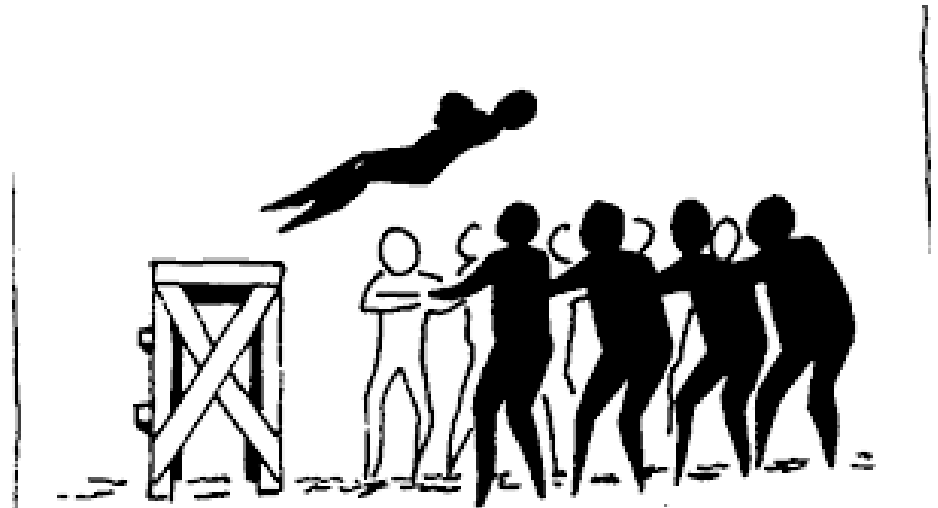
- Maintain and develop man-made capital (infrastructure, human capital etc)



# Social dimension

Social institutions that help human needs to be fulfilled.

- Distribution and control of power
- Create and sustain trust
- Efficient and capable institutions



# Nuclear and sustainable development

**Accidents** – a problem, mainly for present generation (and probably not larger than for other technologies)

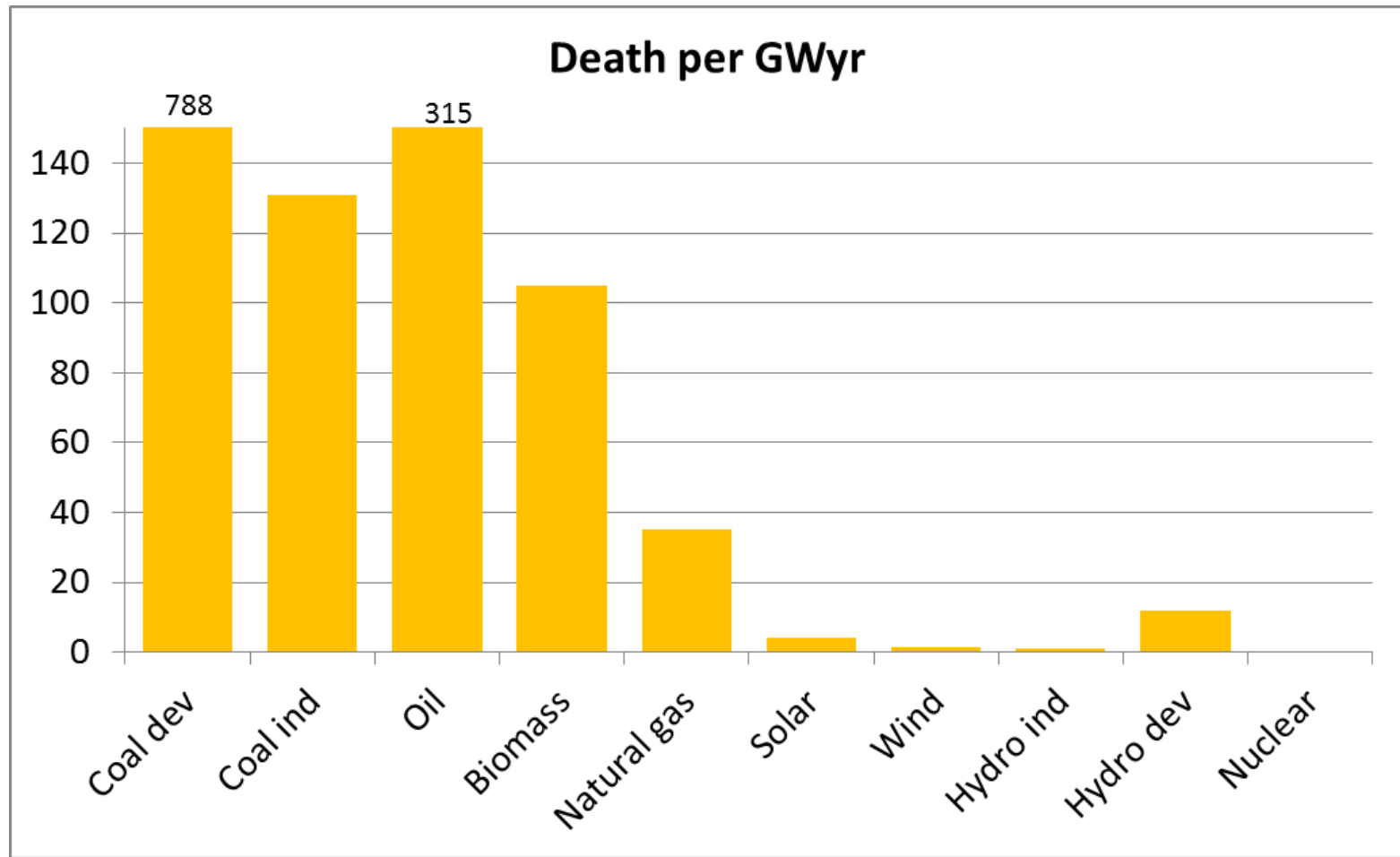
**Waste** – potential threat for future generation – but how large?

**Resource base** – Limited (but large), but if substitutes are developed, it could be considered sustainable as a transient solution.

**Nuclear proliferation** – Mainly affect the social dimension, and is a larger problem in a world with low trust. Potentially large effect on human needs.



# Causalities due to accidents and pollutants

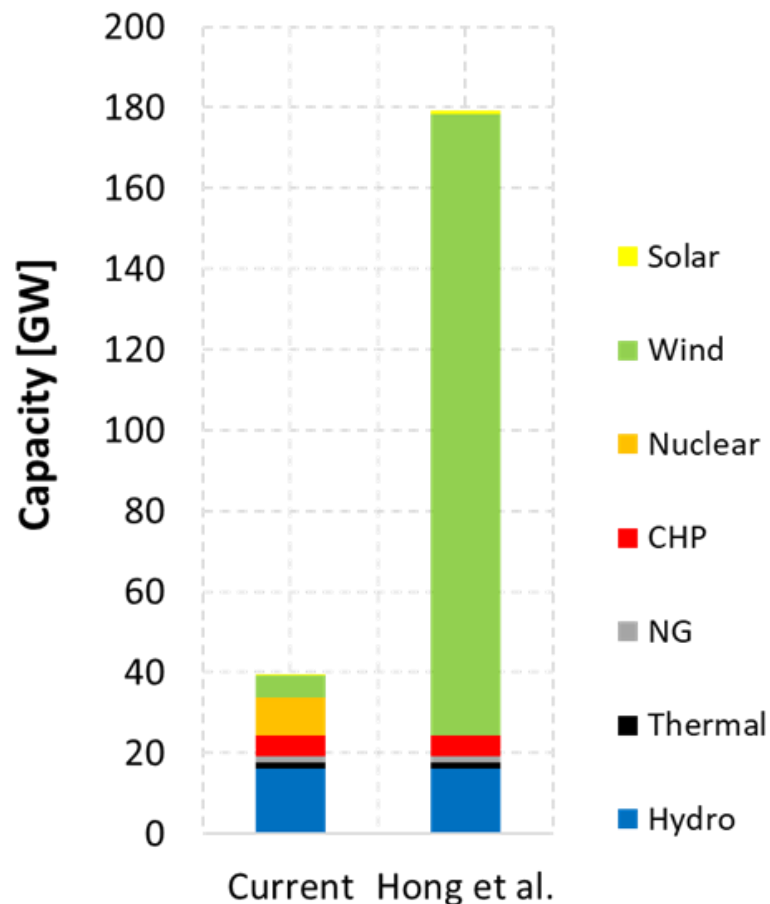


Lethveer, 2012



# Can we replace the nuclear power in Sweden with renewables?

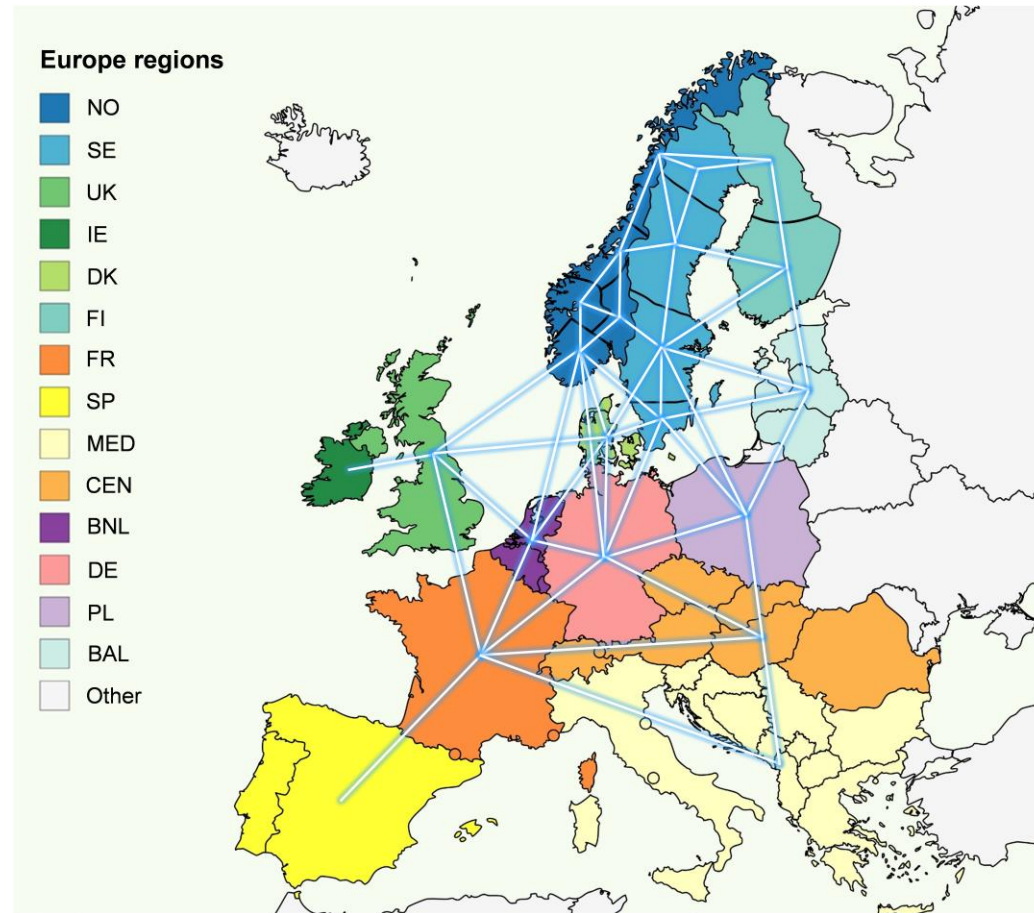
## Capacity of Sweden



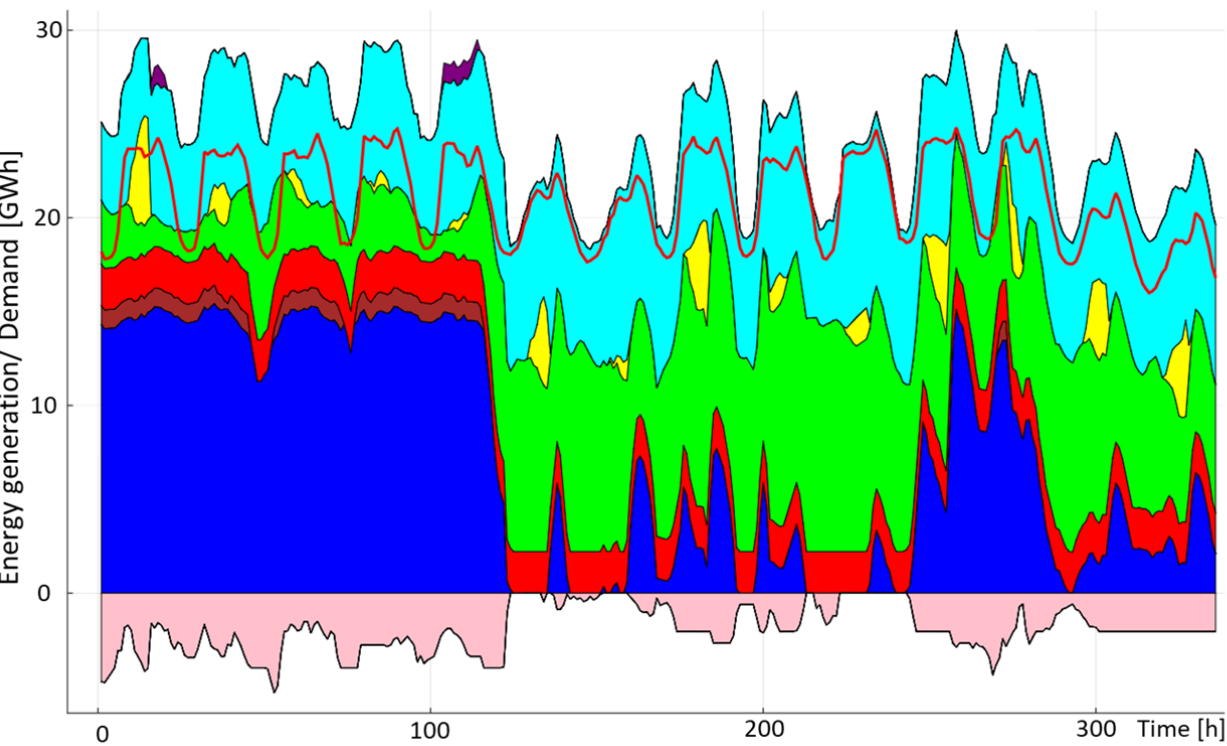
- Total trade as of today
- Wind and solar have to replace the nuclear production as of today
- No battery storage or demand response
- No full system optimization

## Model-REX

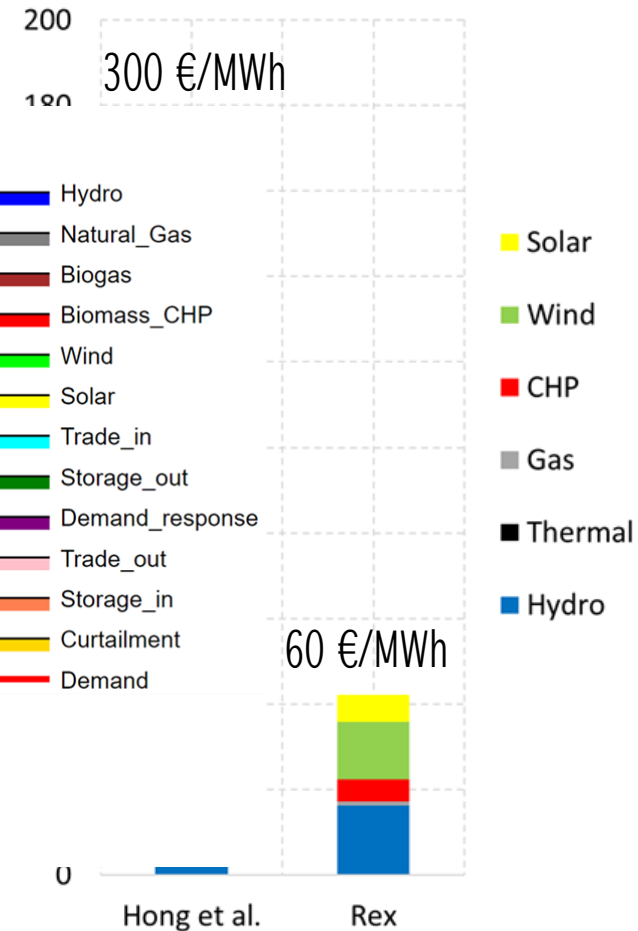
- Method: *Green field cost minimizing electricity investment and dispatch model for Europe*
- Generation: *Wind, solar, hydro, nuclear, etc.*
- Hydropower: *Dry year*
- Variation management: *Transmission, Storage, Demand-response*
- Nuclear: *Capacity upper limited to current value*
- Emission:  $10\text{g CO}_2/\text{kWh}$



# Results

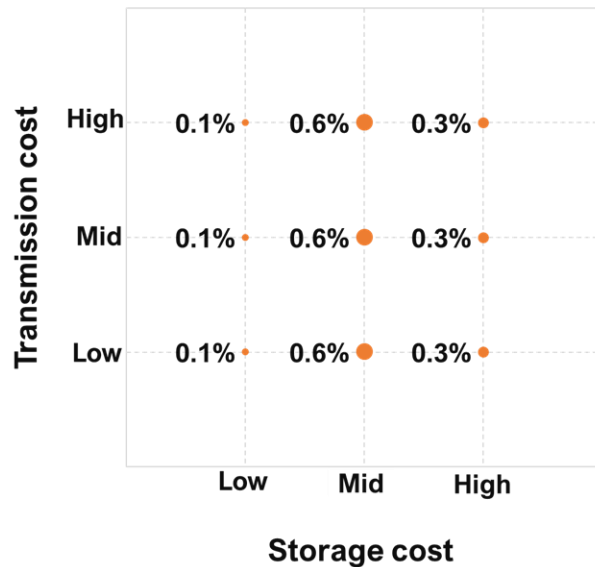
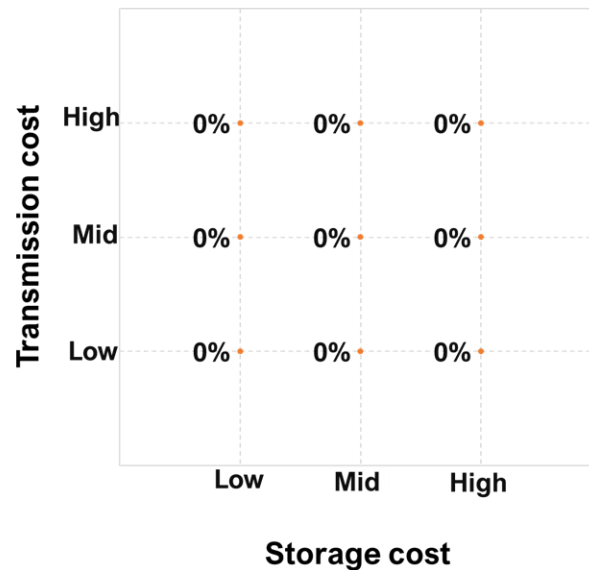
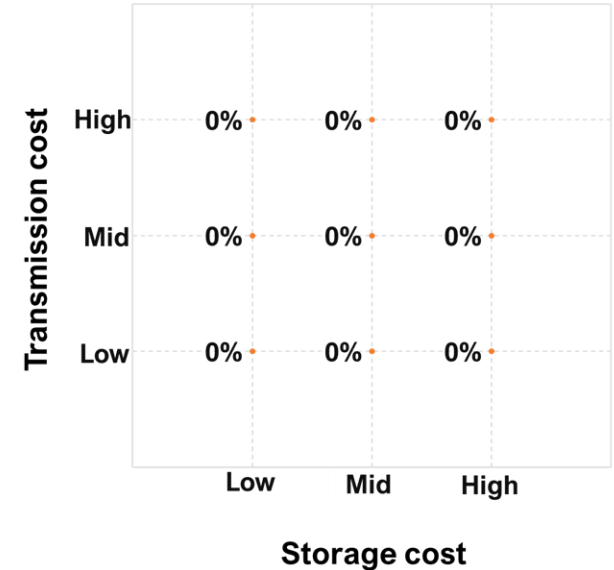


## Capacity for Sweden



Kan, et al 2020

# Cost reduction if new nuclear can be installed in Sweden compared to a renewable system.

**Nuclear Cost Low****Nuclear Cost Medium****Nuclear Cost High**

# Conclusions

Sustainable development need to be understood as something more precise than just "What I think is good" or "What can go on forever"

Nuclear power could be consistent, at least for a transient period, with a sustainable development.

There are very limited economic rational for investing in new nuclear power plants in Sweden