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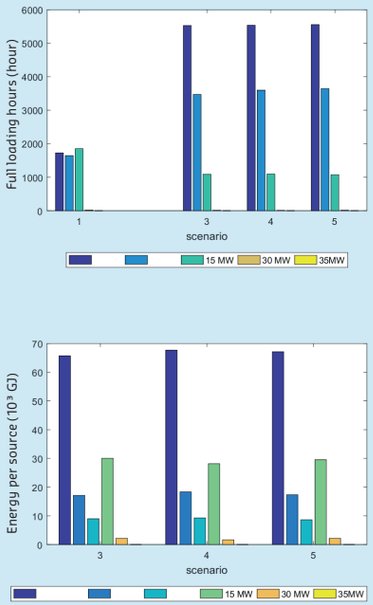
Smart thermal grid at Delft University Campus

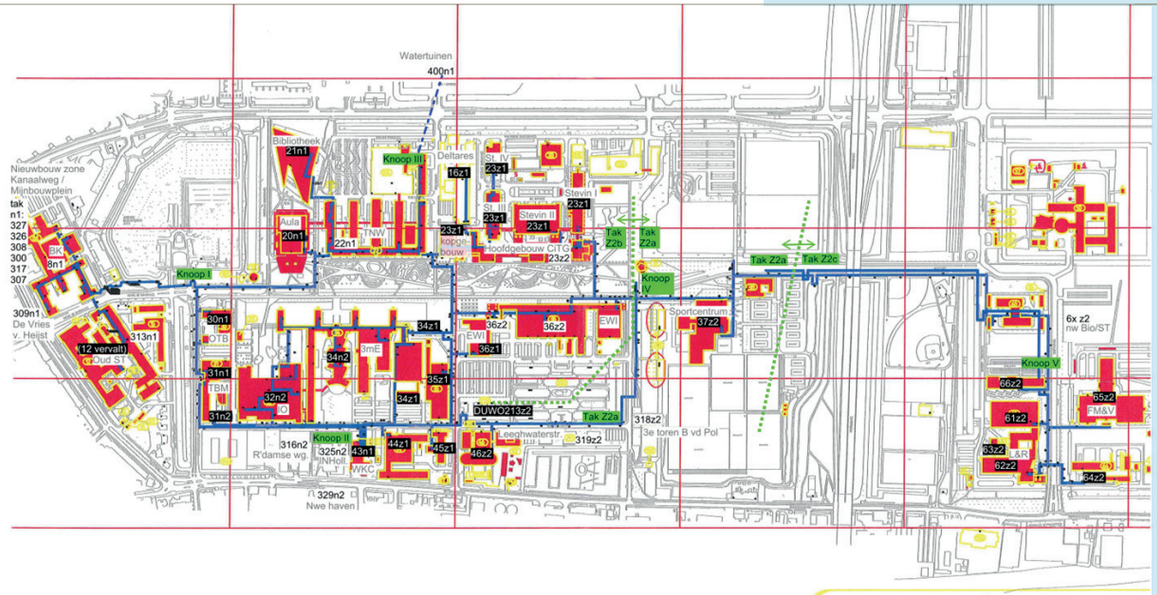


Energy and loading hours for different scenarios

Delft University of Technology wishes to be a prime example of an academic campus with energy efficiency measures and sustainably sourced power. The campus aims to reduce energy use by up to 30% by 2020 relative to 2009, to source 50% of all energy from sustainable sources by 2020, and to become 100% CO_2 neutral by 2020.

One of the areas being investigated is the district heating system (DHS) at the campus. Facility Management and Real Estate (FMVG) has started a range of projects to support a transition from a conventional DHS (120 – 80ºC) to a medium temperature DHS (80 – 40ºC). This project includes the investigation and implementation of a smart district heating control system that allows the system to run at a low temperature. One reason for the switch to a lower temperature regime is the possibility of raising the number of full-load hours for the two combined heat and power (CHP) units. Another is the possibility of drawing on a geothermal source which supplies heat at approximately 70ºC.

A model predictive control (MPC) system will be required that determines the minimum supply temperature and optimal use of the different sources. This MPC system is based on two simulation packages. The first is Low Energy Architecture (developed by Deerns), which can be used to minimise the supply temperature while providing a comfortable climate inside the building. The second is the Deltares Wanda package, which can be used to simulate hydraulic and thermal transients in pipeline systems like a DHS. Wanda is used to determine the source usage and required supply temperature on the basis of the results of the Low Energy Architecture simulation for optimal source usage with minimal carbon dioxide output.



Simulations for a standard climate year show that the supply temperature of the buildings can be reduced with minor modifications to the building envelopes. This leads to a lower return temperature at the CHP units, allowing for an increase in the number of full-load times for these two units. In the optimal scenario, an increase of 20% in the full-load hours can be achieved. This cuts CO_2 production by approximately 10%.

The MPC system has been implemented on the basis of these results for one sub-system supplying heat to three buildings. This system has been in operation since September 2016 and it will be validated during the winter. The system will be extended to include the other buildings if the results are favourable.

Further reading:
Further reading: https://www.deltares.nl/en/projects/energy-saving-by-implementing-first-smart-thermal-grid-for-buildings/