ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Data centres in Ireland

SCENARIO ANALYSIS FOR ETSAP WORKSHOP

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Data centres overview

Physical facilities that companies use to host their critical applications and data.
Demand increased rapidly in recent years and will further increase stimulated by new data-intensive technologies such as artificial intelligence, machine learning.

Why is it relevant for the energy system?

Electricity consumption for:

- IT equipment (servers, storage, transmission)
- Cooling system
- Others

Hyperscale DCs can have a demand capacity >100 MW

But… waste heat recovery is possible!

Why is it relevant for Ireland?

Factors that make it perfect for hosting DCs:

- Weather conditions
- Good fibre connections with US
- Attractive corporation tax

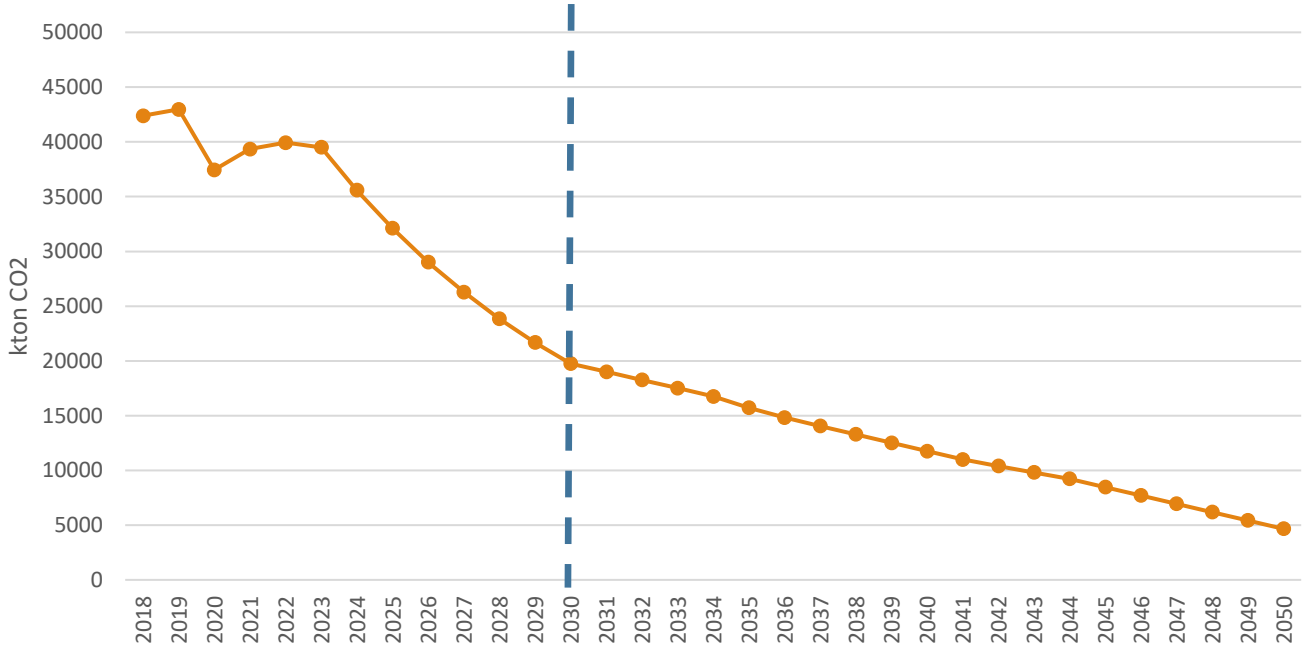
Factors that make DCs hard to handle:

- Big growth expected in the next decade
- Concentration in Dublin area
- Isolated energy system (lack of grid connections with other countries)
- Decarbonization targets

Ireland decarbonization pathways

"Climate Action & Low Carbon Development (Amendment) Act 2021" targets to reduce greenhouse-gases [GHGs] by:

- 51% by 2030,
- net-zero by 2050.



A33E61:

- 33% reductions from agriculture,
- 61% reductions from energy & industry

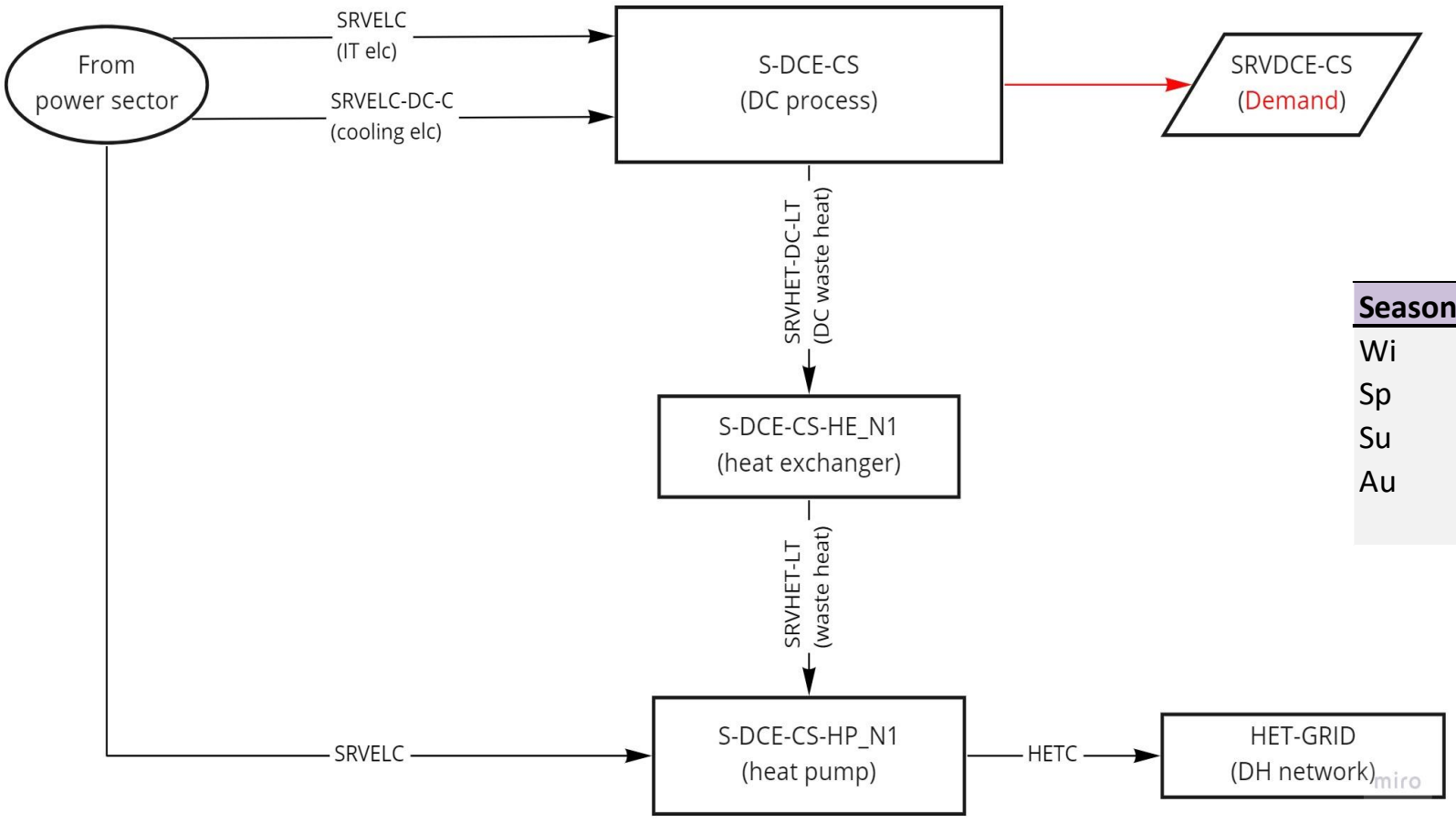
by 2030

More mitigation scenarios developed by the MaREI Energy Policy and Modelling Group available:

https://tim-carbon-budgets-2021.netlify.app/scenarios

https://zenodo.org/record/5517363#.YZ-uVtDP02w

DCs in TIM



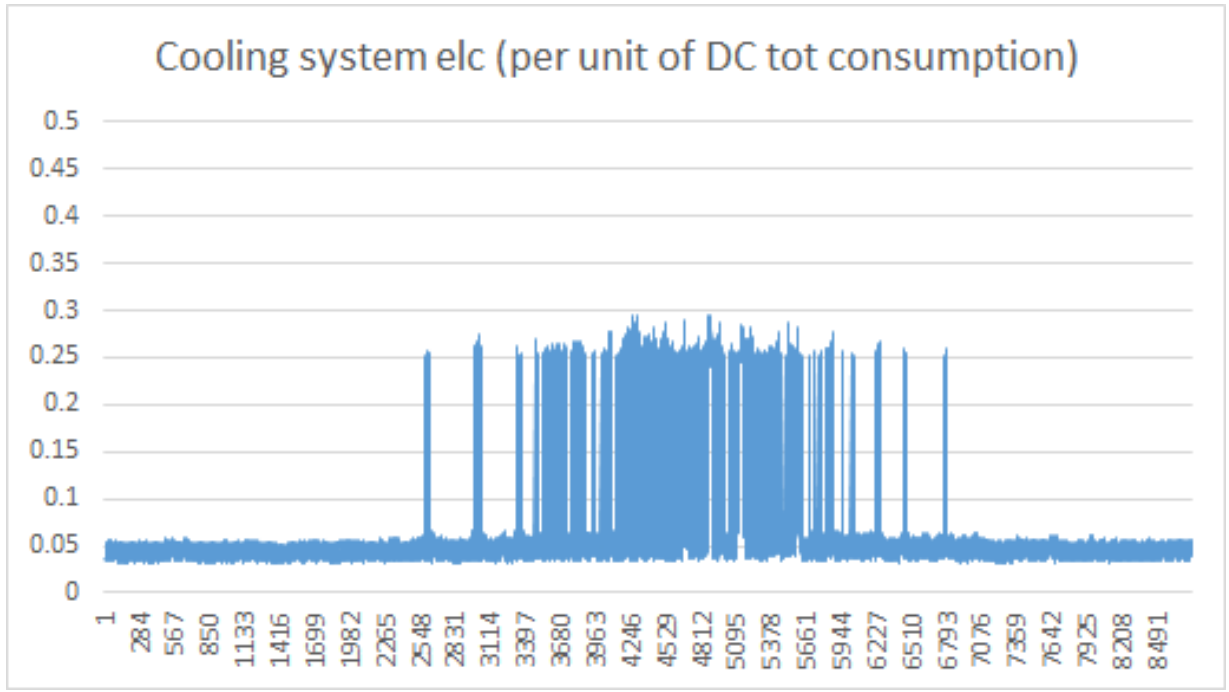
40 time-slices

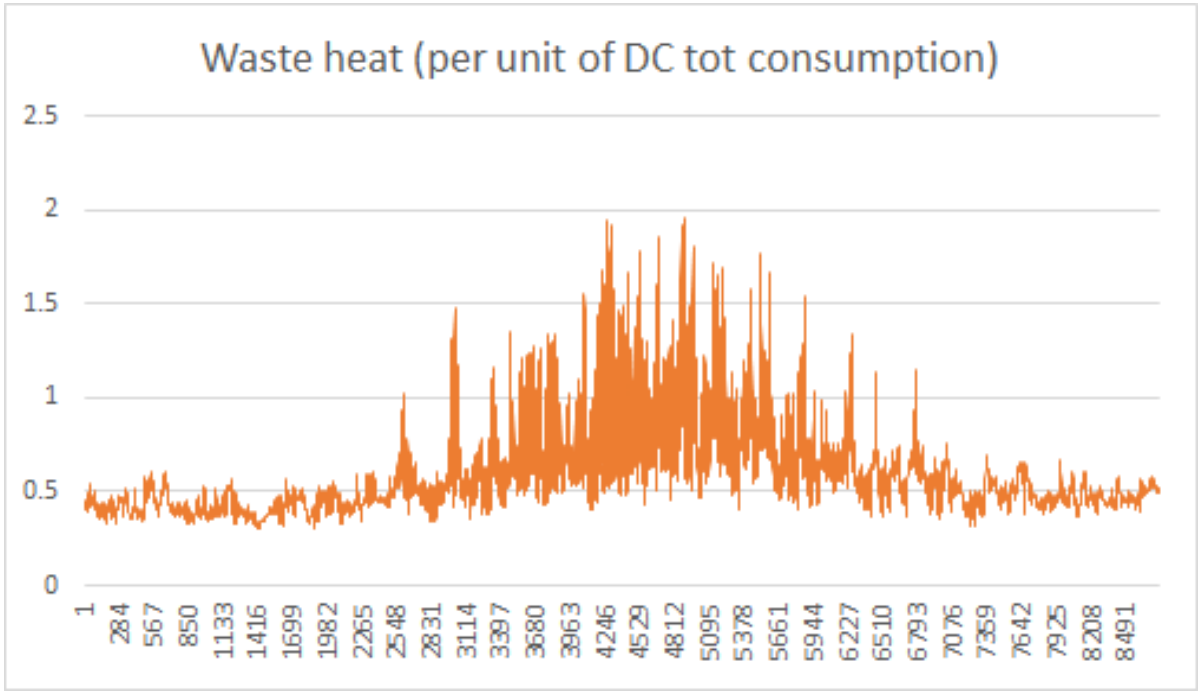
Season	Weekly	DayNite
Wi	NW	A (0-7)
Sp	WD	B (7-9)
Su		C (9-17)
Au		D (17-19)
		E (19-0)

DCs in TIM

Cooling system electricity and waste heat are expressed as share of the total consumption of the process.

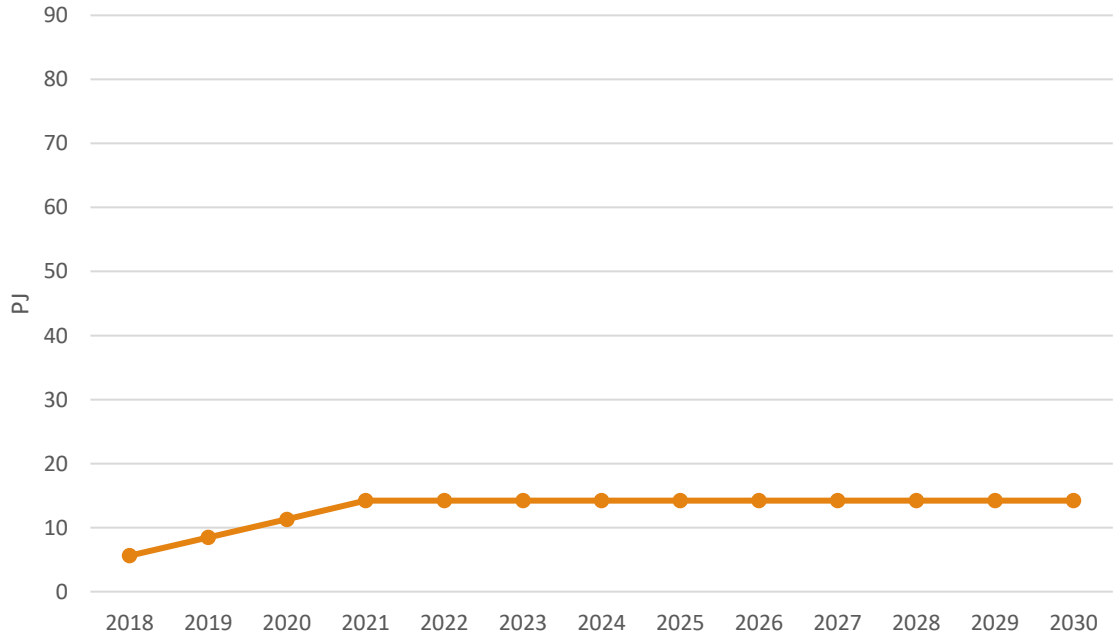
Shares are taken from a thermodynamic model on hourly level, then aggregated on time-slices level in TIM.





Demand projections

1_Flat: Flat demand



Capacity: 1100 MW (already connected)

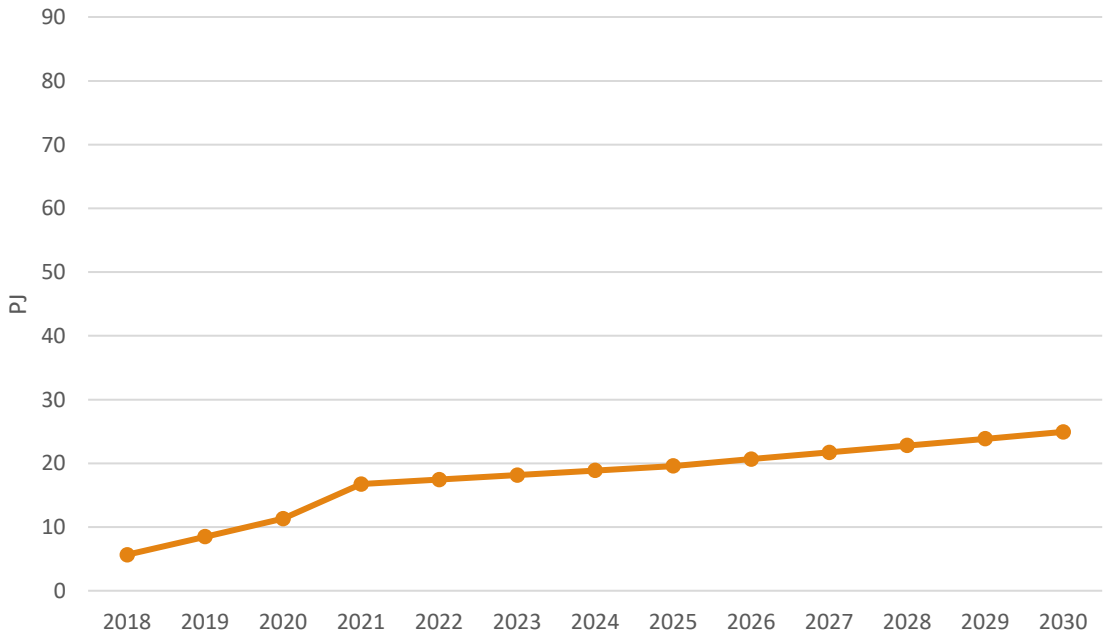
Eirgrid, All-Island-Generation-Capacity-Statement-2020-2029

Load factor: 40%

Eirgrid, All-Island-Generation-Capacity-Statement-2020-2029

Demand projections

2_LF: load factor increase



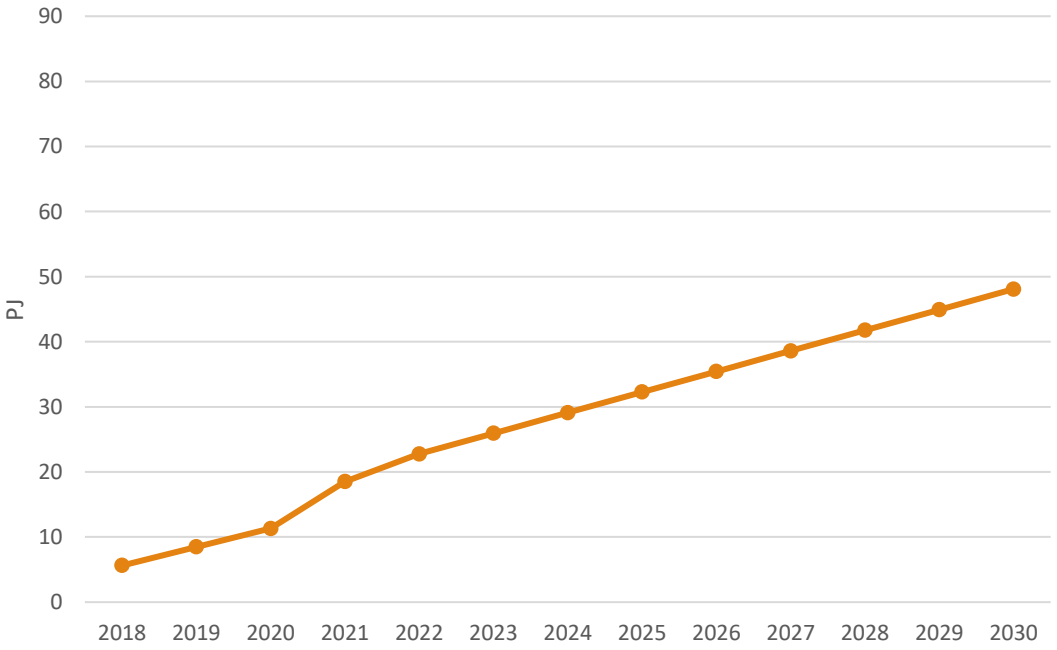
Capacity: 1100 MVA
(already connected)

Load factor: grows linearly
from 40% up to 70% in 2030

Eirgrid expects the load factor to rise as customers build out to their full potential.

Demand projections

3_cap: All current applications approved



Capacity:

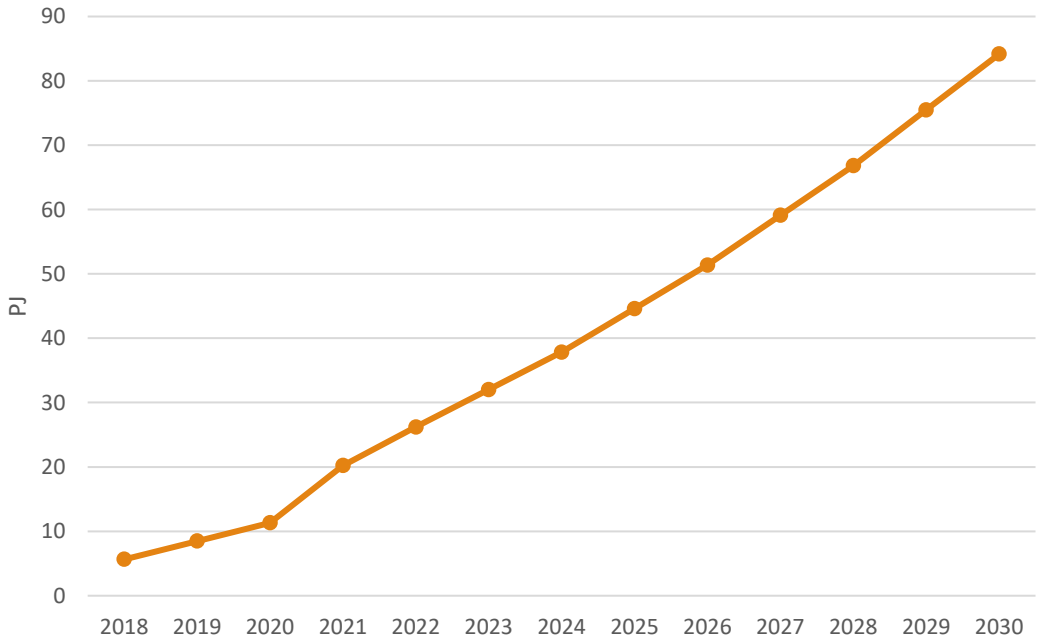
- 1800 MVA in 2022
  (connection agreements already in place)
- +2000 MVA up to 2030
  (additional requests already received)

CRU21060-CRU-consultation-on-Data-Centre-measures

Load factor: 40%

Demand projections

4_LFcap: All current applications approved and load factor increase



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CRU21060-CRU-consultation-on-Data-Centre-measures

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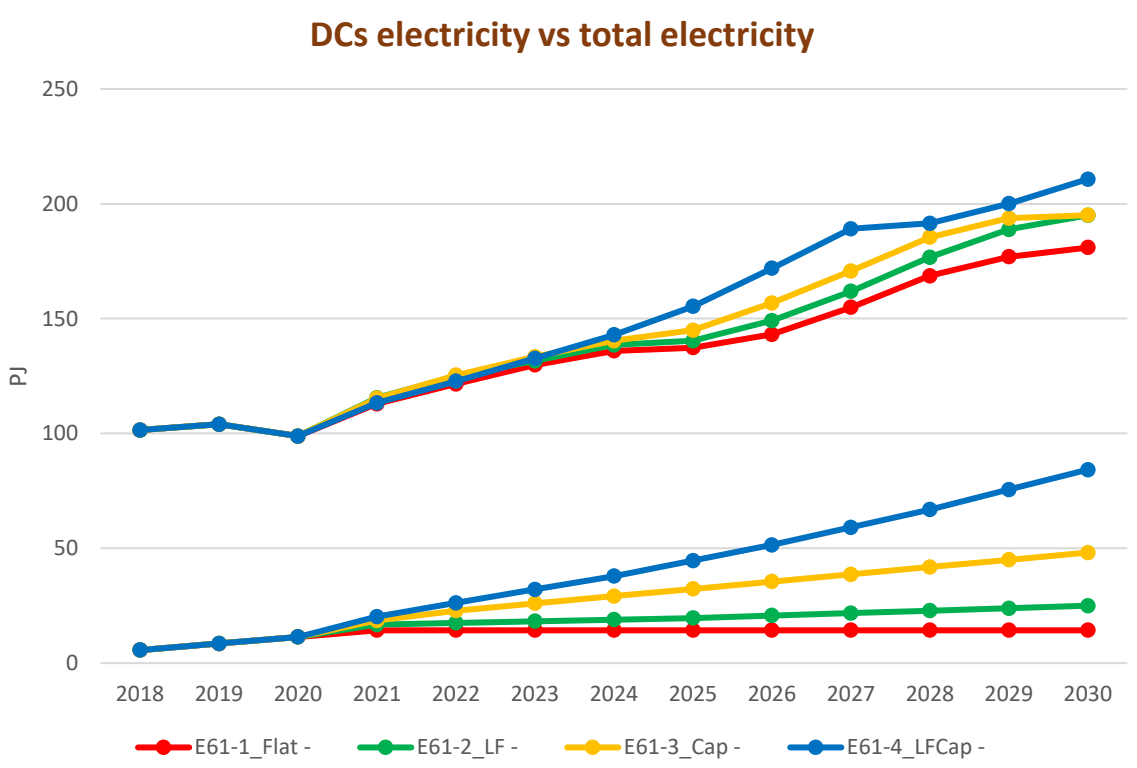
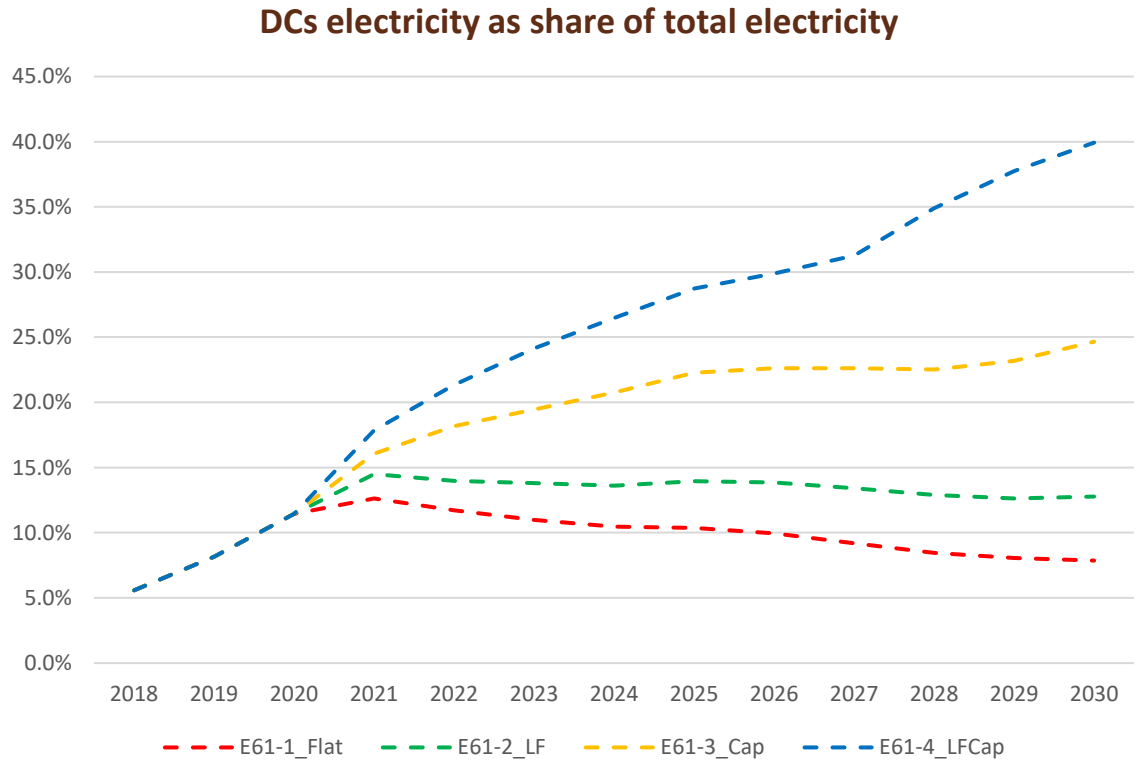
DCs elc vs total elc demand

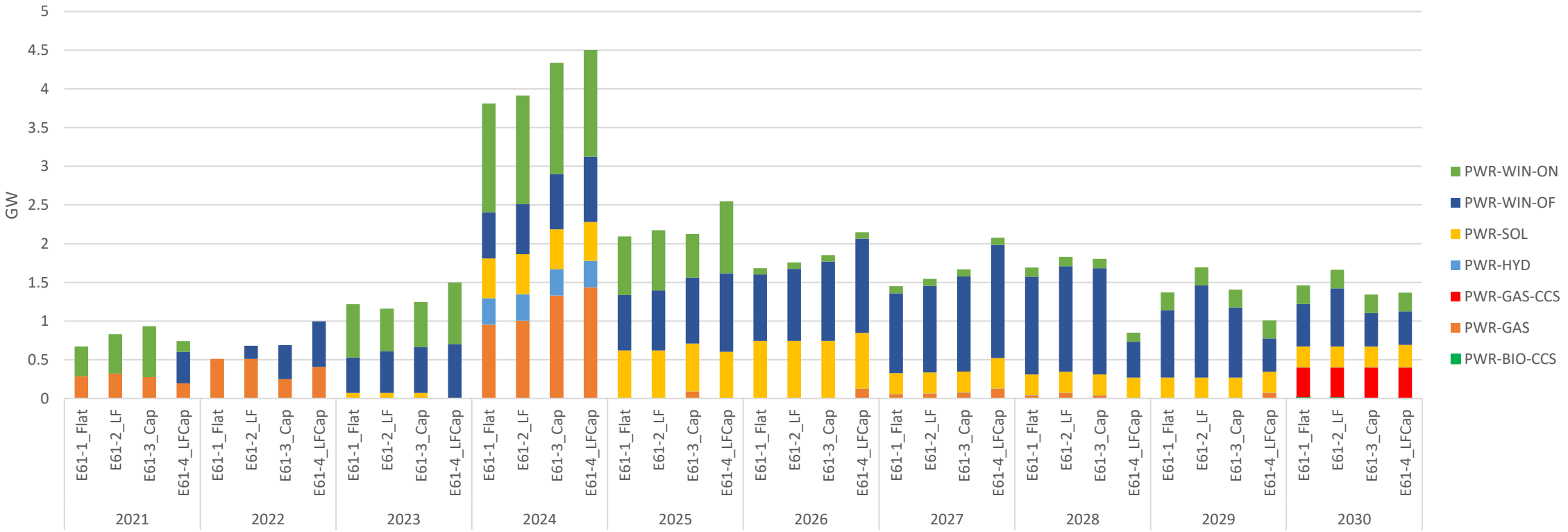
	Capacity [MVA]			Load factor [%]		Demand [PJ]	
	2021	2022	2030	2021	2030	2021	2030
E61-1_Flat	1100	1100	1100	40	40	14.19	14.19
E61-2_LF	1100	1100	1100	40	70	14.19	24.83
E61-3_Cap	1100	1800	3800	40	40	14.19	47.93
E61-4_LFCap	1100	1800	3800	40	70	14.19	83.89

Scenarios recap



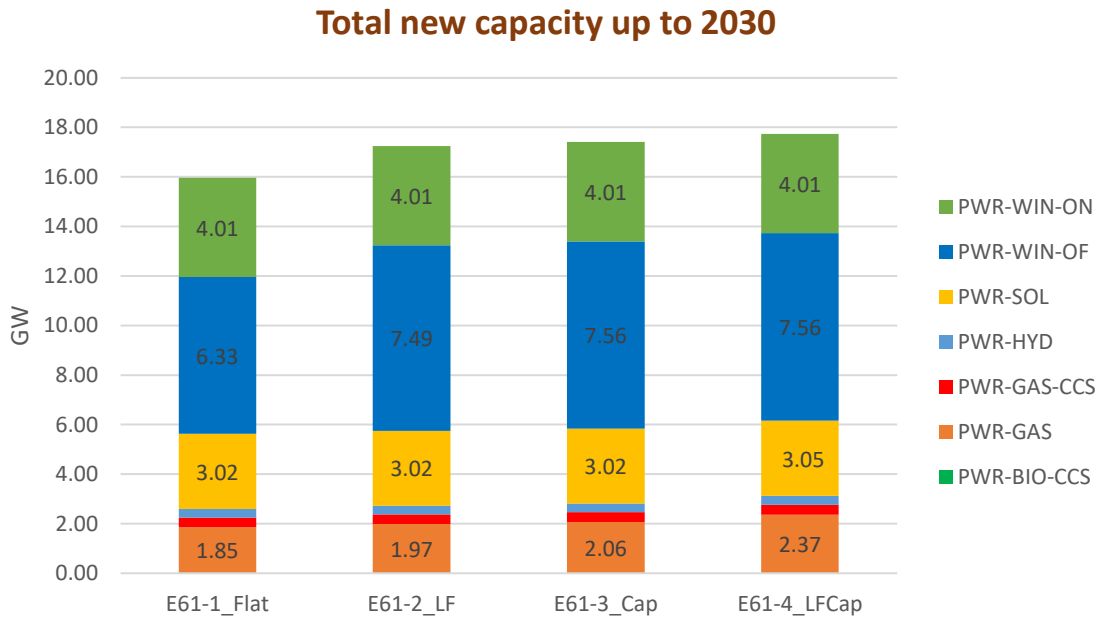


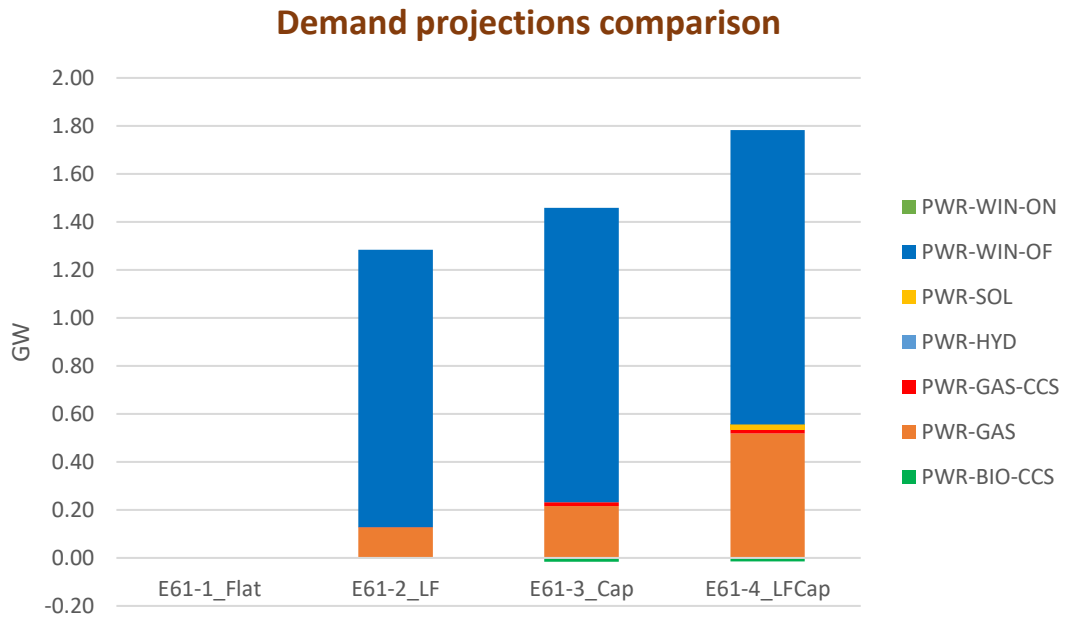
New capacity installed



- Investments in gas power plants in 2024 due to **coal phase out** in 2025
- Each year a considerable level of new wind off-shore capacity
- Some investment in CCS technologies in 2030

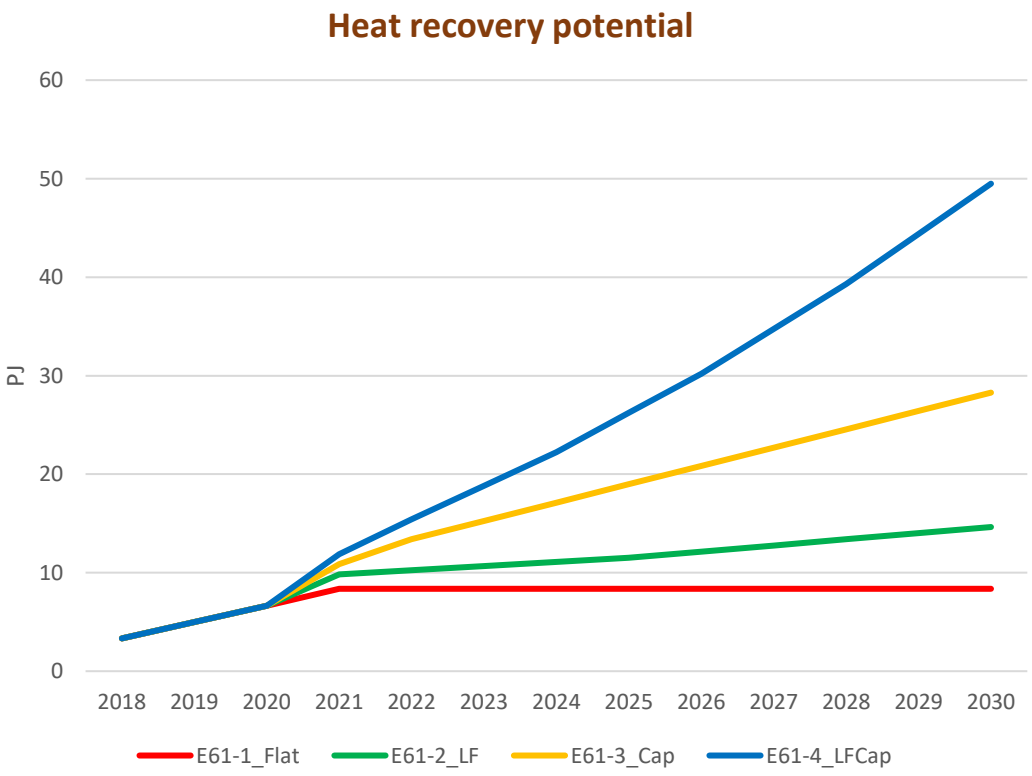
New capacity installed (Up to 2030)

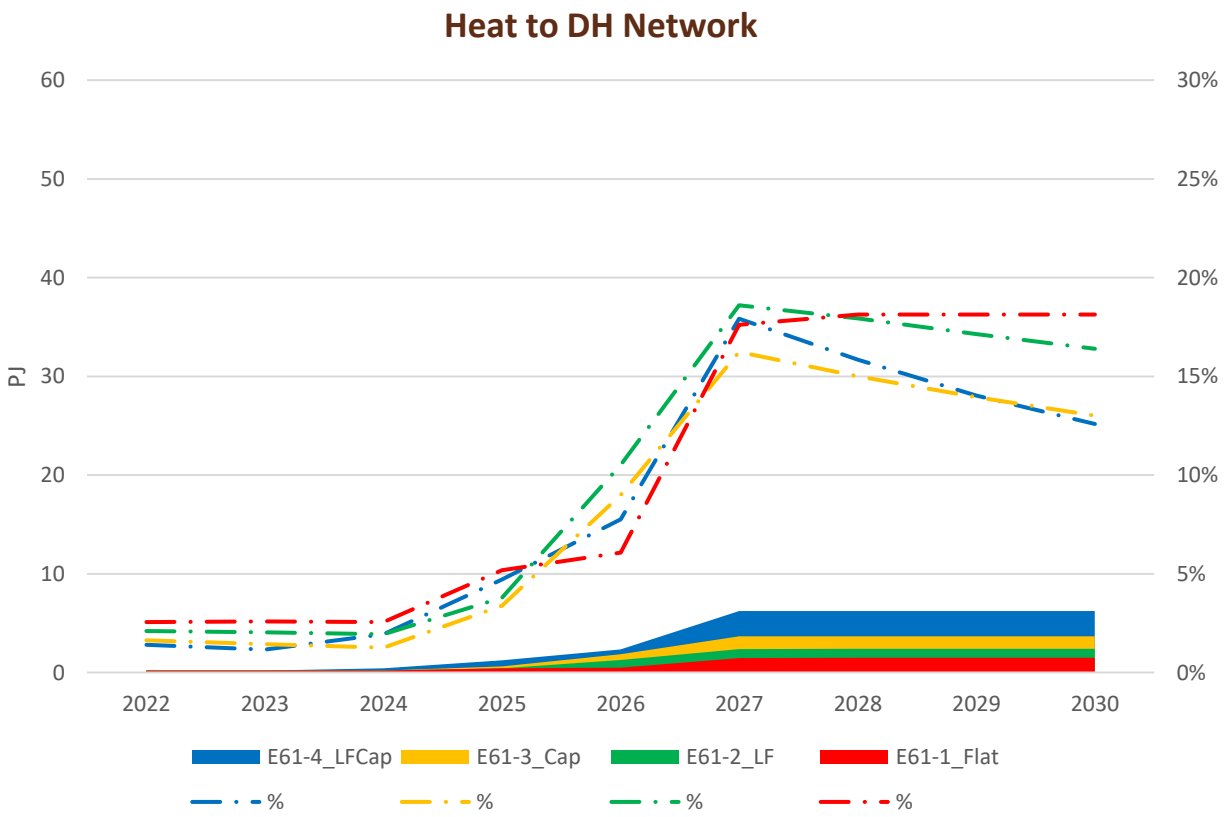




- In the next 8 years the system will need from **16 to 17.8 GW of new capacity** to meet decarbonization targets
- This 1.8 GW difference is covered mostly from **wind off-shore**
- But… in the case of very high demand the further difference is covered by **new gas power plants**

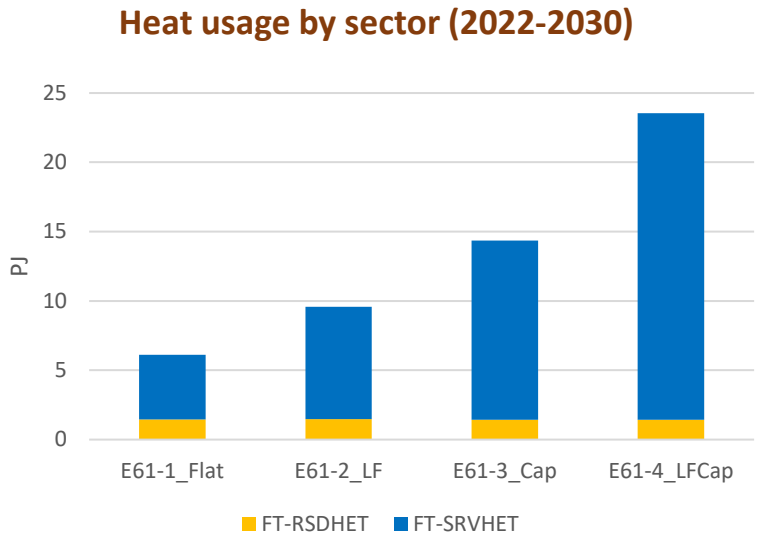
Waste heat recovery



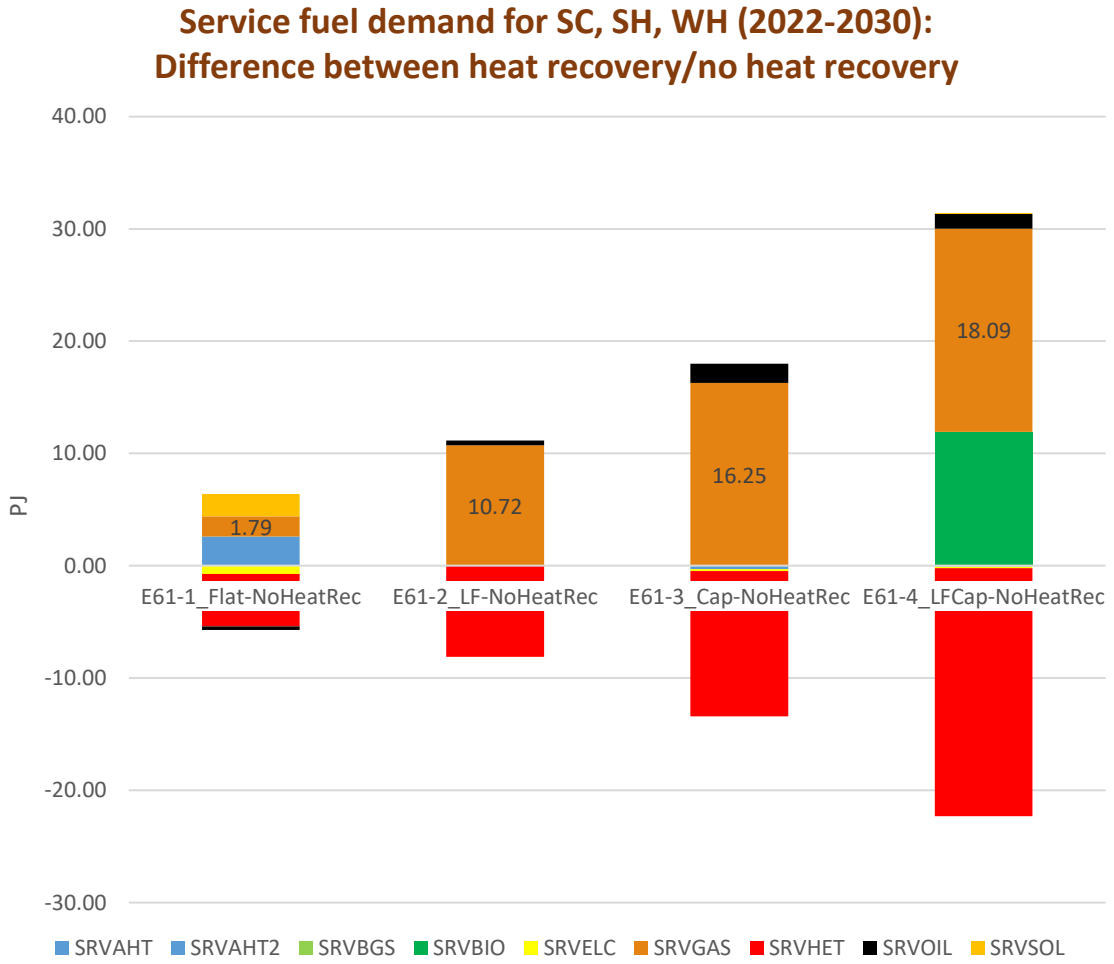


From 2027, in 3° and 4° demand senarios, **new investments** in DH networks are **no longer cost optimal**
While the potential grows the share of heat actually used decrease

What if no heat recovery?



SRV sector

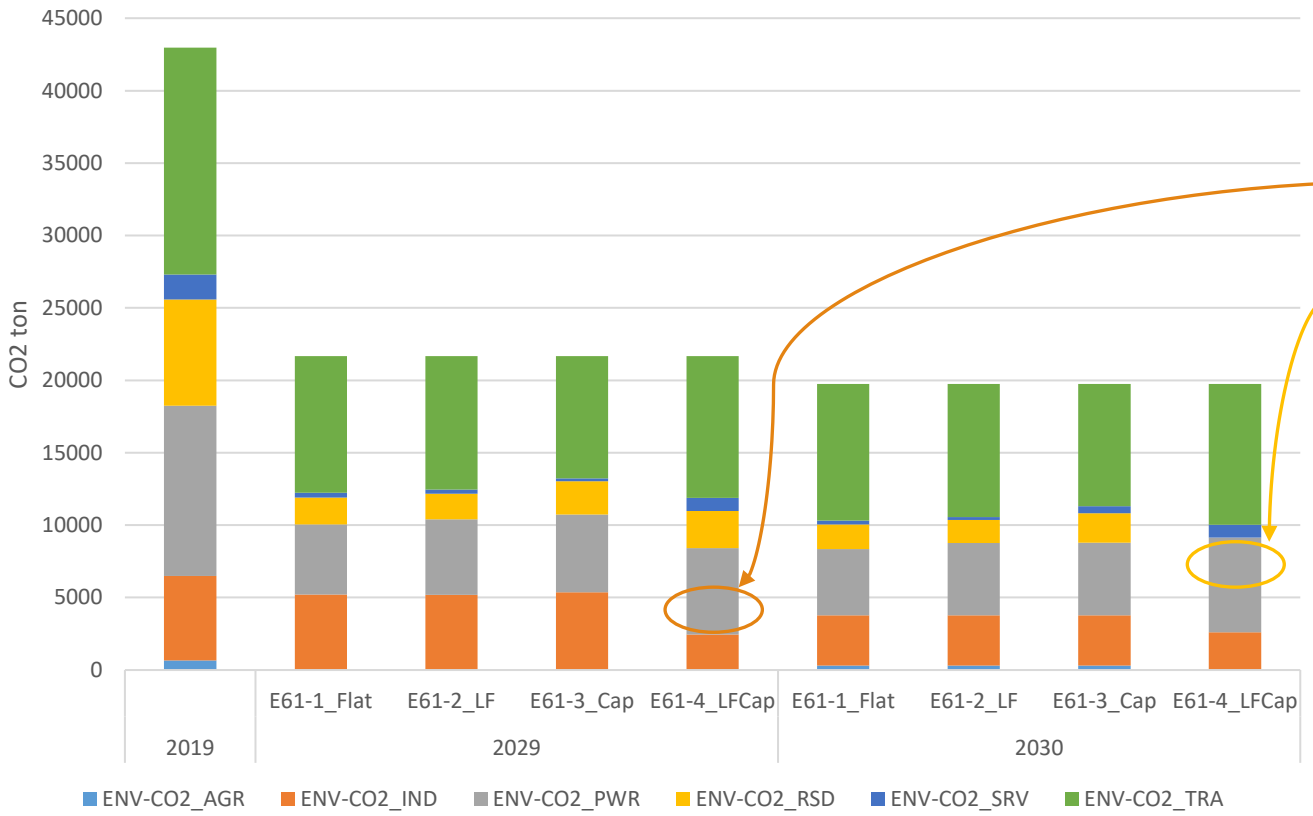


- The heat recovered from DCs is used for **space and water heating** in service and residential sectors.
- Heat is **replaced** mostly by **gas** and to a small extent by **oil**. In the 4th case there's also a big contribution of **biomass**.
- The amount of **gas avoided** by recovering the waste heat is **lower** than the amount of **additional gas required** in the power sector due to DCs growth (18.09 PJ vs 53.90 PJ in the 4th case)

Emissions by sector

Emissions from the **power sector** increase as the demand from DCs grows

more pressure on the other sectors to speed up the transition



- What happens in 2029 to the industrial sector?
- What happens in 2030 to the residential sector?

New investments in greener technologies?

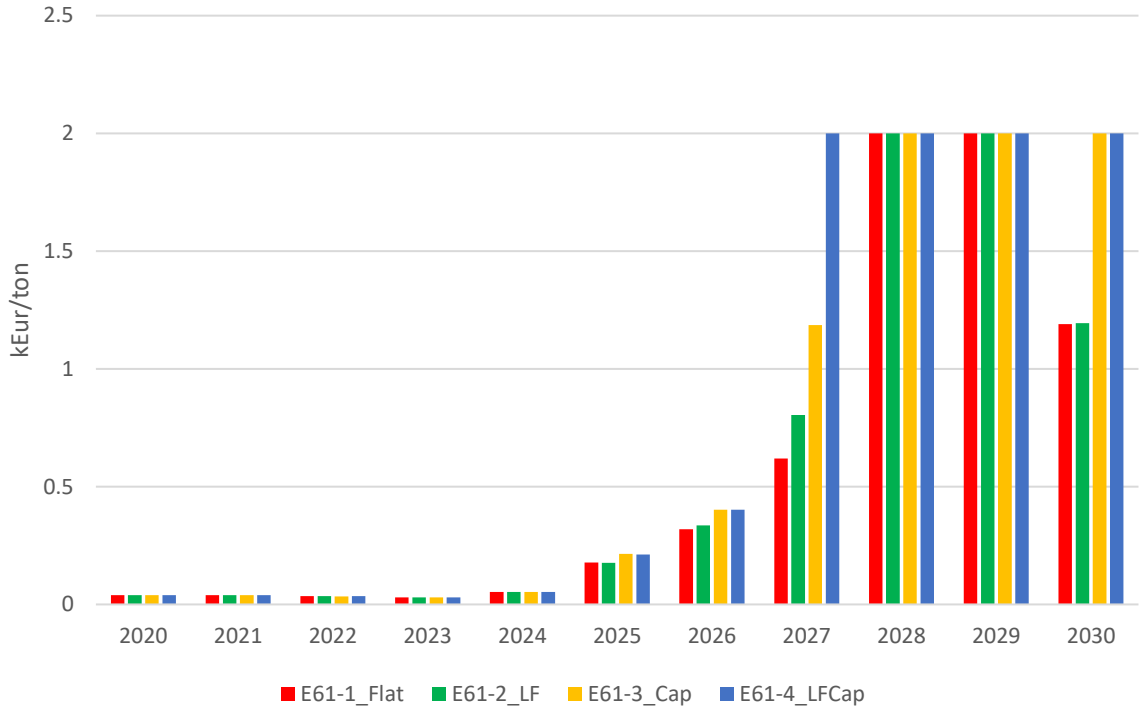
CO2 Price

CO2_price = 2 kEur/ton

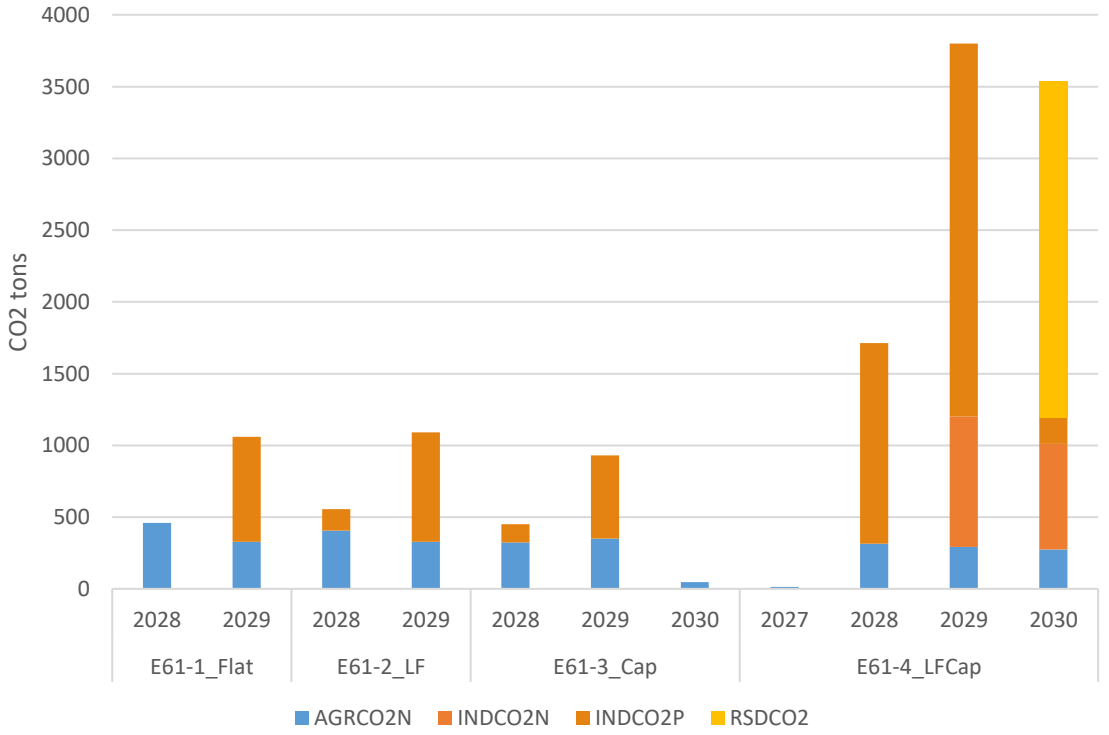
No cheaper options
to mitigate emissions than
Direct Air Capture

«backstop» technology used to make the scenario feasible

CO2 price



Backstop emissions



Discussions

Assumptions / input data:

- Cooling system
- Waste heat
- Load factor increase

Lack of reliable data: Literature review and sensititvity analysis

Analysis:

- Impact to other sectors
- Comparison with less challenging scenarios

New ideas are welcome

THANK YOU FOR LISTENING

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