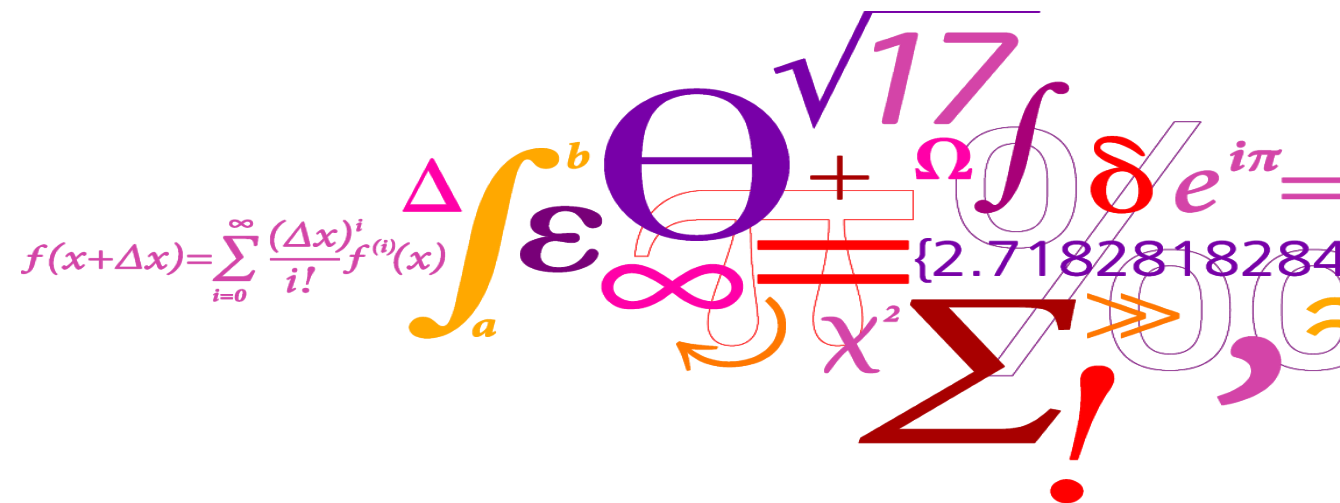


Data centers in the future Danish energy system

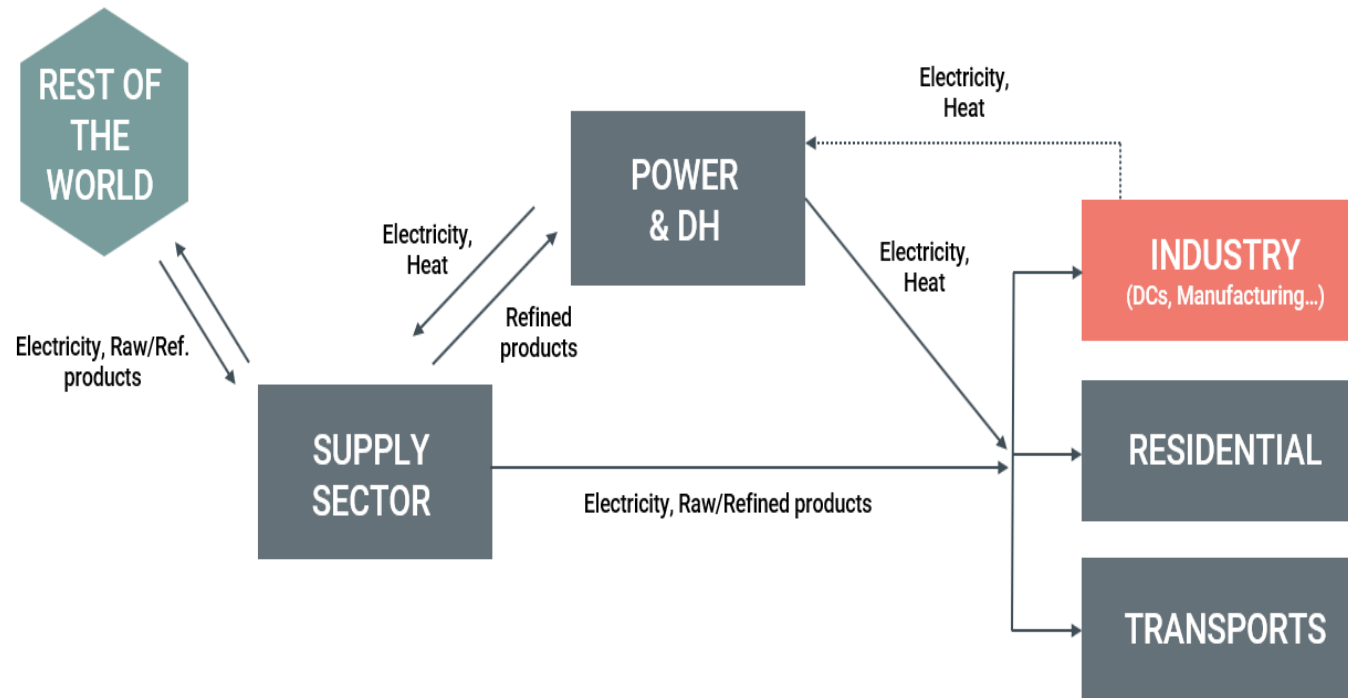


Stefan Petrović,
ClimateRecon2050 webinar
October 29th, 2018

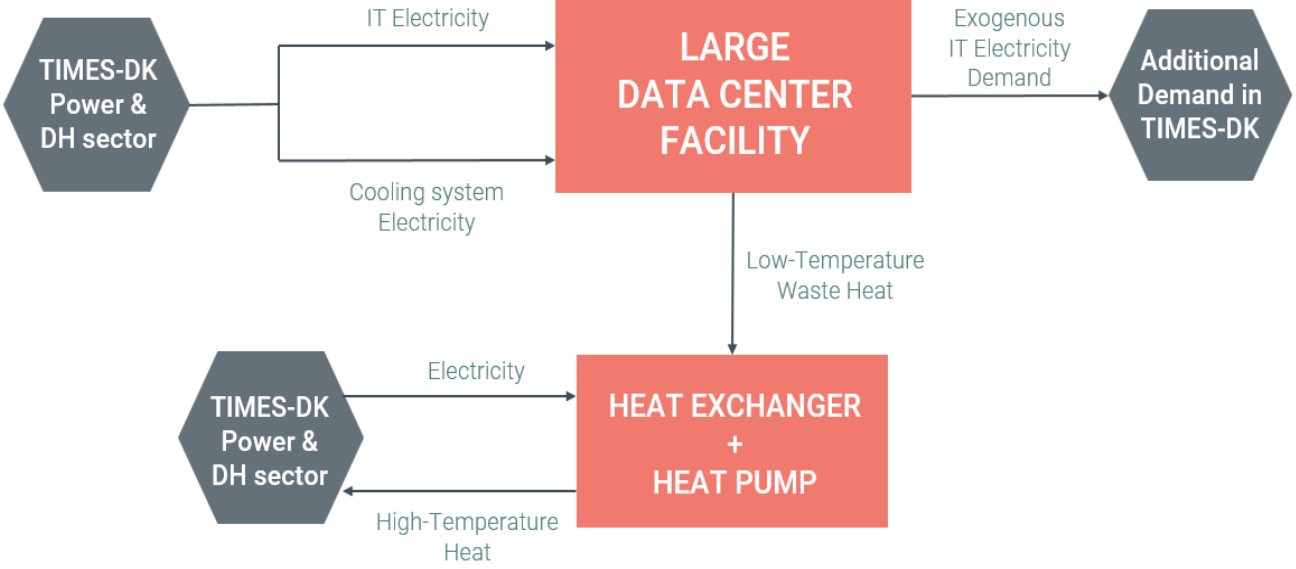
Based on the master thesis of Alessandro Colangelo and the work of Stefan Petrovic, Mikkel Bosack, Olexandr Balyk, Kenneth Karlsson and others



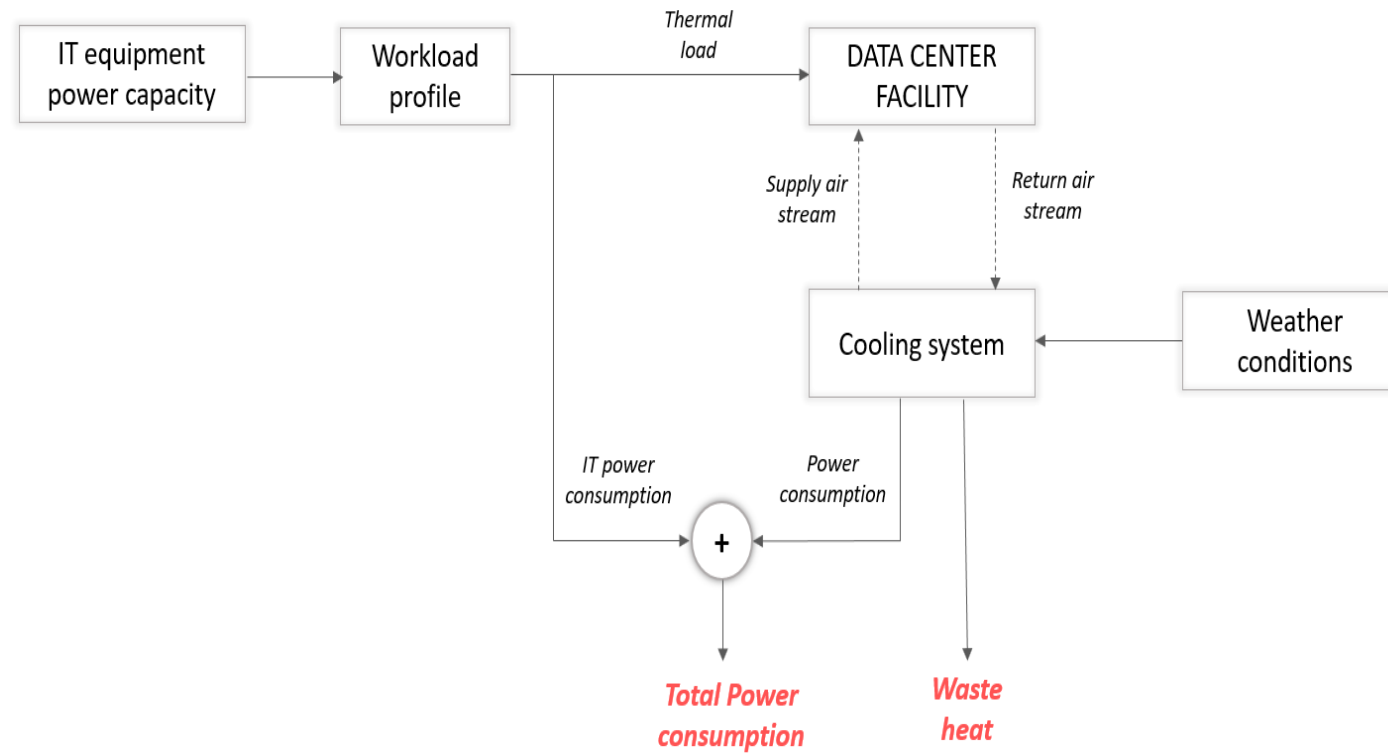
Data centers in the energy system



Electricity and excess heat to/from the data centers



Simplified representation of data centers



Data centers – market considerations

- There are no big variations in the large data centers' electricity consumption and surplus heat output over the day or over the year, but the volumes will be a little bigger when it is hot.
- The speed of commissioning is very uncertain, and it is therefore uncertain how quickly the electricity consumption and potential surplus supply will increase.
- Developments in recent years have shown that data center owners can quickly shift focus from one country to another – the reasons range from "ease of doing business" to the bandwidth of fiber connections across the Atlantic and to assessing political stability.
- In addition, there is great uncertainty about technological development
- Outcomes of the scenarios are very different, which underlines the great uncertainty of these kind of projections based on developments ranging from policy to technology. The Linear Growth scenario is considered to be the Base scenario, have been linear.

Source: COWI's report "Temaanalyse om store datacentre" from February 2018

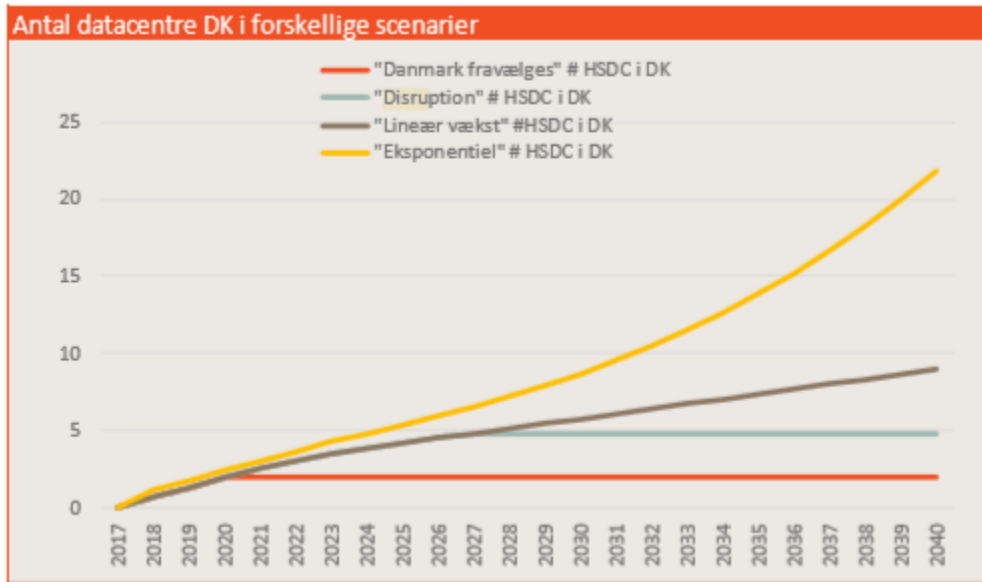
https://ens.dk/sites/ens.dk/files/Analyser/temaanalyse_om_store_datacentre.pdf

Data centers - scenarios

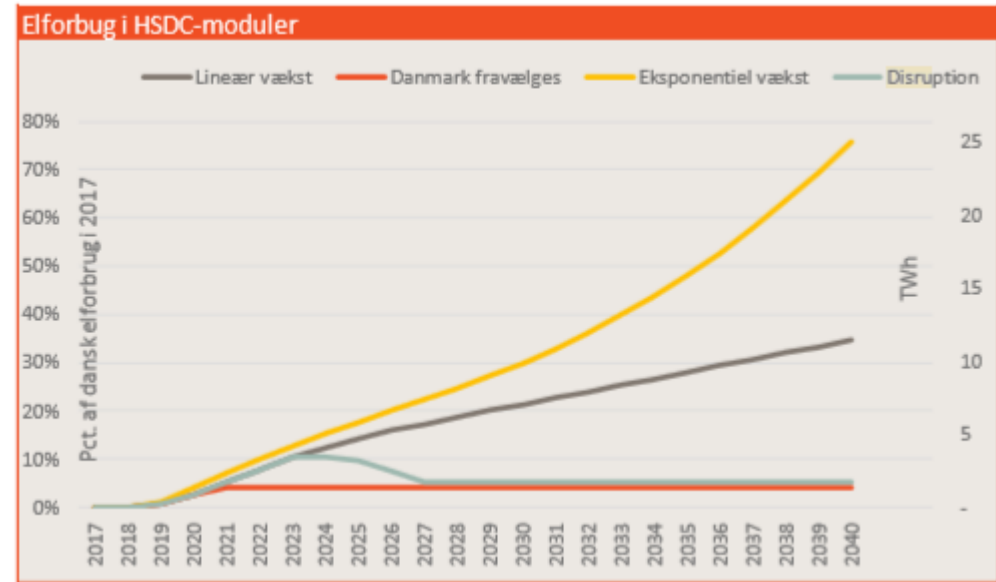
- **Linear scenario (Base):** Linear growth in the number of HSDCs and continued high Danish market share that support development. The number of HSDCs rises during the analysis period until 2040, with 9 data centers in Denmark.
- **Opt-out Scenario (Low):**
All overall global and European scenarios for HSDCs are maintained. The total European market share is also maintained, but the Danish market share of new HSDCs falls to zero. Two data centers will be established by 2020, after which no more will be established.
- **Disruptive scenario:** New technology and efficiency enhances the HSDC market. Five HSDCs will be established until 2027, after which no more will be established. The power consumption in the data centers decreases because the efficiency of the servers increases.
- **Exponential (High):** Exponential growth in the number of HSDCs and continued high Danish market share. The number of HSDCs rises during the analysis period until 2040, with 22 data centers in Denmark.

Source: COWI's report "Temaanalyse om store datacentre" from February 2018
https://ens.dk/sites/ens.dk/files/Analyser/temaanalyse_om_store_datacentre.pdf

Data centers in the future Danish energy system



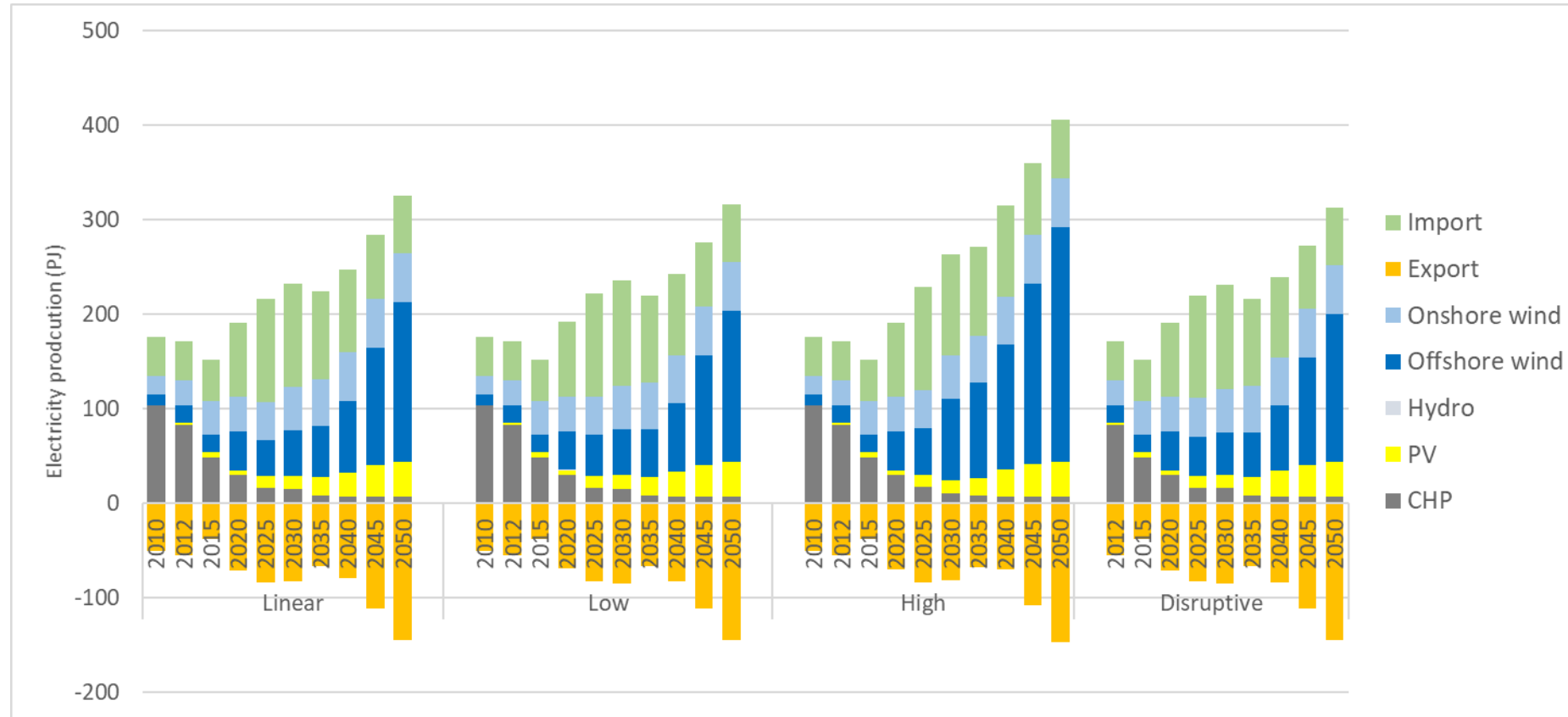
Number of HSDCs



Electricity consumption of HSDCs

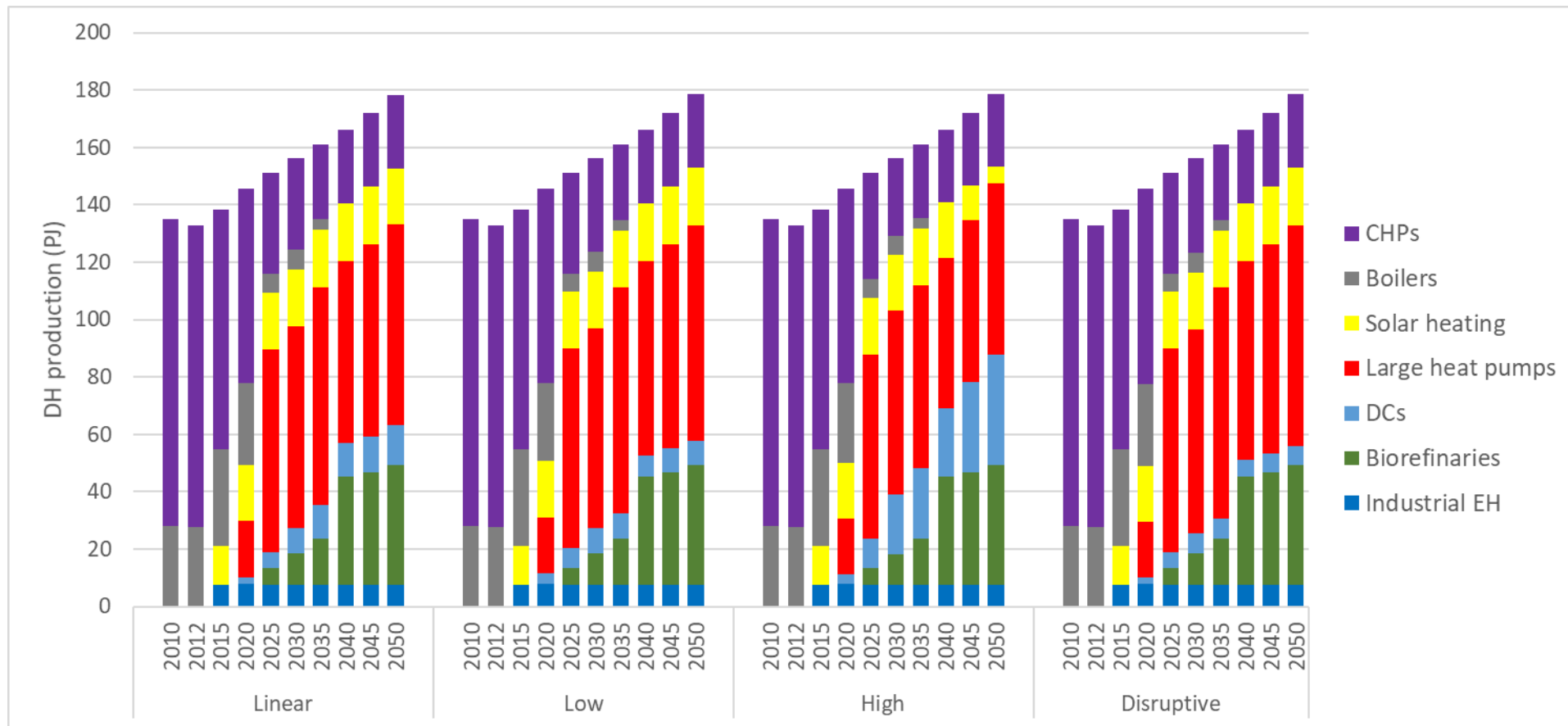
Source: COWI's report "Temaanalyse om store datacentre" from February 2018
https://ens.dk/sites/ens.dk/files/Analyser/temaanalyse_om_store_datacentre.pdf

Data centers in the future Danish energy system



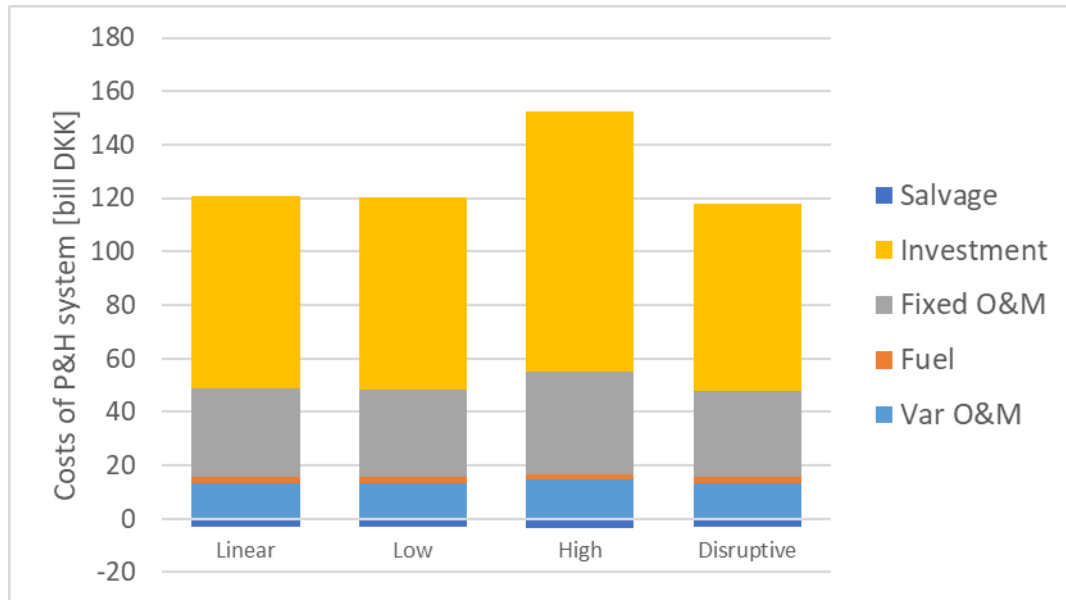
Electricity production

Data centers in the future Danish energy system

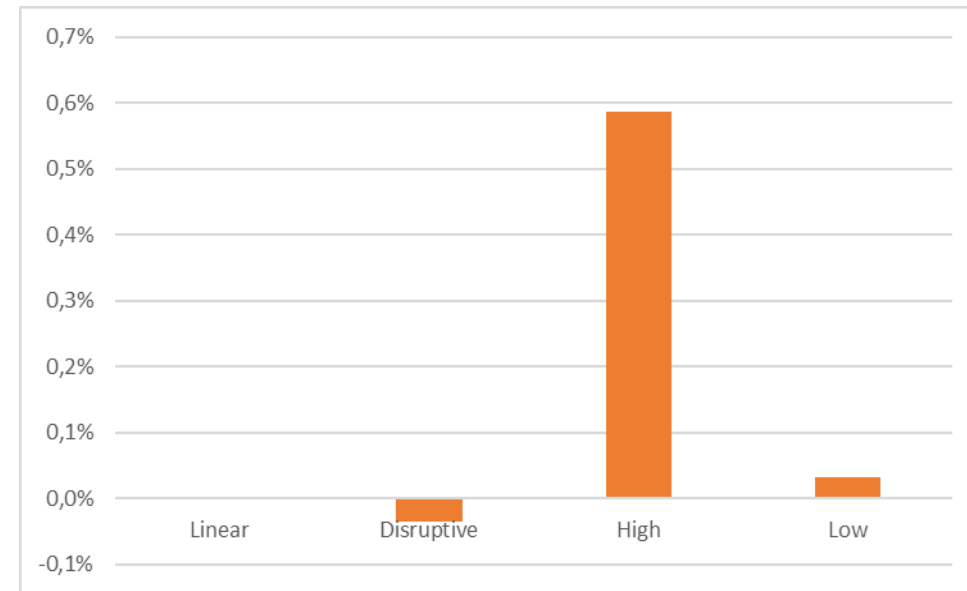


DH production

Data centers in the future Danish energy system



Costs of power and DH system



Total system costs

Thank you for your attention



- Questions
- Answers
- Comments
- Suggestions

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