From 3G heating networks to 5G heating and cooling networks

A large number of heat networks have been installed in recent years. Many of these heating networks were set up in the past with a central gas boiler (often with cogeneration) and more recently with a biomass plant as a heat source. Of course, it is clear that a heat source based on gas is not an alternative to make homes gas-free. Equally, despite the initial enthusiasm, the use of biomass on a large scale does not appear to be an alternative solution to make the Netherlands CO2-free. Even the use of (industrial) residual heat is questionable. After all, most of that heat is also made with fossil fuels and therefore results in CO2 emissions. If the industry is going to reduce their CO2 emissions, it is likely that this will also lead to a reduction in residual heat.

In other words, it looks like that in order to achieve a further reduction in CO2 emissions, many of the current heat networks can no longer be expanded in the future and in some cases can no longer be used. Even when using industrial residual heat, it is plausible that unless alternative high-temperature sources such as deep geothermal energy are found, the current users can be cut off and have to look for alternatives for their heating.

This doomsday scenario can be averted to some extent by thinking of network expansion solutions that avoid an increase in the capacity of the central heat source. Lowering the supply temperature is a first step and because it reduces network losses, it is a good alternative to be able to connect more homes. Especially in summer, a small installation in the house for hot tap water can lead to significant reductions in network losses, whereby the network can then be used for cooling at that time (due to the low temperature). Through this strategy, a High Temperature/Medium Temperature (3rd or 4th generation) network starts to transform into a Very Low Temperature exchange network (ZLT-U). Because poorly insulated homes are slowly being upgraded as consequence of among other things EU legislation, they can also be connected to the existing network with a lower temperature (thus reducing the CO2 emissions of the existing power plant per home).

An alternative to the expansion of existing heating networks is to expand with a 5G District Heating and Cooling (5GDHC) network that initially uses the "heat surplus" of the existing heating network as a peak supply until this network can largely function "autonomously". It should be noted that most 3G and 4G networks often have a growing surplus because households require less heat (insulation, acceptance of lower indoor temperatures, etc.), but that this surplus is insufficient to implement a serious and financially acceptable expansion of the traditional heat network. In other words, an expansion by connecting a 5GDHC network makes it possible to connect more homes to the same heat source without harming the homes already connected.

The initial heat source of the existing 3G or 4G network therefore serves as a backup for the start-up of the new 5GDHC network, which can then be expanded by adding other local sources. Once this 5GDHC network has become independent of the initial heat source, it is possible that more future ZLT and 5GDHC networks will be able to make use of the now "excess" heat or that the heat produced can be scaled back. It may even be possible in special cases that the 5GDHC network could supply heat to parts of the existing 3G or 4G network (especially if a conversion to a ZLT-U network has taken place).

The same philosophy can be used in the case of waste heat: this source primarily serves to quickly develop a ZLT-U or 5GDHC, without exchange, buffering and local sources having already been optimally utilized. Here, time is gained to develop a fully-fledged independent system in which heat and cold exchange are central. Since the amount of residual heat will decrease over time as a result of the social pressure on industry to reduce their CO2 emissions, it is not necessary to disconnect installed 3G or 4G and even some ZLT-U networks. Well-structured 5GDHC networks can disconnect themselves after some time and thus possibly make way to connect newer networks or, as mentioned, perhaps also supply part of the required heat from the already existing network.

In summary: The use of 5GDHC technology and to a certain extent ZLT networks in combination with the traditional heating networks can be a good strategy to enable connect a larger number of connections with a limited amount of generated heat. When industrial waste heat is seen as a source, it must be used in conjunction with the development of 5GDHC systems so that the producer of this heat source has the freedom to reduce the heat produced and thus his CO2 emissions.