Danish Energy Agency

Trade-off between energy efficiency (EE) and renewable energy (RE) investments in a Danish context

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Overview

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Background

This presentation studies the possible trade-off between energy efficiency (EE) and renewable energy (RE) investments in a Danish modeling context.

- This trade-off reflects that increasing investments in EE could reduce the need to invest in RE technologies, by virtue of lowering final energy demand.

- On the other hand, if RE investments lead to lower electricity prices, then households and industry would have less of an incentive to invest in EE.

Understanding this trade-off is of key importance to policy makers, assuming that resource needed to meet long term climate policy goals are scarce.

Research Questions

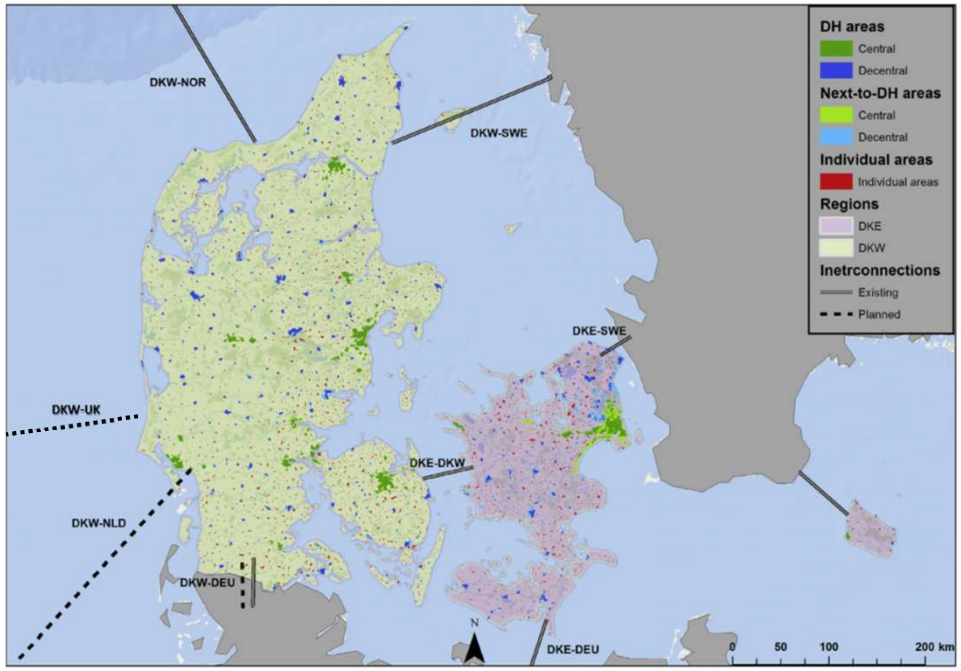
The presentation develops two set of comparative scenarios on top of the reference scenario to address the following questions:

I. What happens to optimal level of investments in EE in 2040, when investment in RE are changed exogenously relative to the reference scenario?

II. What happens to optimal RE investments, when EE investments are changed exogenously relative to the reference scenario?

TIMES-DK – Danish Energy System model

- 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



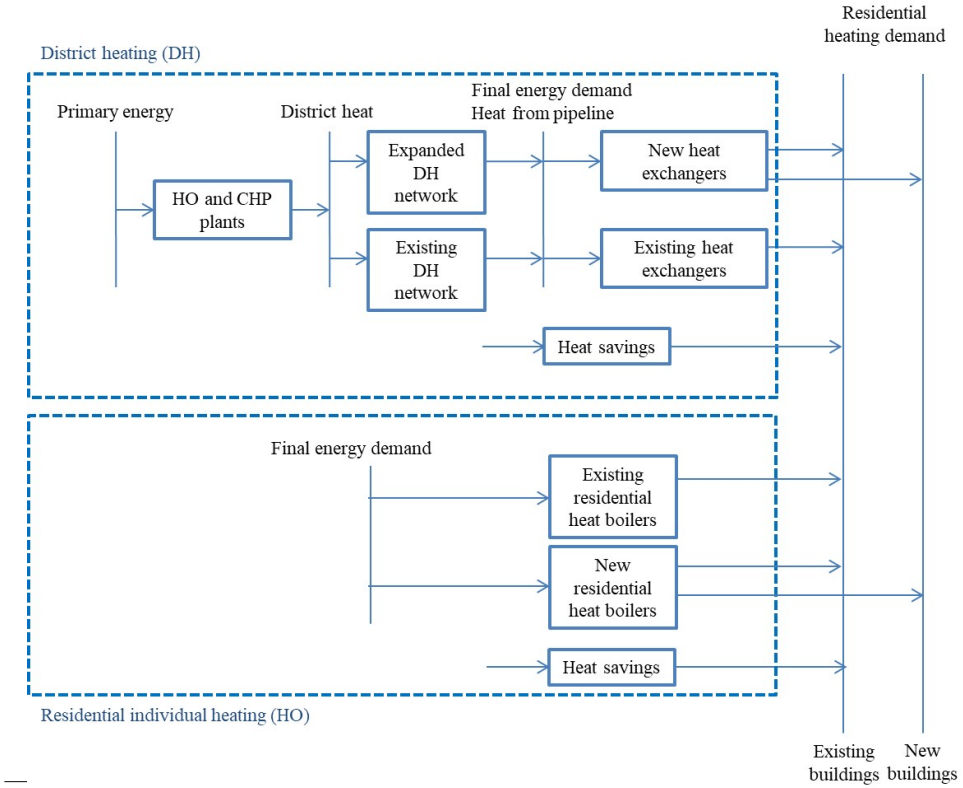
Modeling energy savings in TIMES-DK

The TIMES-DK model is the result of a growing need to prioritize and describe optimal socioeconomic pathways towards a low-emission society across all economic sectors.

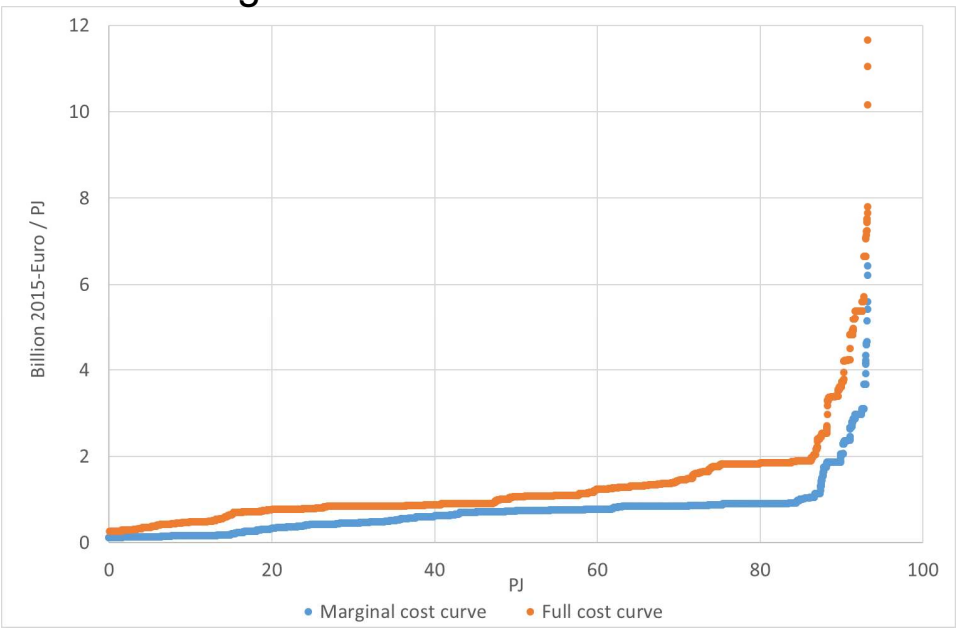
TIMES-DK has some distinct design features:

1. a detailed representation of heat demands and heat-saving measures by building type in the residential sector;
2. a detailed industry modeling which includes a rich representation of energy savings measures
3. the version of TIMES-DK used in this presentation further includes a representation of 60 district heating areas.

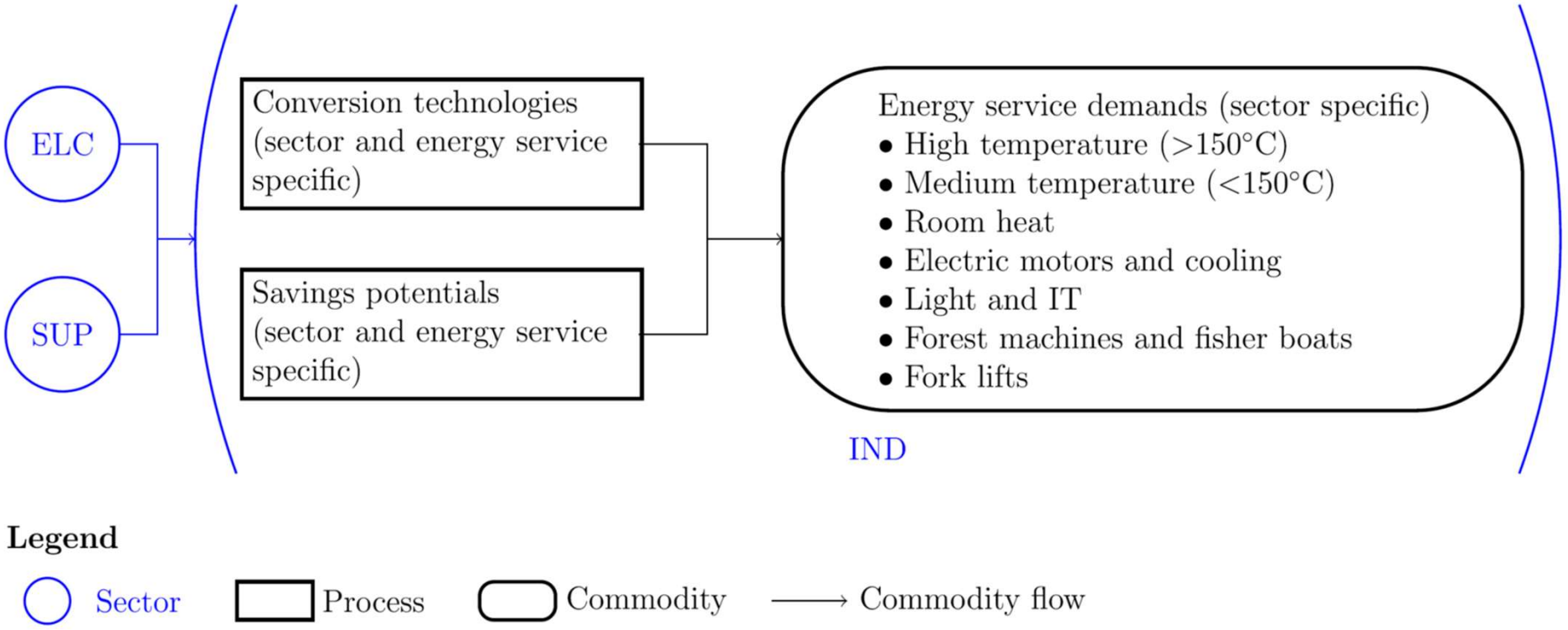
Modeling residential heating demand and savings



Full and marginal cost curves for residential heat savings

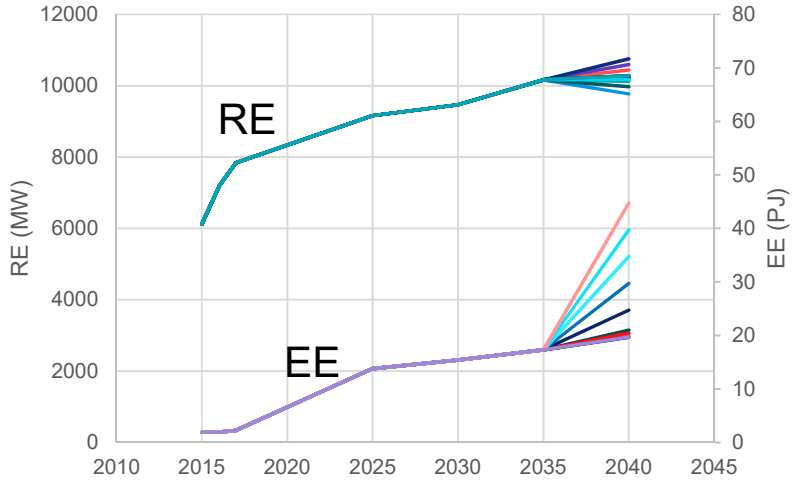


Modeling industrial energy service demand and savings



Reference scenario (until 2035)

- It is presumed that investment in RE corresponds to 275 MW of new capacity annually towards 2035.



- Households and firms investment in EE reflects numerous barriers to catch real-world behavior in the absence of energy efficiency policy measures.

Preliminary results

Increasing investments in RE

Exogenous		Endogenous	
Additional RE in 2040		Additional EE in 2040	
MW	*billion €*	*PJ*	*billion €*
155	0.17	2.6	0.40
195	0.22	2.5	0.38
235	0.29	2.5	0.37
275	0.36	2.4	0.34
315	0.40	2.4	0.34
355	0.42	2.4	0.34
395	0.44	2.4	0.34
	0.27		*-0.07*

Increasing investments in EE*

Endogenous		Exogenous	
Additional RE in 2040		Additional EE in 2040	
MW	*billion €*	*PJ*	*billion €*
275	0.36	2.4	0.34
272	0.36	3.4	0.51
267	0.35	4.4	0.72
260	0.34	5.4	0.99
254	0.32	6.4	1.28
247	0.31	7.4	1.63
	-0.05		*1.29*

**These results do not consider benefits from EE-investment in terms of avoided investment in grid expansion*

Conclusion and future work

Conclusions

- Investing in RE may have a significant spillover effect by reducing investment in EE in case the RE investment reduces the price of electricity faced by firms and consumers.
- Within the applied modeling framework (TIMES-DK), investing in EE has a small effect on the level of investment in RE. However, note that the analysis does not account for the avoided investment in grid expansion from increasing investment in EE.
- The need to prioritize and describe optimal socioeconomic pathways towards a low-emission society across all economic sectors requires an energy system approach like the TIMES-DK model.

Limitations and future work

- TIMES-DK only models the Danish Energy system, whereas the interaction with neighboring countries is modelled using price profiles and availability factors. Future work should examine uncertainties with respect to these assumptions.
- The version of TIMES-DK model used here, does not consider a number of new technologies; such as power-to-X technologies. Adding such technologies to TIMES-DK could potentially change the dynamics surrounding EE and RE trade-off.

Thank you for the attention!

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