4th Generation District Heating definition

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Review

4th Generation District Heating (4GDH) Integrating smart thermal grids into future sustainable energy systems

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ABSTRACT

This paper defines the concept of *4th Generation District Heating* (4GDH) including the relations to *District Cooling* and the concepts of *smart energy* and *smart thermal grids*. The motive is to identify the future challenges of reaching a future renewable non-fossil heat supply as part of the implementation of overall sustainable energy systems. The basic assumption is that district heating and cooling has an important role to play in future sustainable energy systems – including 100 percent renewable energy systems – but the present generation of district heating and cooling technologies will have to be developed further into a new generation in order to play such a role. Unlike the first three generations, the development of 4GDH involves meeting the challenge of more energy efficient buildings as well as being an integrated part of the operation of smart energy systems, i.e. integrated smart electricity, gas and thermal grids.

Background

When mentioning the basic idea of 4GDH, most people, both professional and non-professional, respond with two questions:

- How do you define 4GDH?
- How do you define the three preceding generations?

Paper content

1. Introduction
2. The first three generations of district heating and cooling (answer to the second question)
3. The future 4th generation of district heating (answer to the first question based on five challenges)
4. Summary and definitions

Five challenges of 4GDH

1. Ability to supply **low-temperature** district heating for space heating and domestic hot water (DHW) to **existing buildings, energy-renovated existing buildings and new low-energy buildings**.
2. Ability to distribute heat in networks with **low grid losses**
3. Ability to **recycle heat** from **low-temperature** sources and integrate **renewable heat sources** such as solar and geothermal heat.
4. Ability to be an **integrated part of smart energy systems** (i.e. integrated smart electricity, gas, fluid and thermal grids) including being an integrated part of 4th Generation District Cooling systems.
5. Ability to ensure **suitable planning, cost and motivation structures** in relation to the operation as well as to strategic investments related to the transformation into future sustainable energy systems .

Final definition

The 4th Generation District Heating (4GDH) system is consequently defined as a coherent technological and institutional concept, which by means of *smart thermal grids* assists the appropriate development of sustainable energy systems. 4GDH systems provide the heat supply of low-energy buildings with low grid losses in a way in which the use of low-temperature heat sources is integrated with the operation of smart energy systems. The concept involves the development of an institutional and organisational framework to facilitate suitable cost and motivation structures.

Illustration of the final definition

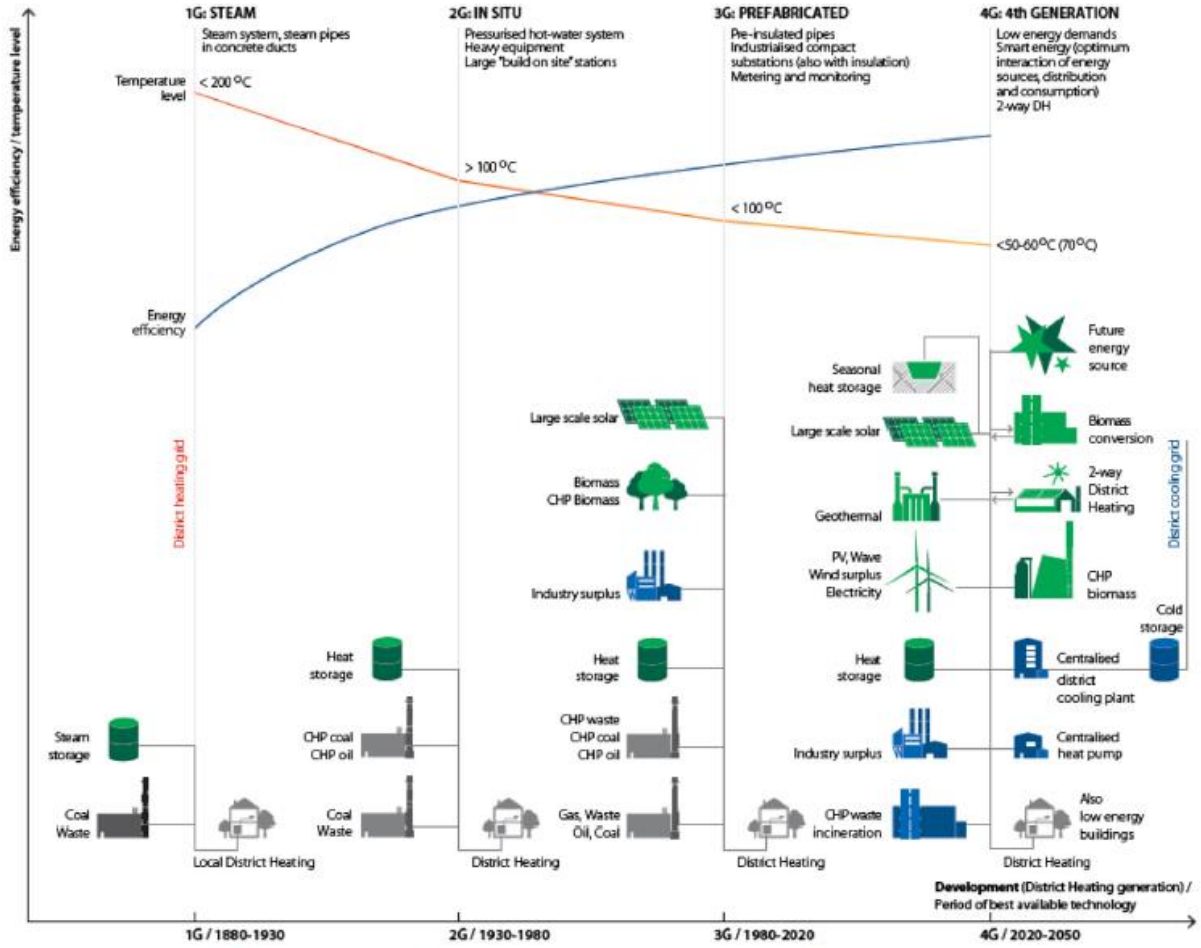

Fig. 2. Illustration of the concept of 4th Generation District Heating in comparison to the previous three generations.

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This paper originates from a four page memo finalised in April 2010 for the DHC+ network and written by Svend Svendsen and Sven Werner . This memo was elaborated by Robin Wiltshire into a seven page discussion paper, which was presented at the DHC+ meeting in Frankfurt, January 2011. Henrik Lund attended this meeting, was inspired, and wrote an eleven page draft proposal in February 2011. Henrik later realised the full potential of this draft paper, suggested a final consolidated definition paper at the 4DH PhD seminar in March 2013, gathered an extended writer group within 4DH in May 2013, and headed the finalisation of this 4GDH definition paper, published in March 2014.