Amsterdam's Heat Transition & Water Hotspots?

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Introduction: a Water-Energy-Food Nexus

The concept of the Water-Energy-Food Nexus provides a lens to identify tensions, synergies and trade-offs between water, energy and food resources (Hoff 2011). Stresses driven by Climate Change, urbanisation, population growth and resource scarcity have motivated an increasing interest in Water-Energy-Food Nexus research.

Knowledge gaps should be addressed to create actionable knowledge with Water-Energy-Food Nexus research. Currently most nexus research focus on developing a framework for quantitative analysis, leaving gaps for the **implementation of nexus research**. Voskamp et al. 2018 show that information on a **higher spatio-temporal resolution** is needed for urban planning and design interventions in the case of Amsterdam.

This research aims to fill this knowledge gap by providing a spatio-temporal analysis about the **change of water demand due to a urban heat transition**. This Water-Energy Nexus research is part of the first year of a PhD project and will later be extended to include the agricultural sector (where heating is predominantly used for greenhouses). The end product is therefore a spatio-temporal model for Water-Energy-Food Nexus research.

Importance of Urban Heat and Water Demand

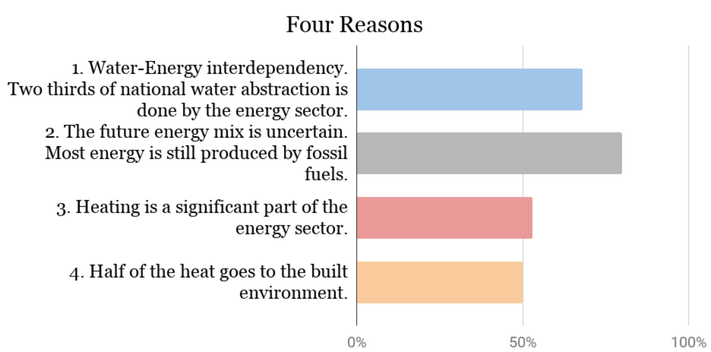

Fig. 1: Four reasons to consider the impact of an urban heat transition and water demand. Sources used: CBS 2019 and Menkveld et al. 2017.

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Research Design: Optimising the Water Use of Heat Supply

Supporting the sustainability of the Dutch energy transition by optimising spatio-temporal water use demand of urban heating in 5 steps:

Cluster neighbourhoods according to energy demand profile (residential, business, industrial, and mixed).

Determine spatio- temporal picture of heat demand using demand profiles and monthly heat demand curves.

Design heating scenarios based on local possibilities for heat networks, electrification of heating, and biogas.

Quantify spatio-temporal water demand due to abstraction and water consumption of heat network and sources.

Identify future hotspots and create actionable knowledge with heating scenarios based on costs, carbon emissions and water footprint.

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Case Study: Heat Transition in Amsterdam

The city of Amsterdam is a place for more than **400,000 households**, and many **economic activities** which take place in the Port, touristic areas, datacenters, and the financial district. It is also the center of the **Amsterdam Metropolitan Area,** which has a population of almost 2.5 million people.

The city envisions to become **'gas free' by 2040**. This means not only an increase in usage of renewable energy sources like solar and wind power, but also a **transition of the heating infrastructure**; from decentralised heating by natural gas to a heterogeneous system with district heating (from 103.000 connections in 2020 to **230.000 connections in 2040**), electrification of heat, and biogas (City of Amsterdam and Department of Urban Planning and Sustainability 2015). Experts **are exploring alternative sources** to extract heat from, such as datacenters, underground thermal energy storage, waste water, solar thermal collectors, hydrogen, and geothermal energy.

In this project we investigate the water use of different heat sources and propose scenarios for sustainable technology integration.

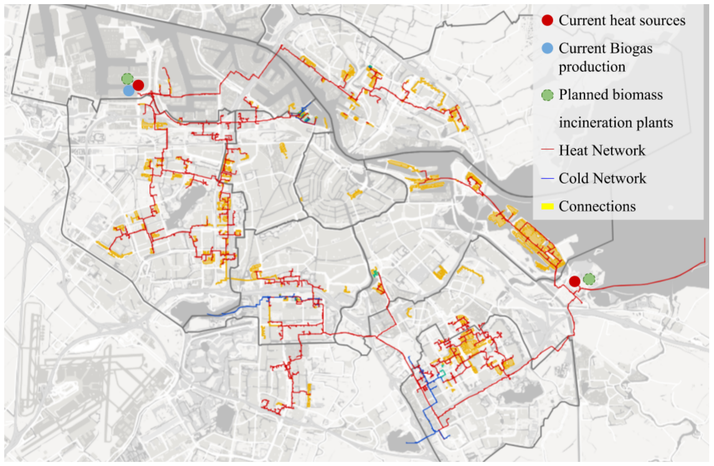

Fig. 3: Map of Amsterdam of heat network (currently operating and planned). Edited map from online source: Maps Amsterdam, data from Nuon Energy 2018.

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