Assessing impacts of a regional collaboration on large-scale excess heat utilization

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Smart heat synergies

- CHP waste incineration
- Heat storage
- Geothermal
- Intermittant electricity
- Transport biofuel production
- **Industrial waste/surplus/excess heat**

Perssson U, Werner S (2012). District heating in sequential energy supply. Applied Energy **95**: 123–131.

Industrial excess heat

Challenges

- Unknown energy system impacts
- Uncertain environmental impacts
- High investment cost
  - Lock-in effects ?

➔ Sustainable ?

Questions

- What are the impacts on the energy system and its CO_2-emissions of a large-scale excess heat utilisation?
- Is it economically sustainable?
- Is it sustainable from a broader perspective?

Methodology

- Case study
- Local and regional scales (regional biomass market)

Coincidence

Parallell processes

- Academic project/s
  - Industrial process engineering
  - Energy systems analysis
  - Energy market studies
- Actors
  - Chemical industries
  - DH utilities
  - The region

➔ Project + reference/stakeholder groups

➔ Common case

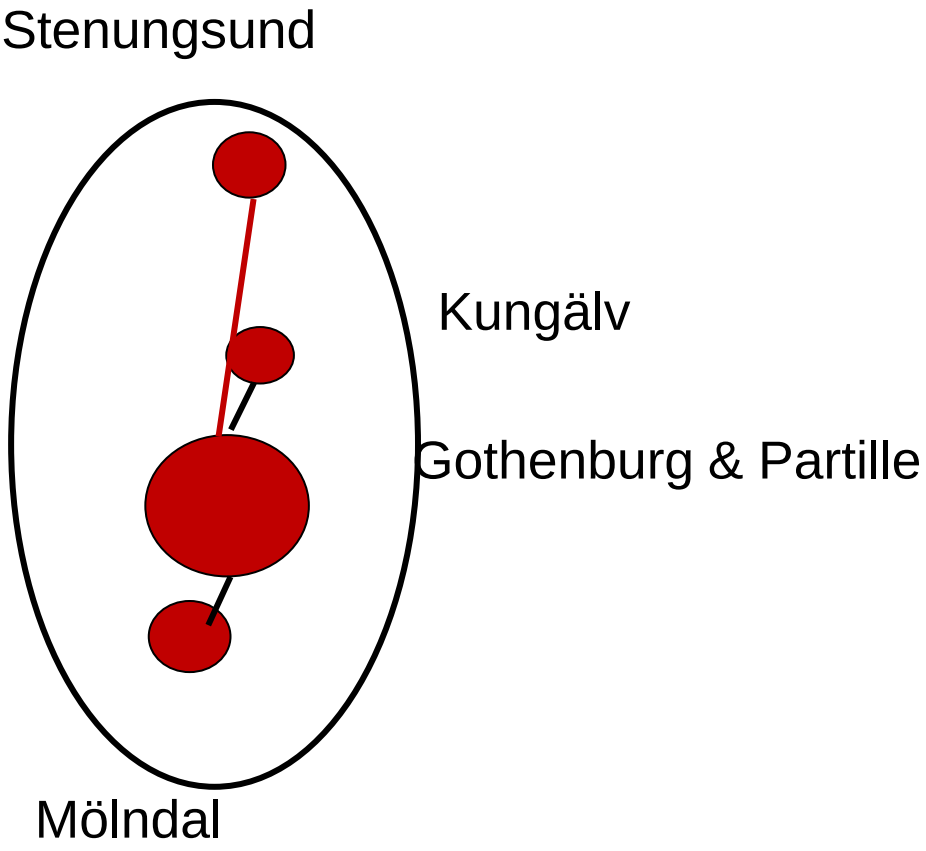
The Stenungsund case

➔ Project:

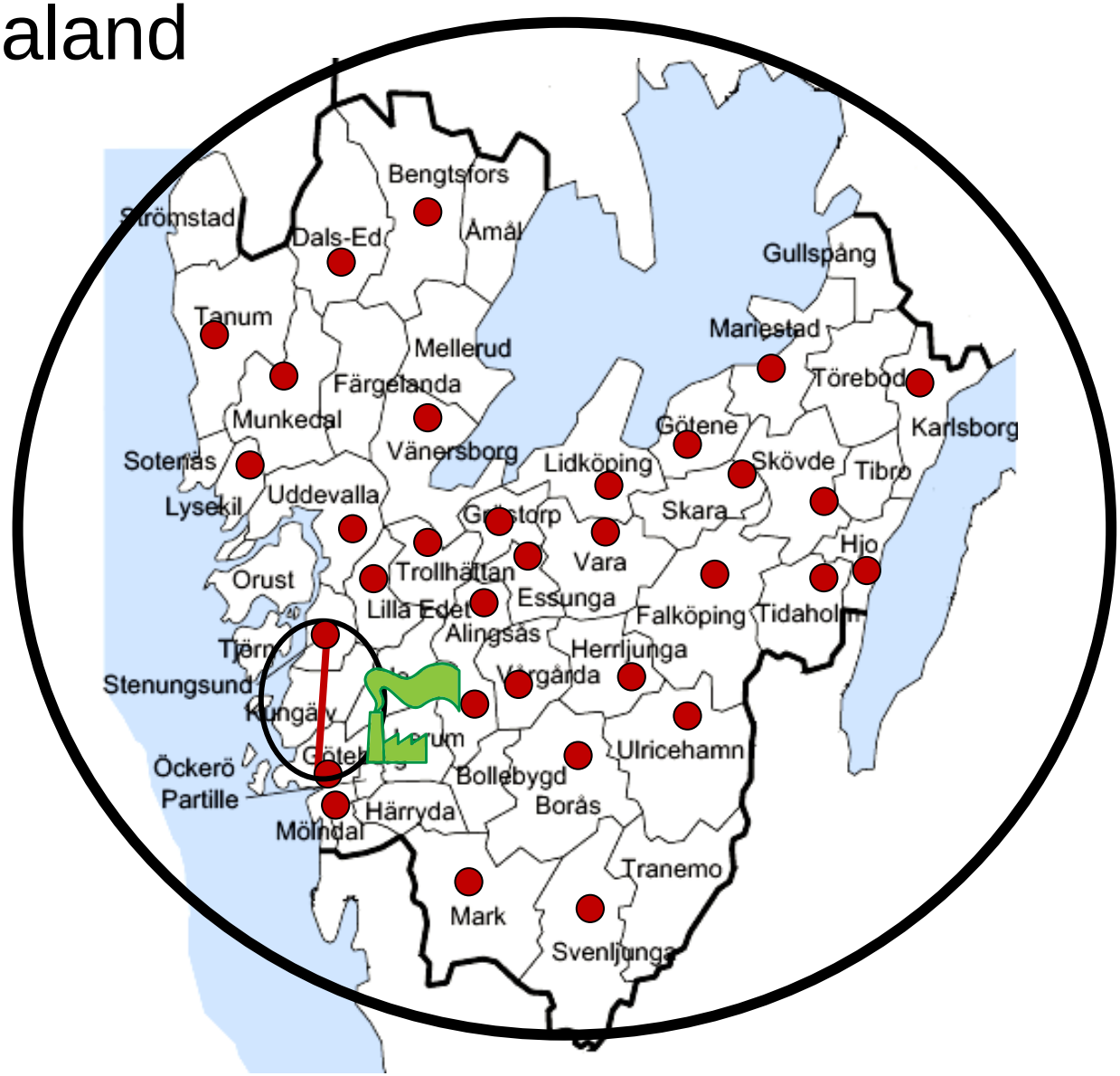
West Sweden collaboration on industrial excess heat

The case - local

50-55 km



Västra Götaland **(VG)**



Industrial heat extraction

- Different levels requires various degrees of collaboration
- Extraction costs input to system calculations

DH today

DH in the region:

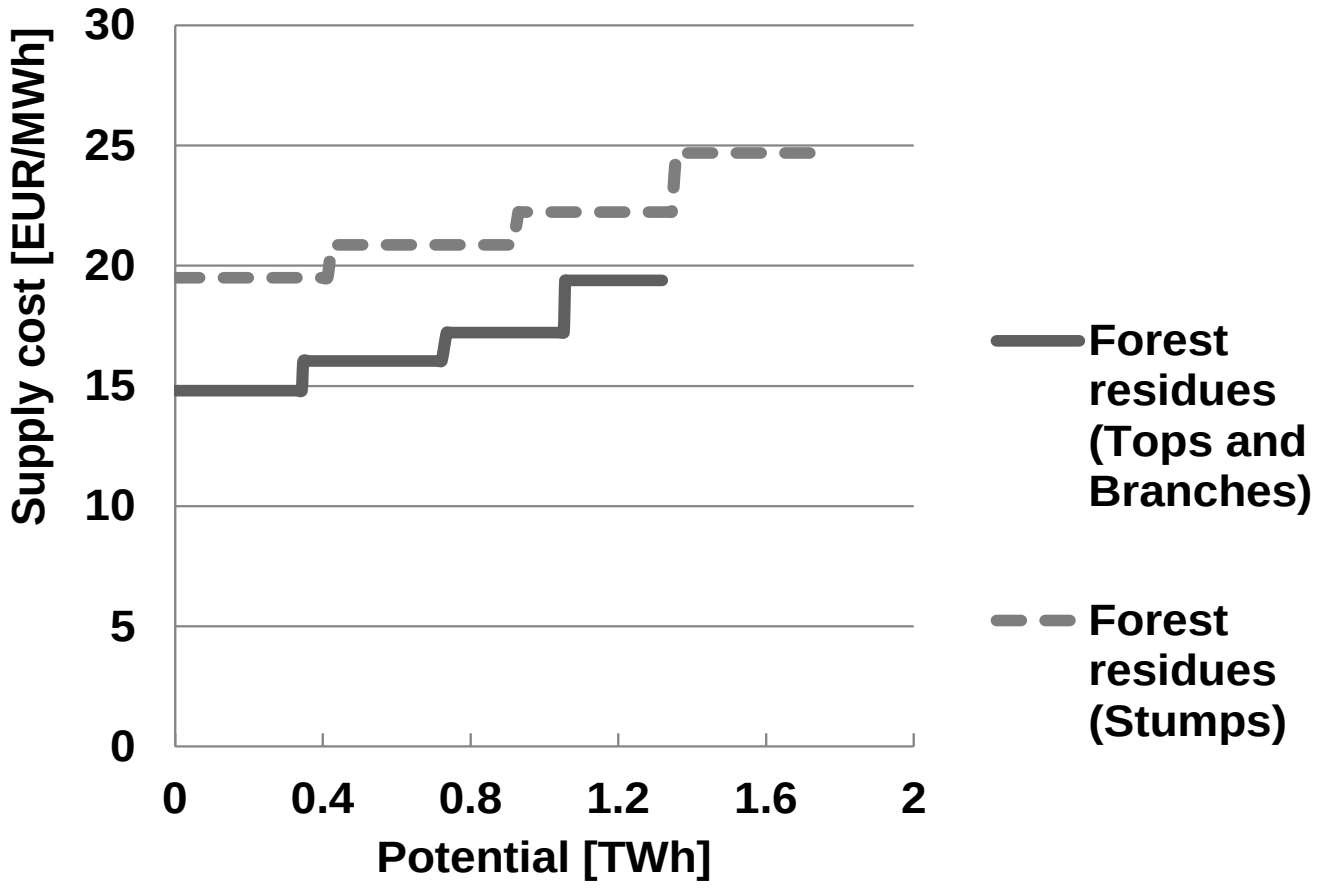
- Biomass
- Waste heat (MSW incineration + Refineries)
- NGCC
- Heat pumps

Unused biomass

- Co-combustion with coal (export)
- CHP elsewhere
- Biofuel production

Börjesson M; Athanassiadis D; Lundmark R; Ahlgren EO (2014). Bioenergy futures in Sweden – System effects of CO2 reduction and fossil fuel phase-out policies. *GCB Bioenergy*; in press.

Regional biomass supply curve



Climate policy scenarios

- 450PPM or BASE (450 ppm)
- NEWPOL (New Policies)

Sensitivity analysis

- **No NG** (after 2030)
- **REHD** (reduced heat demand)
- **LIC** (50% lower pipline cost)
- **INTRATE**
- **REFINERY** (cont´d operation)
- **RES-S** (cont´d el.certificates)
- **NOSNG** (NO alternative regional biomass demand)

Optimisation modeling

- **MARKAL_West Sweden**
- Time horizon: 2010-2050
- Load curves
- 37 DH system represented
  - Investment opportunities
- Transport biofuel production

Assumptions

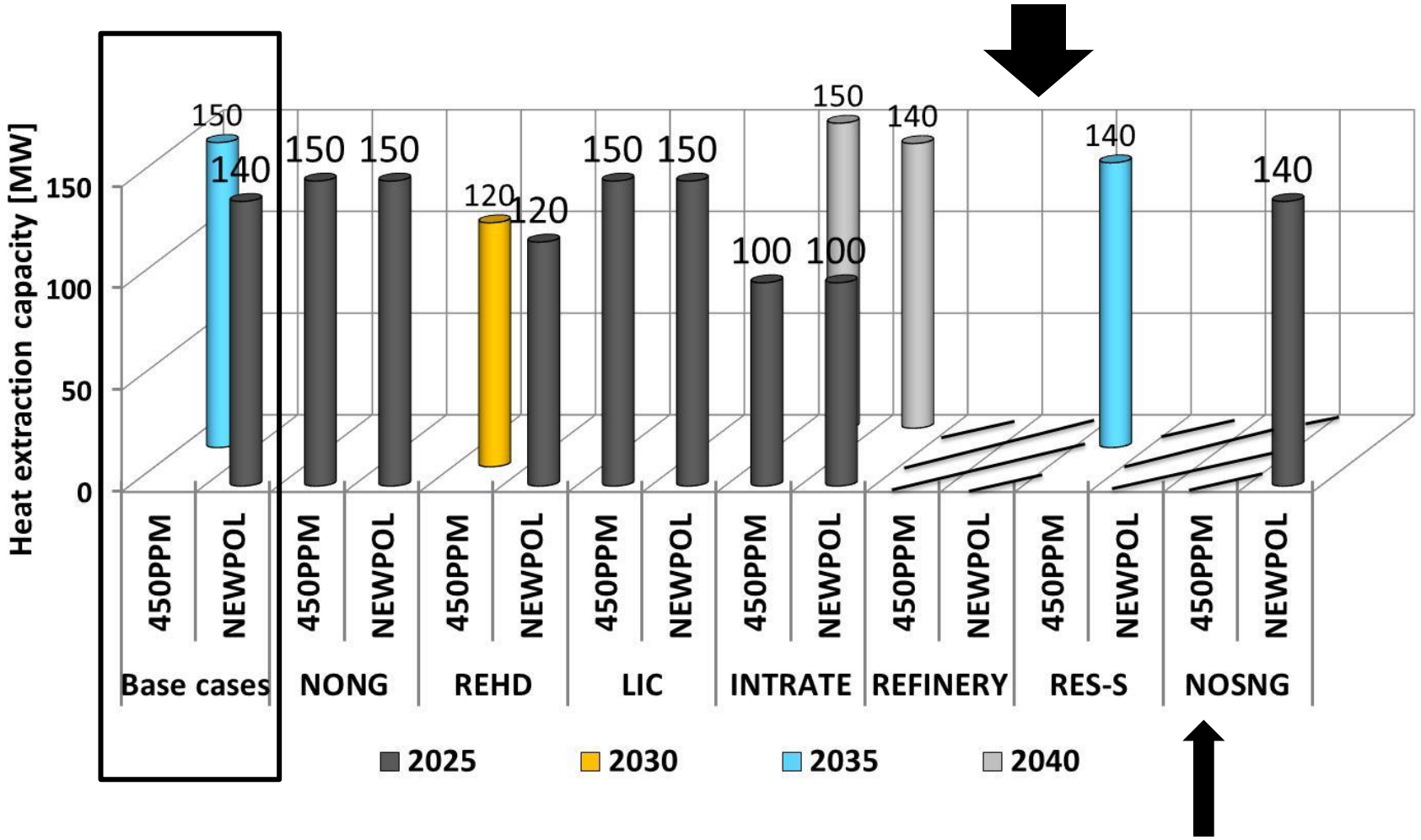
- Marginal electricity
  - Short-term
  - Long term (built)

Results

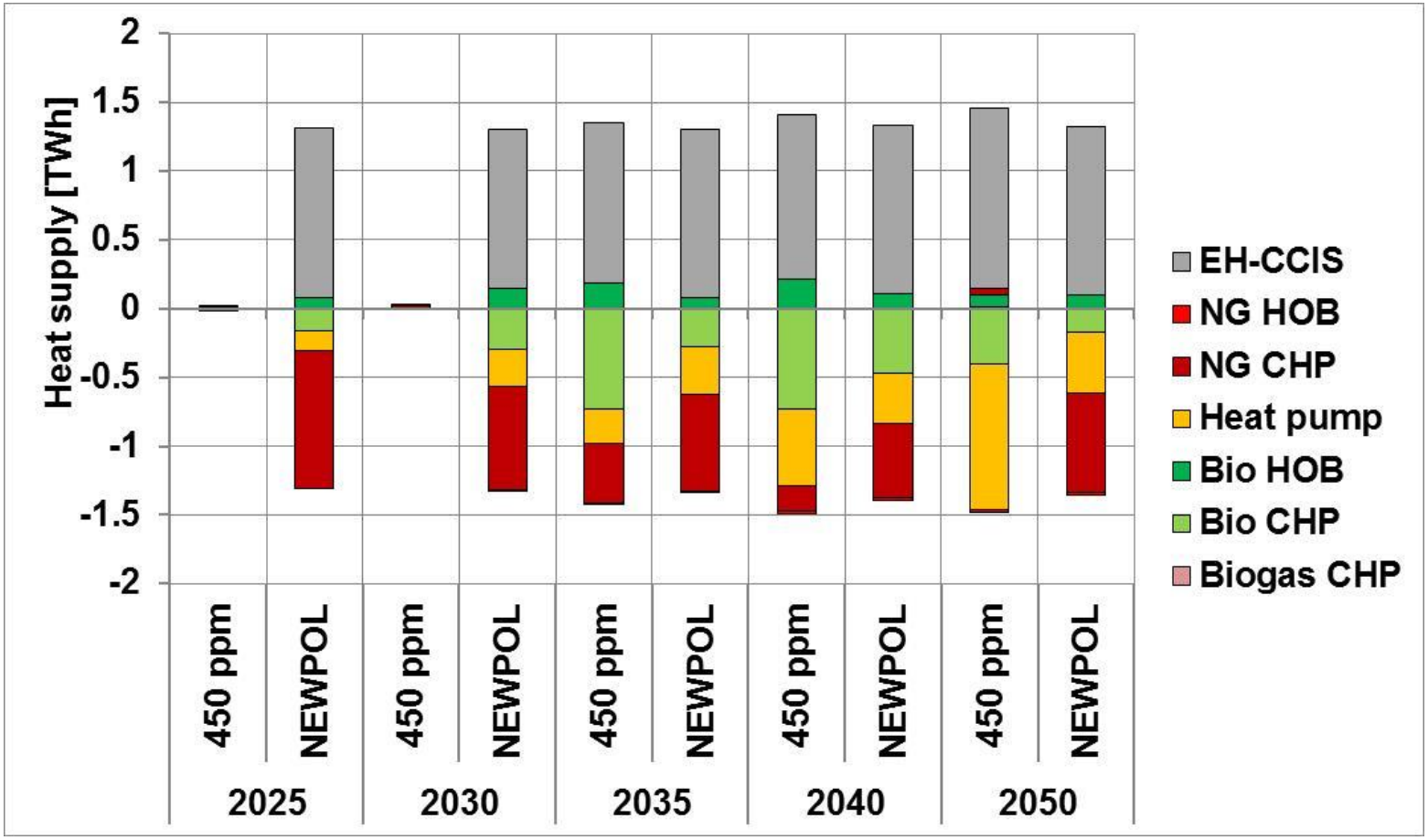
Does the model build the pipeline?

- Is this solution providing more welfare (more cost-efficient) that any other solution to supply the heat demand?

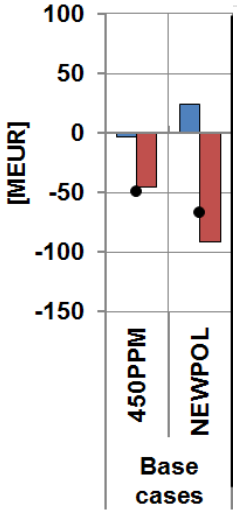
Resulting cost-optimized excess heat capacity

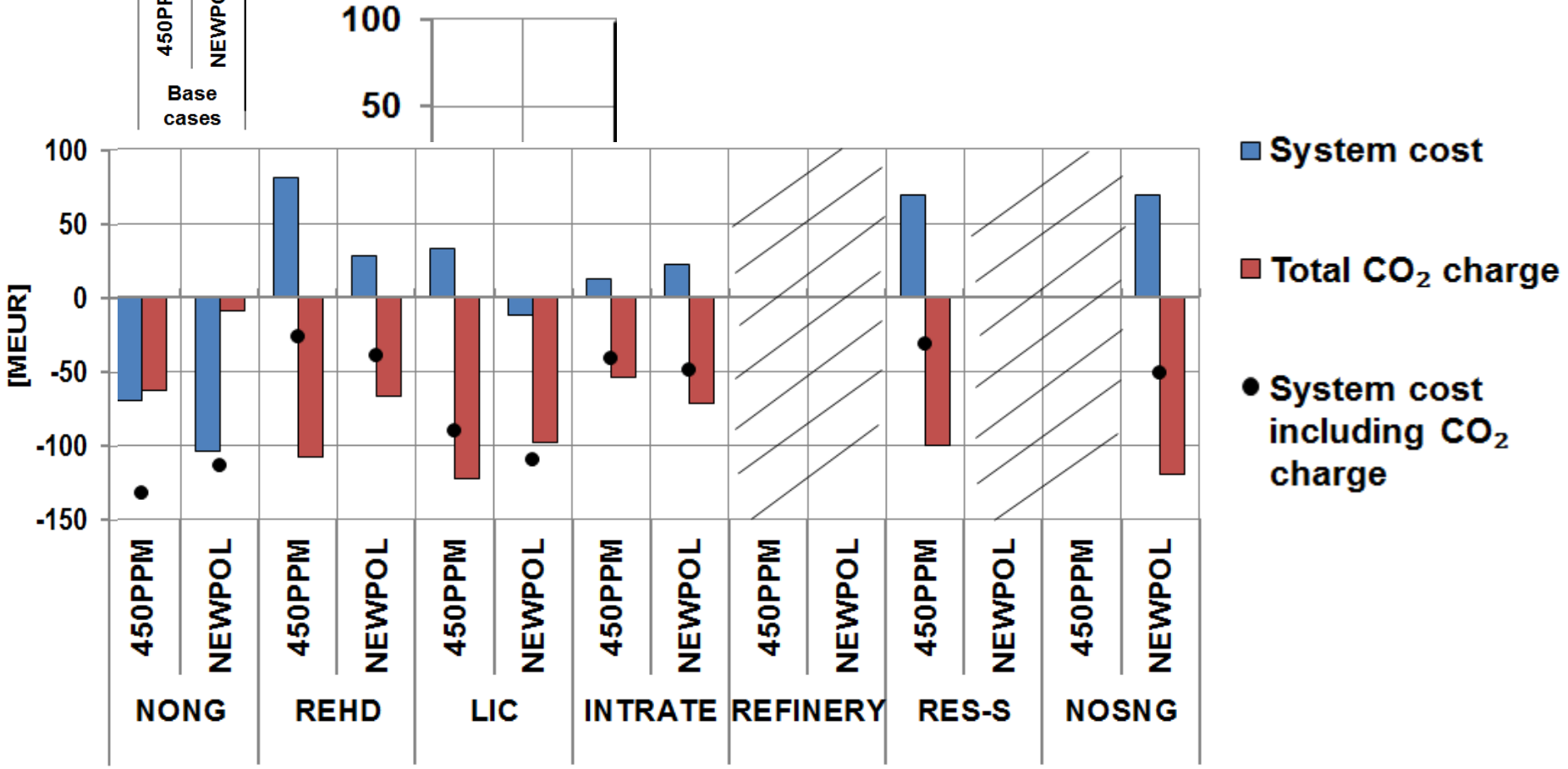


Change - regional district heat delivery

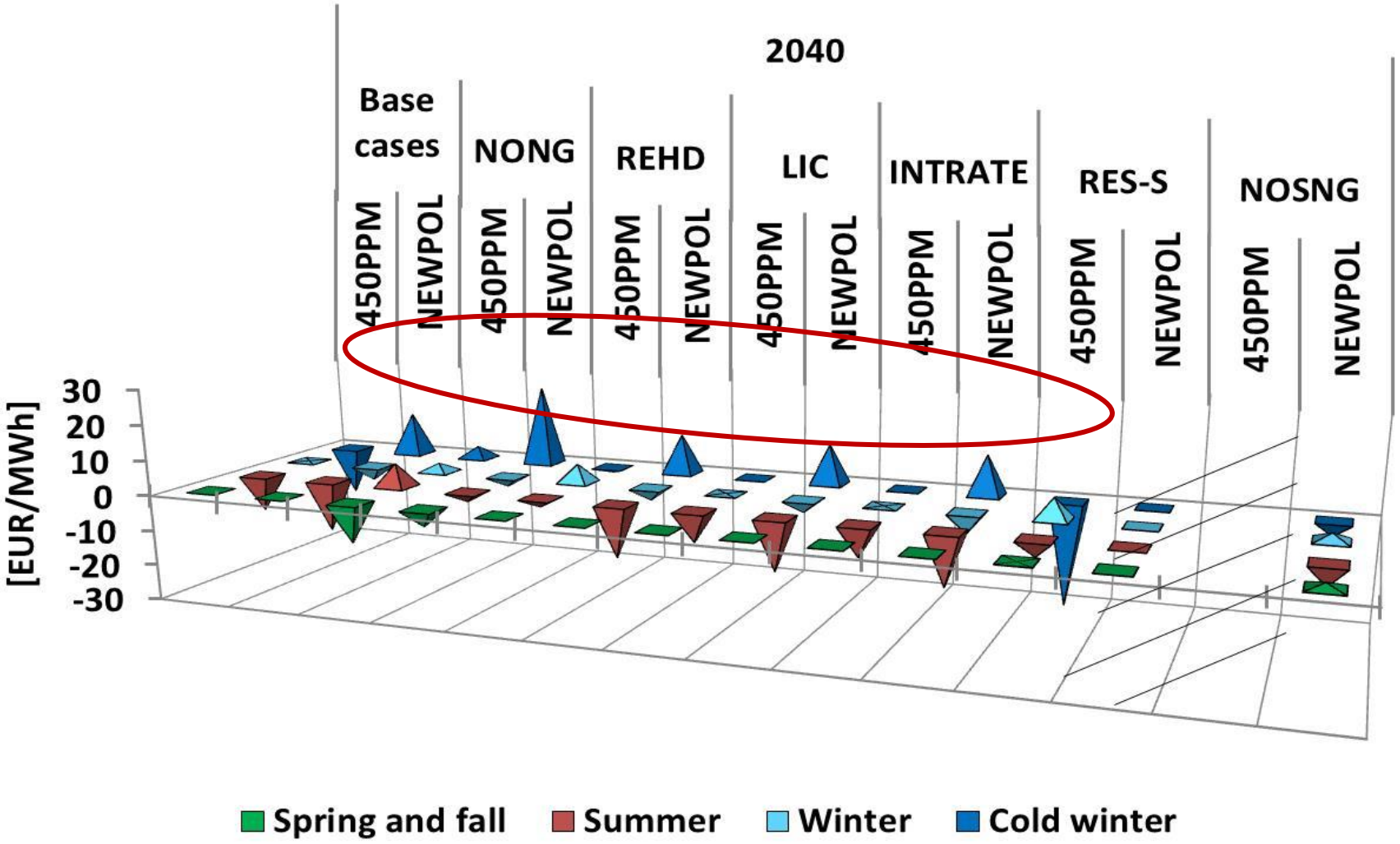


System cost change (I)

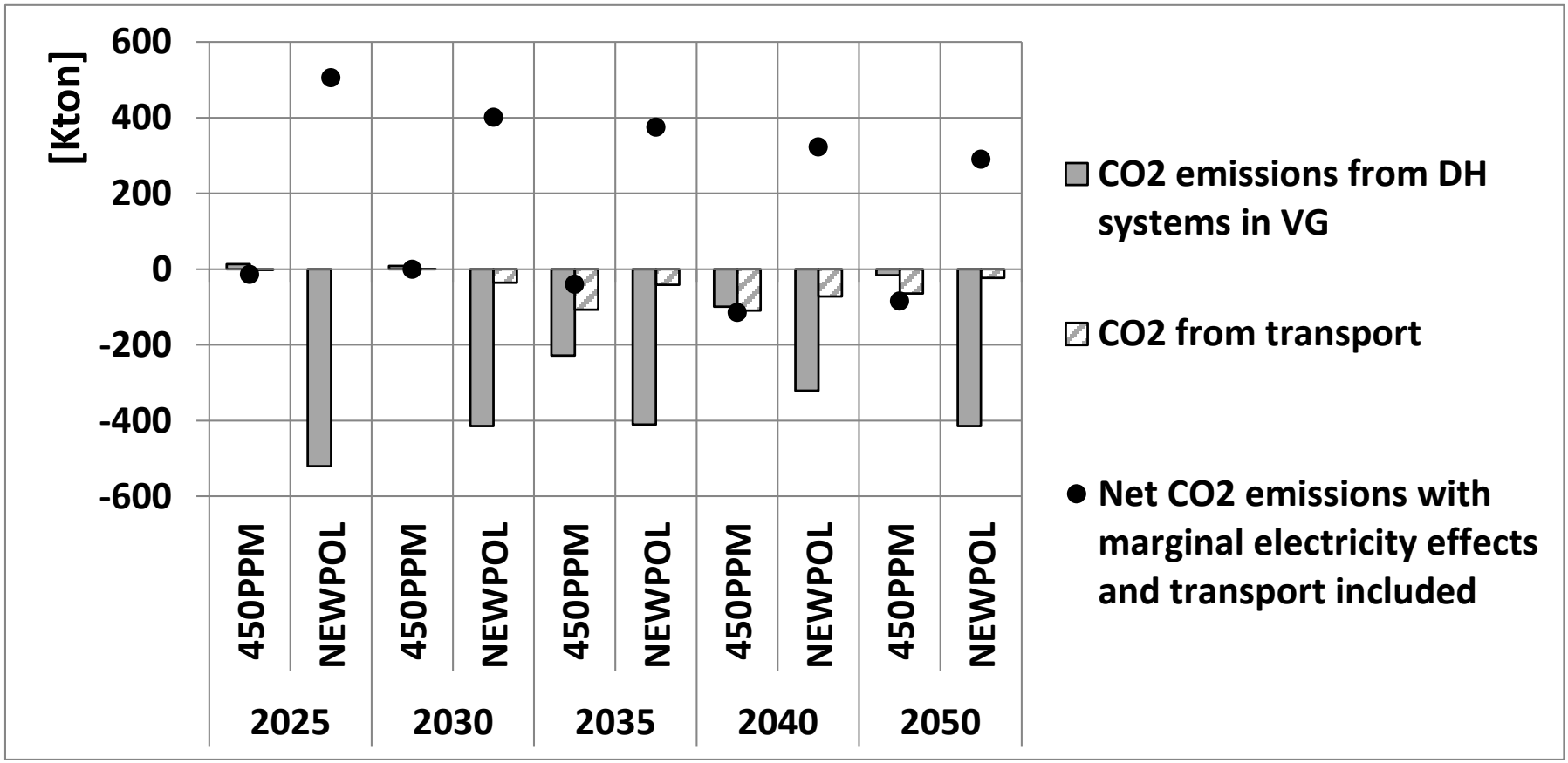




Marginal cost change (Göteborg)



Change - CO2-emissions



Other sustainability impacts?

- Acidification
- Eutrophication
- Job creation
- **Risk**

Conclusions

Investment profitable?  In most tested cases

Climate?  Dependent on perspective and marginal electricity

Generally? Complex system effects

Resource efficiency!

Process learning

- Collaboration
- Round-table discussions
  - Energy system model

Will it be built?

Thank you!

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