Fossil fuel free heating and the power sector

NORENS

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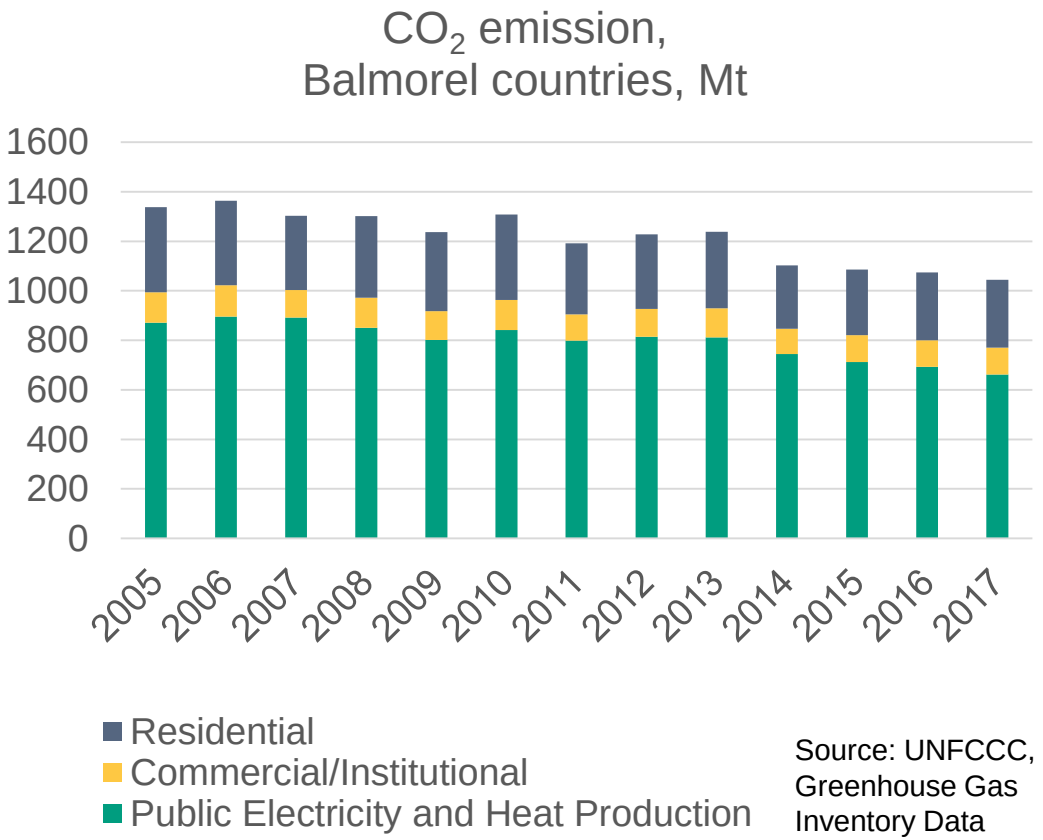
08.06.2020

Facts…

- *In EU households, heating and hot water alone account for 79% of total final energy use.*
- *According to 2018 figures from Eurostat, 75% of heating and cooling is still generated from fossil fuels while only 19% is generated from renewable energy.*

https://ec.europa.eu/energy/topics/energy-efficiency/heating-and-cooling_en?redir=1#facts-and-figures

Emissions and targets



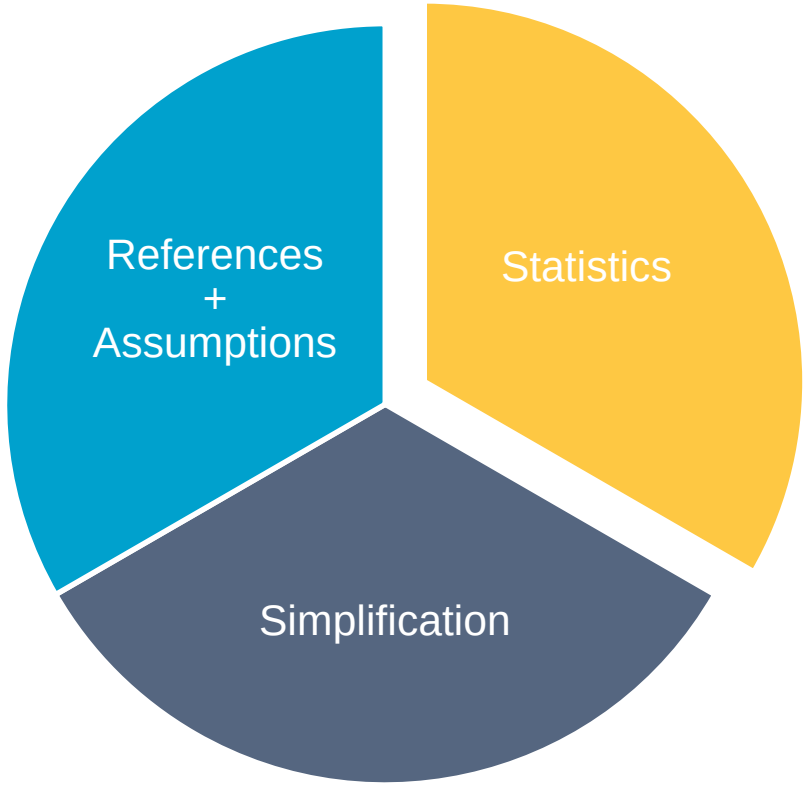
Source: UNFCCC, Greenhouse Gas Inventory Data

Targets for non ETS sector (Effort Sharing Regulation)

(base year 2005)	2020	2030
Norway	**-17 %	-40 %
Sweden	-17 %	-40 %
Finland	-16 %	-39 %
Denmark	-20 %	-39 %
Estonia	11 %	-13 %
Latvia	17 %	-6 %
Lithuania	15 %	-9 %
France	-14 %	-37 %
Germany	-14 %	-38 %
United Kingdom	-16 %	-37 %
Netherlands	-16 %	-36 %
Poland	14 %	-7 %
Belgium	-15 %	-35 %

Challenges on modelling the heating sector

- Data
  - Heat demand (energy service)
  - Heat demand profile
  - Existing heating technologies and installed capacities
- Behavior
  - Willingness to switch/invest



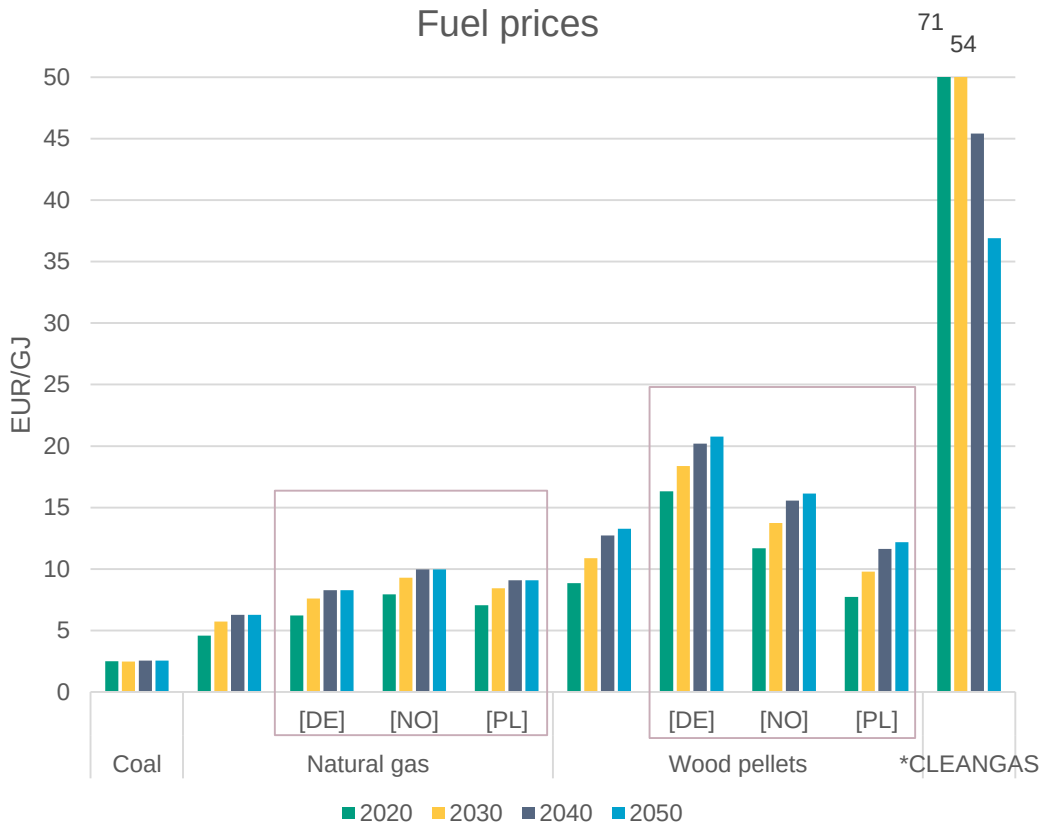
Model Setup

Individual heat definition: **space heat** and **domestic hot water**,
used in residential and commercial sector

Main model settings

- Year: 2020, 2030, 2040, 2050
- 6 weeks * (12 hours *2)

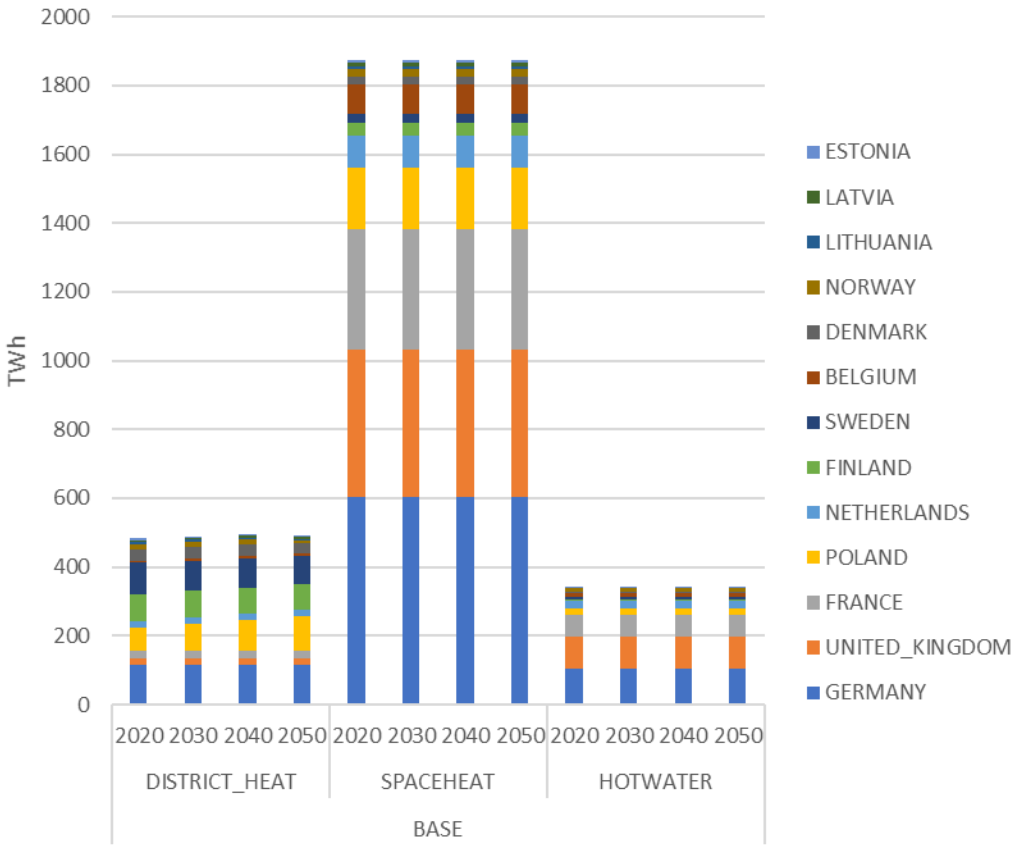
- Emission policy
  - Power & DH: one overall cap
  - Individual heat: national caps
  - 2050 fossil free



Individual heat demand

- 2016: data from statistics
- 2016-2020: same trend as district heat
- 2020-2050: constant

- No interlink between individual and district heating systems.



Individual heating technologies

- Coal boilers, oil boilers, gas boilers
- Biomass boilers (wood pellets), wood stoves
- Electric boilers, electric heating
- Air-to-air heat pumps, air-to-water heat pumps
- Solar heating
- Hot water tanks

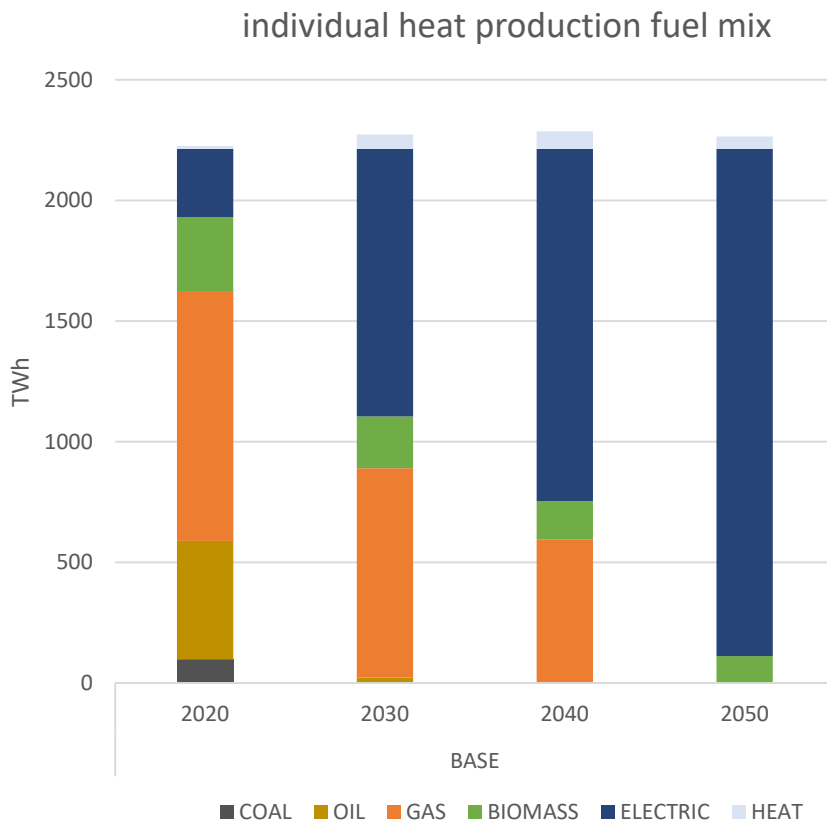
Space heat + hot water
Space heat only
Hot water only

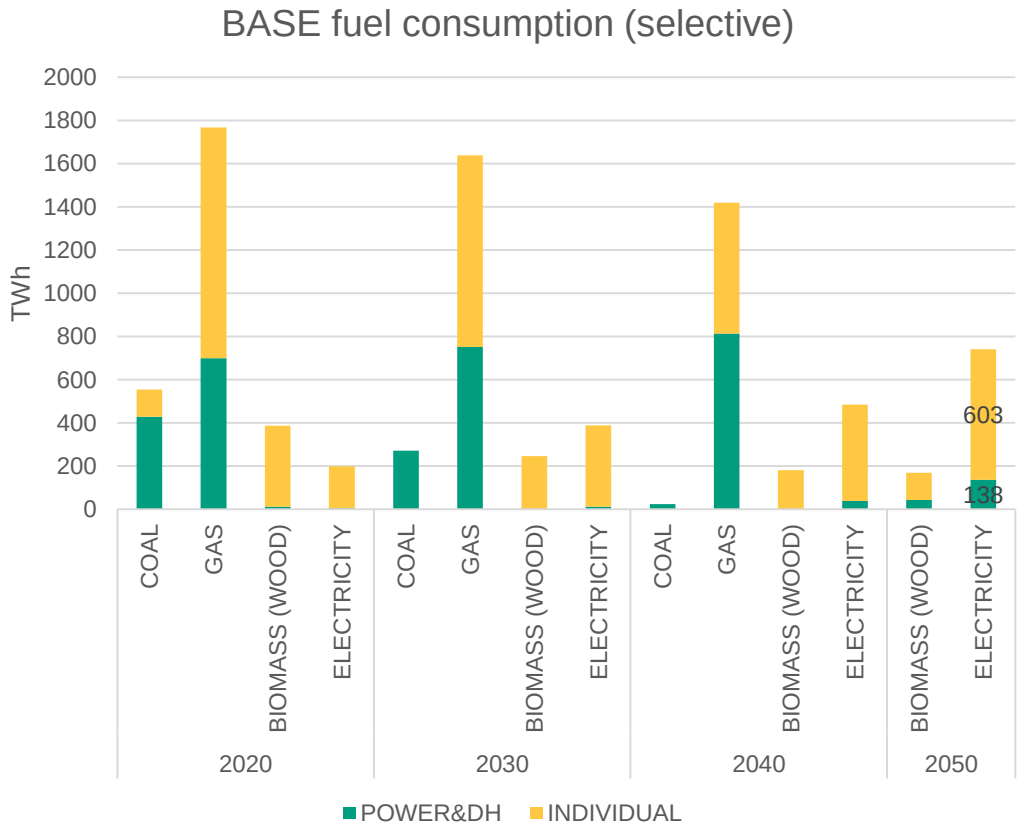
30% willingness to shift (decided by the model) every 10 years

– except for fossil fuel based heating

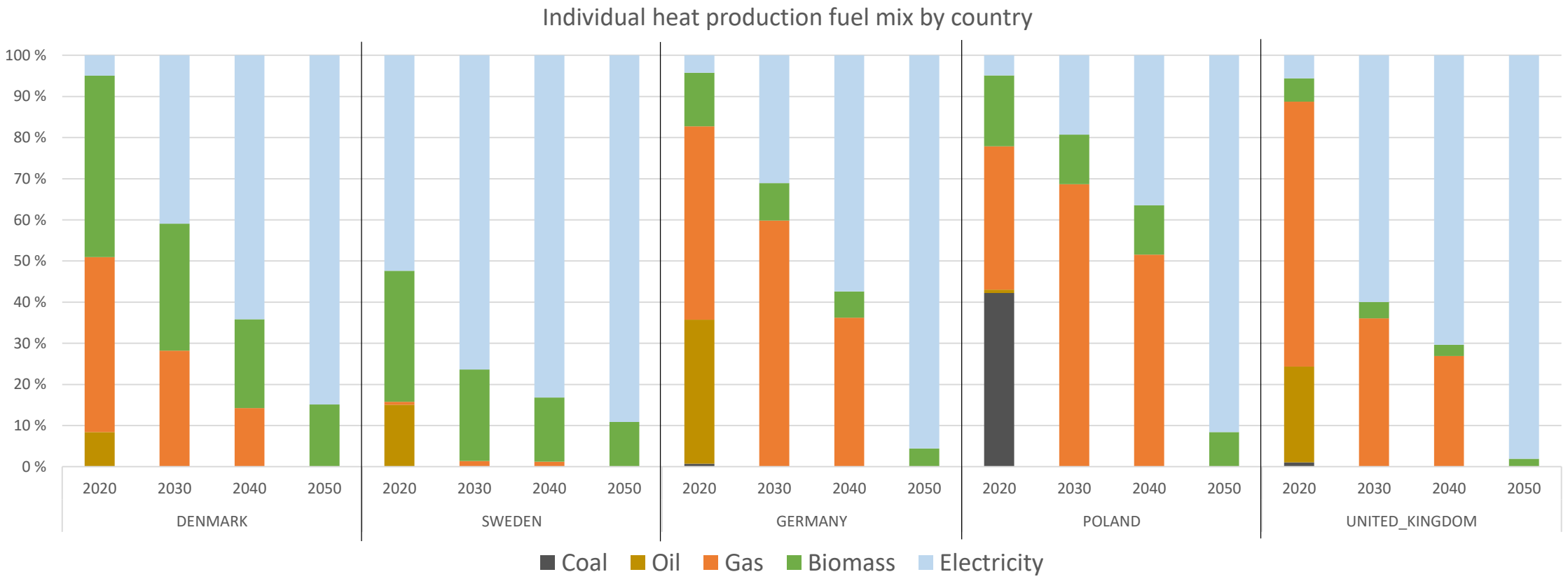
Results

Decarbonization of individual heating setor relies strongly on electrification

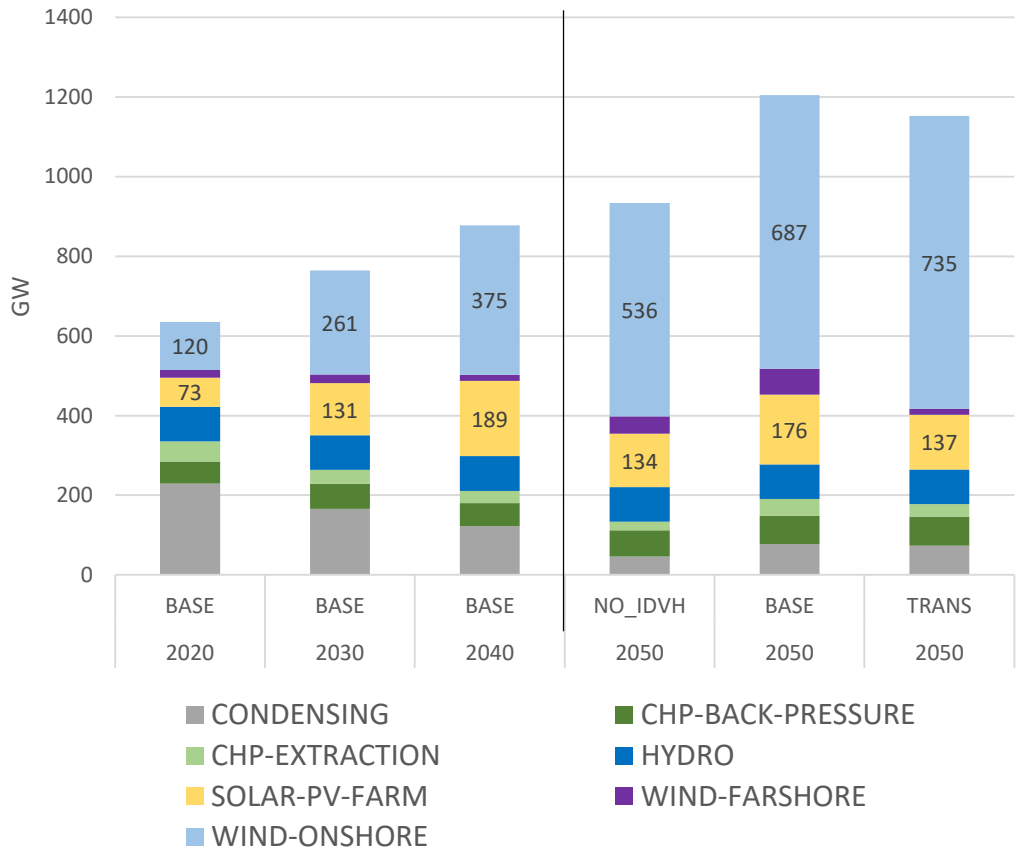


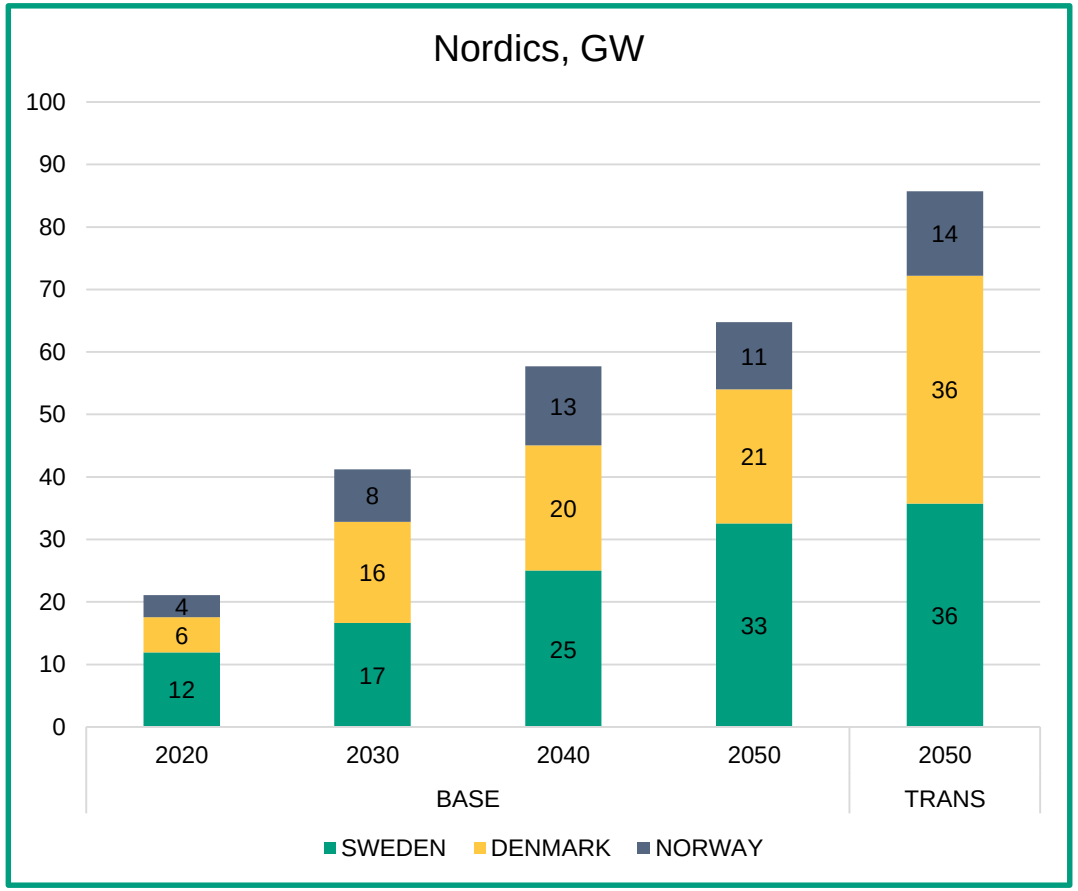


Countries show small differences in decarbonizaiton paths.

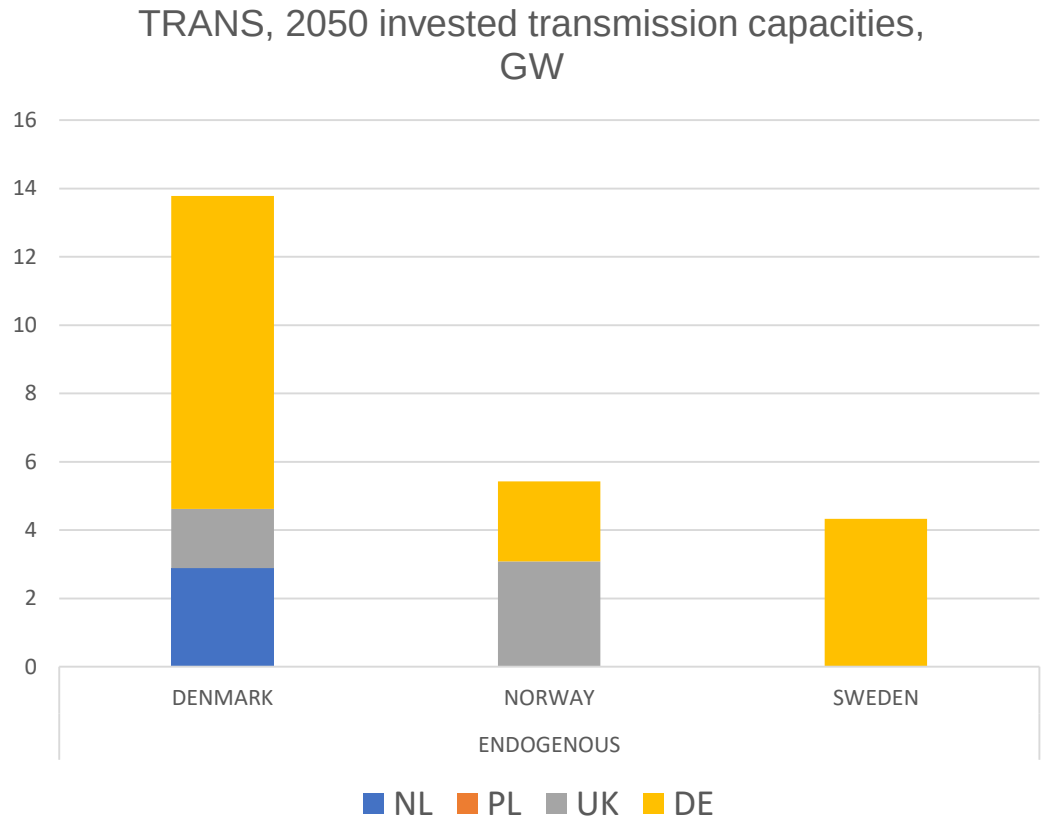


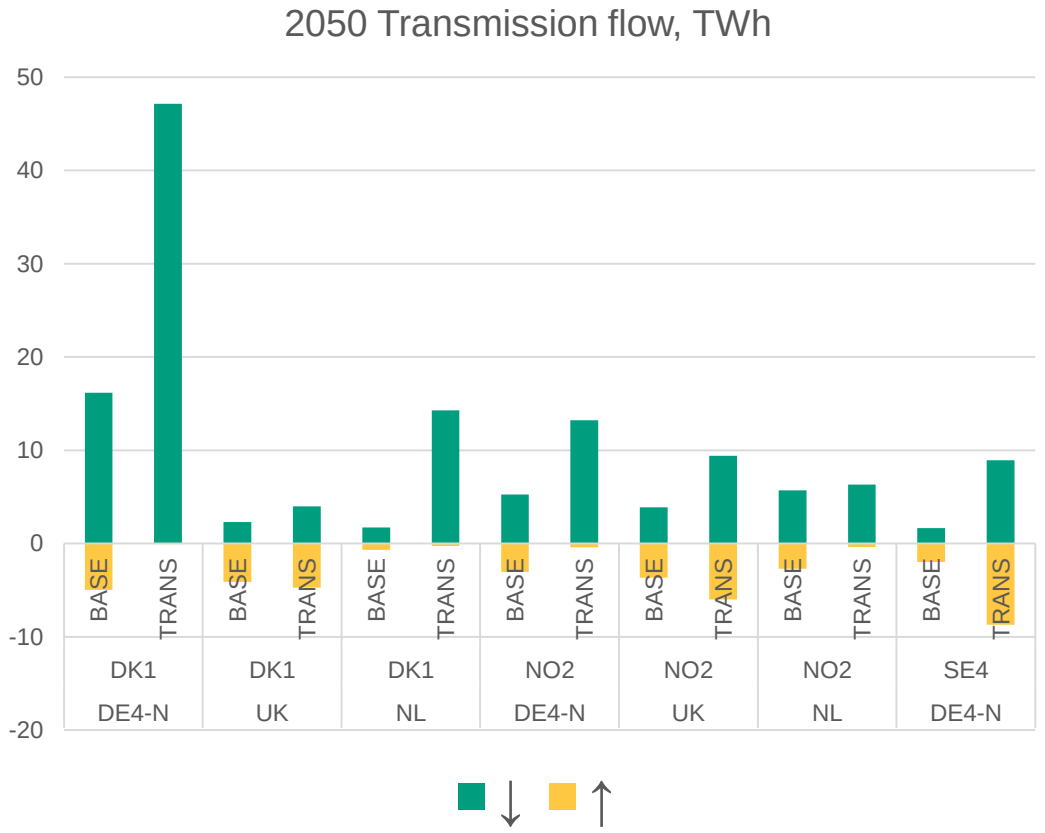
We need 150 GW onshore wind and 50 GW PV farm in addition to decarbonize individual heating sector too.



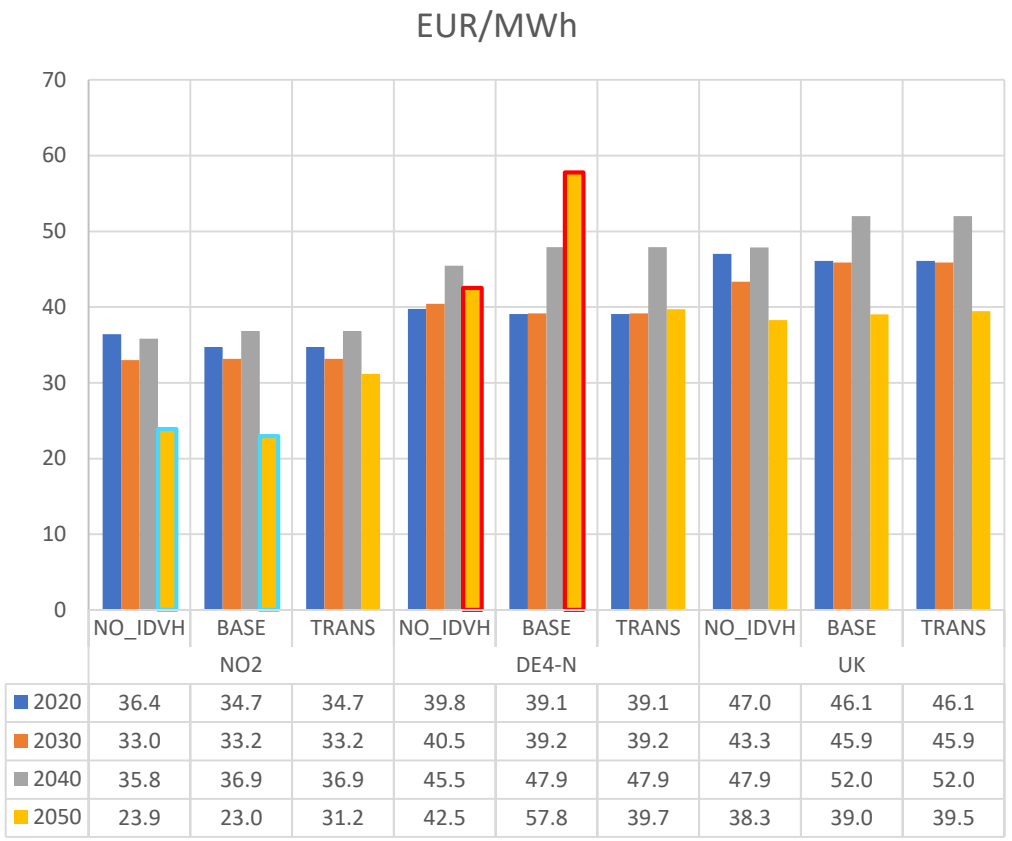


Allowing transmission investment creates large markets for Nordics towards Germany and UK.

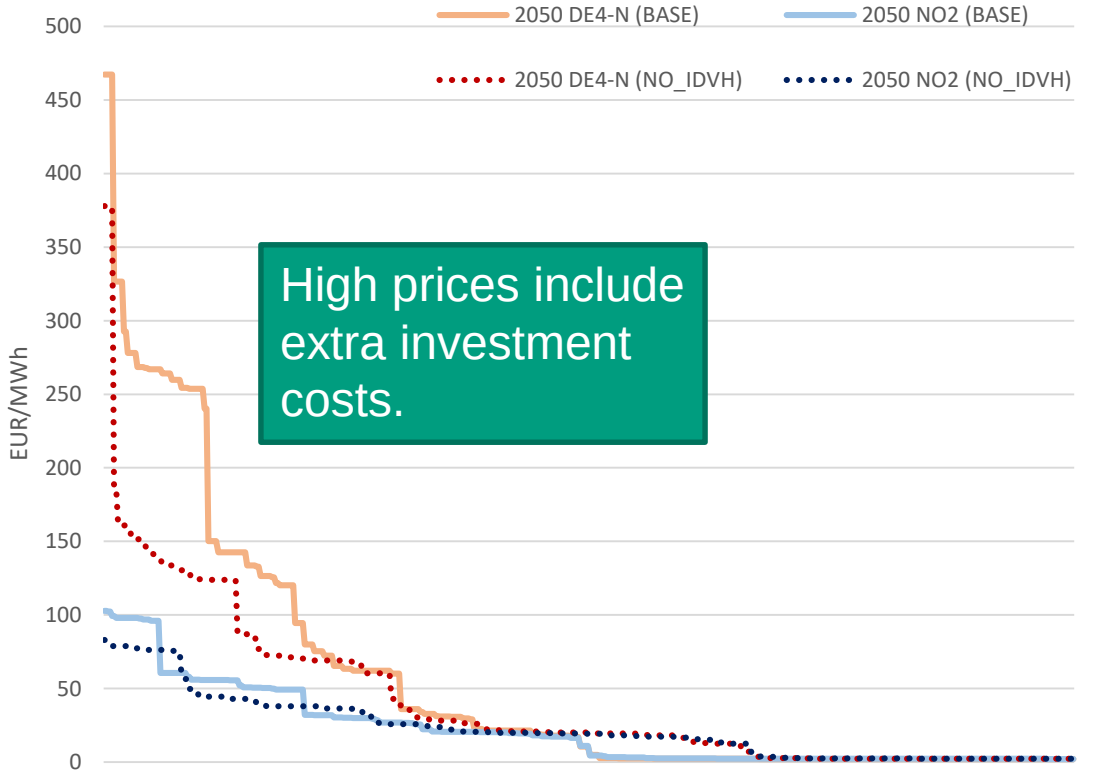




Power prices go towards extremely high and extremely low.



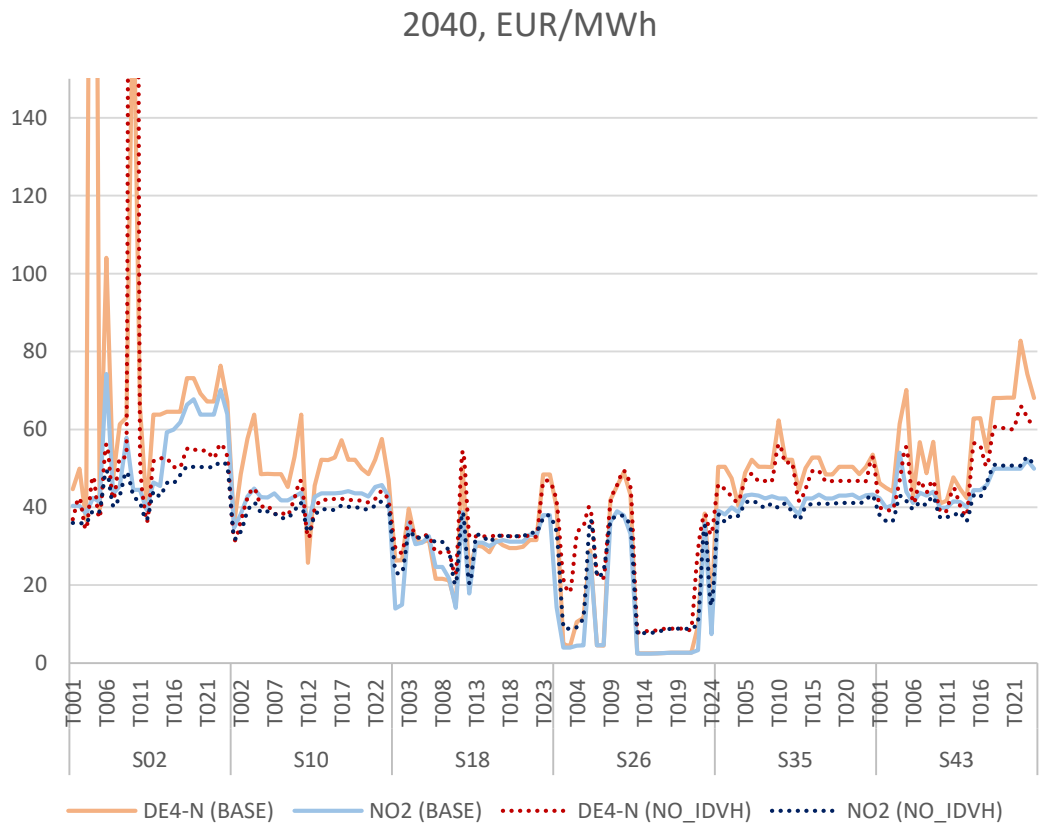
	NO_IDVH	BASE	TRANS	NO_IDVH	BASE	TRANS	NO_IDVH	BASE	TRANS
	NO2			DE4-N			UK		
2020	36.4	34.7	34.7	39.8	39.1	39.1	47.0	46.1	46.1
2030	33.0	33.2	33.2	40.5	39.2	39.2	43.3	45.9	45.9
2040	35.8	36.9	36.9	45.5	47.9	47.9	47.9	52.0	52.0
2050	23.9	23.0	31.2	42.5	57.8	39.7	38.3	39.0	39.5

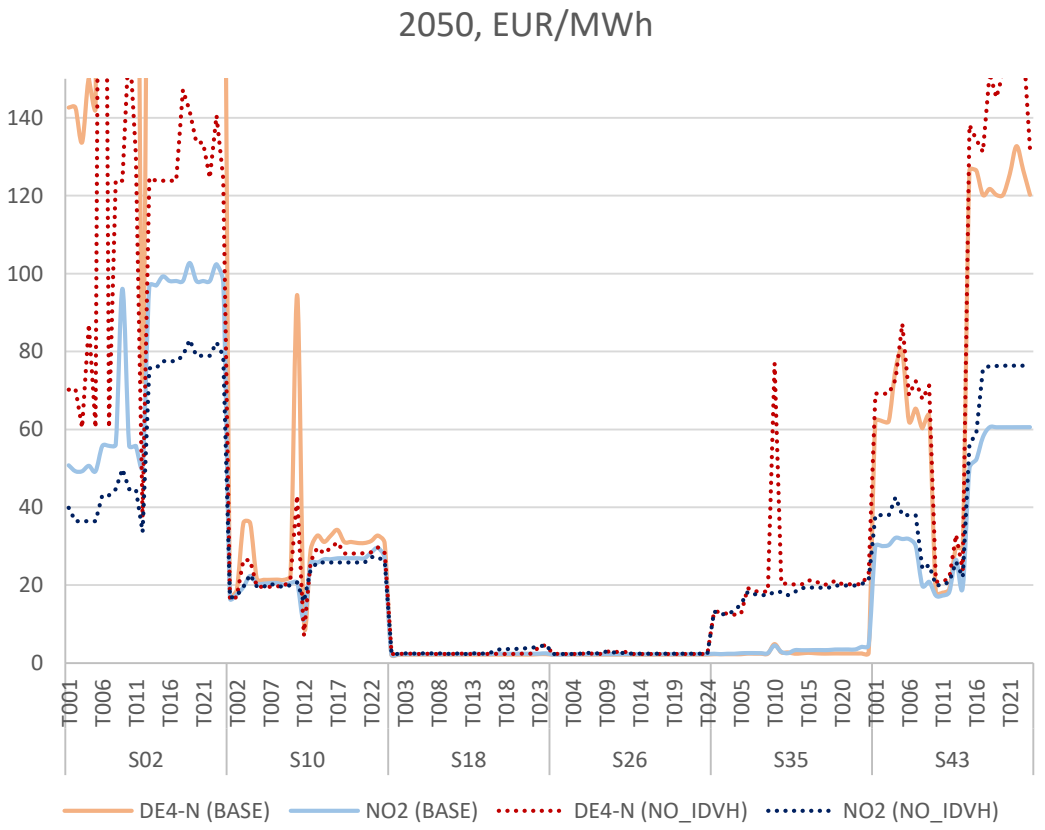


High prices include extra investment costs.

Low prices are driven when VRE produces.

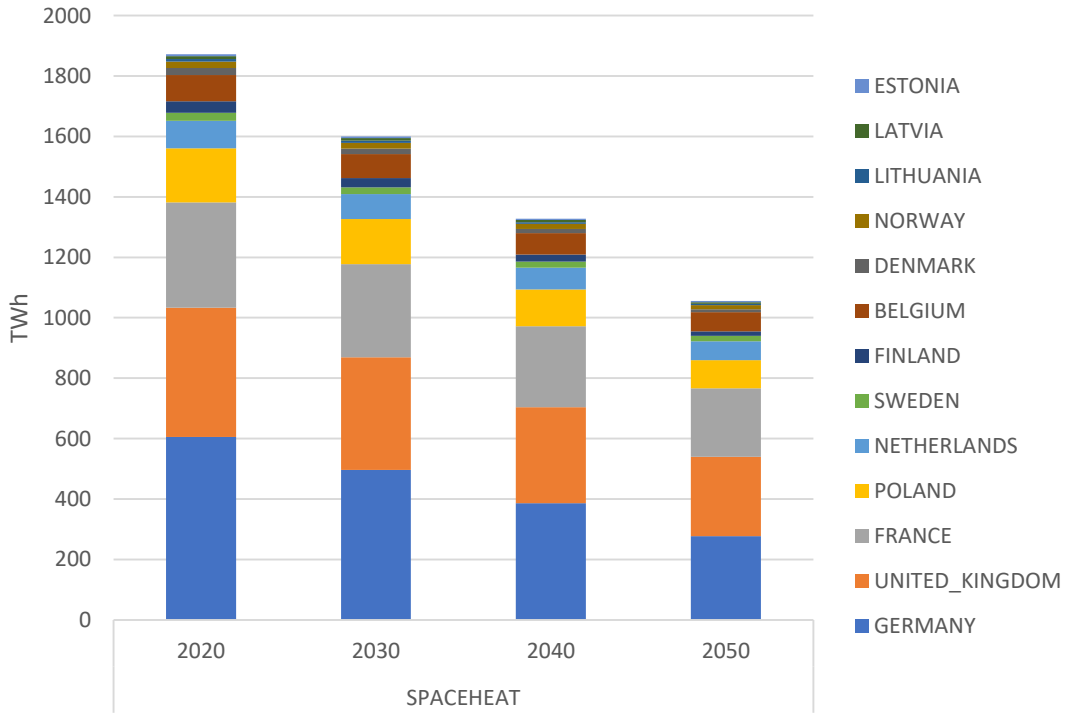
Significant seasonal price variation comes with a 100% renewable energy system.





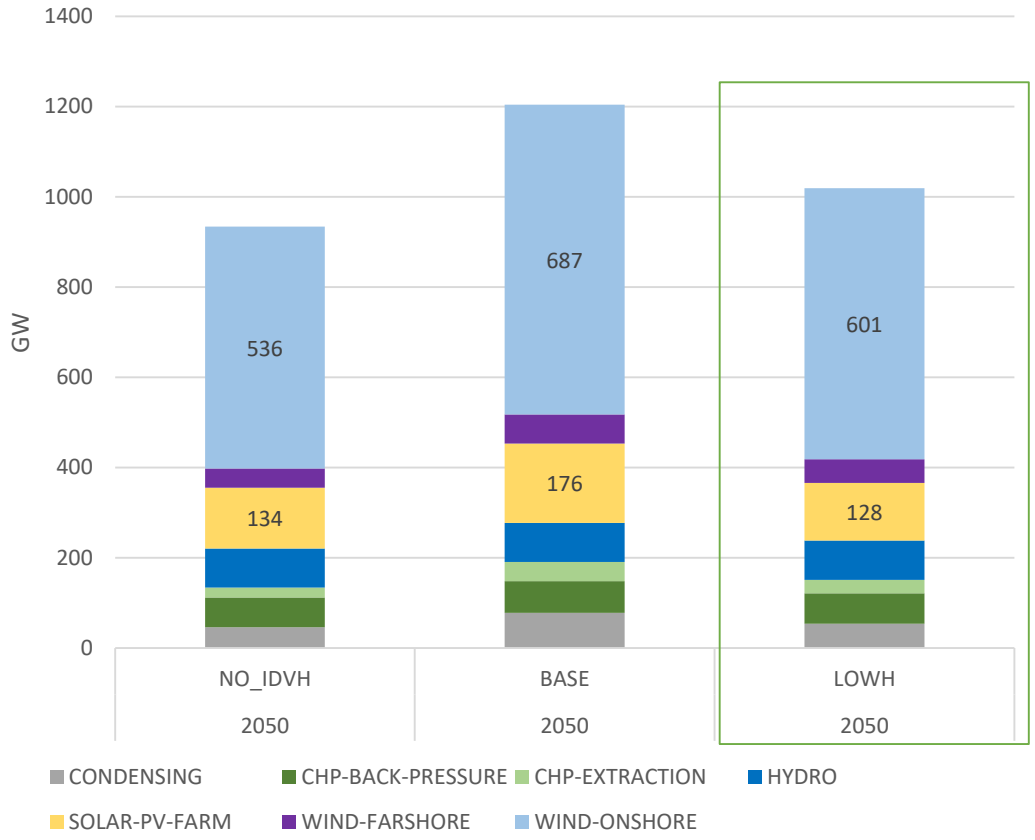
Sensitivity on space heat demand: assuming good progress on efficiency improvement…

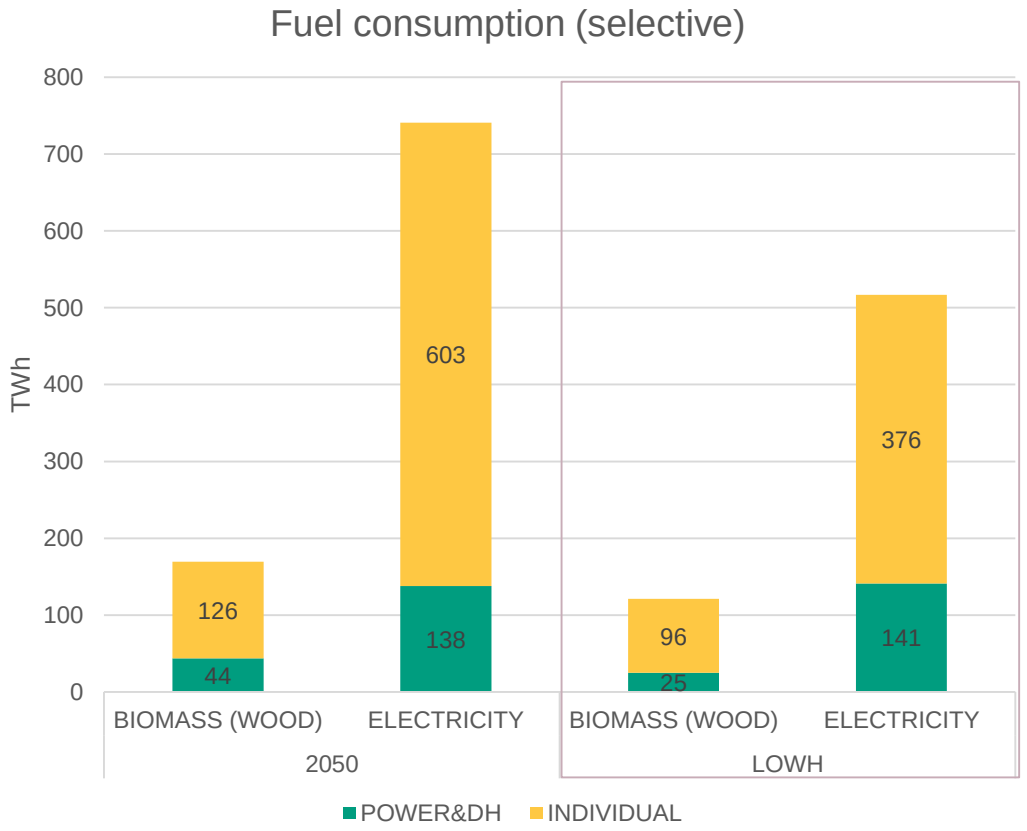
- Space heat demand decrease ratio refers to the Conventionally Decarbonized Scenario in Heat Roadmap Europe 4 project. (Linear path)
- Hot water demand is kept constant.



Decrease of space heat demand from 2015 to 2050	
SWEDEN	-27 %
FINLAND	-58 %
GERMANY	-51 %
UNITED KINGDOM	-36 %
NETHERLANDS	-47 %
BELGIUM	-35 %
FRANCE	-46 %
POLAND	-42 %
DENMARK	-58 %
NORWAY	-27 %
ESTONIA	-42 %
LATVIA	-42 %
LITHUANIA	-42 %

Still, 370+ TWh electricity is needed to supply individual heating, and it adds 65 GW onshore wind capacity.





Conclusions

- Electrification might be the least cost solution to decarbonize the individual heating sector.
- The amount of required electricity is significant (>600 TWh), which will push more VRE installation.
- Frequency of extreme power prices increases with large seasonal power price variations.