

5th International Conference on Smart Energy Systems
Copenhagen, 10-11 September 2019
#SESAAU2019

Flexsumers

Smart-Energy ready heat customers



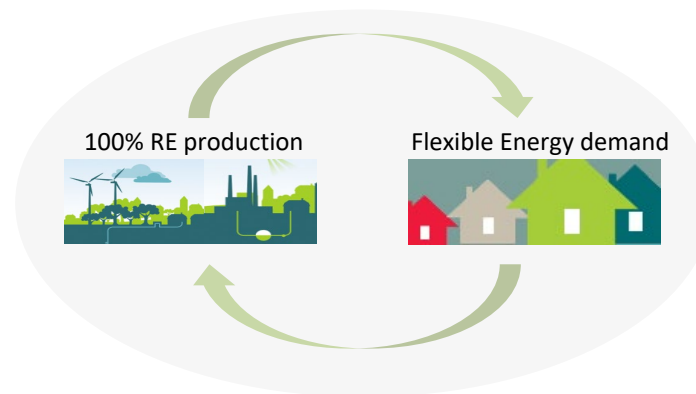
Århusgadekvarteret in Nordhavn, Copenhagen. Source: arkitekten.dk. Photo: Adrian Täckman.

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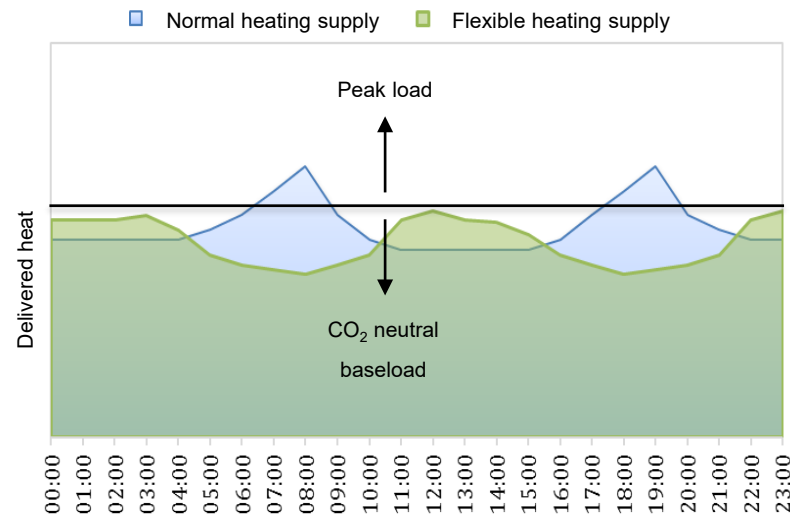
- **Incineration plants and CHPs lacks the needed flexibility** to cover the frequent short-term peak demand, thus fossil fueled boilers help secure a stable DH supply
- A transition towards a 100% CO₂ neutral energy system in the future push for the penetration of **decentral and fluctuating renewables**, and an electrification of the heating system
- Flexibility is crucial to ensure economic efficiency, reliability, and resilience of the future **smart energy system**
- Customers who actively contribute to balance out the demand in the district heating system by increasing/decreasing their consumption on-demand are called **flexsumers** (demand-side response)



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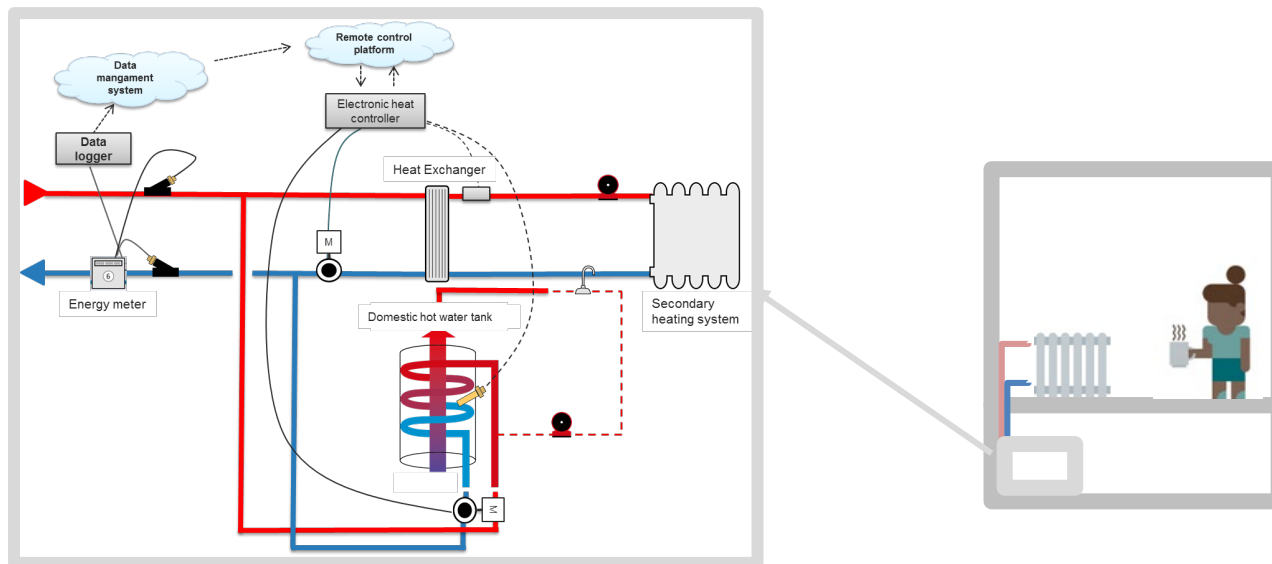
- **Short-term peak demand** typically occurs weekdays from ~6-9, and ~17-20 due to customer behavioural patterns, and at random hours in the event of operational challenges in the distribution system
- Long-term peak demand occurs during very cold periods, or in the event of a failure at a production plant
- Peak demand is typically covered by **oil- or natural gas fueled boilers**
- **By managing the heat demand at the customers,** we can address the short term peak demand (load shifting)



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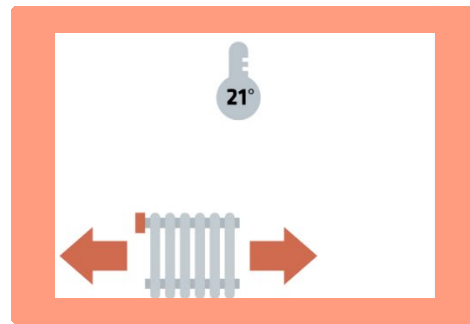
- Electronic heat controllers connected to the internet is used to **remote control the heating supply in buildings**
- The heating supply to the secondary heating systems is reduced for periods of up to four hours
- To automate and optimize the operation of flexsumers further, **AI is added to the heat control** (historical data, real-time data (1h res), weather forecast)



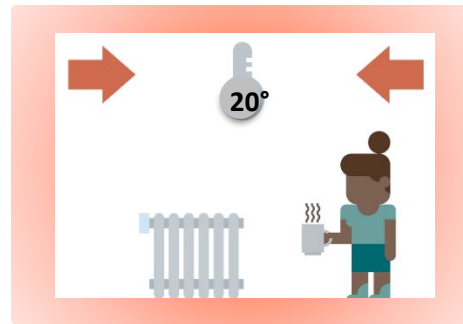
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- By exploiting the **short-term heat storage potential in buildings** the thermal comfort of residents is maintained ($\Delta t_{\text{indoor}} < 1^\circ\text{C}/\text{h}$, and $\Delta t_{\text{indoor}} < 2^\circ\text{C}$ pr. flexibility interval)
- Thermal energy is stored in the building mass during normal-supply hours,
- During reduced-supply hours, the thermal energy stored in the building mass is released into the room
- The short-term heat storage potential in buildings differ based on the **thermal mass, level of insulation, and secondary heating systems**



Normal heating supply

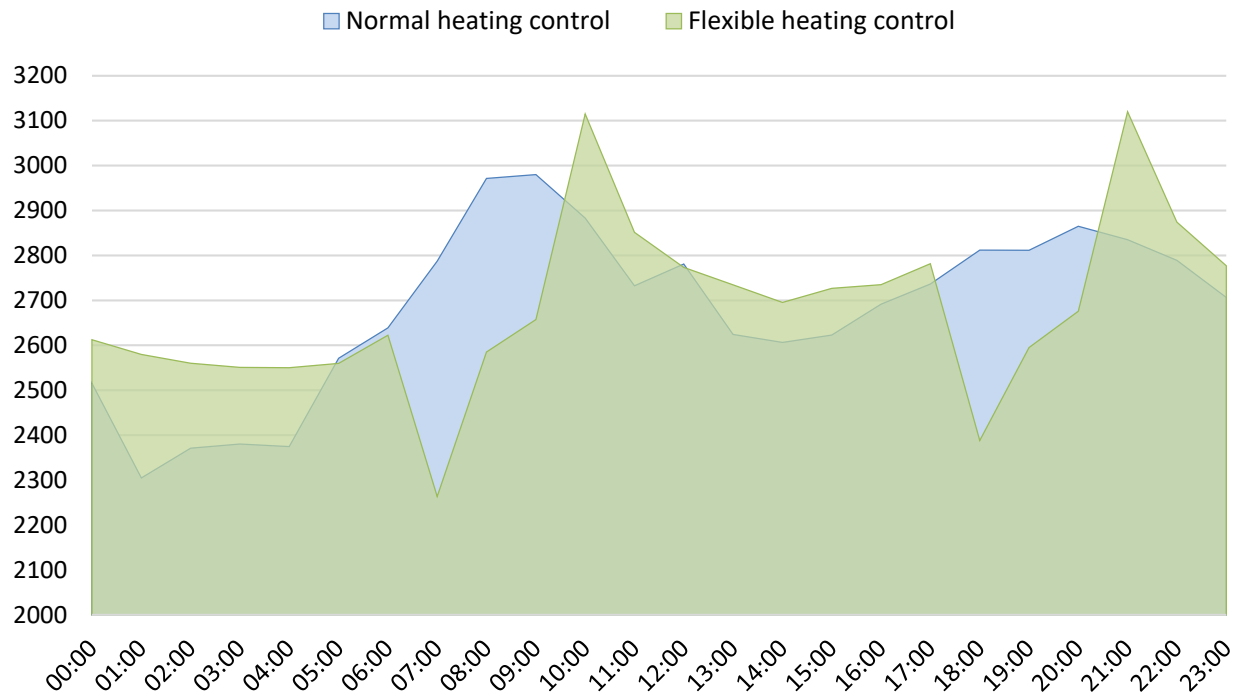


Reduced heating supply

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- **Demonstrations in about 50 office- and residential buildings** in Copenhagen in the heating season of 2017-18 and 2018-19
- On average, reducing the heating supply by 5°C gives a **peak power reduction of 12% at building level**



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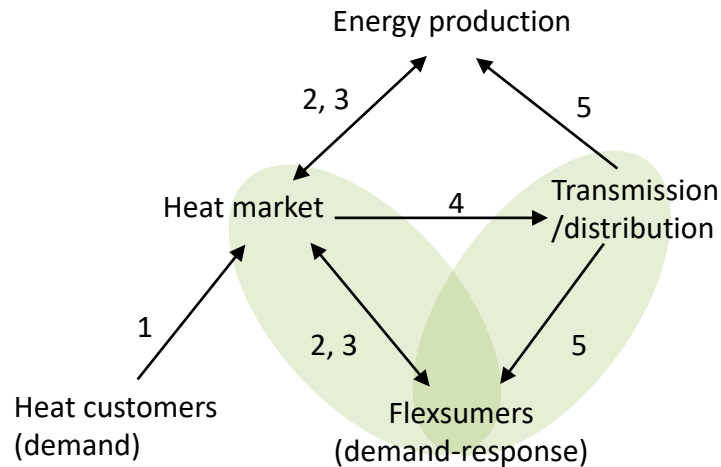


- The flexibility potential of a building is established based on the peak power reduction (kW), and length of flexibility interval (h)
- From Energy Lab Nordhavn the demonstrations of flexumers showed that
 - Old, massive residential buildings have the highest peak power reduction
 - New, massive residential buildings have the longest flexibility intervals
 - The design and daily operation of the district heating substation and the secondary heating system proved to have a greater influence on the flexibility potential than first expected

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- Further develop and optimize AI assisted control of flexsumers
- Investigate and demonstrate the effects the flexible assets in the future district heating system may have on the distribution system
- Development of new digital platform to put flexsumers into play at the heat market to reach the full optimization potential at district heating system level



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