

Renewable Energy in District Heating Systems in China: Current Status, Challenges, and Future Perspectives

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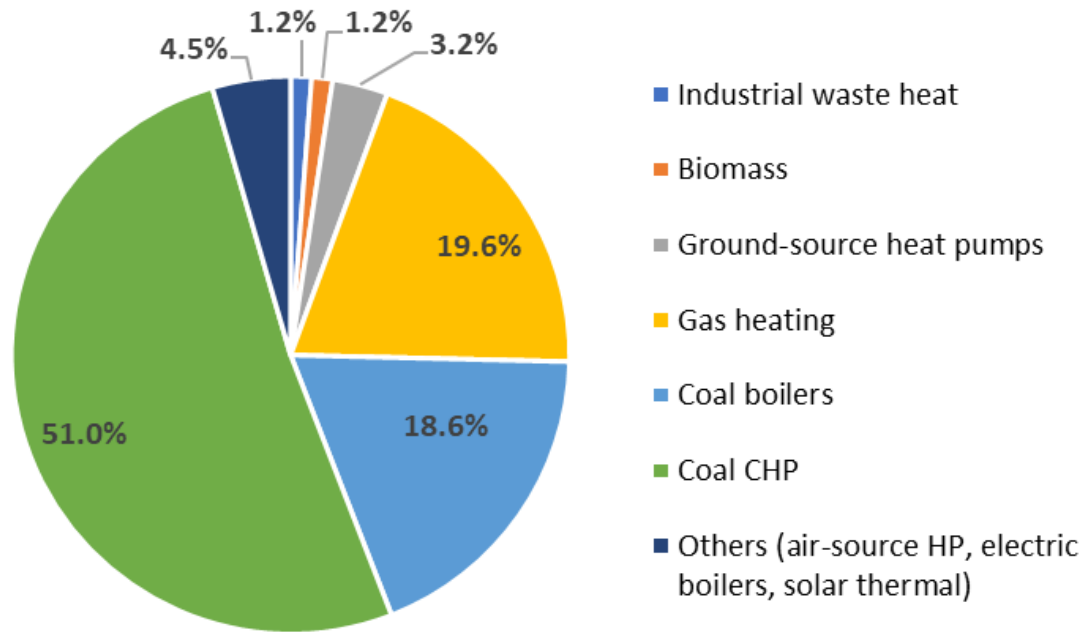
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This work is supported by IEA DHC Annex TS5 and TS7 as well as Sino-Danish Strategic Sector Cooperation for Clean Heating in China

THE 18TH INTERNATIONAL SYMPOSIUM ON
DISTRICT HEATING AND COOLING

Status of DH and renewable heating in China



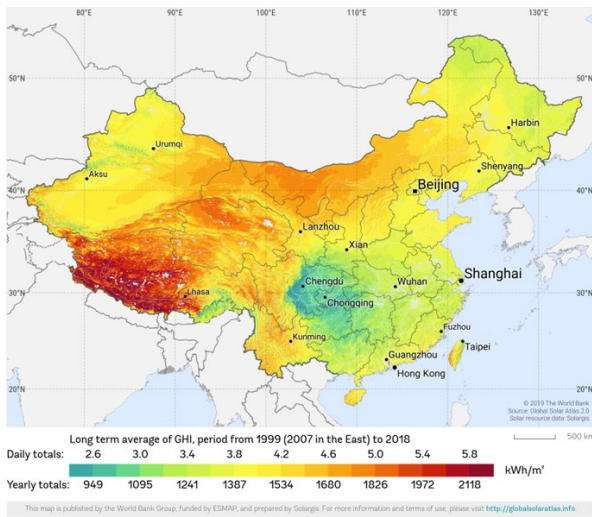
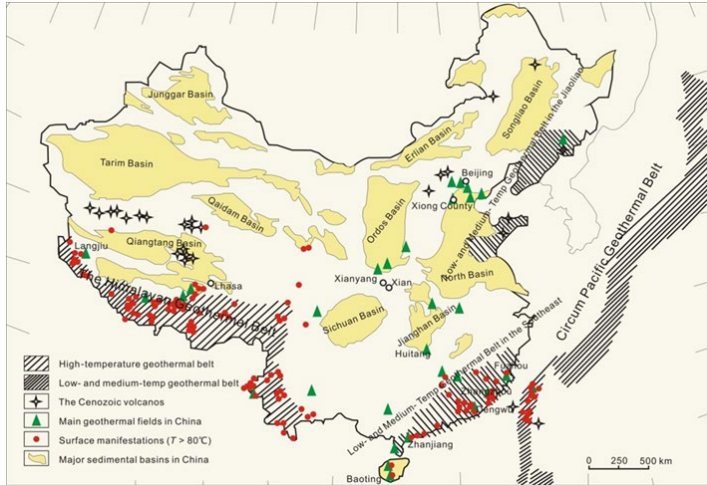
Structure of urban heat supply system in Northern China, 2020

- In 2020, DH accounts for 88.2% of heating demand in the urban areas of Northern China
- The DH area covers 13.78 billion m²
- Coal still dominates the current heating sector
- Non-fossil fuel heat sources accounts for 10.8% in Northern China, including industrial WH, biomass, HPs, electric boilers, solar thermal

Source: China District Heating Association (CDHA)

Potential of RE and waste heat in DH

Distribution of geothermal resources



Global horizontal irradiation

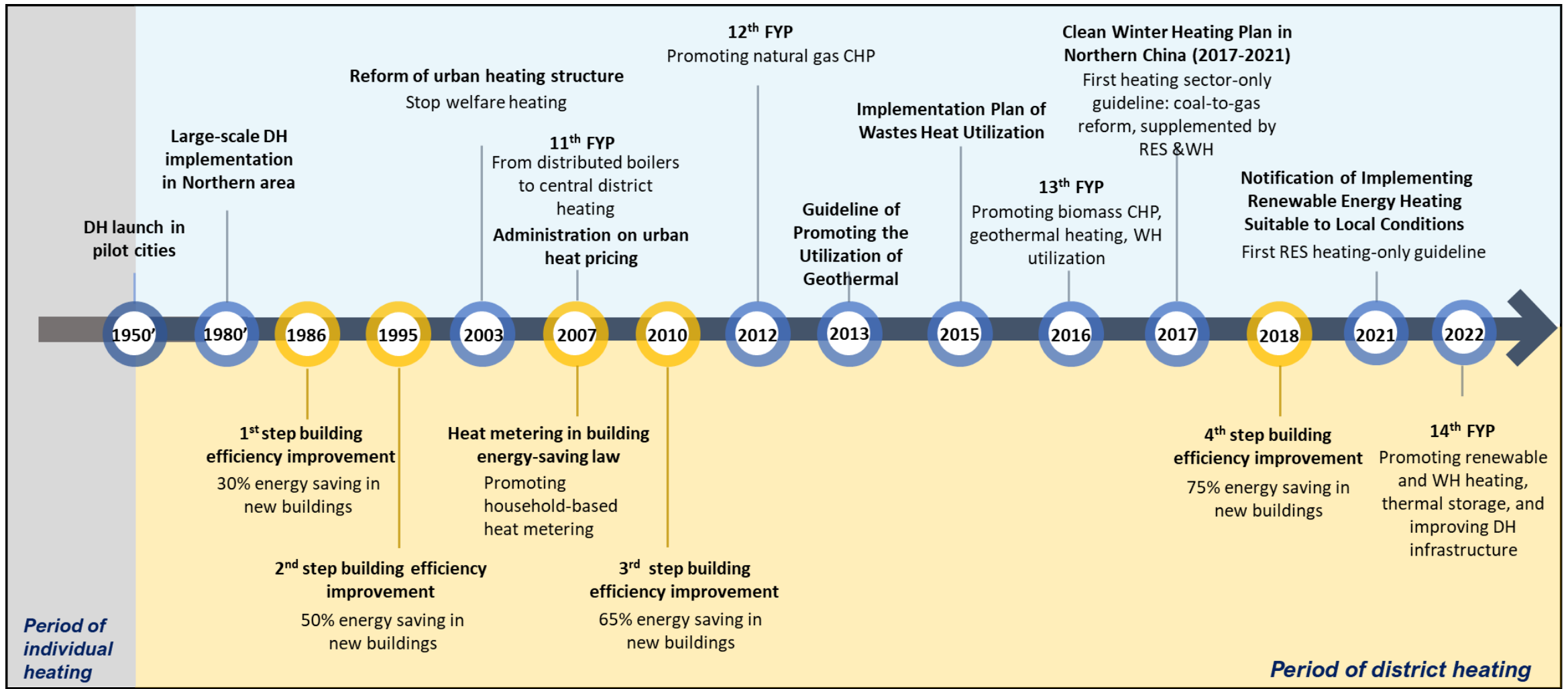


Table: The current and potentials of **industrial WH, biomass and urban wastes** in Northern China (Units: quantity-PJ, capacity-GW)

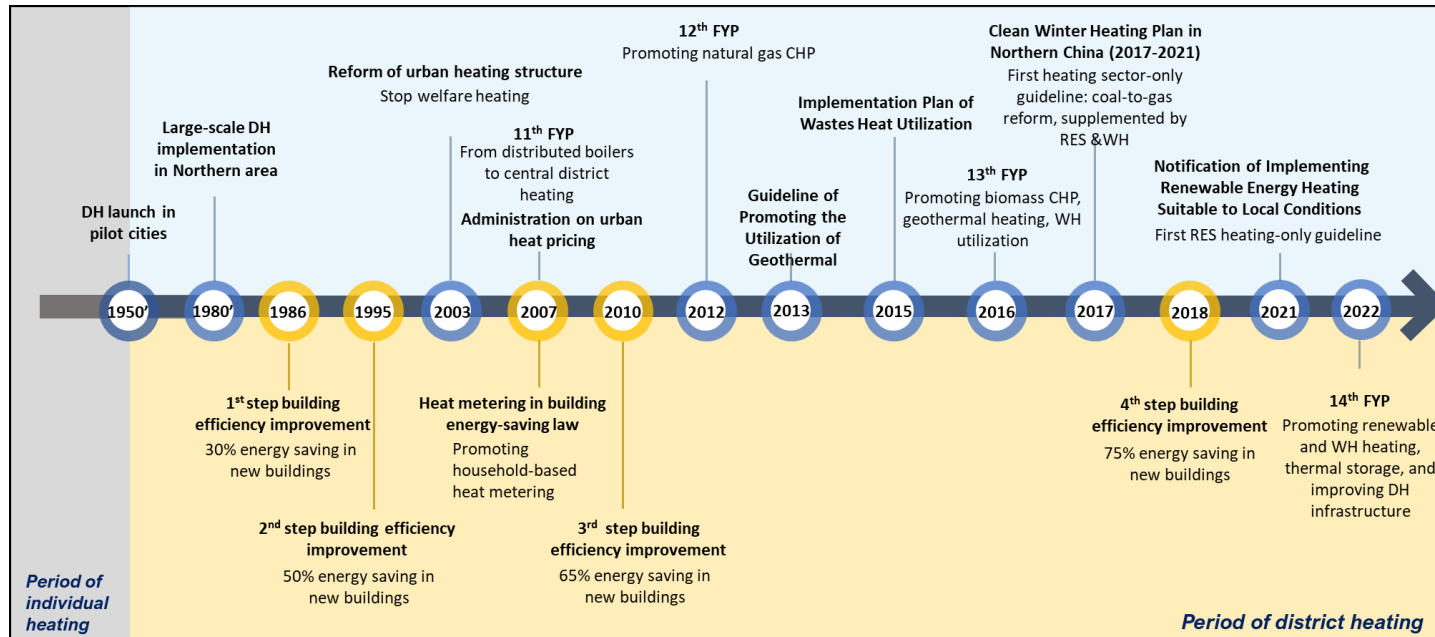
Resources	2018		2050	
	Quantity	Capacity	Quantity	Capacity
WH recovery from CHP	8148	682	7706	645
Industrial WH	1421	148	1171	122
Biomass	922	-	3,058	-
Urban wastes	601	35	565	33

Note: The table doesn't show the capacity of biomass, as biomass can be stored, and the capacity depends on the way of utilization.

Timeline of DH development in China



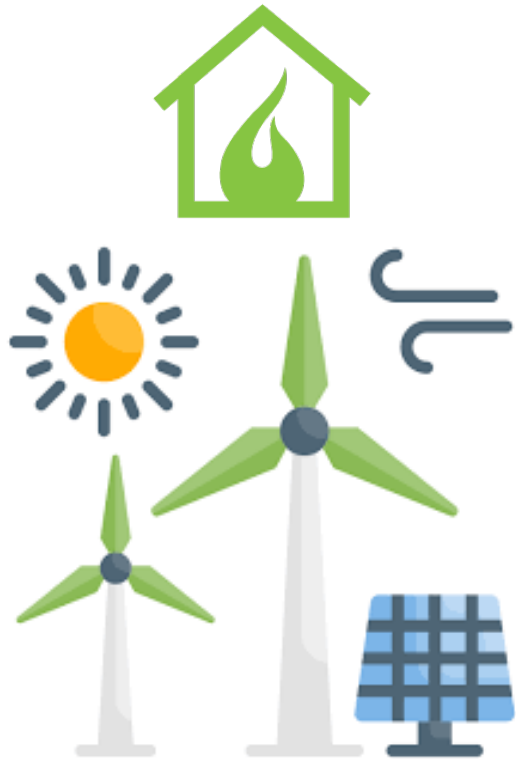
Timeline of DH development in China



14th Five-Year-Plan Target for energy system:

By 2025, the non-electricity purpose utilization of RE in all sectors will reach more than 60 Mt of standard coal (~1757 PJ), including geothermal and biomass heating, biomass fuel, and solar thermal utilization.

Policy perspectives of integrating RE in DH



- The definition of "clean heating" sources is subject to debate.
- Lack of a long-term planning scheme for RE in DH.
- More concrete goals are needed for integrating RE in DH.
- Attention should also be given to southern areas that have heating demand.
- More efforts are required on the reform of heat metering and pricing.
- A deeper understanding on waste heat sources is needed.
- Supporting policies on integrating RE in the heating sector in general is also needed, aside from the electricity sector

Scientific literature review on DH in China

- Approach

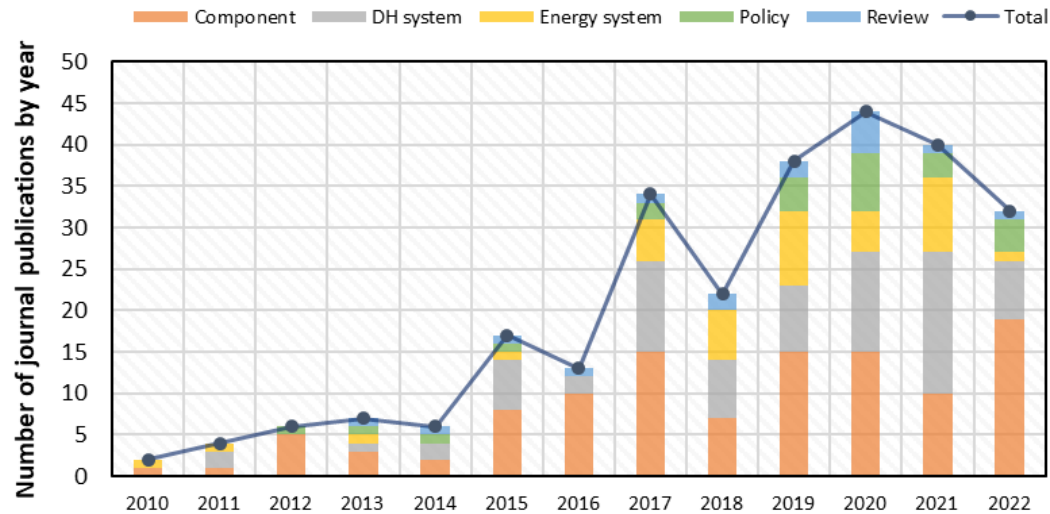
- Scientific articles from international and Chinese journals in 2010-2022.
- Database from Scopus and CNKI, respectively
- Key words: “China” and “District heating, Central heating or Clean heating”

Article categories		Descriptions
Review articles		Review and analyse research previously published or provide survey results of the status of the DH system in China
Research articles	Component	Only focus on the heating sector and investigate a single component of the DH system, e.g., building, DH pipe network, heat generation utilities (CHP, boilers, HP, etc.), thermal storage, and heat sources (fossil fuel, WH, biomass, geothermal, solar thermal, wind)
	District heating system	DH system-level study that only focus on the heating sector and includes multiple system components
	Energy system	Consider the multiple sector synergy in the energy system instead of the single heating sector.
	Policy	Focus on the discussion of heating policy, regulation, or institution related issues

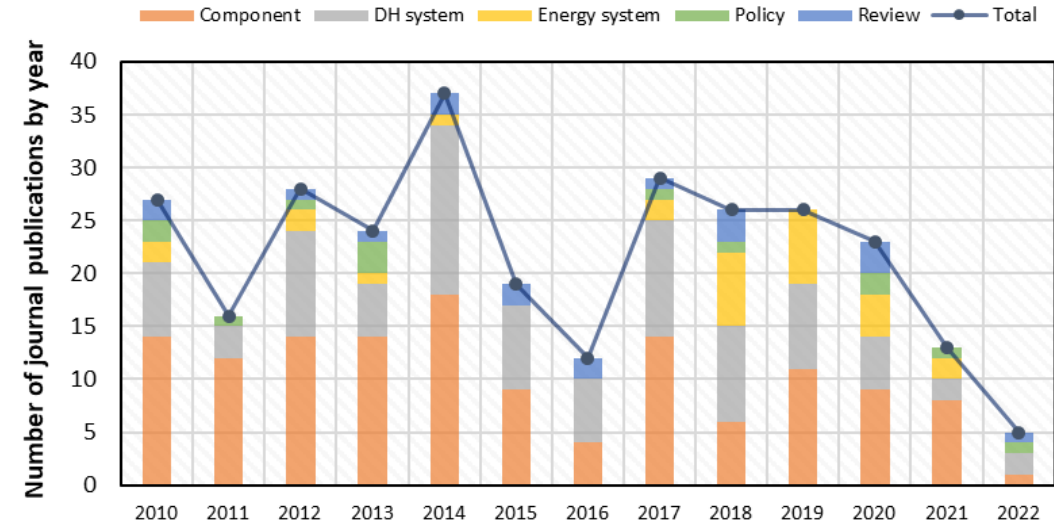
Scientific literature review on DH in China - Result

Findings of publications by numbers

- 268 and 285 papers were identified in international and Chinese journals respectively (2010-2022)
- A **lack** of review study is found that summarises all kinds of RE applications in Chinese DH system
- **Component**-focused & **DH system**-focused papers dominants



a) Number of articles in **international** journals



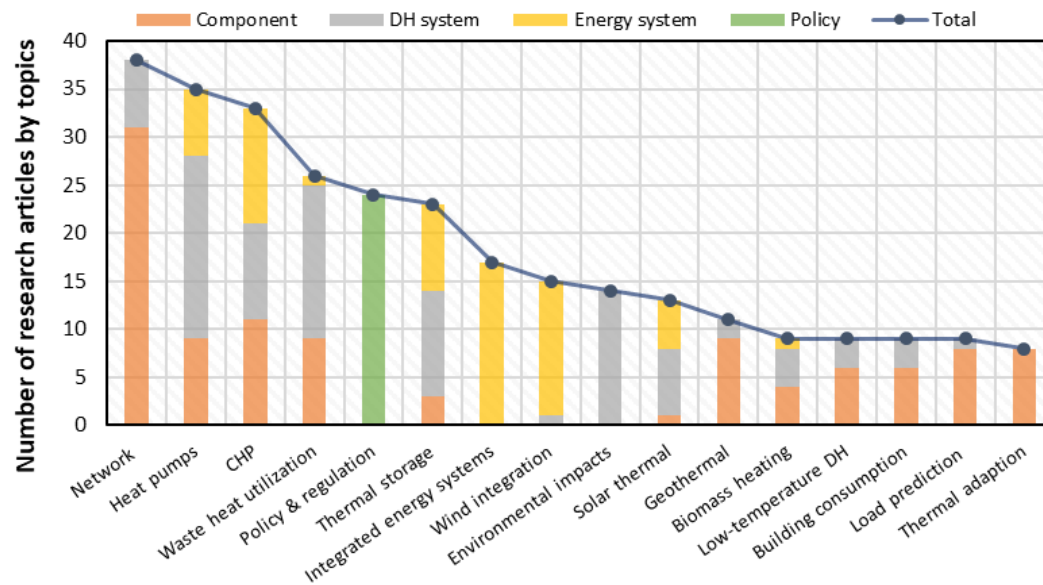
b) Number of articles in **Chinese** journals

Scientific literature review on DH in China

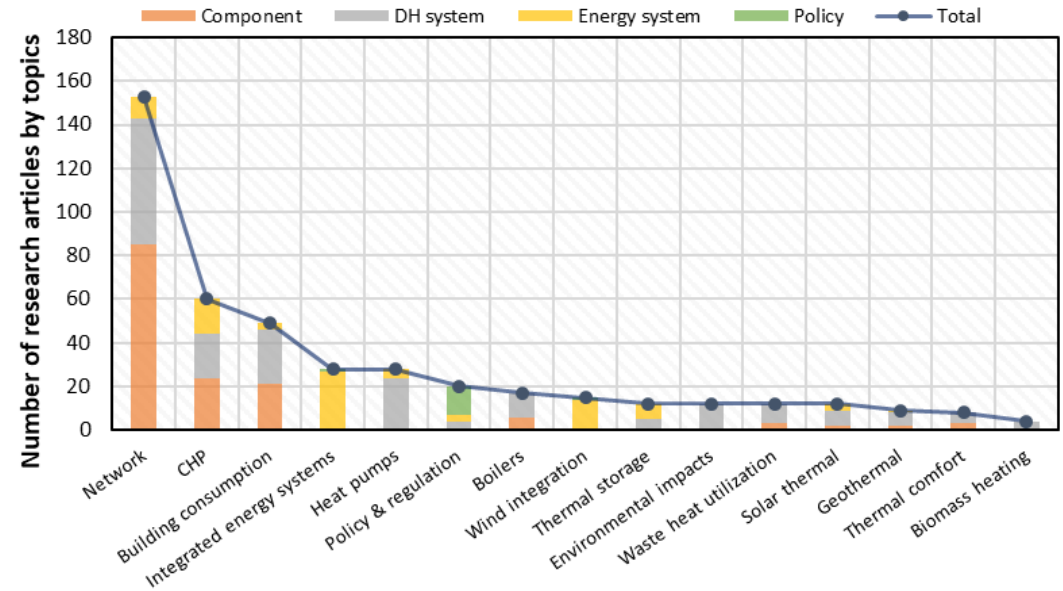
- Results

Findings of publications by topics

- **DH network** is the prevalent topic in both international (operation optimisation, design and reliability analysis) and Chinese journals (theoretical analysis, field research and case studies) while the focuses are different
- Heat pumps, CHP and WH utilization are widely investigated in international publications
- Fewer studies in local journals on the topics of RE heating and WH



a) Number of articles in **international** journals

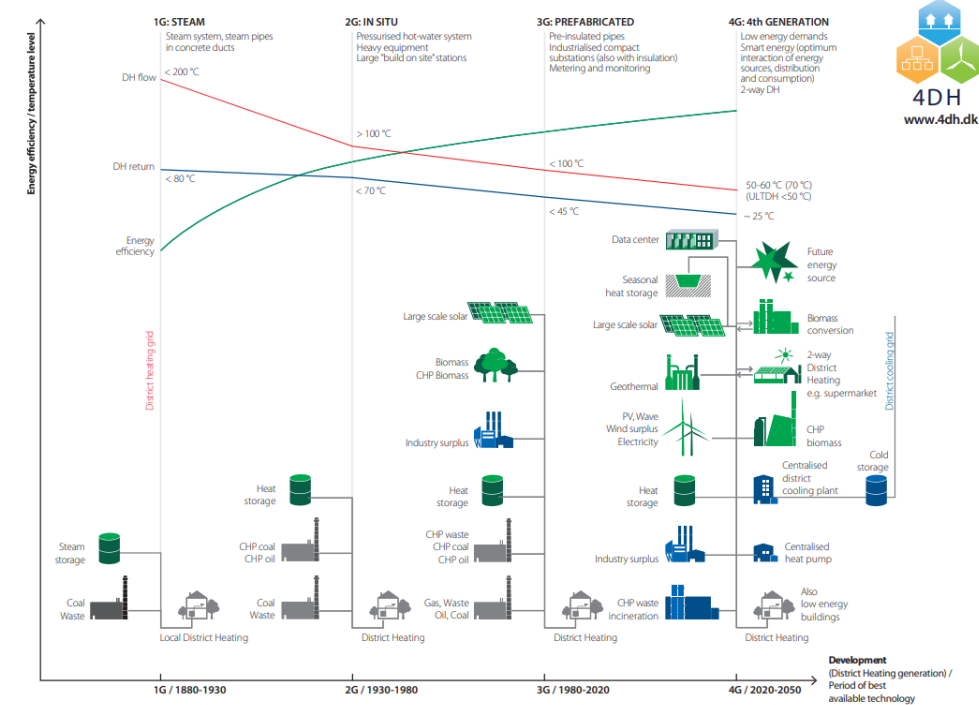


b) Number of articles in **Chinese** journals

Scientific literature review on DH in China

- Research gaps

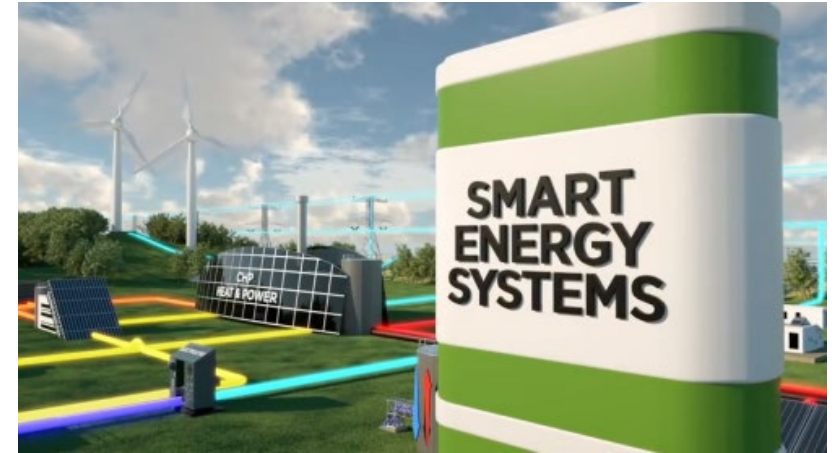
- A general lack discussion on 4th Generation District Heating (4GDH) systems.
- Studies on integrated energy systems are mainly focused on the synergies between the electricity and heating sectors. However, few studies encompassing all sectors.
- Studies on WH utilization are primarily on energy-intensive industries and power generation, while unconventional low-temperature WH sources are lacking in general.
- Studies on WH and RE potentials in Southern China are lacking.
- Little attention is paid to the seasonal thermal storage in literature.



More info: Lund, H., et al. (2014). 4th Generation District Heating (4GDH): Integrating smart thermal grids into future sustainable energy systems.

Scientific literature review on DH in China - Future perspectives

- Encouragement shall be given to booster research efforts in 4GDH in China.
- Carry out long-term DH planning under the concept of Smart Energy Systems (SES), which could enable the utilization of WH, e.g., power-to-X plants.
- Explore the potential and implementation of various low-temperature WH sources, e.g., wastewater treatment plants, datacentres, supermarkets, and metro stations
- Mapping the heat demands and assess the WH and RE potentials specifically in Southern China.



The SES concept includes a focus on energy efficiency, end use savings and sector integration to establish energy system flexibility, harvest synergies by using all infrastructures and lower energy storage cost.

More info: Lund, H., et al. (2017). Smart energy and smart energy systems.

Thank you for your attention!

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Any further questions, please reach out



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Back-up slide: National Policies on RE and WH in heating sector

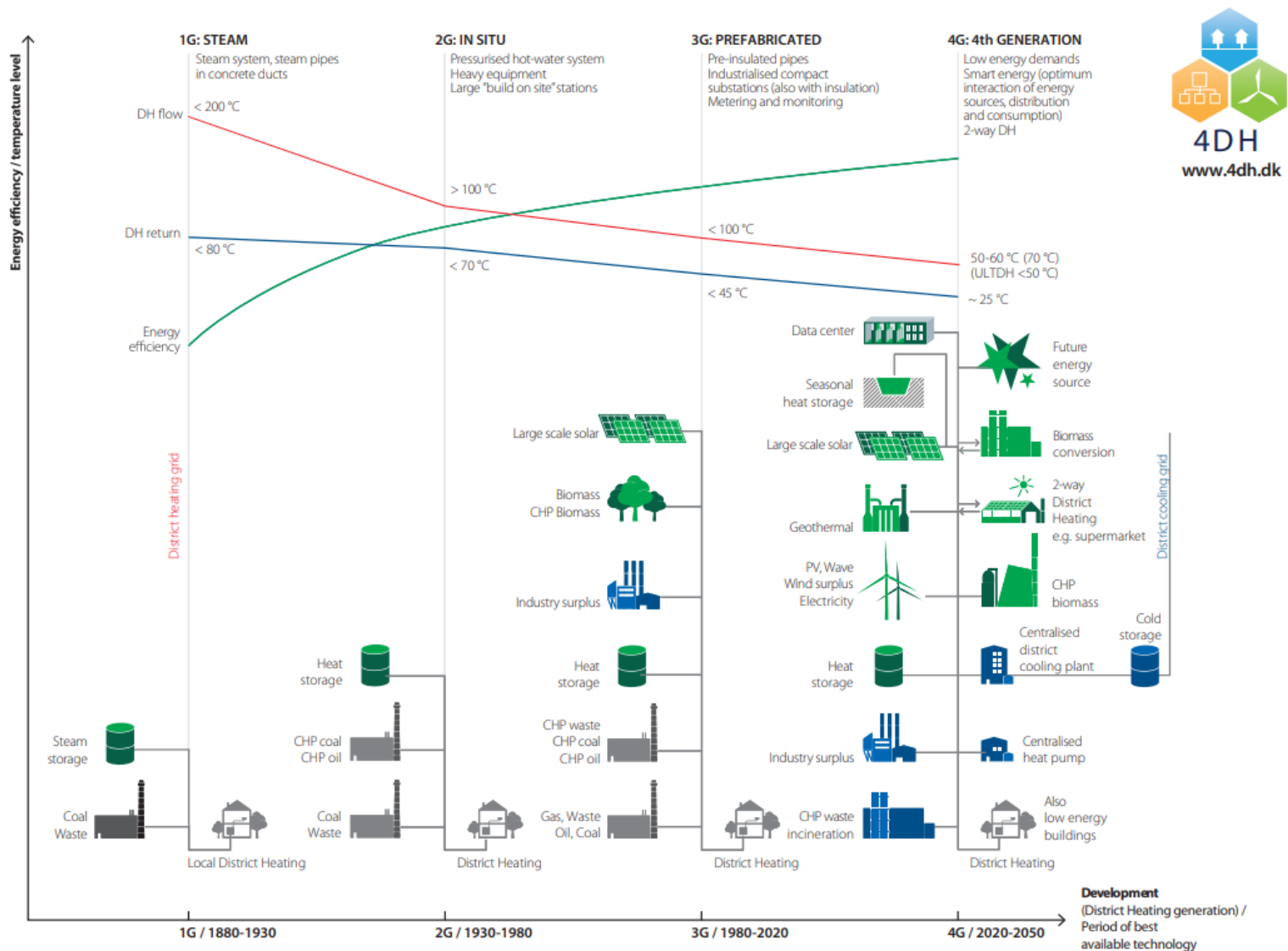
Table: Selected policies covering RE and WH for heating

Year	Policies
2013	Guiding Opinions on Promoting the Development and Utilization of Geothermal Energy
2015	Implementation Plan of Wastes Heat Utilisation Energy Supply and Consumption Revolution Strategy (2016-2030)
2016	The 13 th Five-Year Plan for Energy Development (2016–2020) The 13 th Five-Year Plan for Renewable Energy Development (2016–2020) The 13 th Five-Year Plan for Solar Energy Development (2016-2020) Administrative Measure for Combined Heat and Power Plants The 13 th Five-Year Plan for Geothermal Energy Development (2016-2020)
2017	Guiding Opinions on Promoting the Development of Biomass-based Heat Supply Clean Winter Heating Plan in Northern China (2017-2021)
2018	Launching Country-level Clean Heating Demonstration Project of Biomass Cogeneration in “100 Towns”
2021	Notification of Implementing Renewable Energy Heating Suitable to Local Conditions Several Opinions on Promoting the Development and Utilization of Geothermal Energy
2022	The 14 th Five-Year Plan for the Modern Energy System Implementation plan for promoting the high-quality development of new energy in the new era The 14 th Five-Year Plan for Renewable Energy Development Implementation Plan for the Synergy Efficiency Improvement in Pollution and Carbon Reduction The 14th Five-Year Plan for National Urban Infrastructure Construction Implementation Plan for Science and Technology to Support Carbon Peaking and Carbon Neutrality (2022-2030)

14th Five-Year-Plan Target for energy system:

By 2025, the non-electricity purpose utilization of RE in all sectors will reach more than 60 Mt of standard coal (~1757 PJ), including geothermal and biomass heating, biomass fuel, and solar thermal utilization.

Back-up slide: 4GDH



More info: *Lund, H., et al. (2014). 4th Generation District Heating (4GDH): Integrating smart thermal grids into future sustainable energy systems.*