Technical University of Denmark

# Popular science summary of the PhD thesis

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| PhD student | Dorte Skaarup Østergaard |
| Title of the PhD thesis | Heating of existing buildings by low-temperature district heating |
| PhD school/Department | Department of Civil Engineering |

# Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

This thesis presents the results of four years of research on the possibility of providing existing buildings with space heating based on low-temperature district heating. The study consisted of three main parts. First, we investigated the sizes of current heating elements in existing buildings and the potential for using these heating elements for low-temperature heating. Secondly, we investigated several case study buildings in order to evaluate whether the control and operation of their heating systems constituted a barrier to realizing the full potential of the radiators installed. Thirdly, we investigated the possibility of applying various tools to realize the potential available for low-temperature district heating.

The results showed that there is a big potential for using lower temperatures for space heating because as much as 80% of heating systems are currently over-dimensioned. Temperatures can often be reduced for much of the year even in under-dimensioned heating systems because heating systems are designed for very low outdoor temperatures that only rarely occur in reality. We found several examples of existing single-family houses that have been successfully heated with low-temperature district heating. However, in some of the houses investigated, the results indicated that poor control and heating system design caused heating system return temperatures to be unnecessarily high. Poor hydraulic control was a major issue and this was caused by simple problems like hydraulic short-circuits, thermostats not working optimally, occupants using the thermostats in the wrong way, and a few radiators being too small. It should be possible to overcome such problems by improving the hydraulic control in heating systems and in some cases by replacing a few critical radiators that have a large impact on the overall heating system return temperature.

To ensure long-lasting results, it is vital that continuous fault detection can be carried out. Current research indicates that this can be based on monitoring data from energy meters or heat cost allocator devices. Monitoring of data needs to be combined with a physical inspection of the heating systems to identify crucial design errors, such as hydraulic short-circuits. One drawback of the methods currently used to correct heating system malfunctions is the fact that they are often based on simplifications that do not fit well with the actual conditions in the buildings. It is therefore suggested that these methods should be improved and new efficient tools to ensure proper hydraulic control should be developed, such as a new radiator thermostat with a return temperature sensor or a pump control system that would minimize excess water flows. Finally, in order to ensure that the improvements are carried out, customers must have an incentive to invest in a well-functioning heating system, and there is a need for personnel who can offer the correct service agreements and drive the transition.

The overall conclusion of the study is that there is a large potential for using low-temperature district heating for space heating in existing buildings, and the current results indicate that it is economically feasible to realize this potential between now and 2050. To support the realization of this potential, future work should focus on improving the technical solutions and practical methods for implementing proper heating system control in existing buildings.

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PhD student Dorte Skaarup Østergaard

Please email the summary to the PhD secretary at the department