

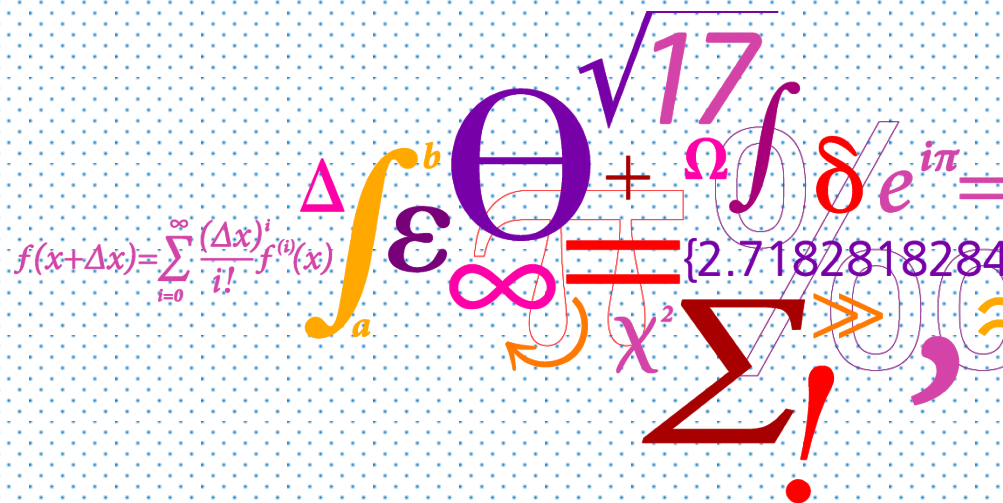
District heating and heat savings in the future Danish energy system – insights from TIMES-DK model



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Model built by:

- Energy Systems Analysis group, DTU
- IntERACT group, Danish Energy Agency
- E4SMA

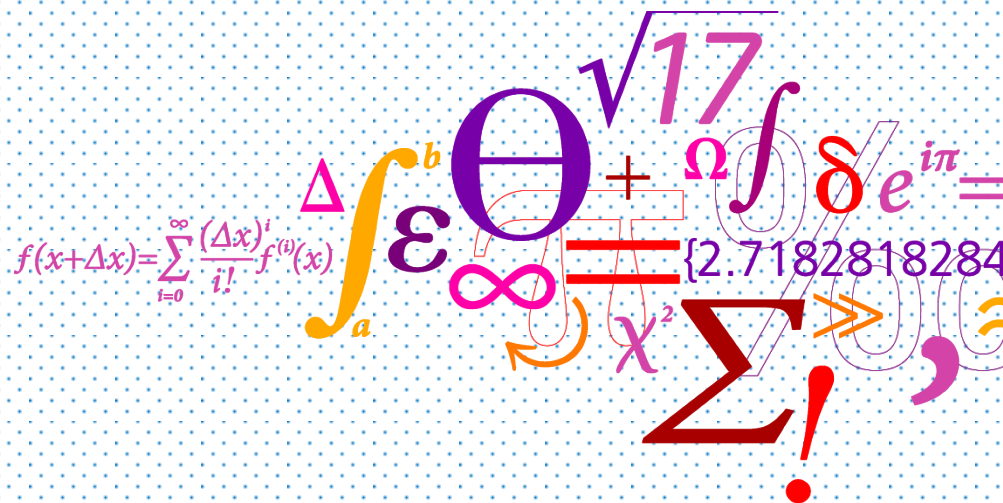


District heating and heat savings in the future Danish energy system – insights from TIMES-DK model



Presentation plan

- Heat savings and district heating in the past 40 years
- Modelling of heat savings in TIMES-DK
- Modelling of district heating in TIMES-DK
- Heat savings and district heating until 2050 – results from TIMES-DK



Heat savings and district heating in the past 40 years

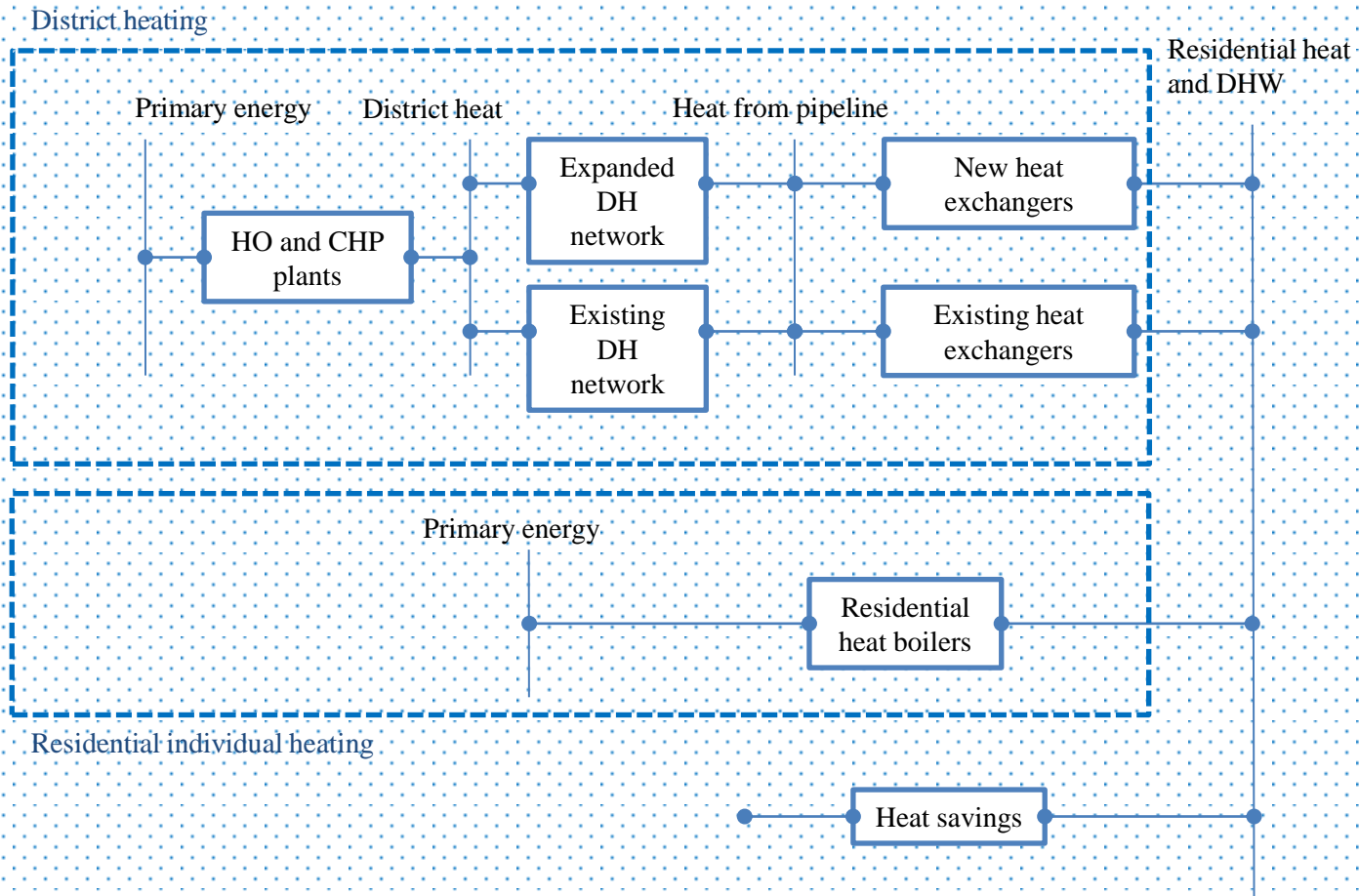


- Denmark was totally dependent on the import of oil in 1973
- Oil has been replaced by the mix of natural gas, coal and renewables
- Primary energy supply remained the same
- Despite the growth in building mass by more than 50%, primary energy consumed for heating decreased by more than 30 %
- District heating share increased from 28 % to 54 %

Danish goals for the future

- 50 % of electricity production from wind starting from 2020
- No fossil fuels in production of electricity and heat from 2035
- No fossil fuels in society starting from 2050
- **What is the role of heat savings and district heating ?**

Supply of heat and DHW in TIMES-DK



Heat savings in TIMES-DK



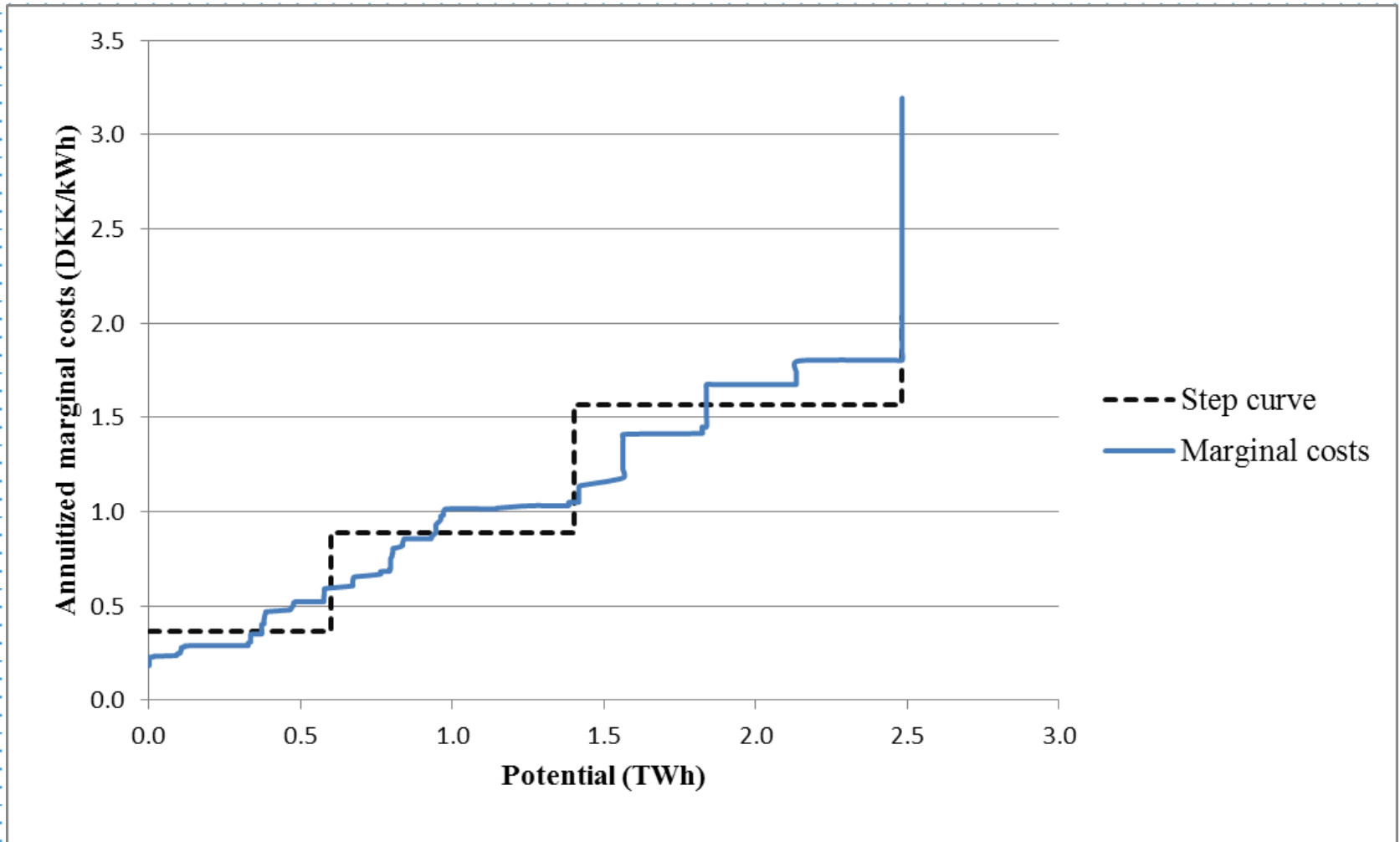
Heating Model

- Detailed calculations of potentials and costs are done for 72 building types
- Different levels for five different elements (walls, floors, ..) were considered
- Least expensive level was chosen for each element

Inputs to TIMES-DK

- Curves of potentials and costs have been grouped by:
 - region (DKE and DKW)
 - building type (Detached and Mulstistorey)
 - construction year (built before and after 1972)
 - position relative to existing district heating areas
(Central, Decentral, Individual)
- Curves of potentials and costs have been approximated with three step-curves

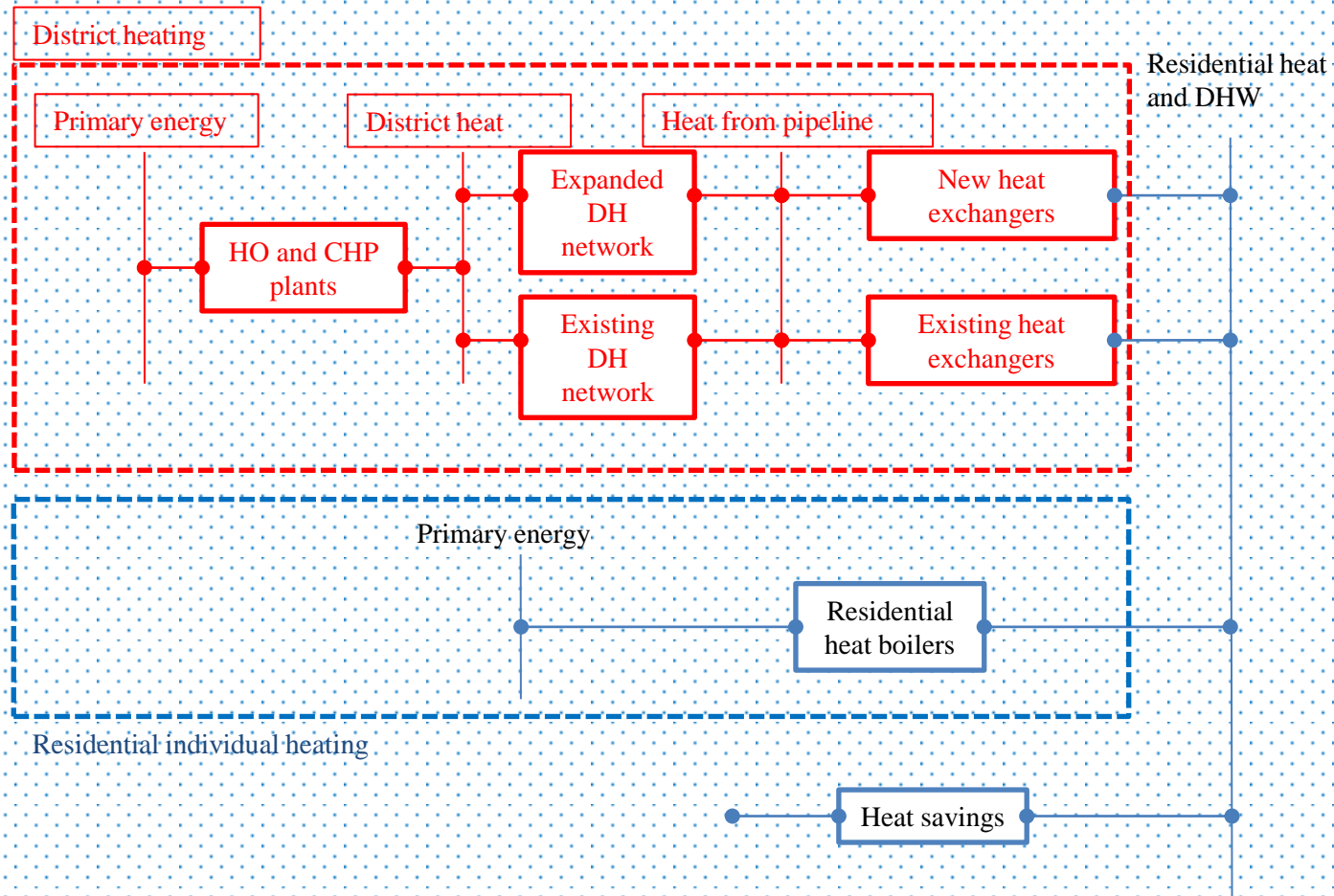
Heat savings in TIMES-DK – potentials and costs



Heat savings in TIMES-DK

- Heat savings deliver "heating services" according to heat degree days without DHW
- Heat savings are delivering "heating services" without any operation costs
- Different "steps" of heat savings have different lifetimes ranging from 30 to 40 years

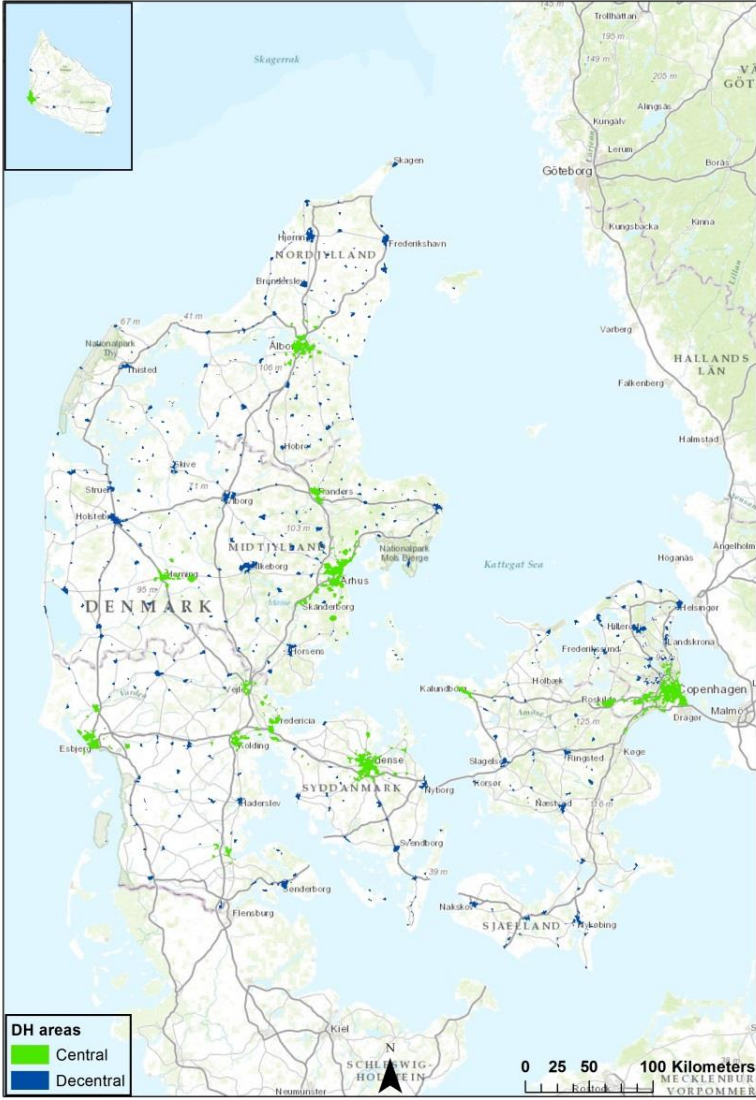
District heating in TIMES-DK



District heating in TIMES-DK

- Two geographical regions: DKE and DKW
- Two types of district heating networks: Central and Decentral

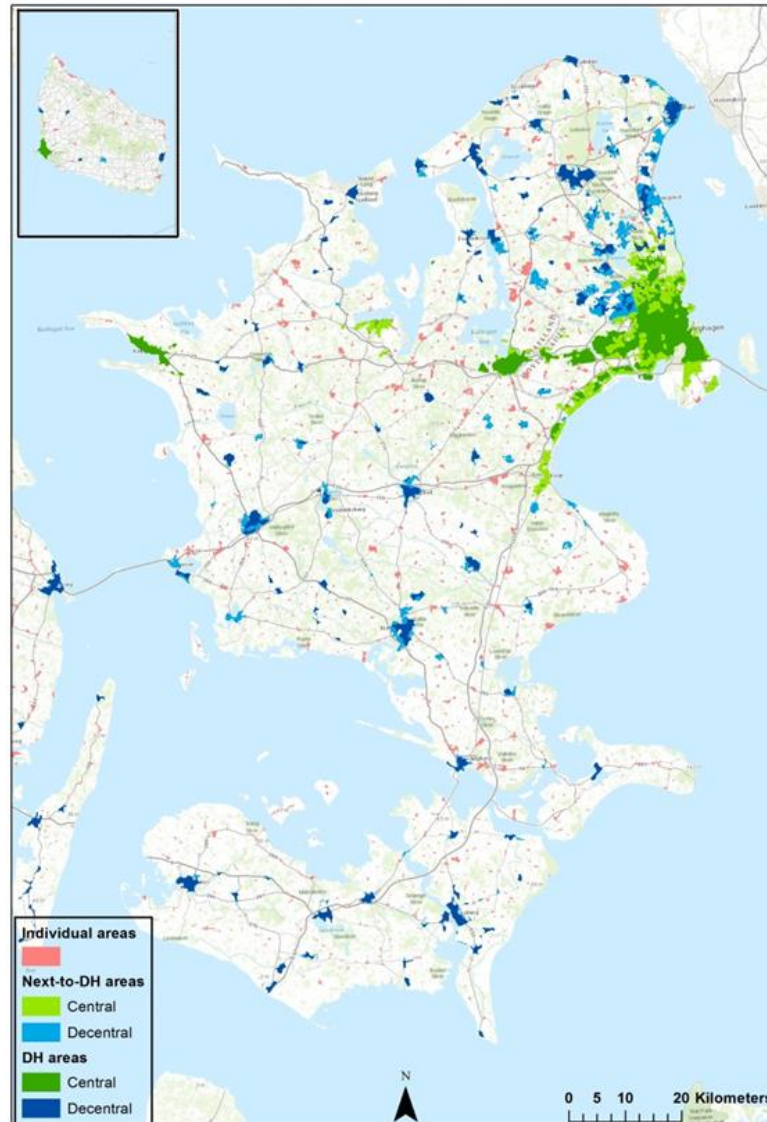
District heating in TIMES-DK – Central and Decentral areas



District heating in TIMES-DK

- Two geographical regions: DKE and DKW
- Two types of district heating networks: Central and Decentral
- Two types of district heating areas: DH and Next-to-DH areas

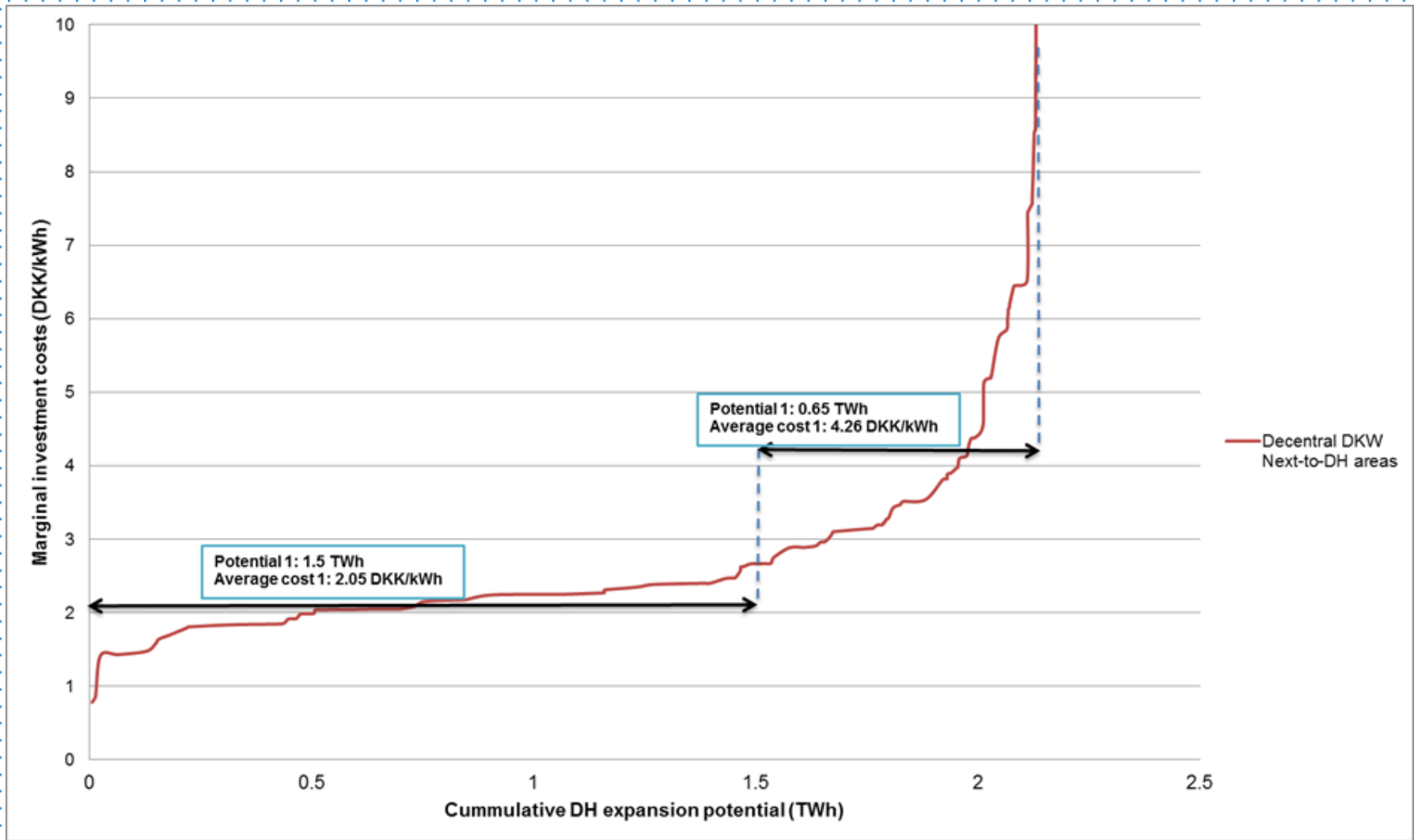
District heating in TIMES-DK – DH and Next-to-DH areas



District heating in TIMES-DK

- Two geographical regions: DKE and DKW
- Two types of district heating networks: Central and Decentral
- Two types of district heating areas: DH and Next-to-DH areas
- Two types of expansion of DH – within existing DH areas and to Next-to-DH areas
- Potentials and costs of expanding DH networks have been approximated with two-step curves

District heating in TIMES-DK – expansion curves



District heating in TIMES-DK

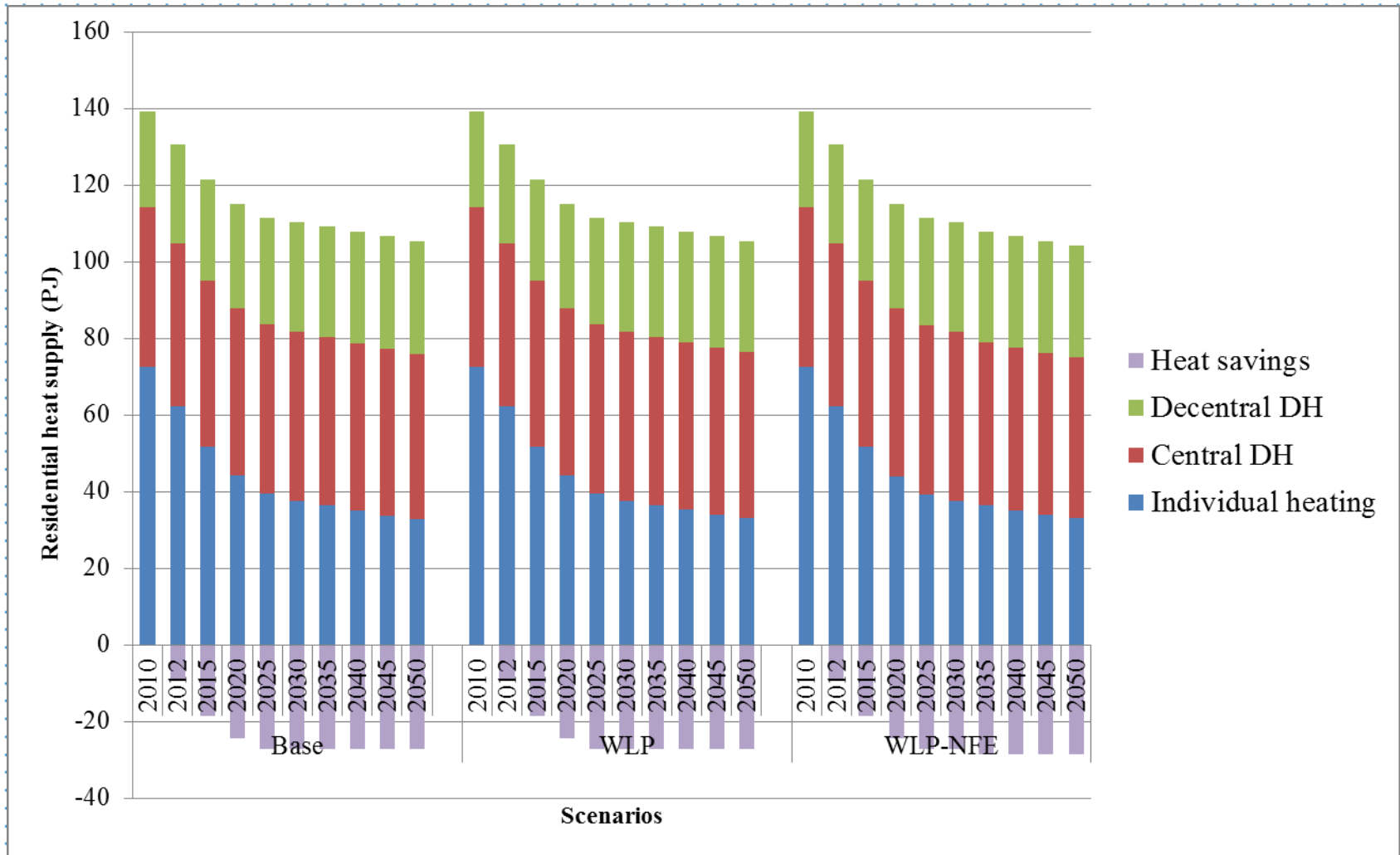
- Two geographical regions: DKE and DKW
- Two types of district heating networks: Central and Decentral
- Two types of district heating areas: DH and Next-to-DH areas
- Two types of expansion of DH – within existing DH areas and to Next-to-DH areas
- Potentials and costs of expanding DH networks have been approximated with two-step curves
- Lifetimes and invest. costs are different for distribution pipes and connecting pipes and heat exchangers

Results from TIMES-DK

Three analysed scenarios:

- Base – base scenario without any policy measures being implemented.
- WLP (Wind Low Production) – starting from 2020 at least 50 % of electricity needs to be produced from wind power.
- WLP-NFE (Wind Low Production – Non Fossil Energy) – in addition to WLP scenario, no fossil fuels are used for production of electricity and heat after 2035 and no fossil fuels in the energy system from 2050

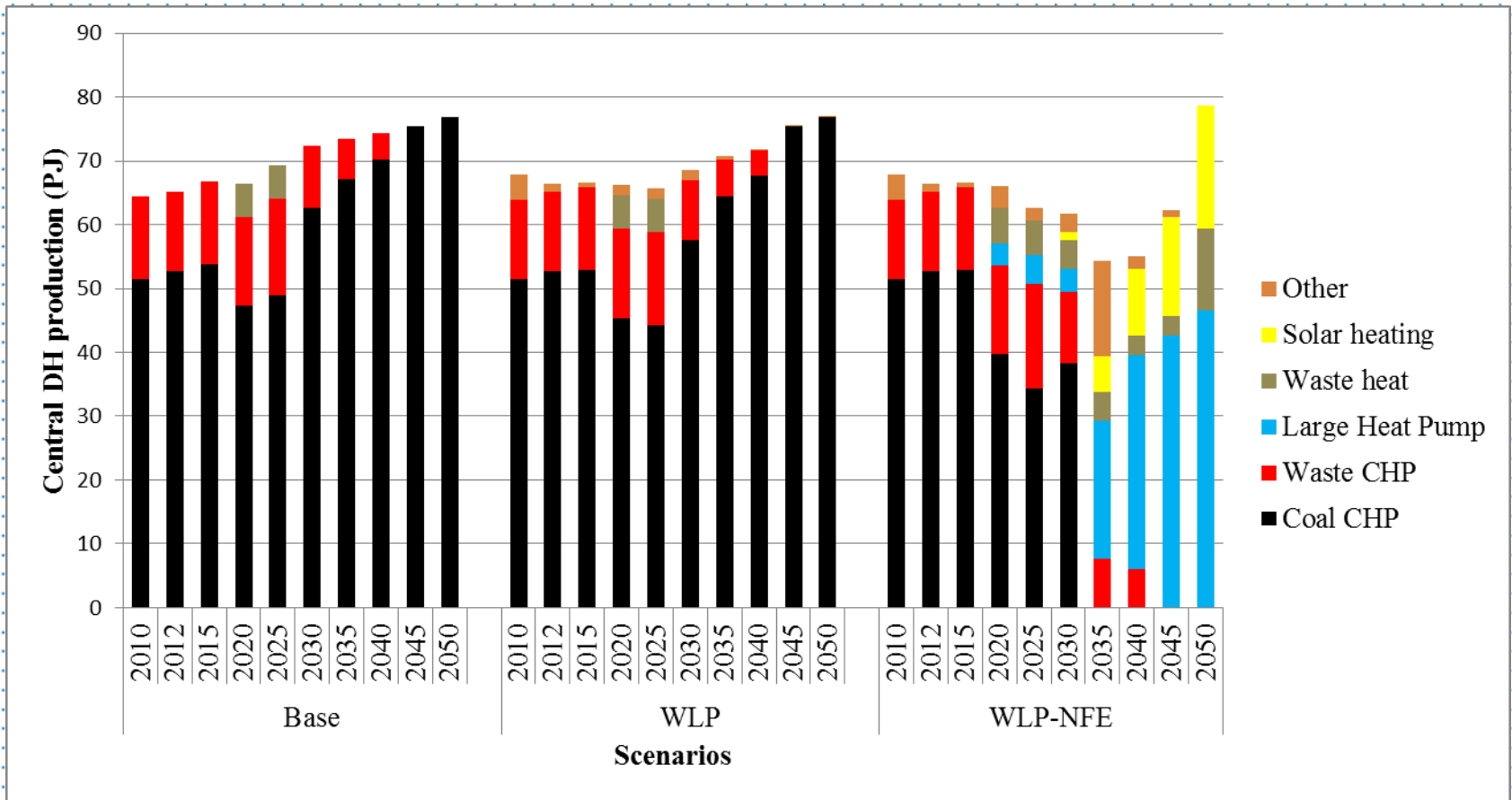
Results from TIMES-DK – Heat supply



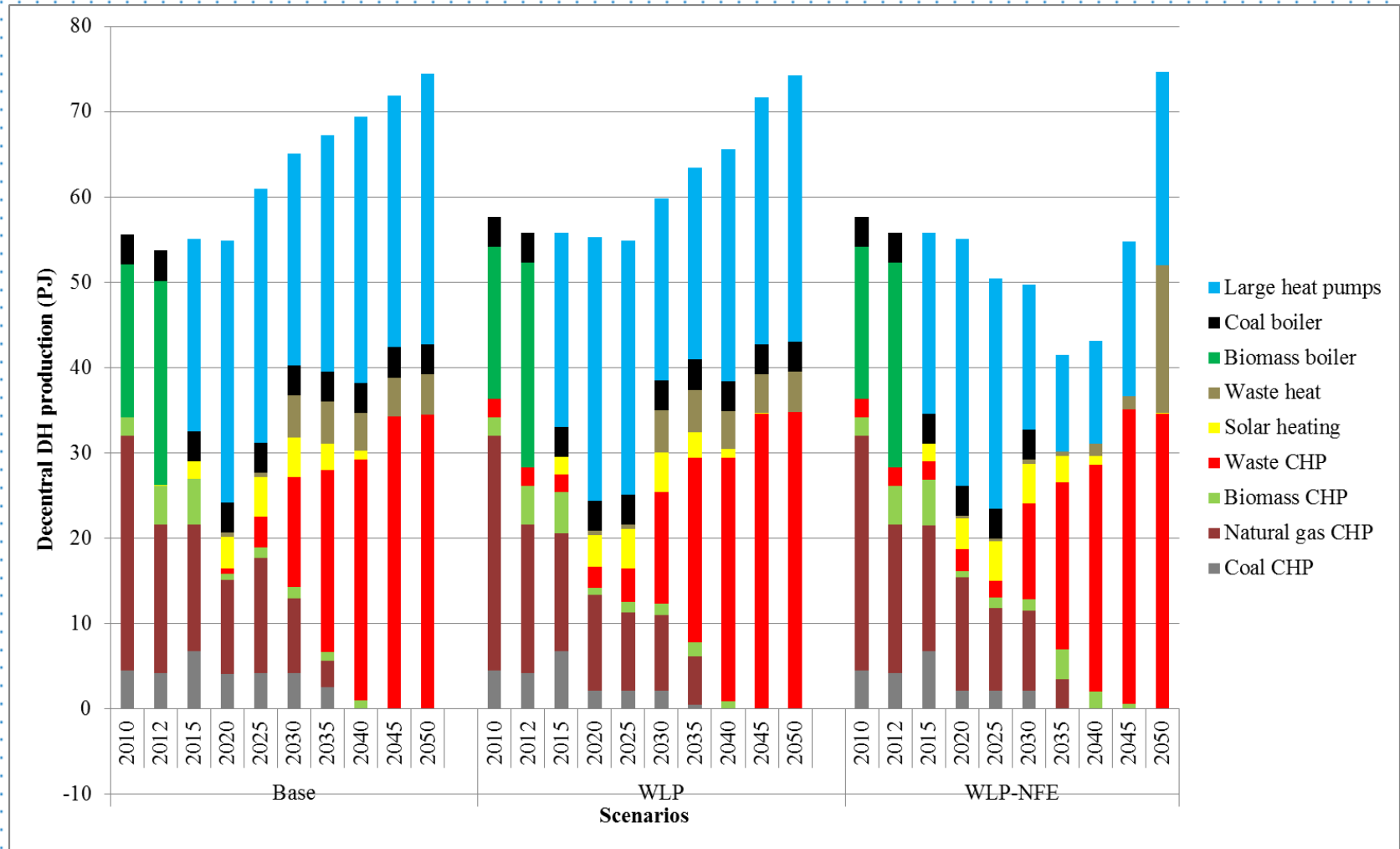
Results from TIMES-DK – District heating share



Results from TIMES-DK – Central DH production



Results from TIMES-DK – Decentral DH production



Conclusion

- Reduction of heating demand by 24-26% by 2050, corresponding to 33-35% reduction of specific heating demand
- District heating share is between 68 and 70% in 2050
- In WLP-NFE scenario Central DH production switches to large HPs, solar heat and waste heat from biorefineries
- In all scenarios Decentral DH production switches to large HPs, waste fuelled CHPs and waste heat from biorefineries
- Total system costs are only 2.5 % higher in in WLP-NFE than in Base scenario

Thank you for your attention



- Questions
- Answers
- Comments
- Suggestions

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