Project assignment

Subject: Engineering Cybernetics

Title: Model predictive control of low-temperature thermal grids with surplus-heat utilization.

Background:
The amount of industrial surplus heat that is dumped (stays unused) in Europe is estimated to be almost sufficient to cover the entire buildings heat demand. Cities often have numerous surplus-heat sources, e.g., data centres, ice skating rinks, or supermarkets, which may be utilized through thermal grids forming a district heating (DH) network, transporting hot water in pipelines to customers with heating demands. The surplus heat, e.g. from data centers, is however often at a low temperature and difficult to utilize in existing DH grids. Local low-temperature thermal grids (LTTGs) extends the ability to utilize low-temperature surplus heat for new building areas. This will in turn help to reduce CO$_2$ emission by decreasing use of fossil-fuel based heat generation.

A goal for LTTGs is to maximize the degree of energy self-sufficiency and thereby minimize the use of peak heating or peak supply from the primary DH grid. Surplus-heat sources are often time varying and so are also heat demands of buildings. Through thermal energy storage (TES), offsets in demand and available heat can be levelled out, though requiring good control for efficient utilization. MPC is particularly suited for this purpose. To this end, the purpose of this project is to:

- Develop a system model of DH networks/LTTG with customers, TES unit, surplus-heat source, and connections to a primary (high-temperature) DH network.
- Develop an MPC scheme for control of charging/discharging of heat from the TES, pumps controlling the grid flow and valves controlling heat exchange with the primary DH grid.
- Test and analyse the model and MPC controller on suitable test cases.

The project is part of the project LTTG+ - Low-temperature thermal grids with surplus heat utilization, and will be carried out in collaboration with SINTEF Energy Research, Statkraft Varme or possibly other partners in the research project.

Pre-requisite knowledge: there is no prerequisite knowledge, but it is beneficial to have some interest in energy systems.

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