Hot water is produced at temperatures above 60°C, while for most of the domestic hot water applications (like taking a shower, washing our hands) temperatures of only 30 to 40°C are required. However, at temperatures below 60°C there is a risk of contaminating the system with *Legionella pneumophila*, a bacterium that, upon exposure, can cause severe pneumonia.

A large potential exists to improve the design and operation of domestic hot water systems in buildings with respect to energy use and health. The continuously high temperature of 60°C impedes the optimization of domestic hot water system design, both on a principal and a case by case basis, resulting both in poor energy efficiency due to strict defaults of high design temperatures and unaccounted risk taking by blindly choosing the lowest ‘acceptable’ cutoff temperatures in practice. Additionally, in contaminated cases, decontamination is carried out more or less on a trial and error basis, making it very time consuming, costly and above all unsafe.

The overall social purpose of this research is to lower the energy demand for domestic hot water whilst obtaining a low *Legionella pneumophila* contamination risk. This can be done by improving design and control processes of domestic hot water systems through the use of simulation models.

A coupled thermohydraulic and biological simulation model is developed that allows to predict *Legionella pneumophila* growth in systems and to test the effectiveness of decontamination techniques on a contaminated system. Based on this model a control optimization algorithm is invented that allows a lower set point temperature in combination with a dynamic heat shock regime without compromising on health.