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NEO WP3

RQ5 and 6 results



Teknologi for et bedre samfunn



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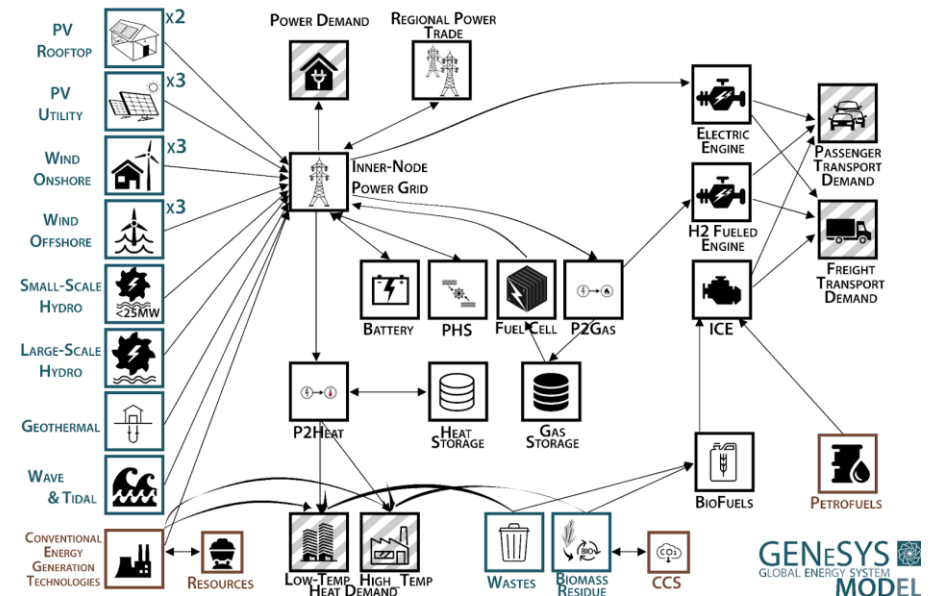
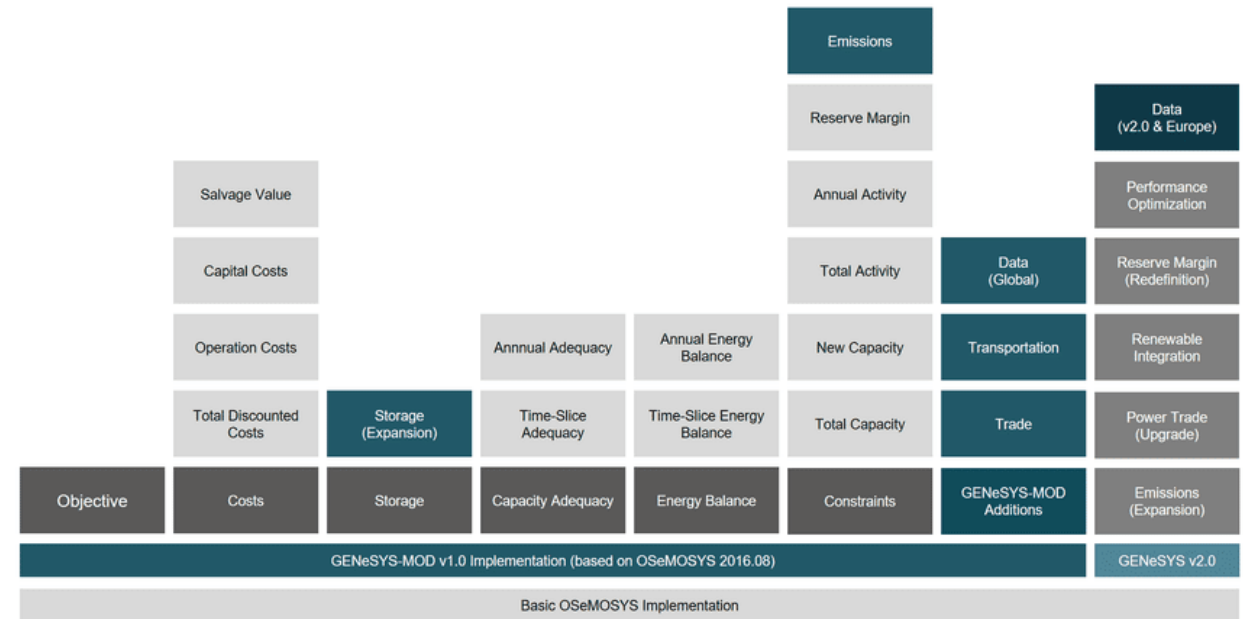
Introduction

Research questions

- RQ 5:
 - How can datasets be improved to represent the Nordic industries, and what gains can be achieved from the increasing level of detail in the industrial sector?
- RQ 6:
 - How can different energy efficiency and conservation measures in industry and buildings be included in energy system models?

GENeSYS-MOD

- Stands for "Global Energy System Model"
- Originally based on OSeMOSYS
- Open source, multi-energy multi-sectoral capacity expansion planning model
- Sectors represented:
 - Power
 - Industry
 - Buildings
 - Transportation



Scenarios – RE-BUILDS model

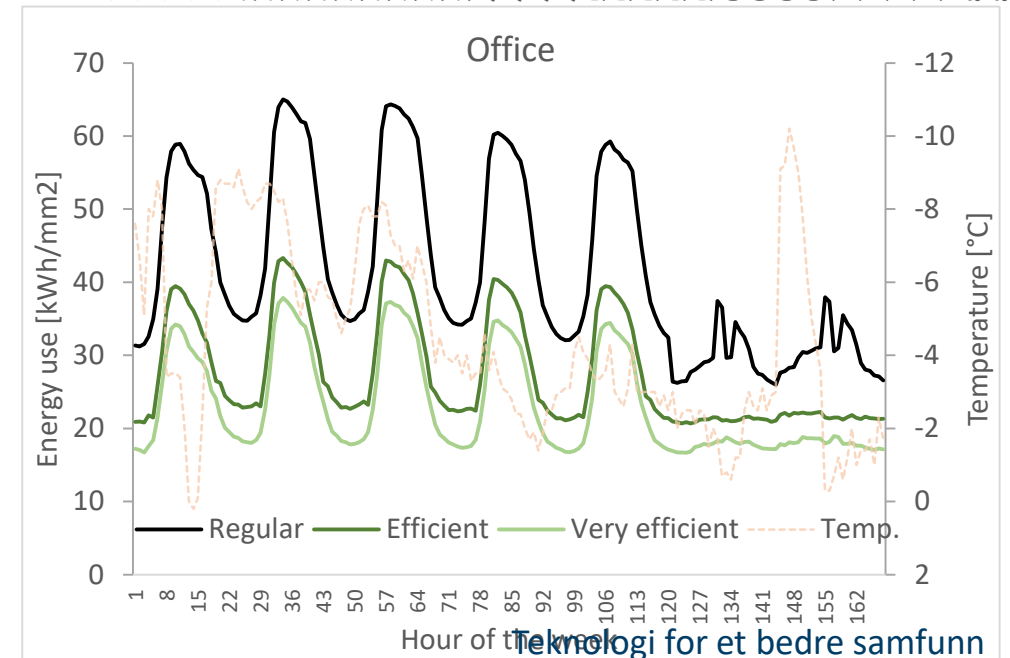
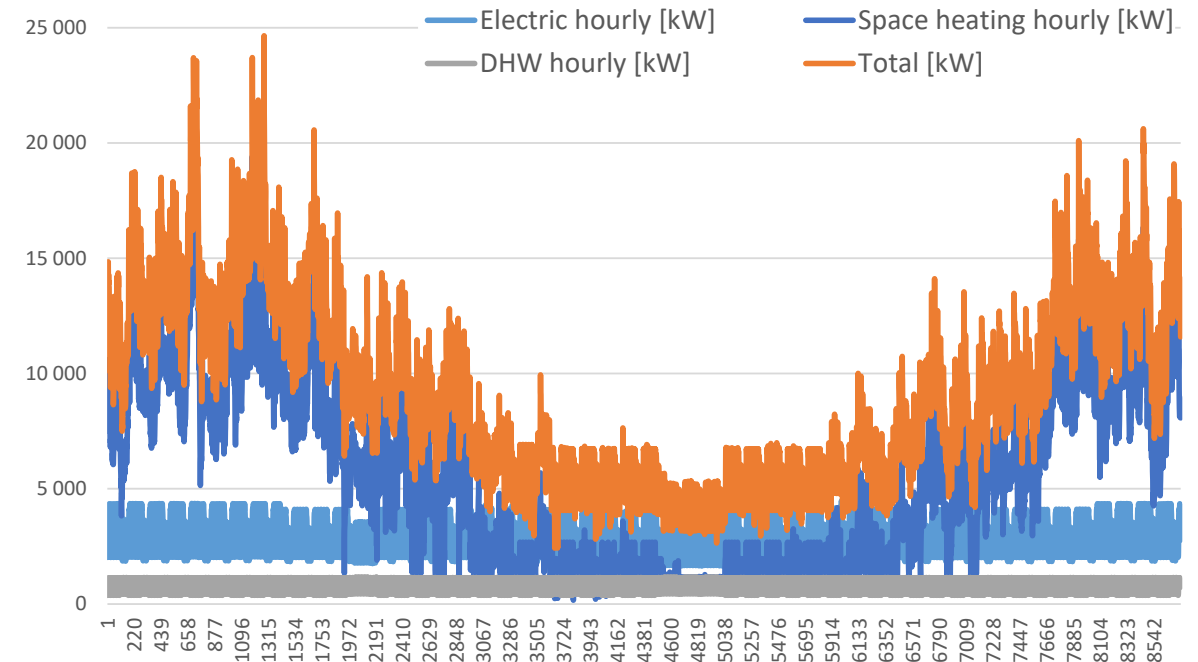
Scenario	Energy efficiency (building envelope)
1-Baseline	BAU • New construction: TEK17 (current standard) • 20% of renovated buildings are energy upgraded
2-MaxEff	MAX • New construction: passive house • 100% of renovated buildings are energy upgraded

Building mass [m²] grows by ca. 16% in 2050 in both scenarios

PROFet

energy demand load profiles estimator

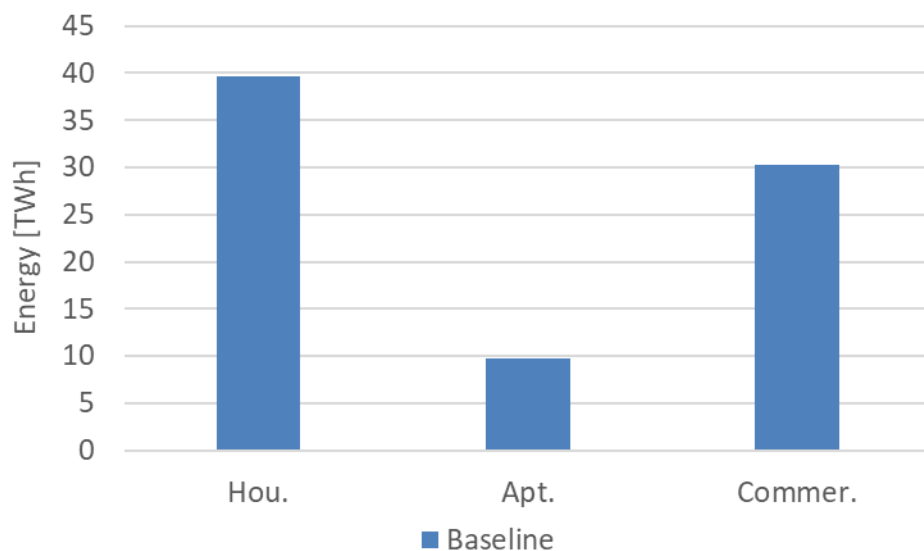
- Built on "trEASURE", database with energy measurements from 2,5 mill m² building area
- Method based on 2 PhDs + scientific papers:
 - Pedersen (2007) and Lindberg (2017)
 - (Lindberg, Bakker and Sartori, 2019), ++
- 11 building categories
- 3 efficiency levels
 - Regular (average of the existing)
 - Efficient (TEK10)
 - Very efficient (passive house)
- 3 energy purposes
 - Space heating
 - Domestic hot water
 - Electricity



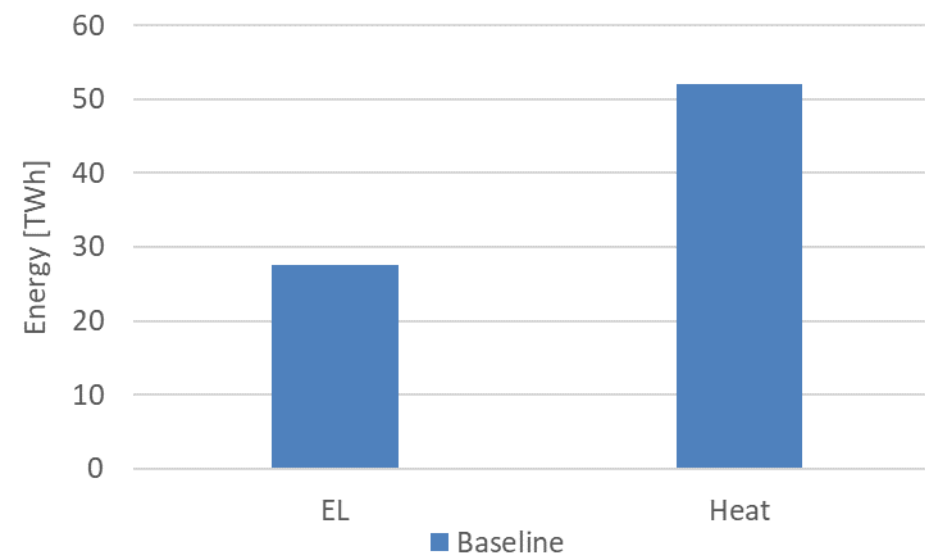


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Energy demand in 2020



TWh	Hou.	Apt.	Commer.
Baseline	40	10	30

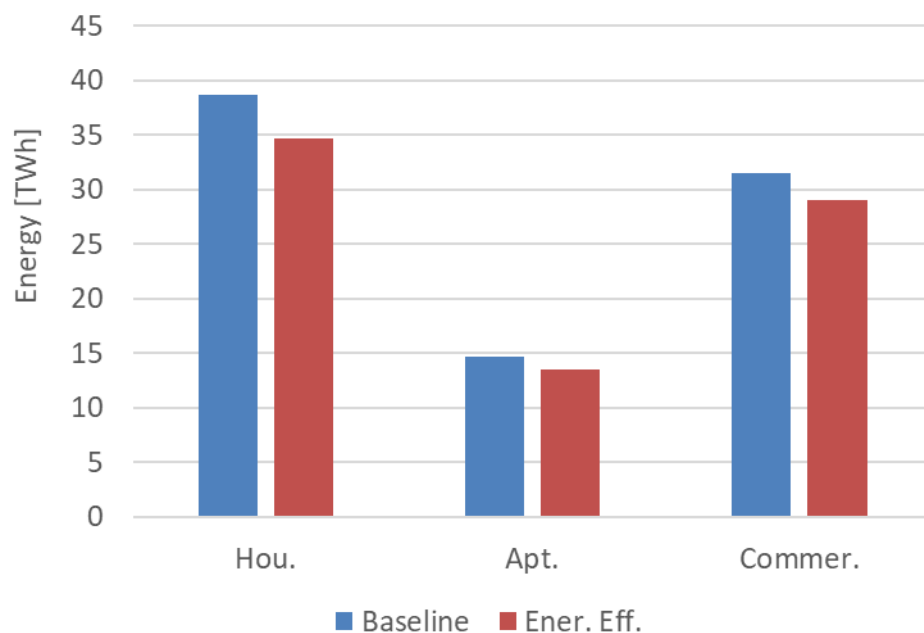


TWh	EL	Heat	Total
Baseline	28	52	80

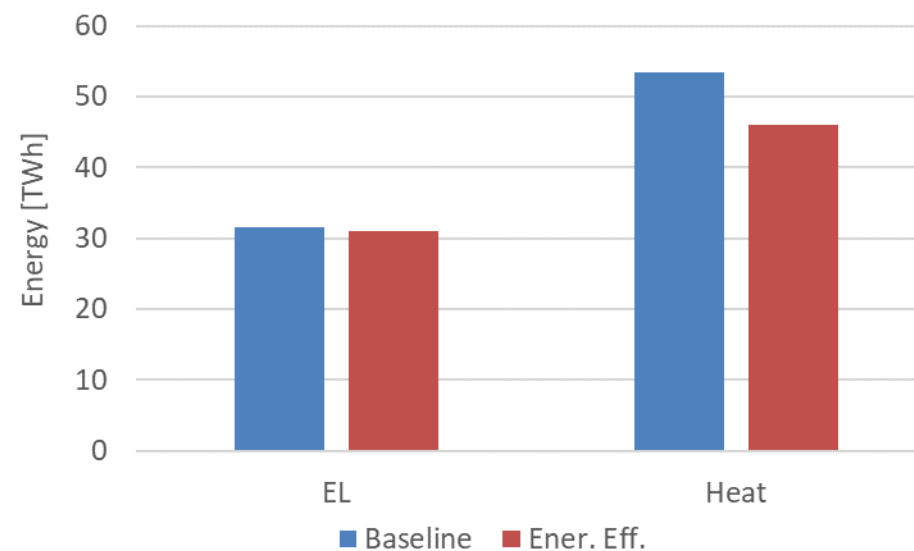


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Energy demand in 2050



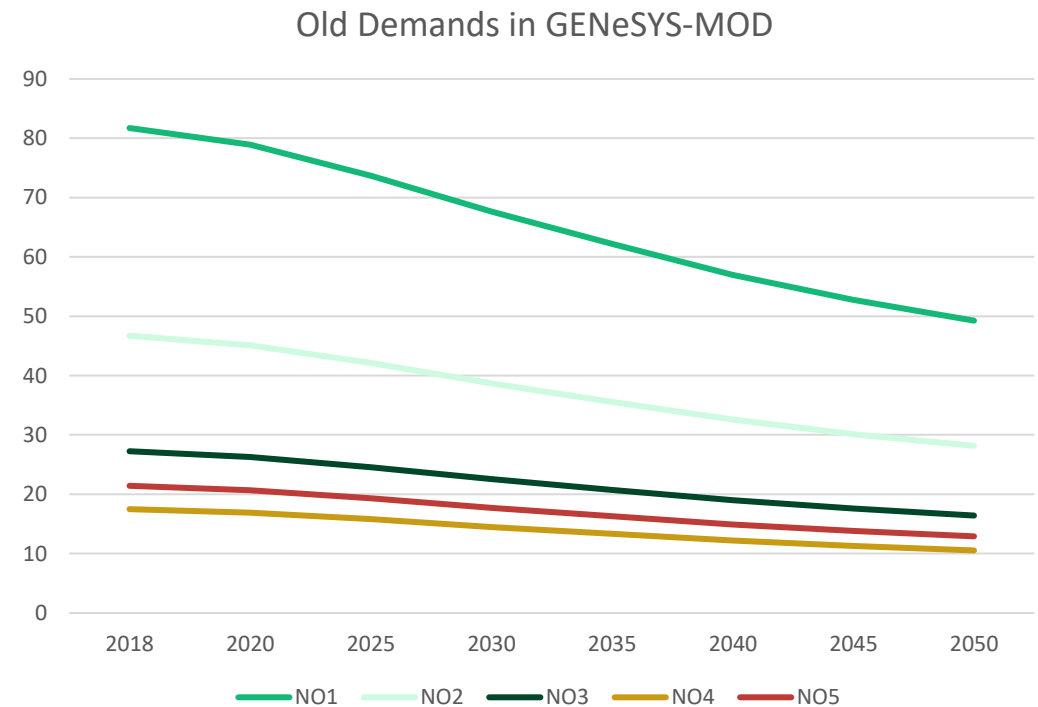
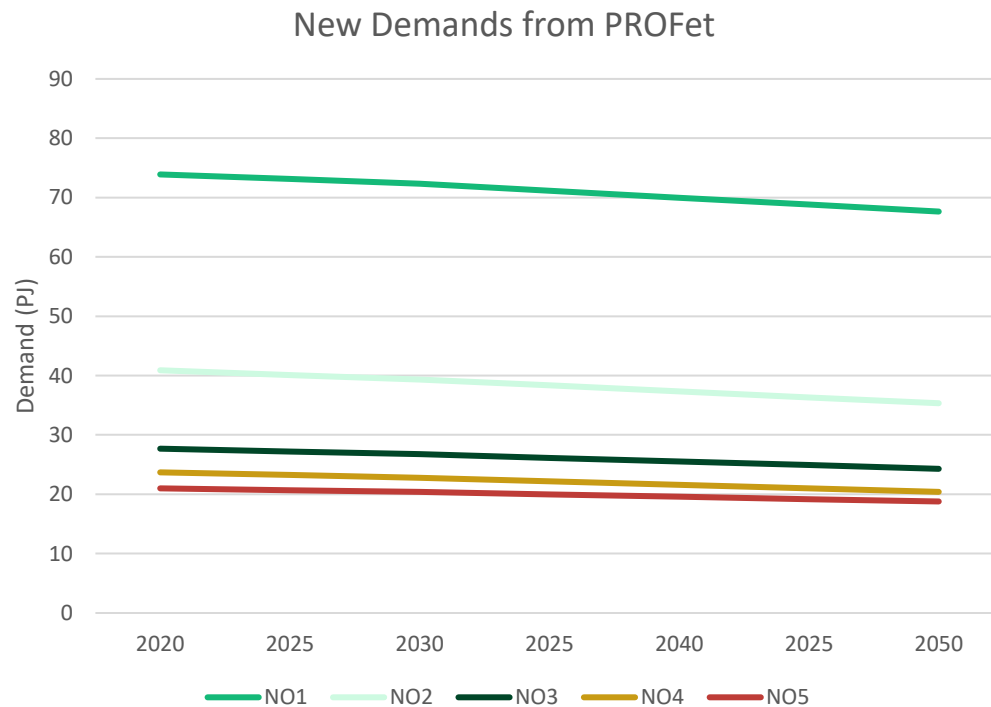
TWh	Hou.	Apt.	Commer.
Baseline	39	15	31
Ener. Eff.	35	14	29



TWh	EL	Heat	Total
Baseline	32	53	85
Ener. Eff.	31	46	77

Residential demand data for Norway

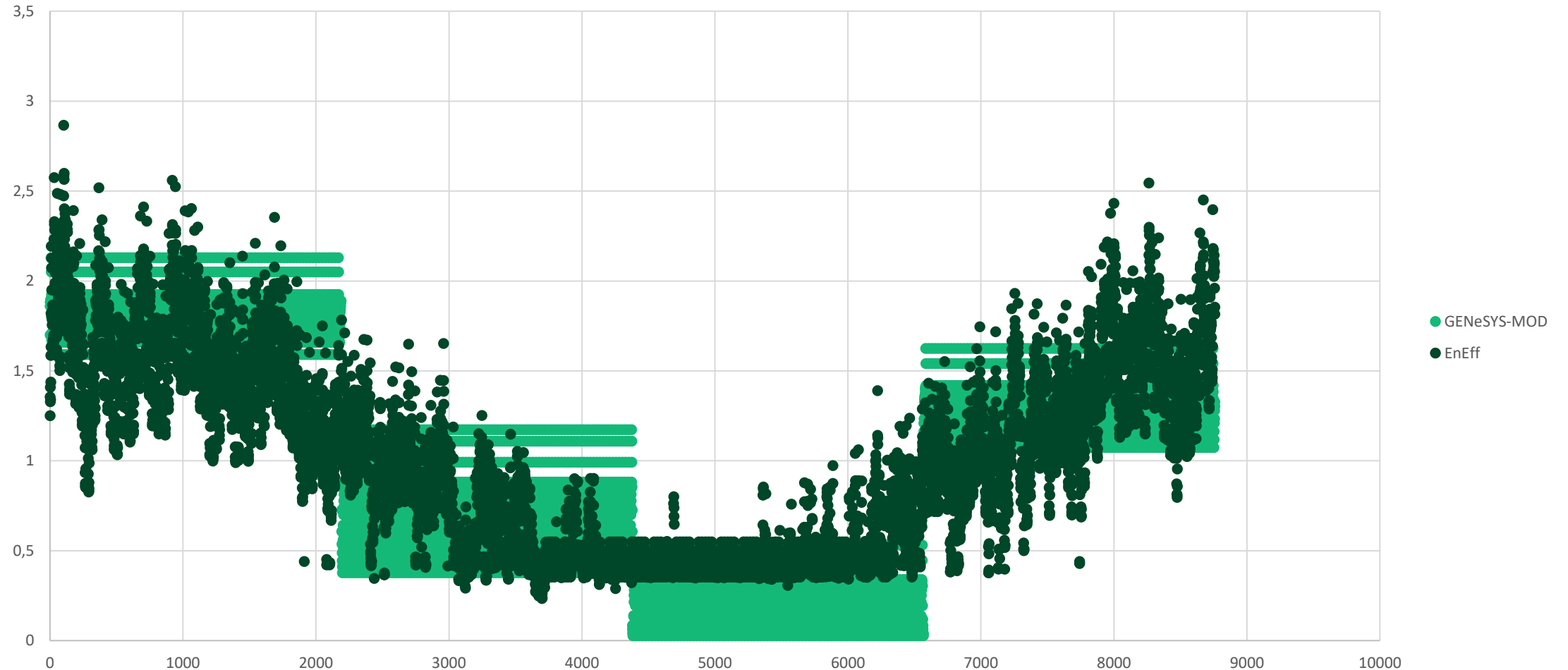
- New values are higher than original





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Residential demand data for Norway



Residential Demand for Rest of Nordics

- Heat specific demand for Sweden, Denmark and Finland
 - Discussion with IVL and ENS provides different sources of data
 - No heat specific demand and different scopes
 - Compare evolution of the demand in GENeSYS-MOD dataset and results from NCES Carbon Neutral Nordic scenario
 - Change in demand between 2020 and 2050:

Country	GENeSYS-MOD	NCES CNN
DK	-25%	-22%
SE	-20%	+3%
FI	-19%	-43%

- Large difference in absolute demand between the models for Finland and Sweden.
 - We keep the values to have a better basis of comparison

Improved Industrial Sector representation in Norway

- In GENeSYS-MOD, 3 temperature ranges for industry:
 - Low (<100C)
 - Medium (100 – 1000C)
 - High (>1000C)
- Disaggregation of the medium temperature range in Norway for more accuracy:
 - 100-150C
 - 150-200C
 - 200-500C
 - 500-1000C
- Updated total industrial heat demand according to NVE statistics

Improved Industrial Sector representation in Norway

- New technologies:
 - Heat pump for low temperature industrial heat
 - Heat pump for medium temperature industrial heat (up to 500C)
- Representation of waste heat as input to the industrial heat pump
- Natural gas reforming must use temperatures >500C in Norway
- Heat to power technologies



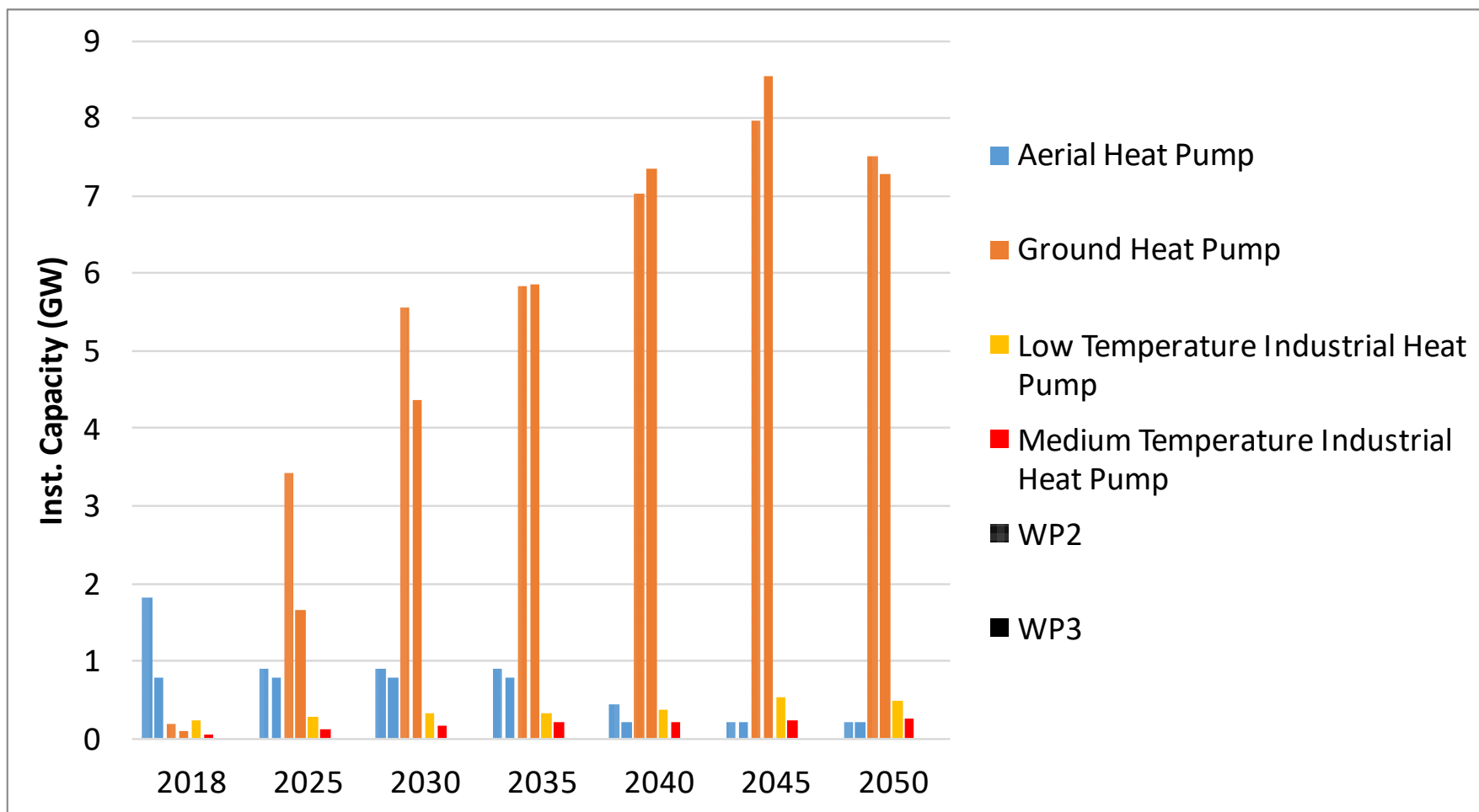
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Results

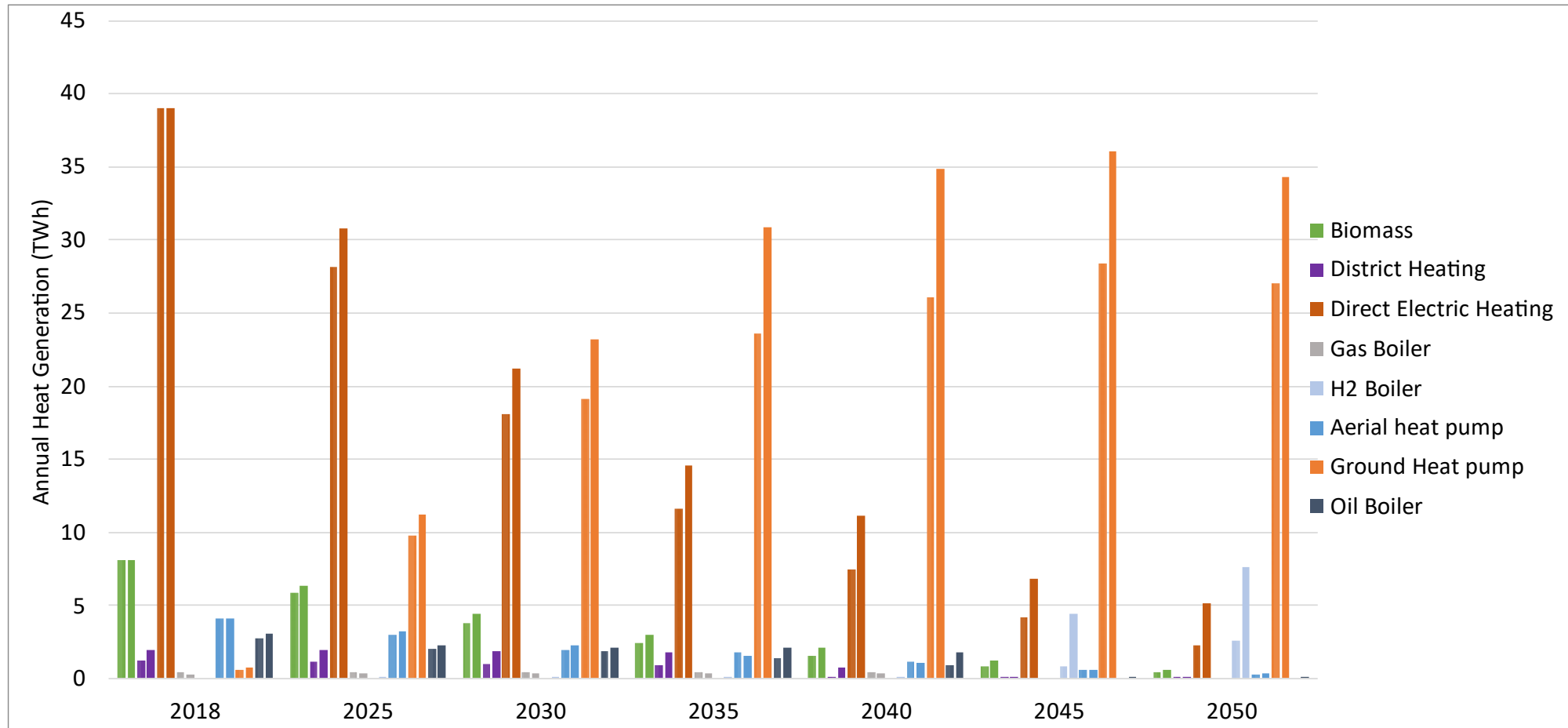


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Heat Pumps in Norway



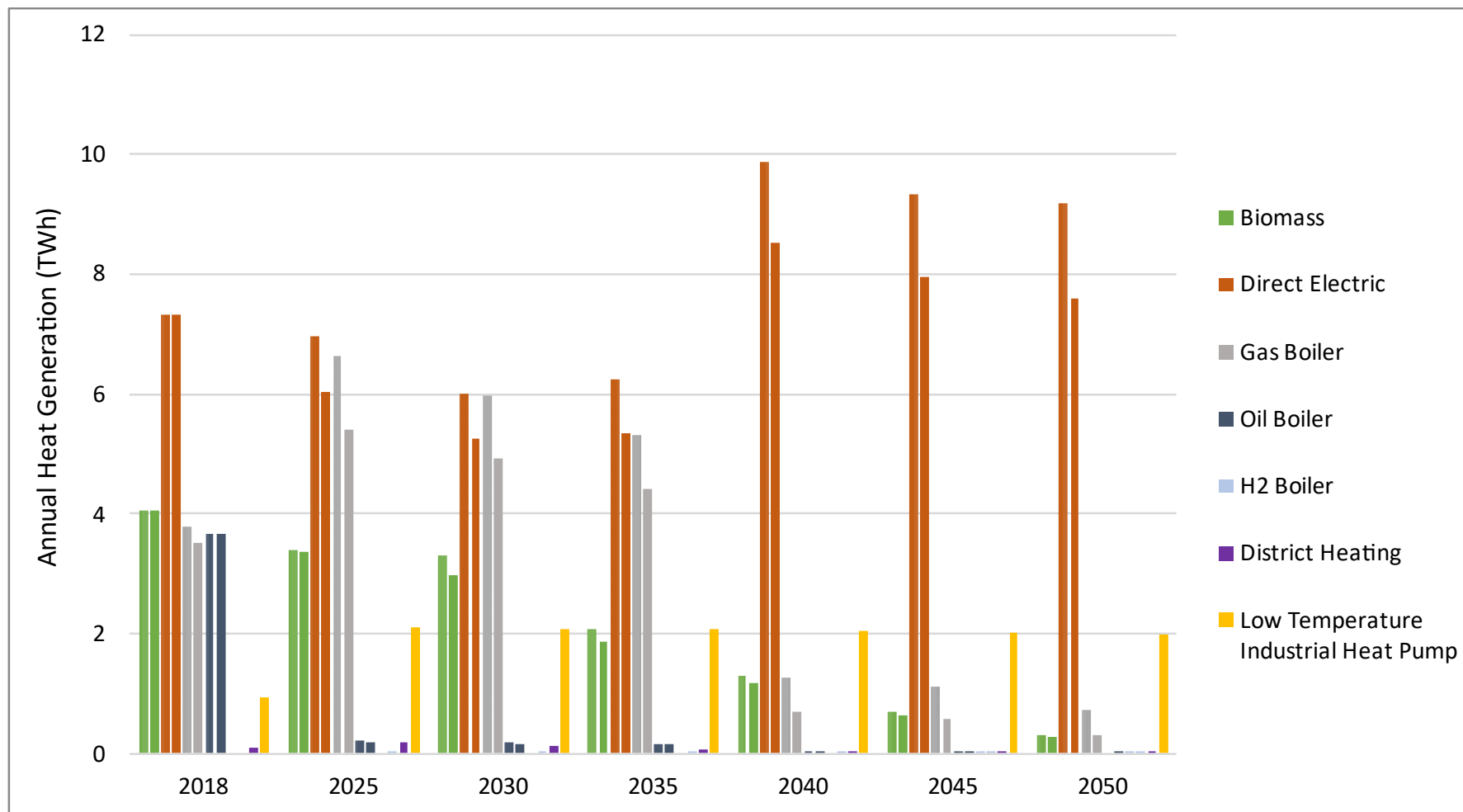
Heat Production in Buildings Sector in Norway





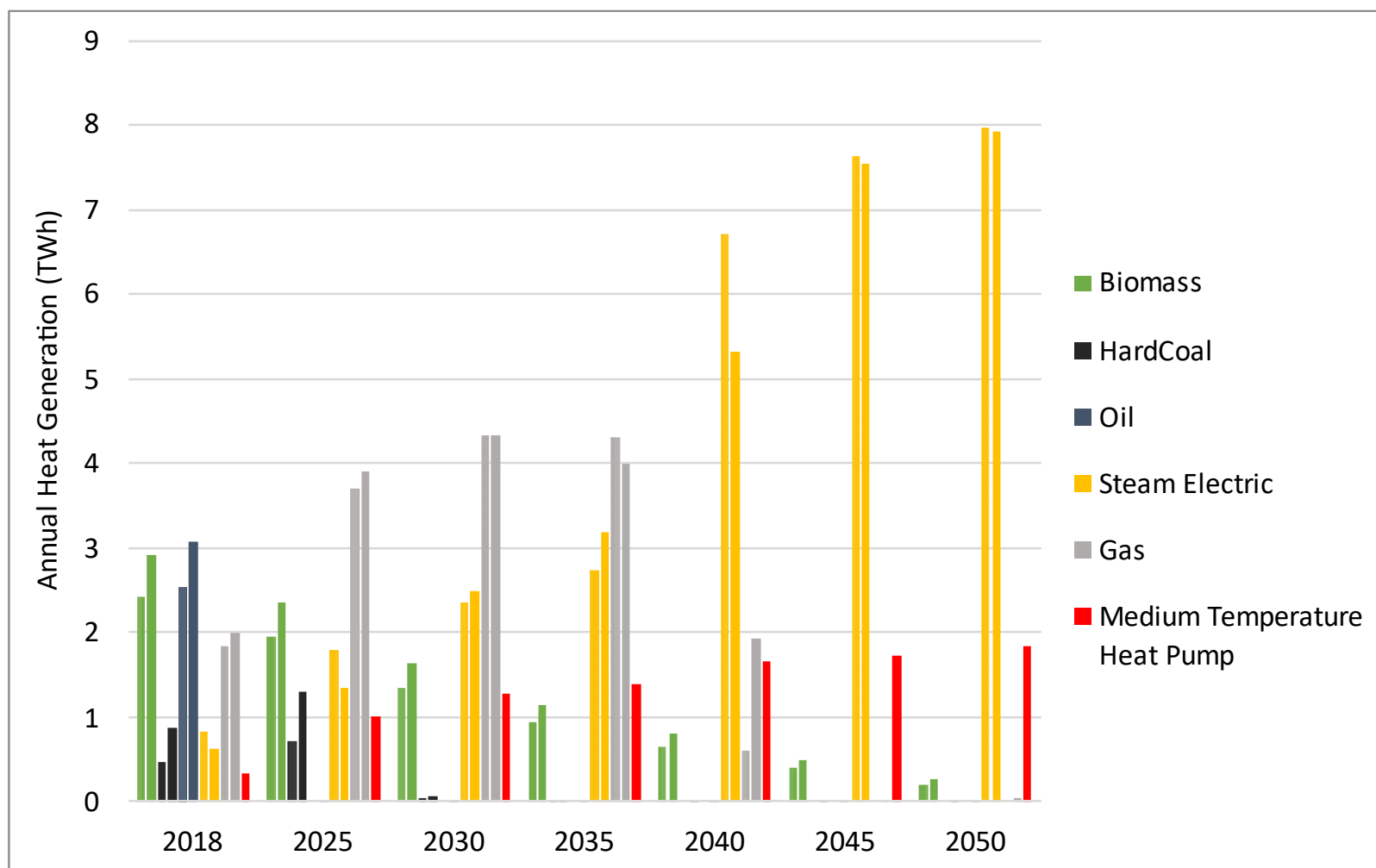
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Low Heat in Industry in Norway

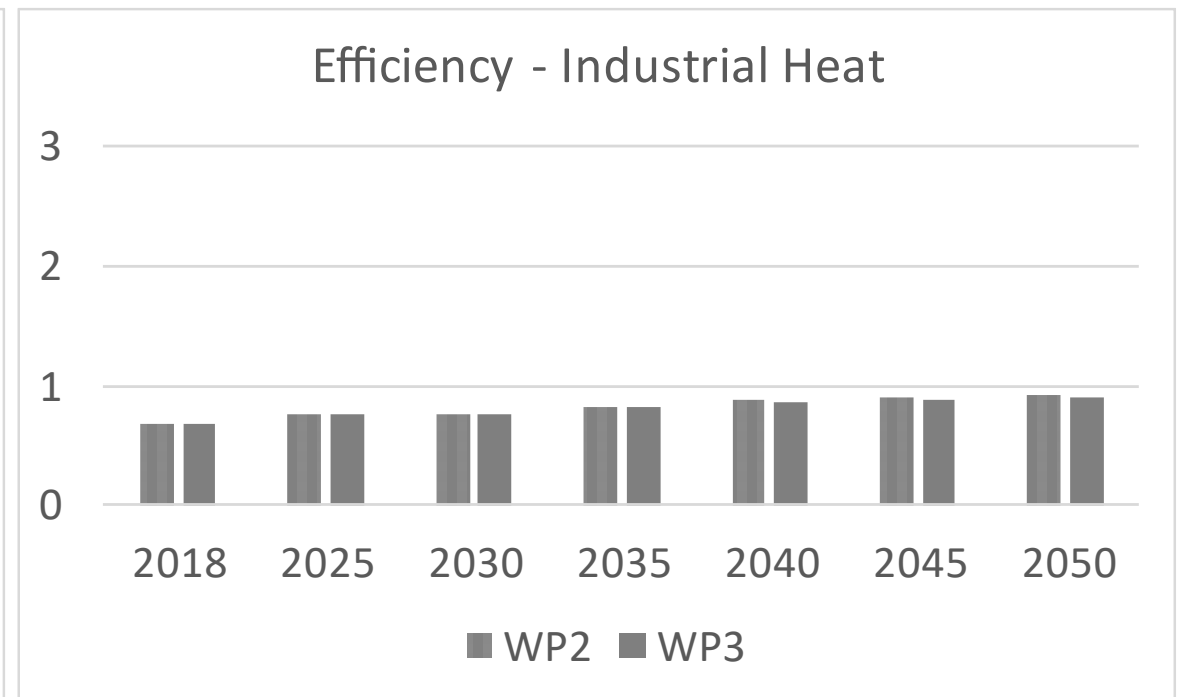
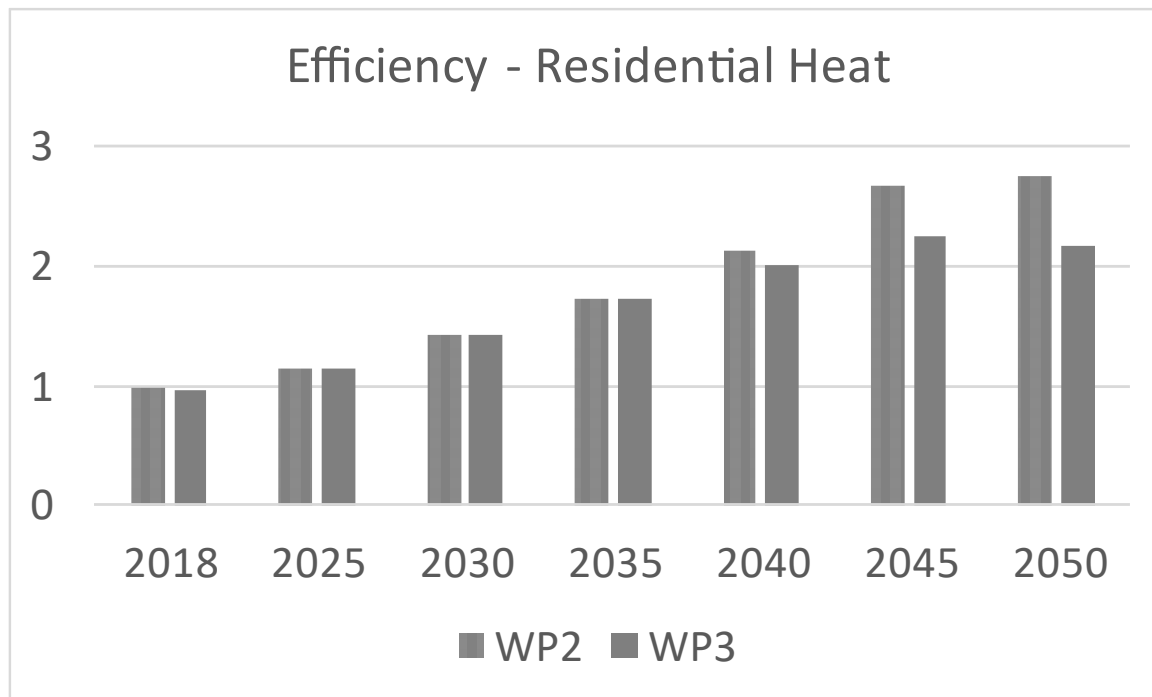




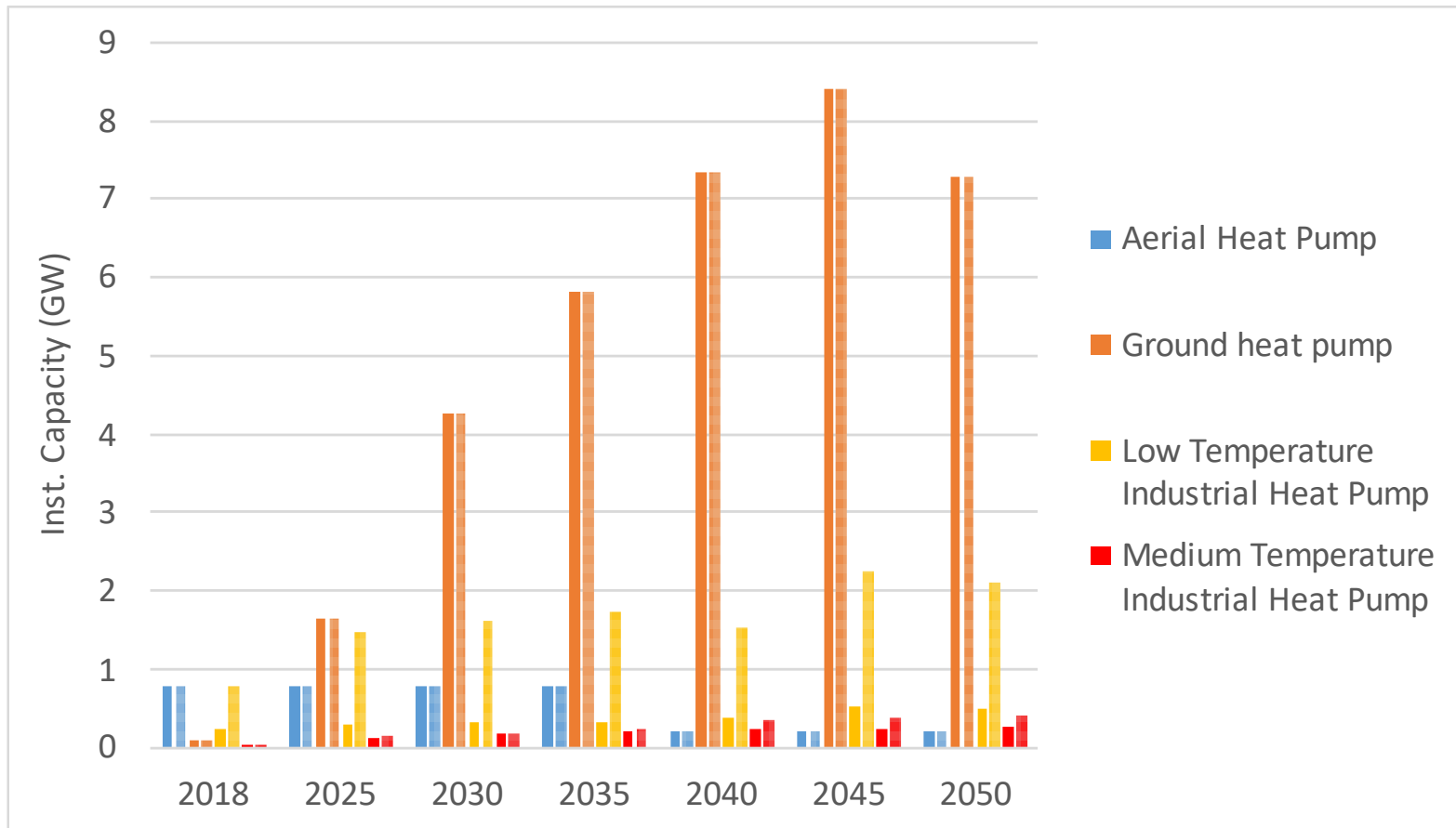
Medium Heat in Industry in Norway



Energy Efficiency



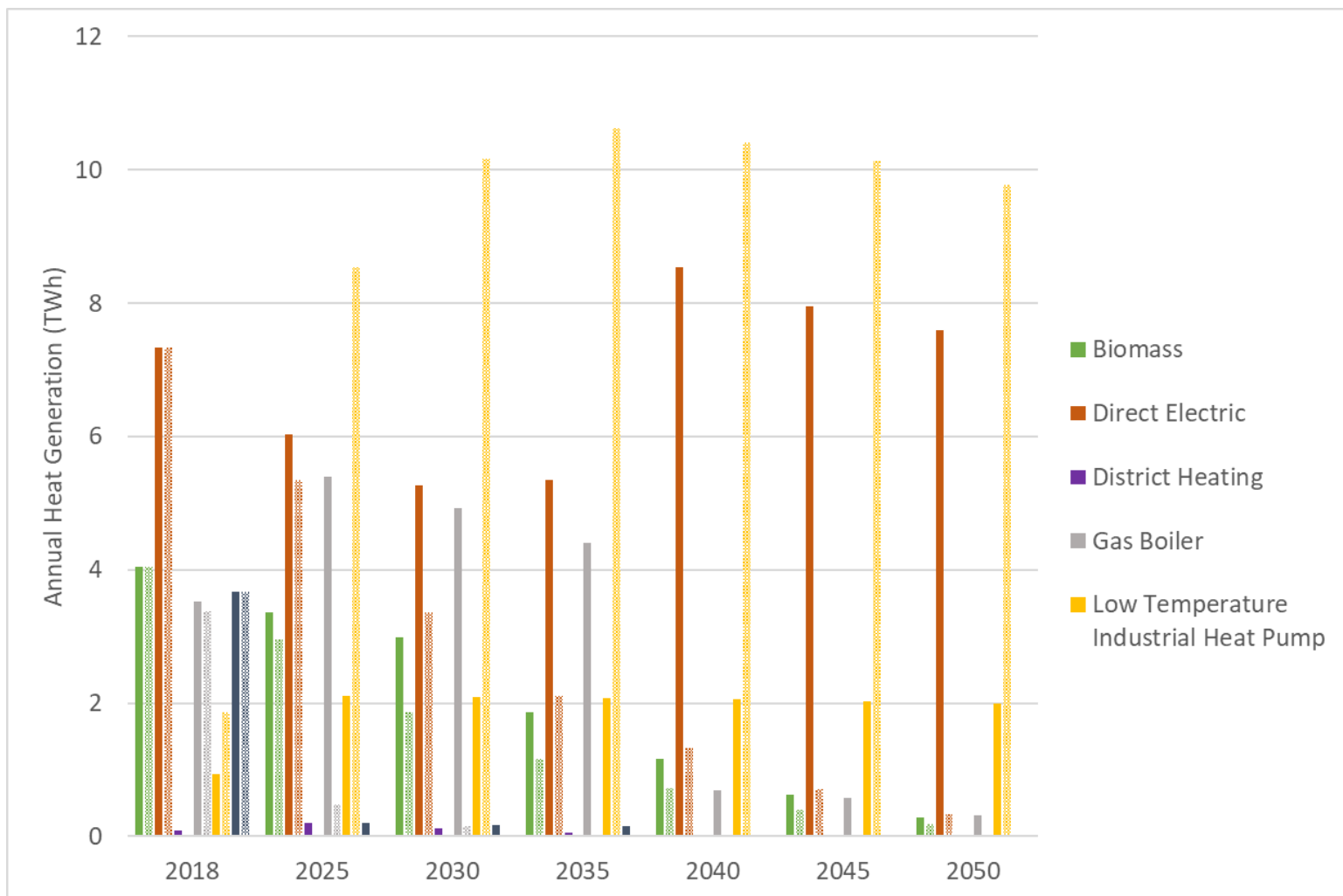
Heat Pumps in Norway with unlimited waste heat





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Low Heat in Industry in Norway with unlimited waste heat





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Conclusions



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Conclusion for RQ5 and 6

- From the work in GENeSYS-MOD:
 - RQ5:
 - Higher level of details in the modelling of industrial processes by representing more temperature levels and representing the potential to use waste heat for some processes.
 - The improved representation of the industrial sector leads to more accurate results and allows to draw a more precise estimation of the use of fossil fuels before their phase outs.
 - RQ6:
 - In industry, waste heat reutilization is introduced to the model
 - In building sector, we modify the modelling of energy efficiency and conservation measures exogenously by updating the demands using a suite of detailed sector specific models
 - Existing assumptions in GENeSYS-MOD should be checked and updated, if necessary, as indicated by the difference in residential heat demands.
 - The new measures introduced in the industrial sectors (heat pumps) are chosen in particular for temperatures lower than 200C. Moreover, an accurate assessment of the availability of waste heat at different temperature levels is important to correctly represent the phase out of fossil fuel for low temperature industrial processes.



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