

# The potential of district heating systems to provide balancing services in the European Union



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# Relevance and content

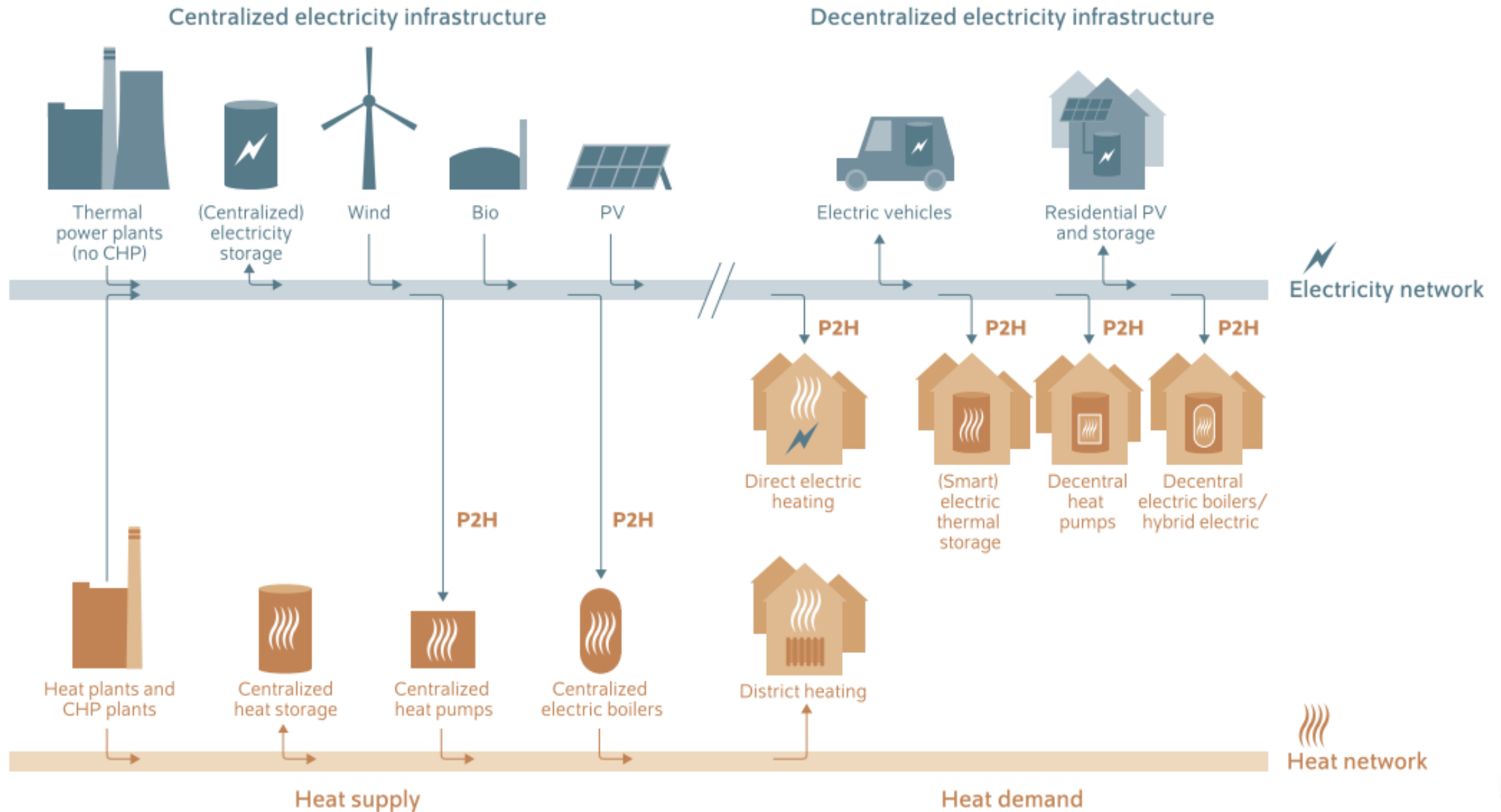
## *Relevance*

1. The integration of vRES requires **flexibility** in the energy system
2. Energy **system integration** allows the exploitation of higher degree of flexibility
3. District heating are good candidate since they are **natural aggregators** of both electric and heat demand

## *Content*

1. Overview
2. Case of Hvide Sande
3. Technical potential at the EU level
4. Discussion and conclusion





# How can district heating provide balancing services?

## Positive imbalance

CHPs

Heat Pumps / Electric Boilers



## Negative imbalance

CHPs

Heat Pumps / Electric Boilers



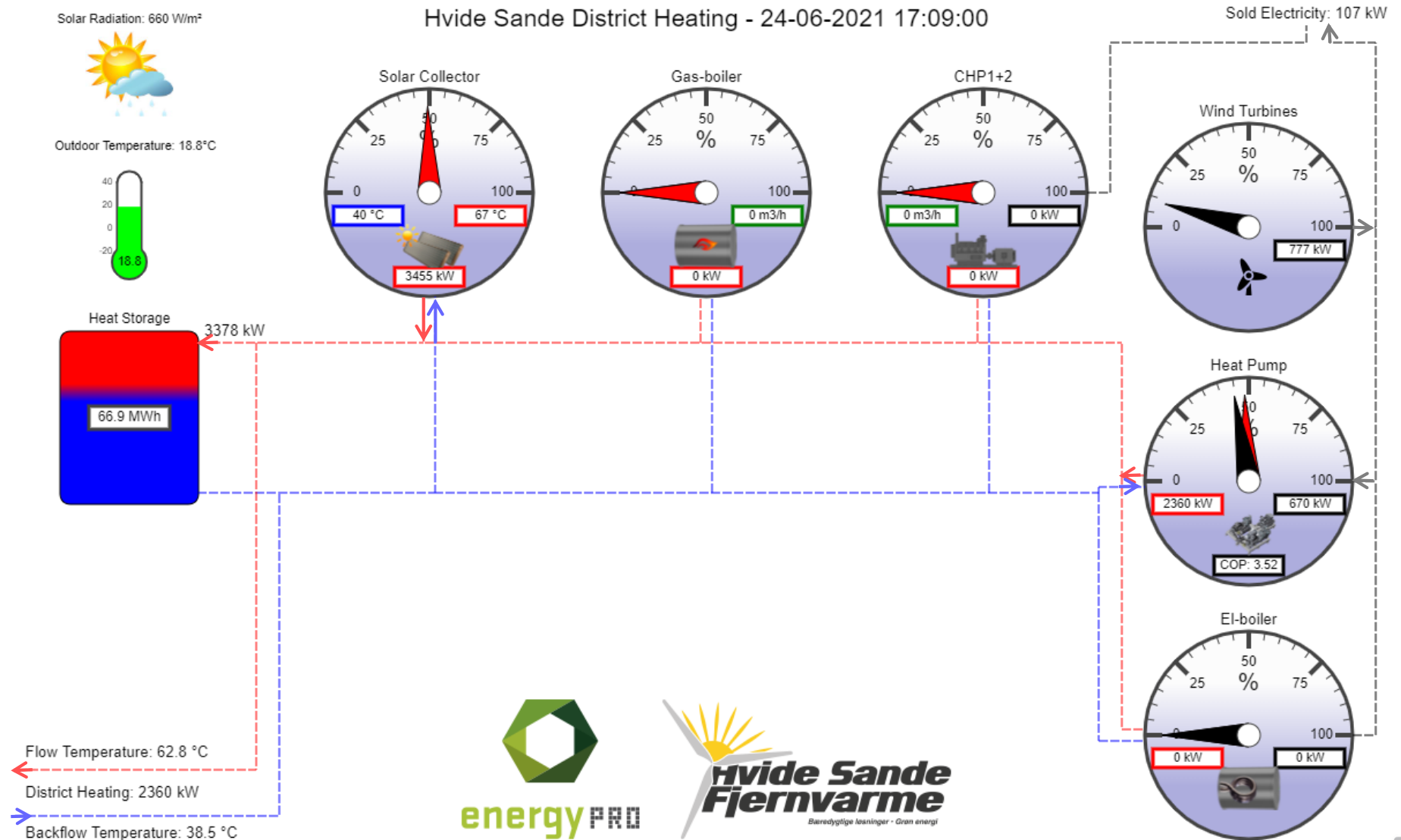
The disruption of heat supply must be compensated by exploiting **flexibility in the district heating system** with:

- Active storage
- Passive storage
- Technology shift



# Hvide Sande district heating (Denmark)

136 TJ of heat in 2017



# Deployment of thermal storage in district heating systems

	Country	Denmark	Sweden	Finland
<i>Geographical scope</i>	<i>District heating</i>	DK all DH systems	SE all DH systems	Helsinki 90% heat supply
	<i>Source</i>	Lund <i>et al.</i> 2018 Hedegaard <i>et al.</i> 2012	Hennessy <i>et al.</i> 2019 Werner 2017	Salpakari <i>et al.</i> 2016 Mikkola <i>et al.</i> 2016
<i>Annual average daily heat demand</i>	GWh	115	156	17-20
<i>Passive storage</i>	GWh	5		1.2
<i>Annual average heat load shift</i>	Hours	1		1.4-1.7
<i>Active storage</i>	GWh	50	42	
<i>Annual average heat load shift</i>	Hours	10	6	

$$\text{Annual average heat load shift} = \frac{\text{Annual average daily heat demand} / 24}{\text{Passive/Active storage}}$$



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# The technical potential for balancing capacity

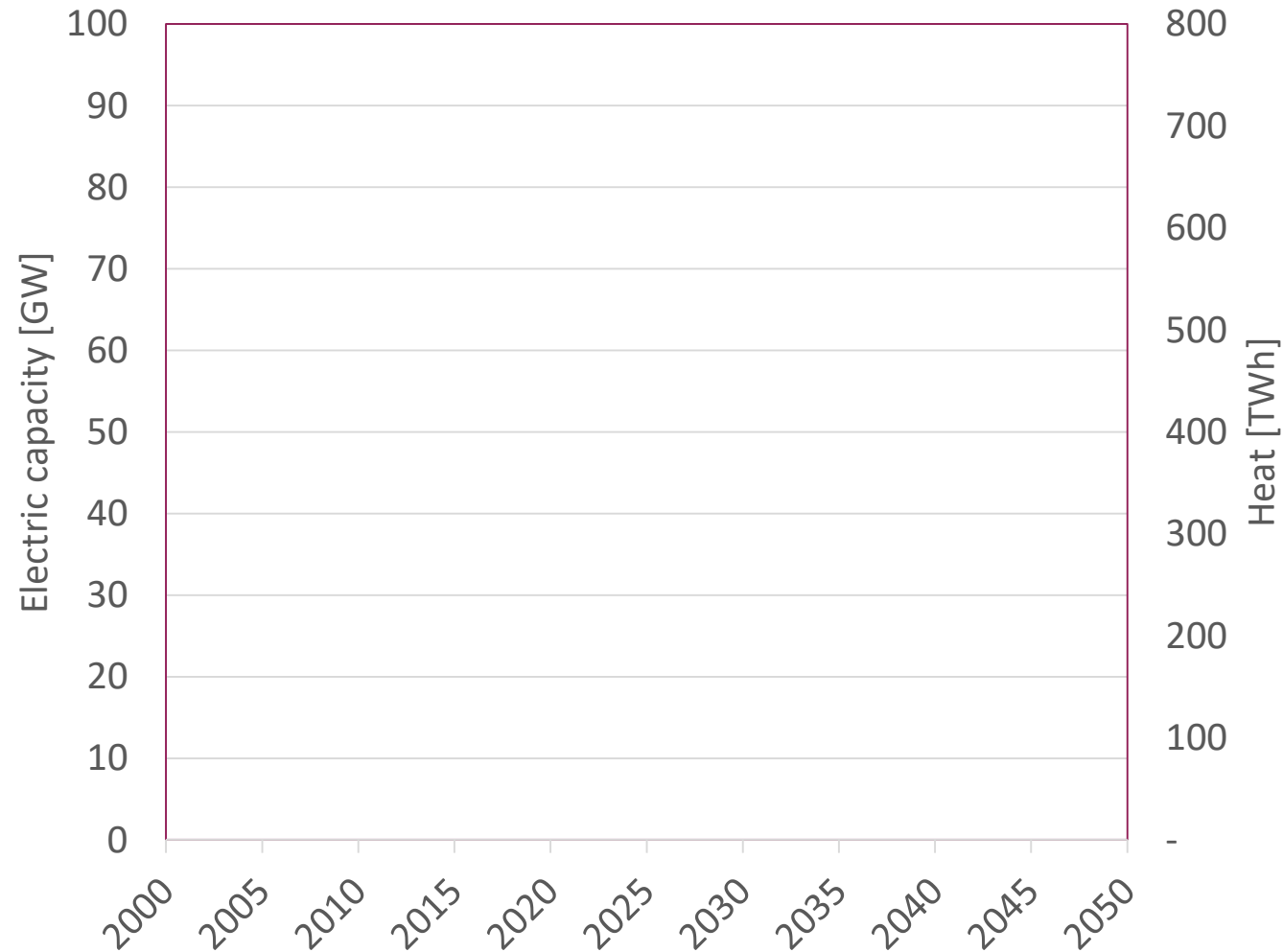
## *Assumptions*

1. The flexibility in DH system is enough to provide balancing
2. The **actual operations** of the district heating systems are not taken into account
3. The only limitation is given by **ramping rates** of the interface technologies

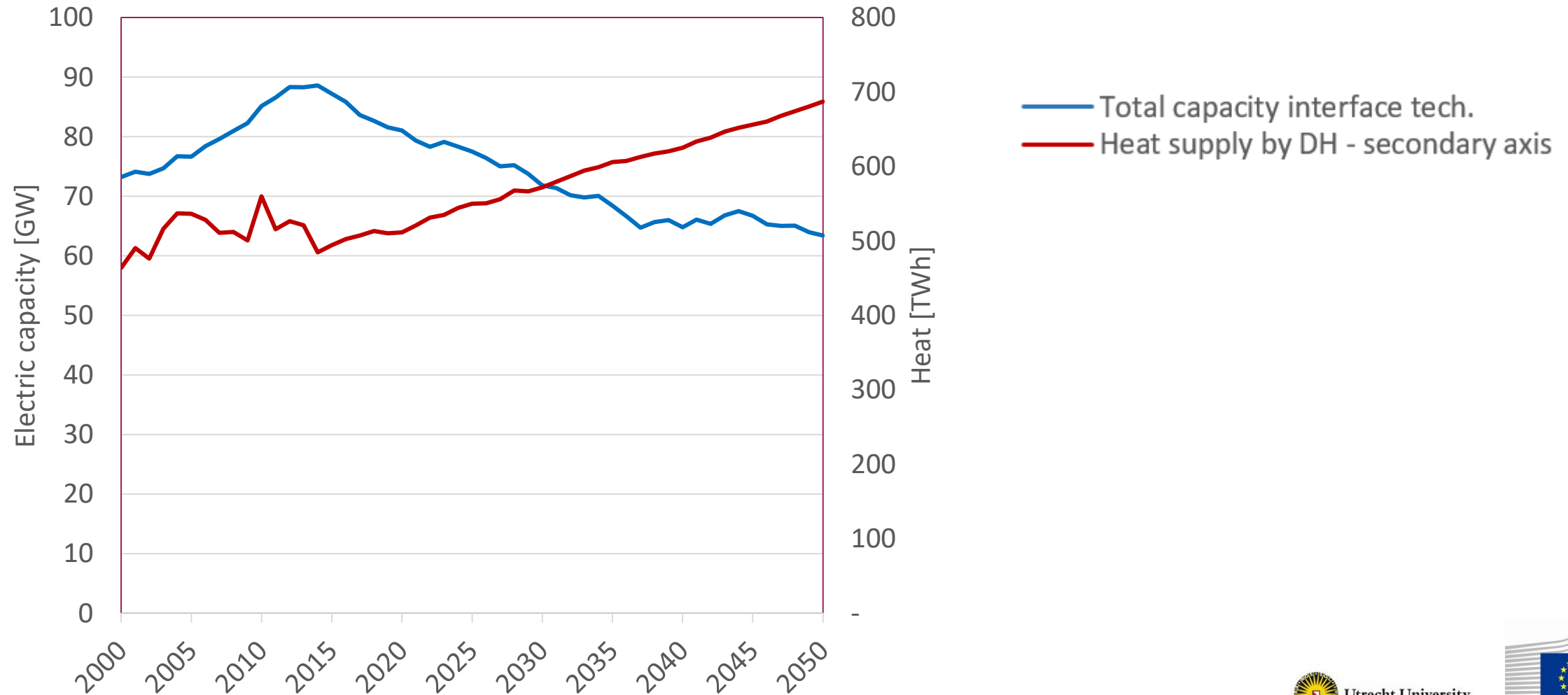
## *Method*

1. Data are retrieved on district heating, CHP and P2H per country, from 2000 to 2050 (**POTEnCIA scenario**)
2. The capacity of the interface technologies that can satisfy the **ramping condition of FCR, aFRR and mFRR** are calculated
3. Only **historical reserve capacity**

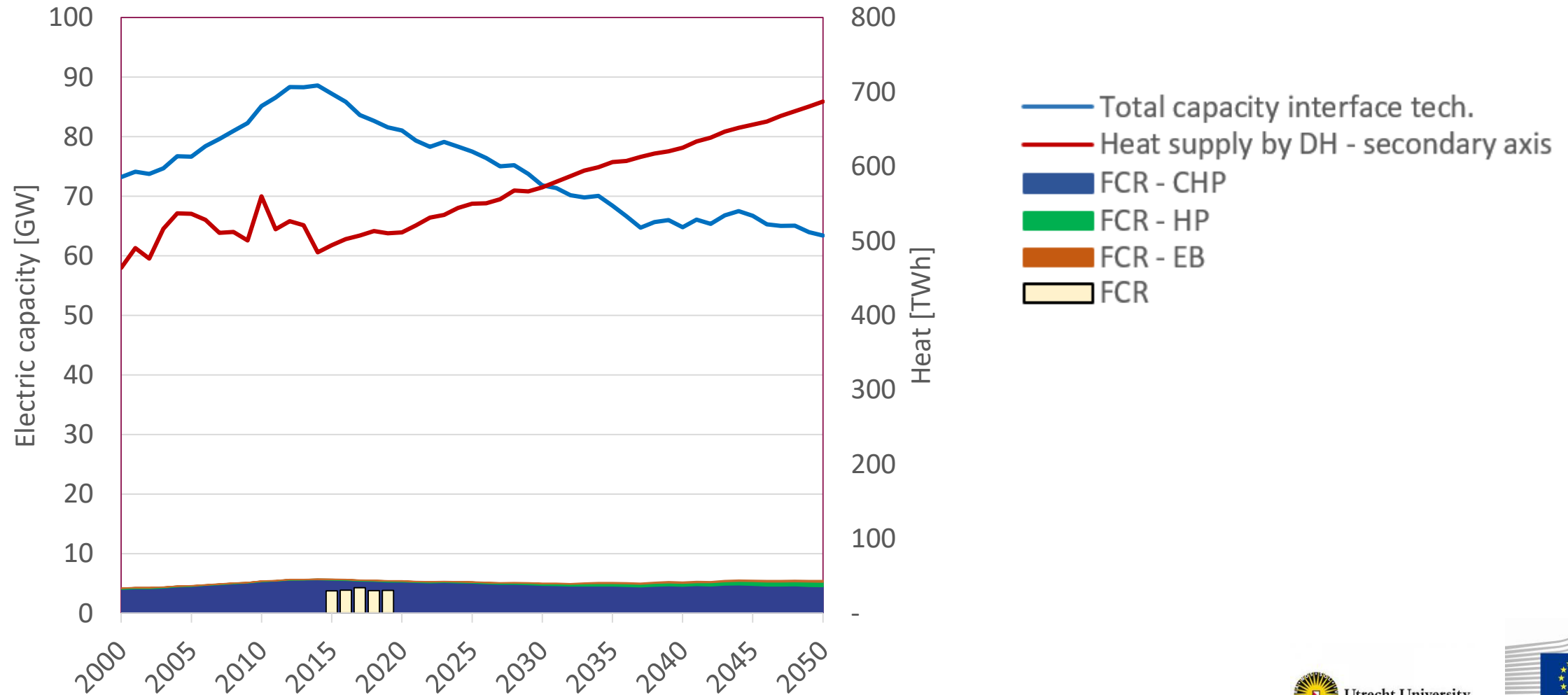
# The technical potential for balancing capacity – EU



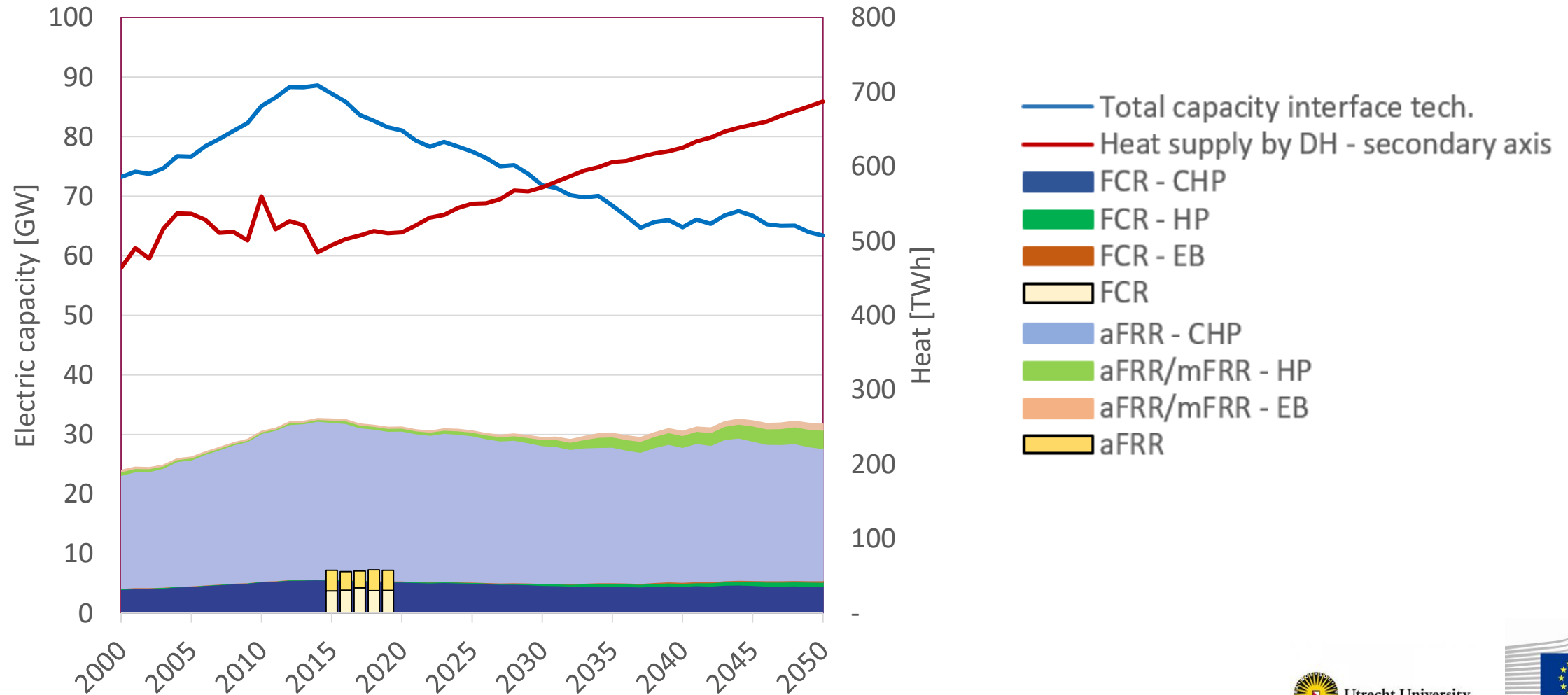
# The technical potential for balancing capacity – EU



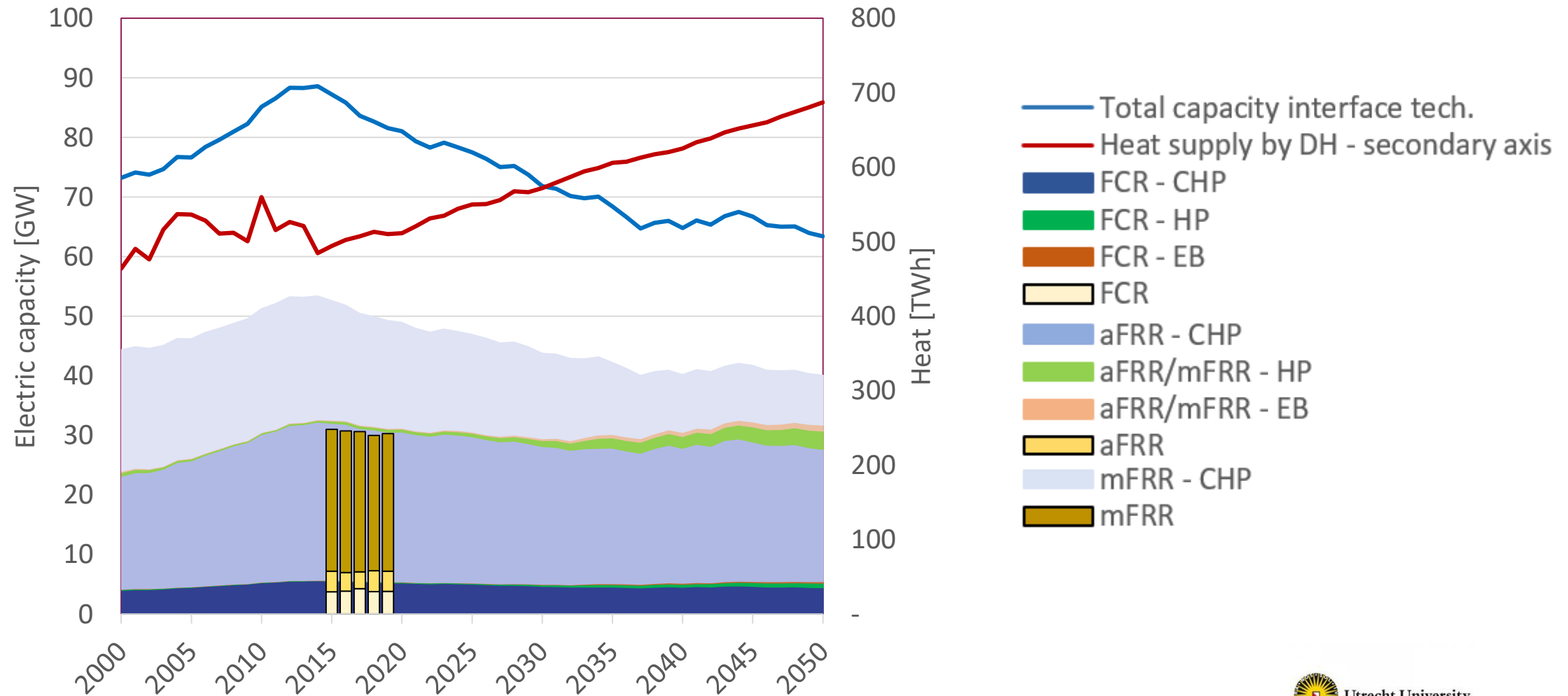
# The technical potential for balancing capacity – EU



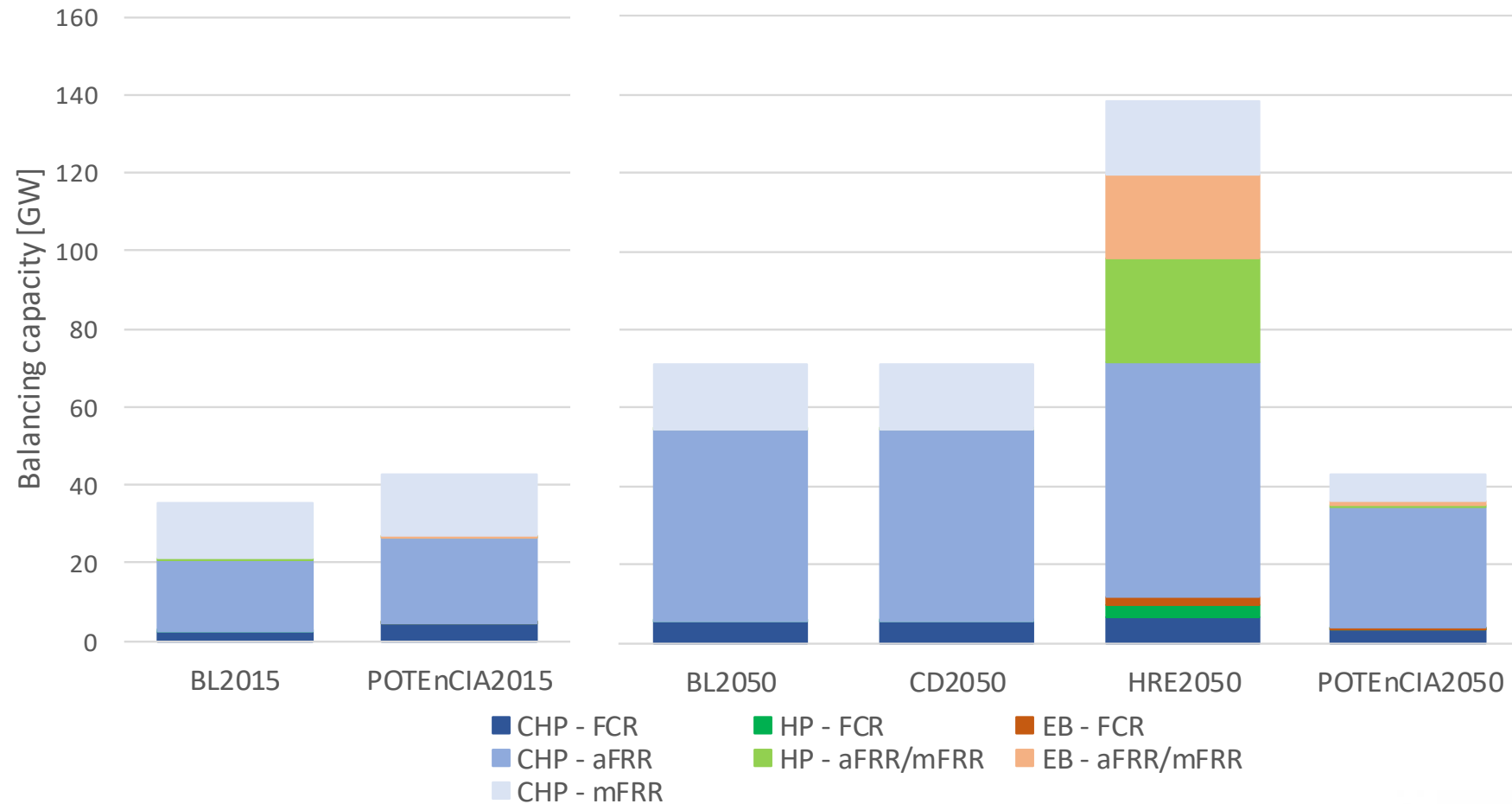
# The technical potential for balancing capacity – EU



# The technical potential for balancing capacity – EU



# What if we apply other scenarios?




# Discussion and conclusion

## *Discussion*

1. Limited progress in coupling of power and district heating for balancing services
2. Scarcity of data available related to district heating
3. District heating are also suitable to provide flexibility on a longer time frame — e.g. intraday
4. Future of CHP

## *Conclusions*

1. Studied the capacities of district heating networks (CHP/P2H) to provide balancing services  
 technical potential is high
2. The economic and market potential should be evaluated for each system by the district heating operator





Thanks for your attention!

Do not hesitate to contact me for any  
further information at

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