Thermal energy storage in buildings makes district heating more climate friendly

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District heating is a common for heating buildings and hot water in many Swedish cities. The heat is largely produced from residual products from forestry, household waste, or waste heat from industries.

But the demand for district heating varies greatly during the day. For example, it substantially increases in the morning when many people take a shower at about the same time. To cover the increasing demand, many district heating producers are forced to temporarily run fossil-fuelled reserve boilers, known as peak load boilers. In Gothenburg, the peak load boilers are fuelled by natural gas.

But now John Kensby, a PhD student in building services engineering, has shown how it can be avoided in a cheap way: simply by storing heat in the buildings that are already connected to the district heating network.

"Buildings have large thermal mass. Heat can be stored in the floor, walls, ceiling, and in the water in the radiator system", says Johan Kensby.

In a pilot study, he investigated how the indoor climate is affected if the district heating system is allowed to provide the buildings a little more heat in the radiators at times and a little less at other times. It turned out that it is possible to store as much as 0.1 kilowatt hours of heat per square meter of a building without the indoor temperature varying by more than 0.5 degrees Celcius.

"The residents do not notice it. Temperature variations of this size are already present, for example when cooking", says Johan Kensby.

Thus it is possible to even out the load on the heating system. Faced with an expected peak, such as morning rush to the shower, the system can prepare by heating the radiators in the buildings a little extra for a few hours in advance. A five-minute shower "costs" about 2 kilowatt hours, which means that an apartment of 80 square meters can store heat energy equivalent of four showers.

When the shower rush comes, the heat pumped into the radiators is redirected to heat the shower water instead. Meanwhile, the buildings keep a nice indoor temperature by using the stored additional heat. When the shower rush is over, heat is directed into the radiators again. Thus, the heat load peak is cut and the district heating supplier can avoid runnig the peak load boilers.

Johan Kensby has further simulated the effects if his method of heat storage in buildings was introduced in Gothenburg's district heating network. The results show that the daily variation can be halved if 500 of the total of 20 000 substations are used for heat storage. (A substation is a building or group of buildings connected to the district heating network.)

"It would reduce the district heating carbon footprint drastically. It would also reduce production costs and thus increase the profitability of district heating. To turn on and off peak load boilers provide additional losses and wear, which also would be avoided", he says.

On Friday, May 8, Johan Kensby presents his research during a licentiate seminar. He will continue his doctoral project by examining how energy storage in buildings could be implemented in practice. It is already clear that every substation will have to be provided with a simple computer

with internet access.

"Then there are two main tracks: either the energy company controls the heating entirely, or they offer hourly rates and leave it to the customers to decide when they want to buy heat", says Johan Kensby.

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