Less energy losses with new heating and cooling solutions?

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Heating and cooling of our homes and public spaces remains both expensive and energy intensive. It is important that as much of the produced energy as possible is delivered to the end customer. E.ON's ectogrid^{TM} offers a more efficient solution, and the losses on the pipes of the grid were studied for greater insight. The warm pipe typically would lose around 1.5 - 2.5 ^{o}C, whilst the cold pipe on average would stay the same temperature or gain 1 ^{o}C. However, due to the design of the grid, these temperature difference may actually be beneficial in some cases.

You might be familiar with conventional district heating and cooling, where warm water supplies consumers with heating, or cold water in the case of cooling. The pipes in these grids are often very well insulated, and the direction that the water flows is predetermined. In these grids, temperature changes during transportation is almost exclusively an undesired side effect. Innovative technologies have emerged to make more energy efficient grids, and one such is the studied ectogrid^{TM}. The grid is a so-called 5th generation district heating and cooling network.

Apart from combining heating and cooling into one, low temperature grid, the ectogrid^{TM} differs from more conventional heating and cooling by re-purposing the residual heating or cooling directly into the grid.The pipes are not insulated and the flow of the water in the pipes is not predetermined and can flow any direction as it is an ambient loop. An illustration of the grid can be seen in figure 1, where the all buildings are connected to both the warm and the cold pipe, and act as both consumers and producers.

By analysing the data obtained from an ectogrid^{TM} located in Lund, Sweden, it was found that the temperatures and therefore energies in the grid changes as water is transported in the pipes. Using a combination of physics-based and regression models, the factors influencing the energy losses were also investigated.

The findings suggest that temperatures on the warm pipe drops by 1.5 - 2.5 ^{o}C on average, which is undesirable when there is a large demand for heating, typically the colder winter months. However during periods when the demand for cooling is larger, this drop in temperature is in fact beneficial to the system. Temperature difference on the cold pipe were more consistent around 0 - 1 ^{o}C heating. That means that the warm pipe is cooled down when the cold pipe is heated. The relative losses are comparable to those of district heating networks in Sweden, that are far more insulated.

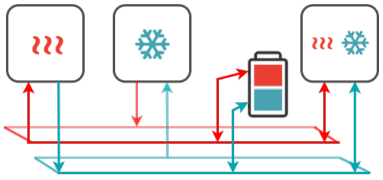

Figure 1: Illustration of a small bidirectional heating and cooling grid

"The results indicate that the uninsulated nature of the pipes and the currently used temperatures will cause interference between the pipes, i.e. that they "cross-contaminate" each other."

Results from the study can not be considered conclusive, due to data inconsistencies. But some major takeaways can still be obtained, namely that even though the low temperature ectogrid generally experiences energy losses, it is more efficient than the conventional alternative. To increase the energy efficiency further, an option is to add some insulation on the warm pipe, in cases where the demand for heating outweigh the demand for cooling, alternatively separating the pipes further from each-other. Decreasing the temperature difference between the pipes is also likely decrease the energy losses.

The findings suggest that although the low temperature grid is already more energy efficient than its more conventional counterparts, it can be further optimised to experience less energy losses.