清华大学能源环境经济研究所
INSTITUTE of ENERGY, ENVIRONMENT and ECONOMY
TSINGHUA UNIVERSITY

Waste heat recovery of data centers for urban heating in China

Siyue GUO, Shiyan CHANG

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Background: District heating in northern urban China

- Heating decarbonisation is a big challenge for China, especially for the northern urban area with its high heating demands and high share of fossil fuels currently.

- District heating is considered as an important clean heating source as it can reduce the growth of electricity consumption in winter, make full use of waste heat, and the northern urban China has relatively young infrastructures.

- The potential of low/zero emission district heating source has **a large uncertainty**.

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- Less excess heat from thermal plant and industry

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- Higher efficiency and coverage rate
- New technologies of heating system

Background: Data center as district heating source

- The power demand of data centers skyrocketed in the past few years.
- Waste heat from data centers can be used for space heating.

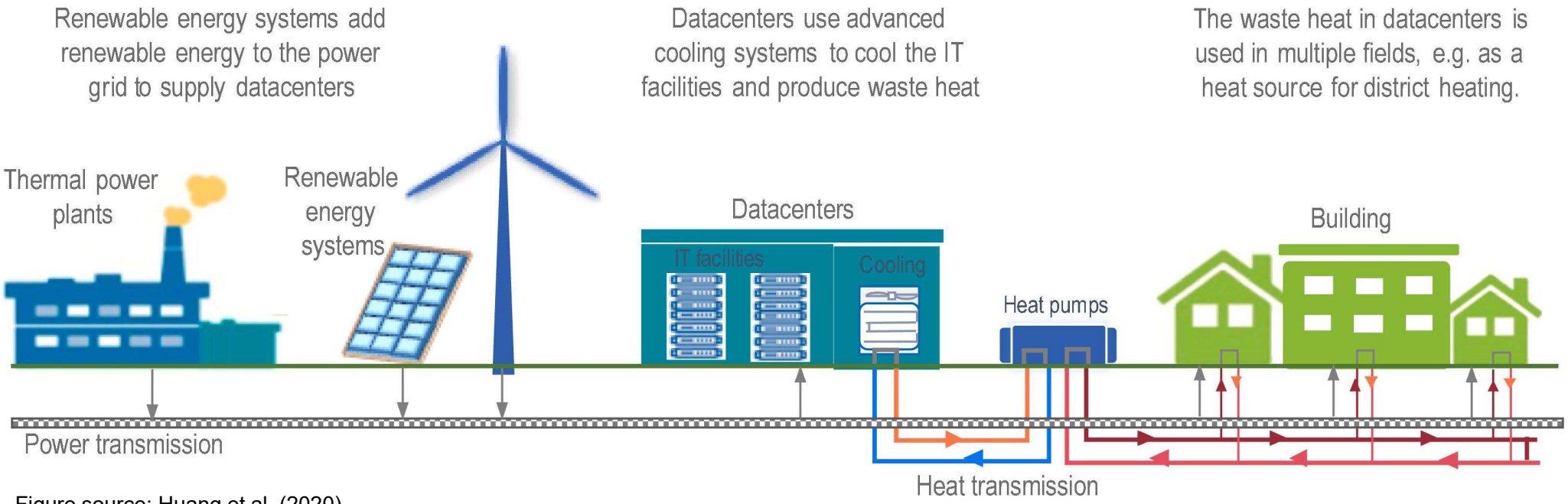


Figure source: Huang et al. (2020).

Background: Data centers as district heating source

- Data center has been considered as an important clean district heating source in many studies and strategies recently.
- In China, there have been policies to encourage the usage of waste heating from data centers.
- However, it is still not clear how much waste heat is available.

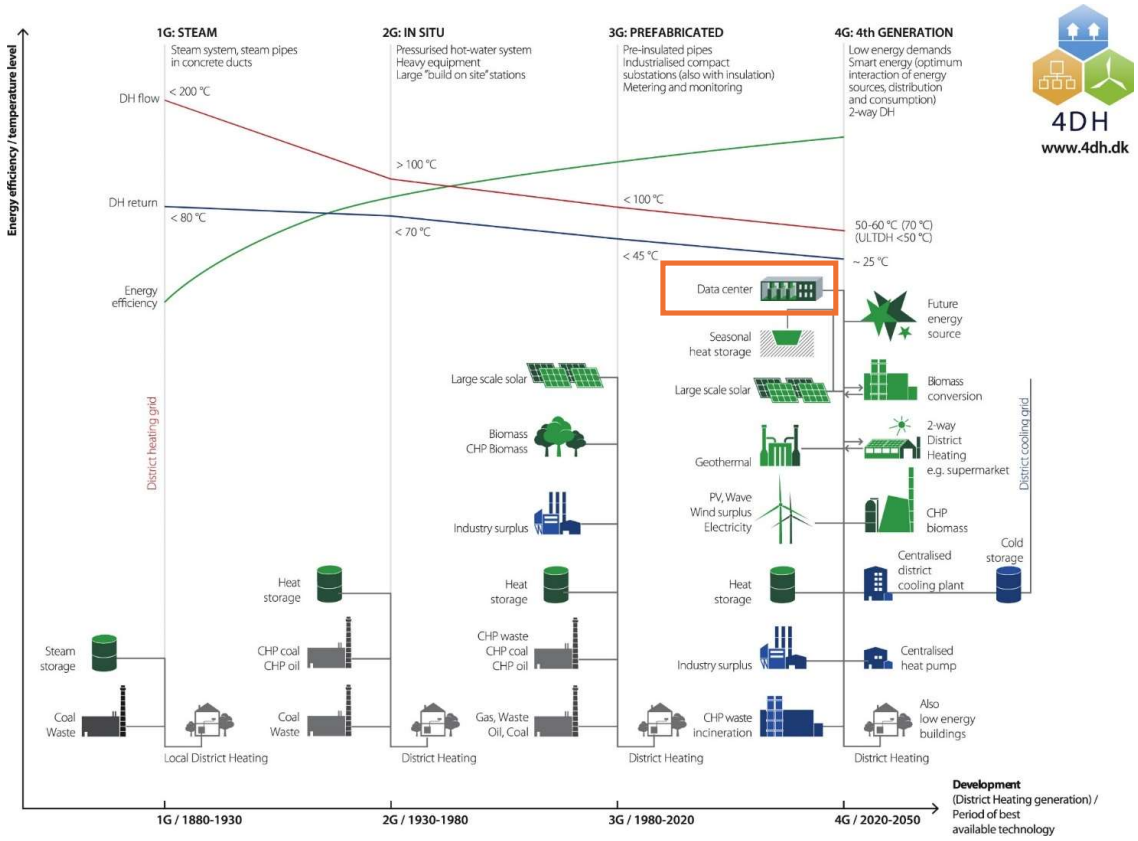
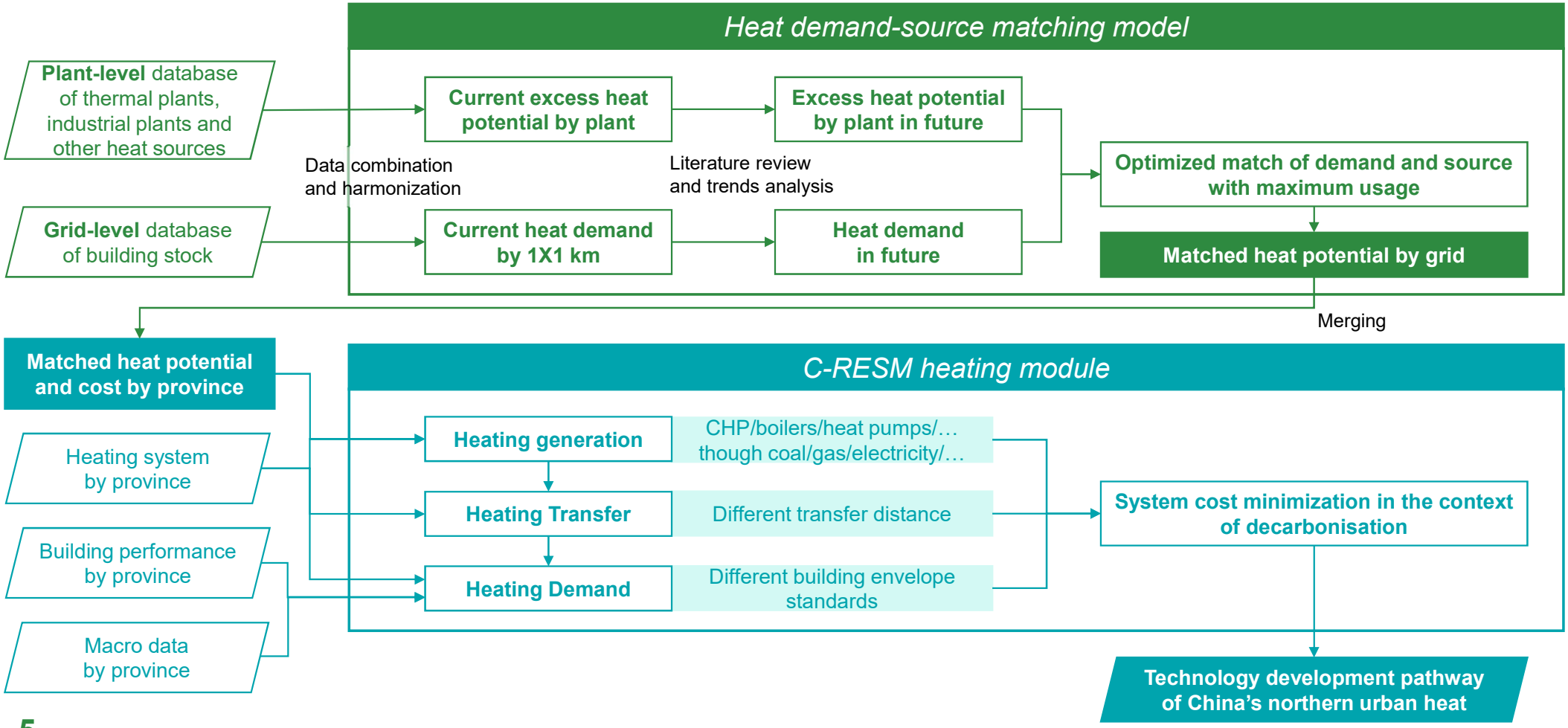


Figure source: Lund et al. (2018/2021).

Methods: Model



Waste heat from data centers

- In 2023, the waste heat of data center in northern urban China is around 70 PJ in winter. 90% of the waste heat could be matched to civil buildings.

- It is expected that with the development of data center as well as the decrease of fossil plants and industrial plants, the contributions of data centers will increase obviously.
- There is large uncertainty about the usage of waste heat from data centers due to the uncertainty of policy, technology improvement, the development of other technologies, etc.

- It is estimated that in the most optimistic scenario for the development of data center waste heat usage, data centers could provide around 300 PJ of waste heat by 2060, equal to waste heat from the industrial plants.

Technology and policy needs

- Technology needs:
  - High efficiency system design and operation;
  - Heat storage;
  - Heat pumps to regulate the temperature.

- Policy needs:
  - Awareness of waste heat from data center;
  - Better planning;
  - Carbon pricing.

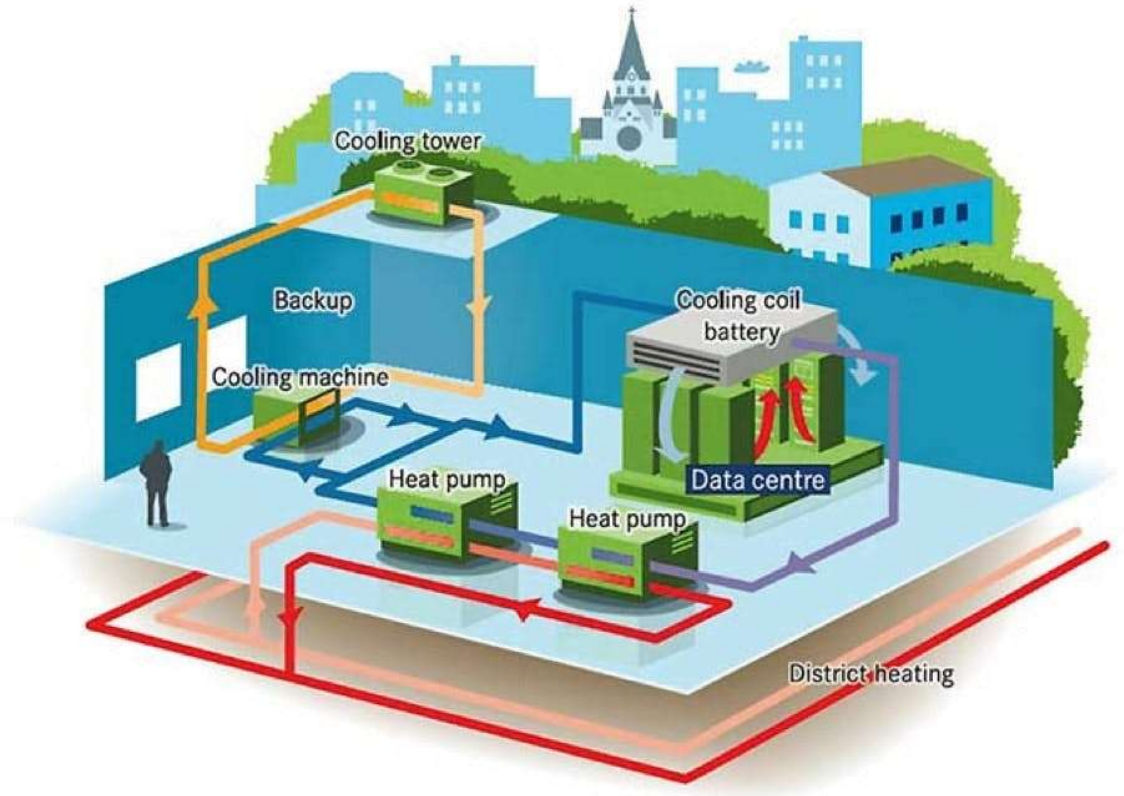


Figure source: S. Frederiksen und S. Werner, District Heating and Colling, Lund: Studentlitteratur, 2013

THANKS!

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