Boundary Conditions for Economically Viable District Heating Networks

Investigating the Influence of Different Parameters on the Economic Viability and Proliferation of District Heating

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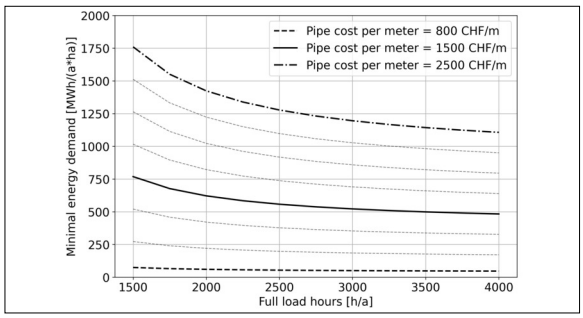
Introduction: District heating networks (DHNs) and seasonal thermal energy storages (STES) are an important part of achieving Switzerland's goal of becoming CO_2 neutral. As part of the GisOptiTes project, a scanner has been developed that uses minimum initial and extension demands (700 and 400 MWh/(a*ha)) to identify potential DHN and STES locations. However, the economic viability of DHNs depends strongly on geographic conditions, making such fixed values insufficient to identify all potential locations.

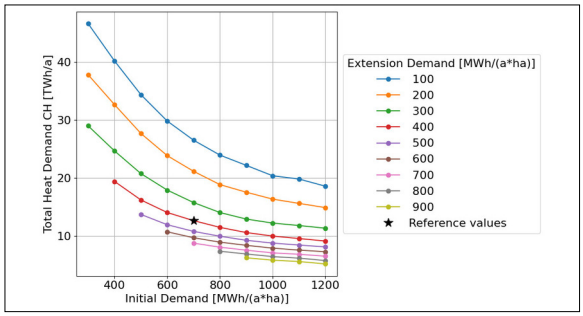
Approach: This thesis investigates the boundary conditions under which economic viability can be achieved, as well as the factors that influence them. To this end, an economic model is created from the network operator's point of view, which is subsequently used in a sensitivity analysis to determine both the most influential parameters and the minimum demand ranges under which a initial DHN and an extension can be economically viable. These minimum demand ranges are then used as inputs to the scanner, to analyze their impact on potential DHNs.

Conclusion: The results show that pipe related costs, full-load hours, and connected power strongly influence economic viability. The obtained minimal demands range from 300 to 1200 MWh/(a*ha) for initial demand and 100 to 900 MWh/(a*ha) for extension demand. Reducing the initial demand is especially beneficial for the economic viability of new DHNs in rural areas. In contrast, a lower extension demand is more useful for the economic viability of extensions for existing DHNs, as well as increasing the total heat demand covered by district heating. With the insights provided the following recommendations can be made: 1) providing a framework which reduces financial risks especially in the early planning stages, 2) aim for an early communication between stakeholders, and 3) create a forward-looking spatial planning to increase full-load hours and reduce pipe related costs.

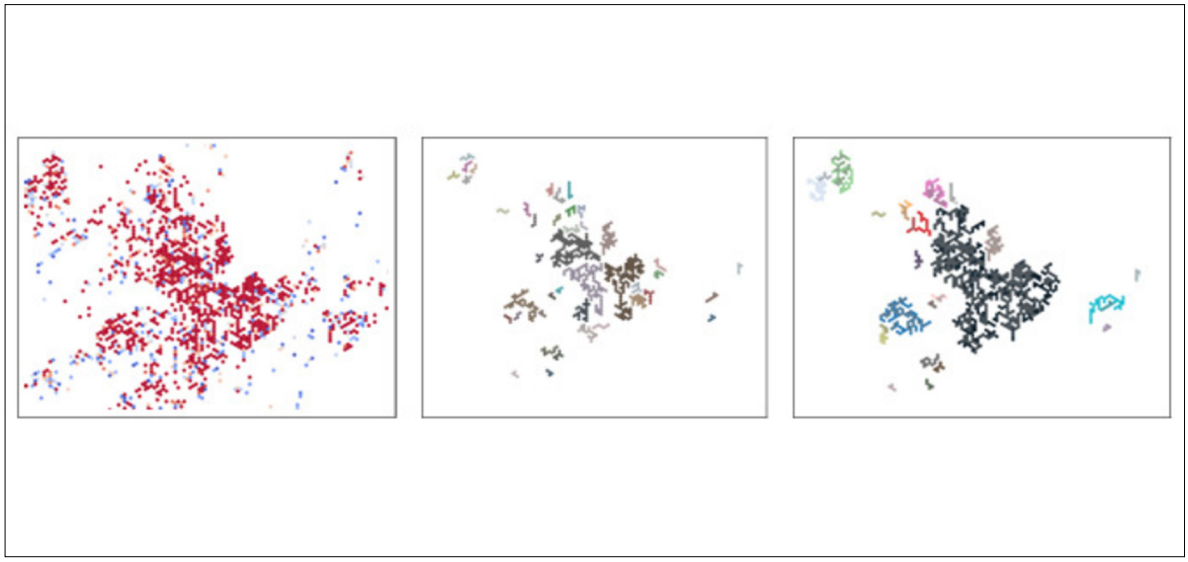
Minimum energy demand for economic viability vs full-load hours and pipe cost per meter
Own presentment



Total heat demand vs initial demand with different extension demands, reference values: 700 MWh/(a*ha), 400 MWh/(a*ha)
Own presentment



Example of district generation, left: indivitual heat demands, middle: initial districts, right: extended districts
Own presentment



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