IEA DHC

District heating network generation definitions

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District heating (DH) generations provide a classification for DH systems that has been widely discussed in various papers [1,2,3,4]. In general, a later generation of DH makes it easier to integrate renewable energies, reduce network losses and decrease the carbon footprint of district heating. However, it is key to note that a later generation is not necessarily better than a previous one in terms of contributing to the mitigation of climate change.

To find the best configuration of a district heating network for a specific case, a thorough multi-criterial analysis is required. Relevant criteria for selecting DH in regard to minimizing the contribution to climate change can be greenhouse gas emissions, resource exergy consumption [5] and life-cycle costs.

In this short document, the IEA DHC Executive Committee (IEA DHC ExCo), which at the time of writing represents seventeen nations [6], provides a simplified definition of the different generations of district heating networks as of 2024. These definitions can be used if scientific definitions such as in [2] cannot be applied based on the available data.

The goal of these simple definitions is to provide a clear, unambiguous and easy-to-use guidelines for the application of the “generations” terminology in district heating communications that is in line with the views of international district heating professionals.

Since the generation side of district heating can be complex, the focus lies on defining the generations based solely on district heating network (DHN) characteristics.

5th generation DHNs are “thermal source networks” (TSNs) and a subclass of 4th generation DHNs.

As of 2024, 5th generation DHNs are often considered a separate generation of district heating. However, it has been shown that so-called “5th generation district heating networks” can be in many ways less beneficial than the “4th generation district heating networks”[7, 8] if only heating is considered.

Therefore, in line with other researchers [2] the IEA DHC ExCo recommends not using the term "5th generation district heating", since it can be misunderstood as an upgrade over 4th generation district heating.

Instead, the IEA DHC ExCo encourages labelling pipe networks that are used mainly as a source for heating and cooling by decentralized technologies such as heat pumps as "thermal source networks" (TSN). These TSNs should be considered a subclass of 4th generation DHNs [2].

An overview over some of the literature on TSNs can be found online [11].

4th generation DHNs provide heat below 70 °C.

The scientific definition of 4th generation (4GDH) as "a coherent technological and institutional concept, which by means of smart thermal grids assists the appropriate development of sustainable energy systems" does not allow a clear distinction from 3rd generation DH in all cases. [9]

The IEA DHC ExCo therefore suggests using a simplified approach to the definition based on network temperatures, as lower temperatures are a key characteristic for enabling a more efficient integration of low-carbon technologies.

70°C maximum forward flow temperature is the temperature required for a thermal disinfection of domestic hot water supply. The label 4th generation of DHNs (4GDHNs) therefore designates district heating networks that operate at maximum forward flow temperatures of 70 °C.

The 4GDHNs encompass many types of heating and cooling networks, including low-temperature networks and thermal source networks.

3rd generation DHNs provide heat between 100 °C and 70 °C.

The 3rd generation of DHNs (3GDHNs) can be defined by not requiring superheated water for its operation.[9]

The IEA DHC ExCo suggests using the term for heat networks operating between 100 °C and 70 °C.

2nd generation DHNs use liquid water above 100 °C.

The 2nd generation of DHNs (2GDHNs) can be defined by using superheated liquid water for its operation.[10]

The IEA DHC ExCo suggests using the term for heat networks using liquid water and operating with maximum supply temperatures of more than 100 °C.

1st generation DHNs use steam.

The 1st generation of DHNs (1GDHNs) can be defined by using steam instead of liquid water for its heat supply.

The IEA DHC ExCo suggests using the term 1GDHNs for heat networks using steam as a heat carrier medium for the forward flow, independent of its temperature.

More information about IEA DHC is available on www.iea-dhc.org.

References

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