Status update
on 4 different themes

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Swiss Federal Office of Energy SFOE

Networks

Willy Villasmil (HSLU)
Tobias Sommer (HSLU)
Jonathan Chambers (UNIGE)

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Networking Conference 25/26 April 2022
Seminarzentrum Campus Sursee

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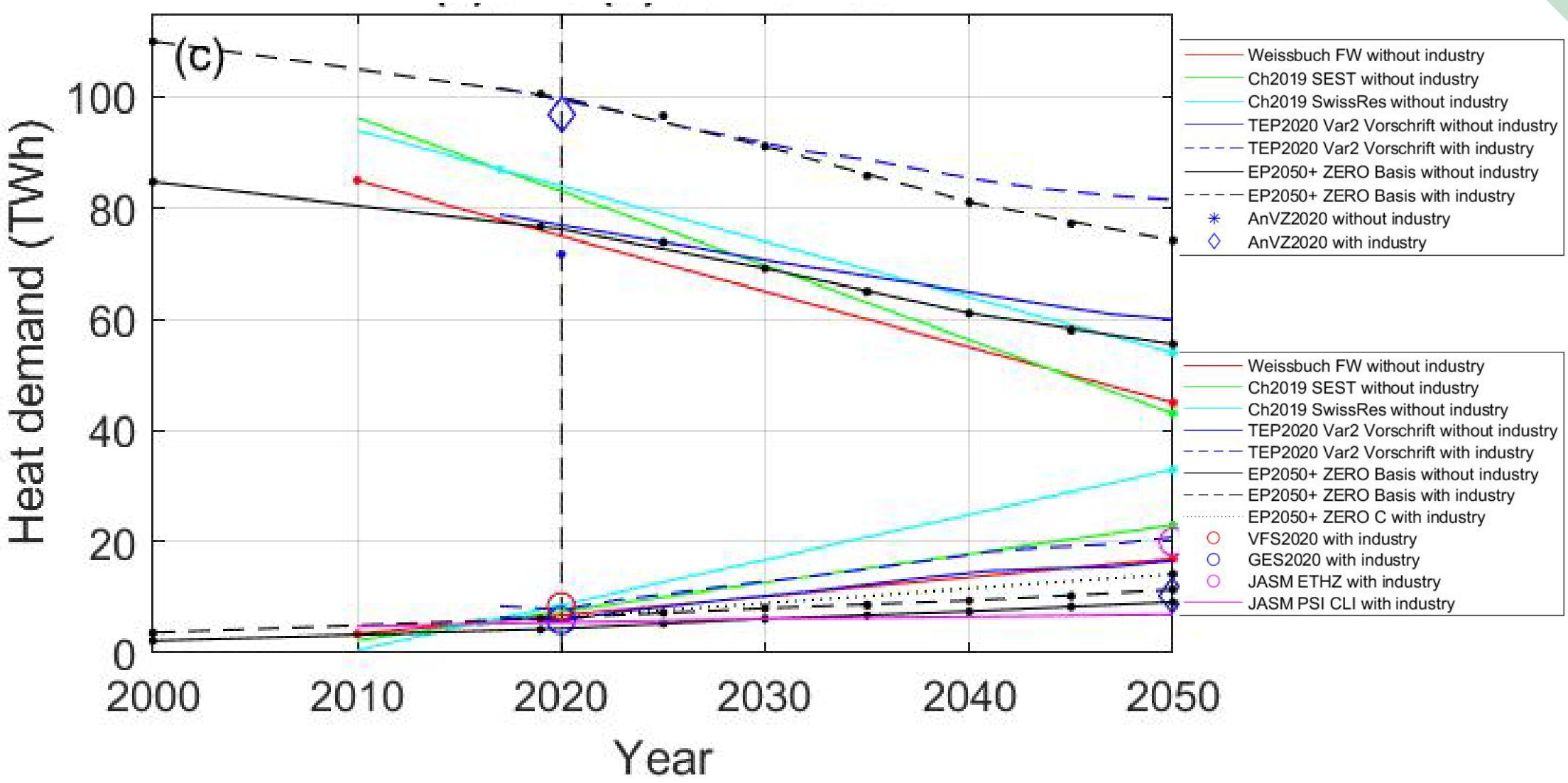
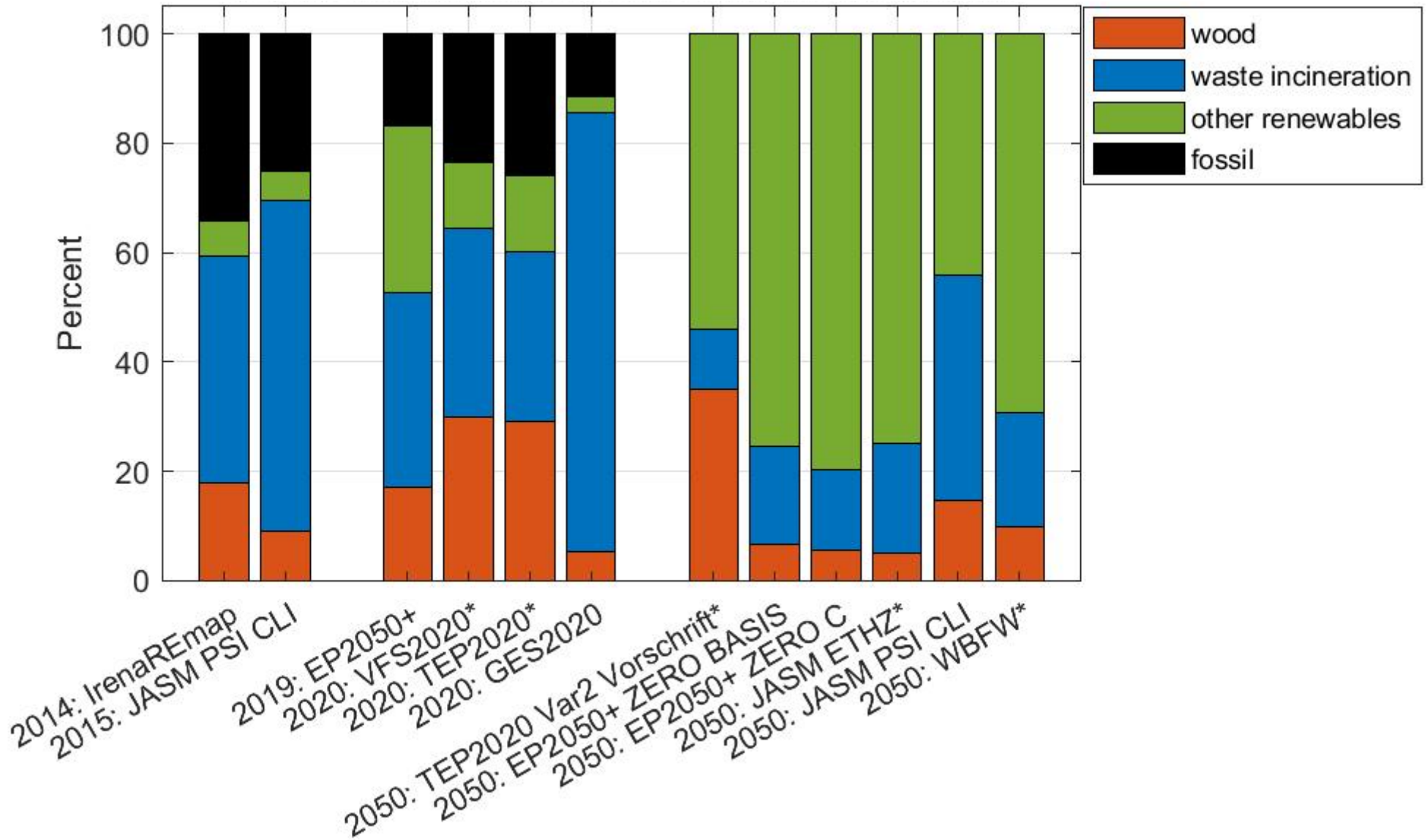
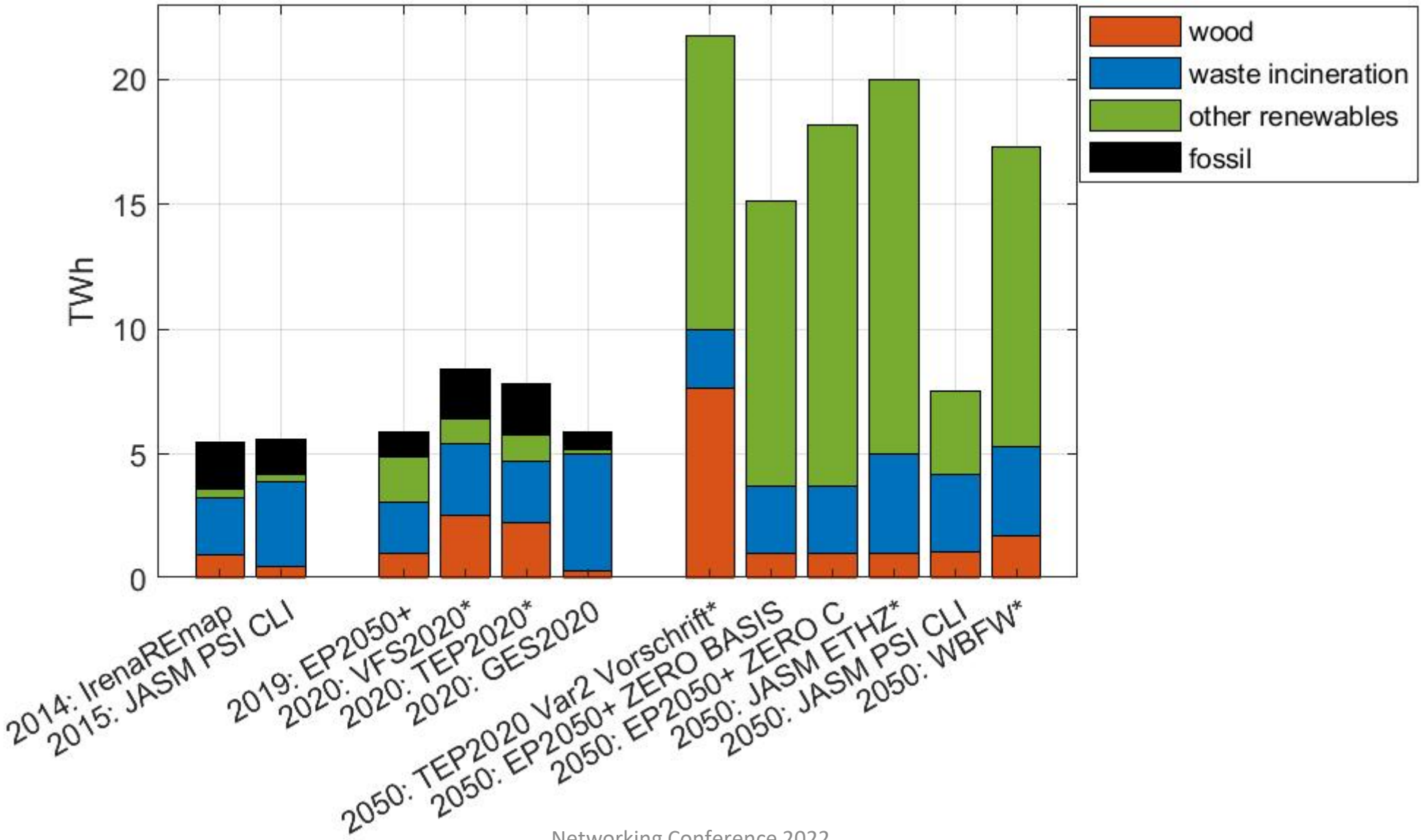
Development of heating demand and district heating



Production mix of district heating in Switzerland



Potential of district heating in Switzerland




Büro
Wohnen
Quelle
ETH
SIEMENS

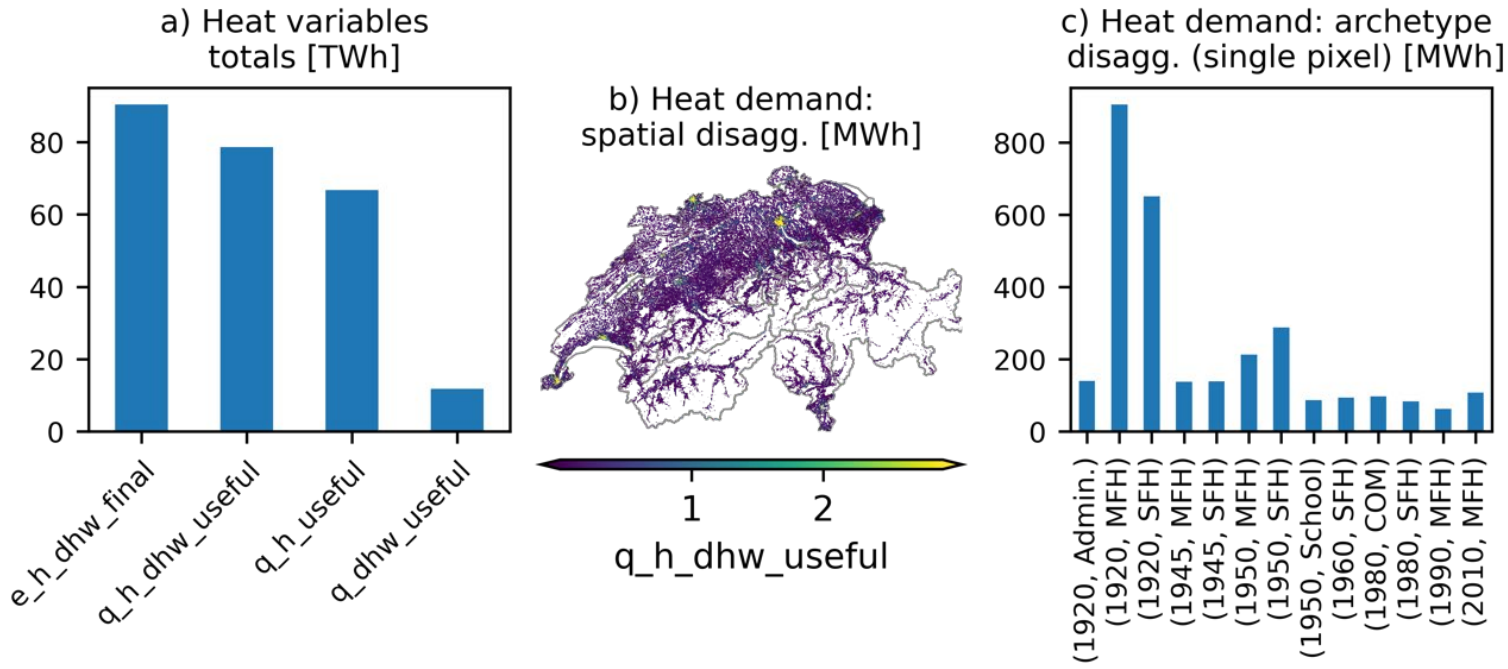
Willy Villasmil and Stefan Mennel new WP3 Lead

National Perspective (WP1)

Task 1: Database

- Now connected with SWEET-CROSS
- Continued development/feedback on data platform
- Publication of open datasets

Example data publication

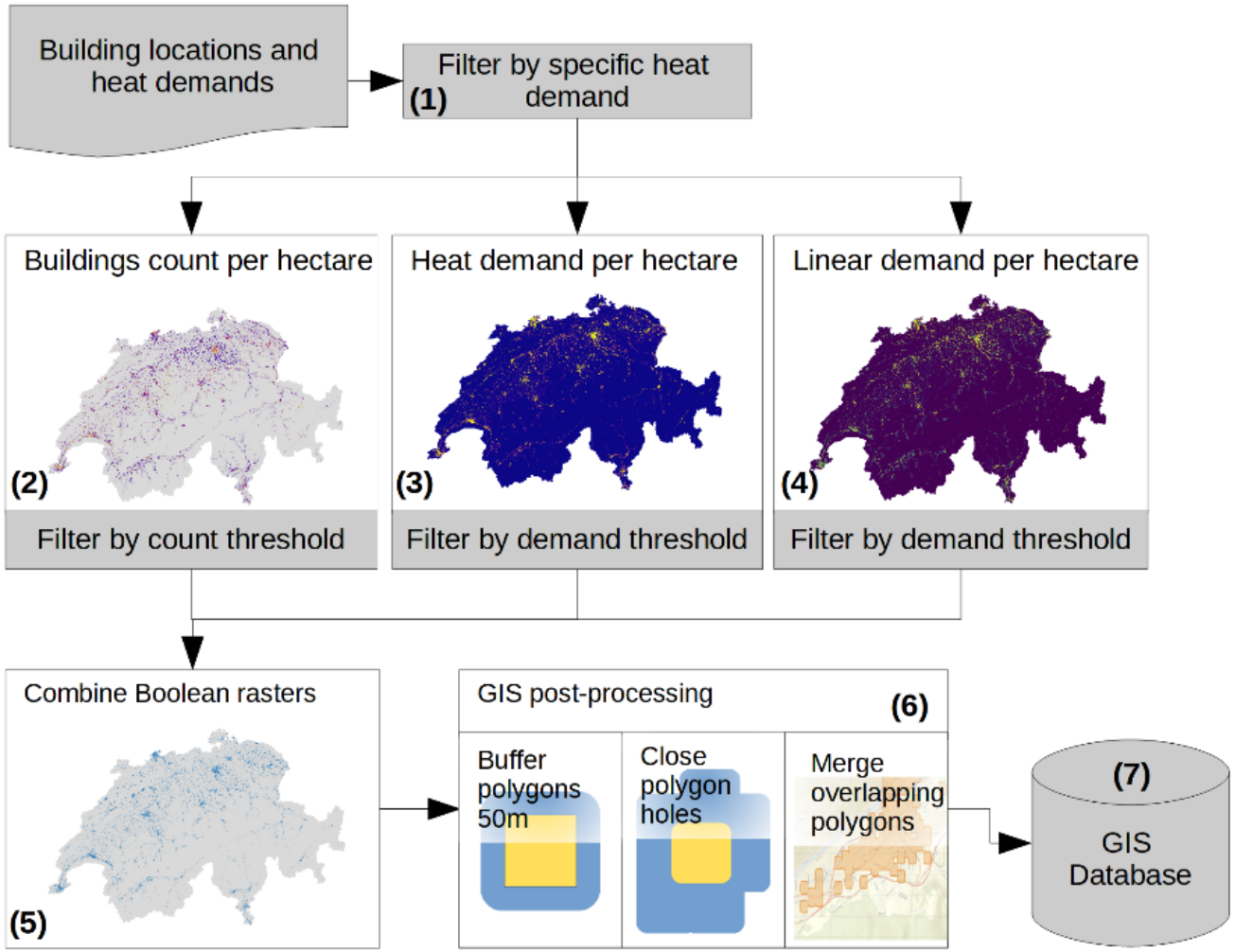


Raster aggregate summary of building stock characteristics building typology, heat demand models by building typology, future cooling demand in service sector buildings
https://sweet-cross.ethz.ch/data/swiss-cooling-demand-service-sector/2021-06-01/
https://sweet-cross.ethz.ch/data/swiss-heat-demand-building-stock/2021-06-01/

Chambers 2021. Presentation of new geospatial datasets for renewable thermal energy systems modelling in Switzerland
https://iopscience.iop.org/article/10.1088/1742-6596/2042/1/012003

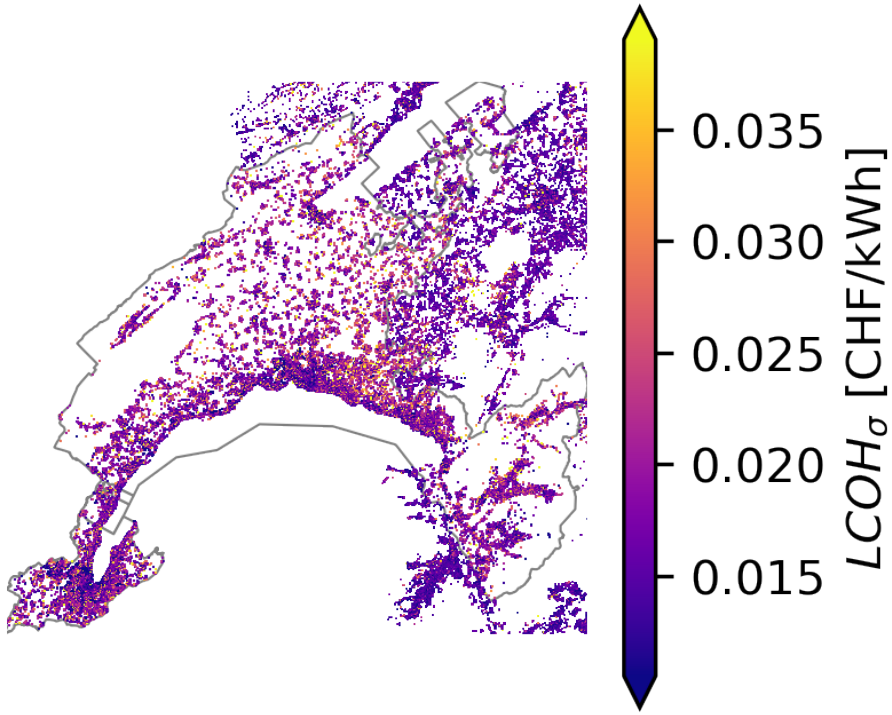
Uncertainty in network potentials

- Wide range of potential supply estimates
  - 1.3x to ~4x present day
- Developed multi-criteria method to estimate potentials
- Study national decarbonisation through retrofit, HP, HTDN,LTDN
- Apply Global Sensitivity Analysis to understand sources of uncertainty

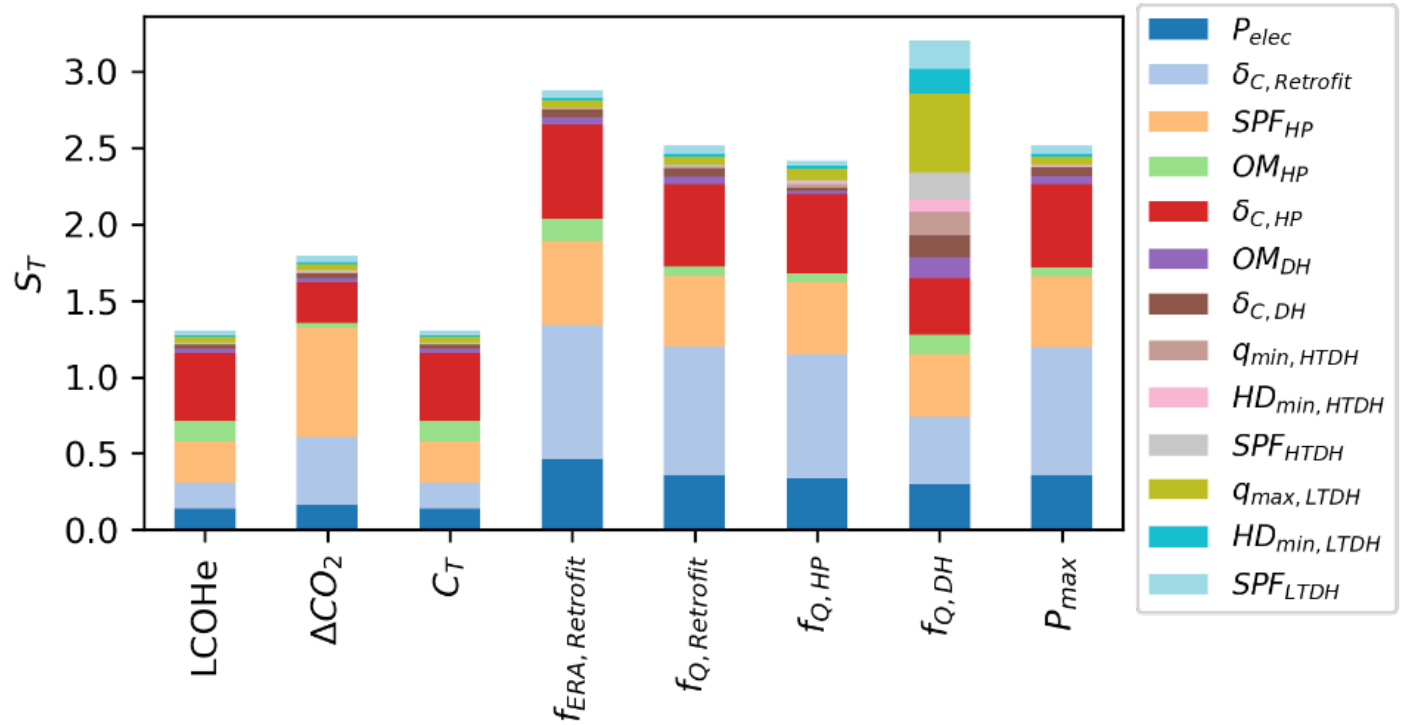


Chambers, J., Narula, K., Sulzer, M., & Patel, M. K. (2019). Mapping district heating potential under evolving thermal demand scenarios and technologies: A case study for Switzerland. *Energy*

High sensitivity limits usefulness of cost-optimal approach



Spatial variance of LCOH in GSA

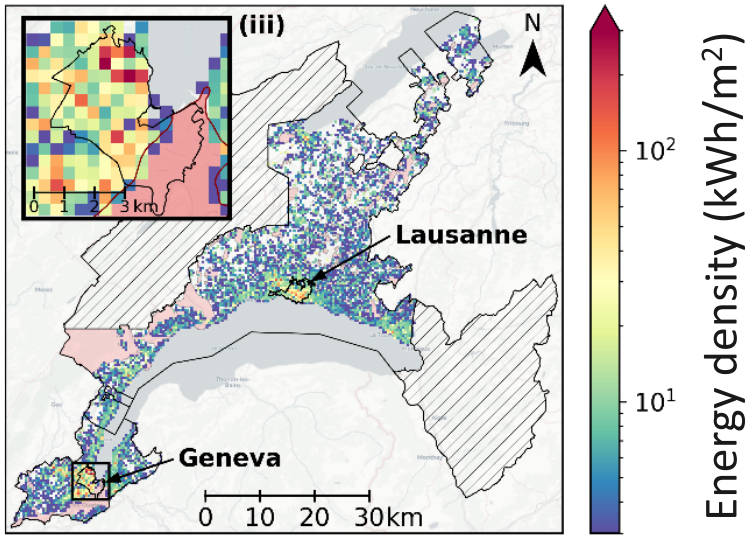


Sobol Sensitivity Index for model KPIs showing high impact of efficiency related parameters

Chambers, J., Zuberi, M. J. S., Streicher, K. N., & Patel, M. K. (2021). Geospatial global sensitivity analysis of a heat energy service decarbonisation model of the building stock. *Applied Energy*, *302*, 117592. https://doi.org/10.1016/j.apenergy.2021.117592

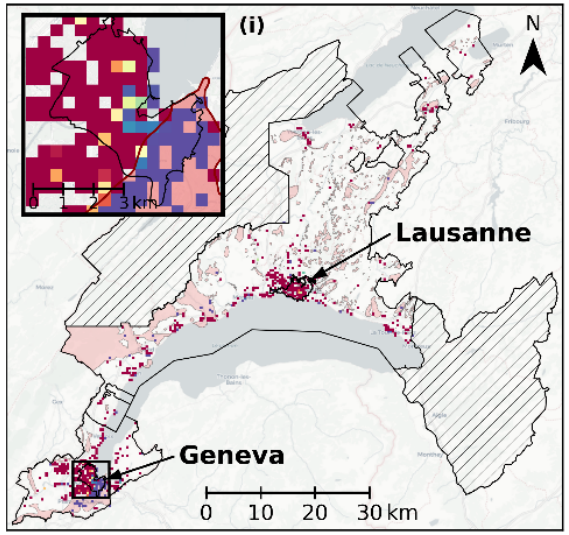
Integrating cooling & regeneration changes potentials

Technical potential for heating

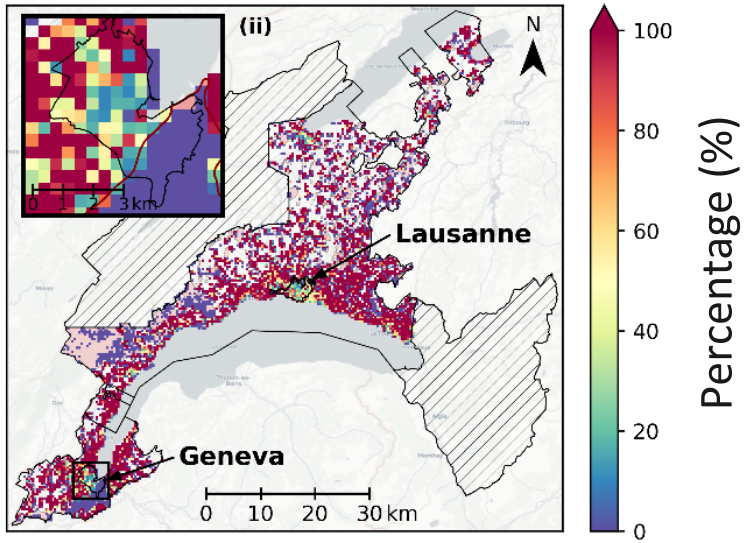


Useful potential to supply heating and cooling demands

Cooling



Heating



Conversion rate 90%
Max heat injection > 330 kWh/m²
Max heat extraction > 300 kWh/m²

Seasonal regeneration and DHC covering up to ~85% of heating and cooling demands

Walch*, A., Li*, X., Chambers, J., Mohajeri, N., Yilmaz, S., Patel, M., & Scartezzini, J.-L. (2021). Shallow geothermal energy potential for heating and cooling of buildings with regeneration under climate change scenarios. Energy, 123086. https://doi.org/10.1016/j.energy.2021.123086

Bottom-up thermal net modelling

- Novel computing methods for building-level grid modelling
- Challenge assumptions using new data driven approach
- Enabled by large GIS datasets

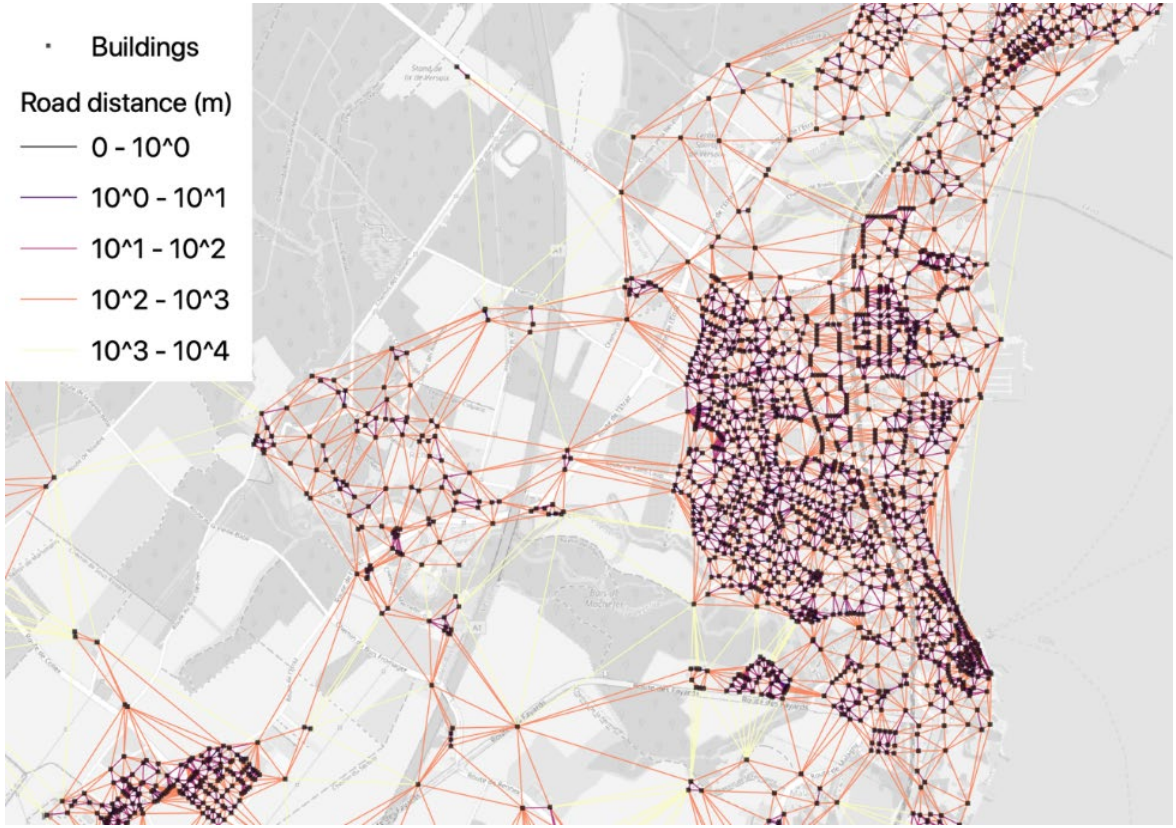
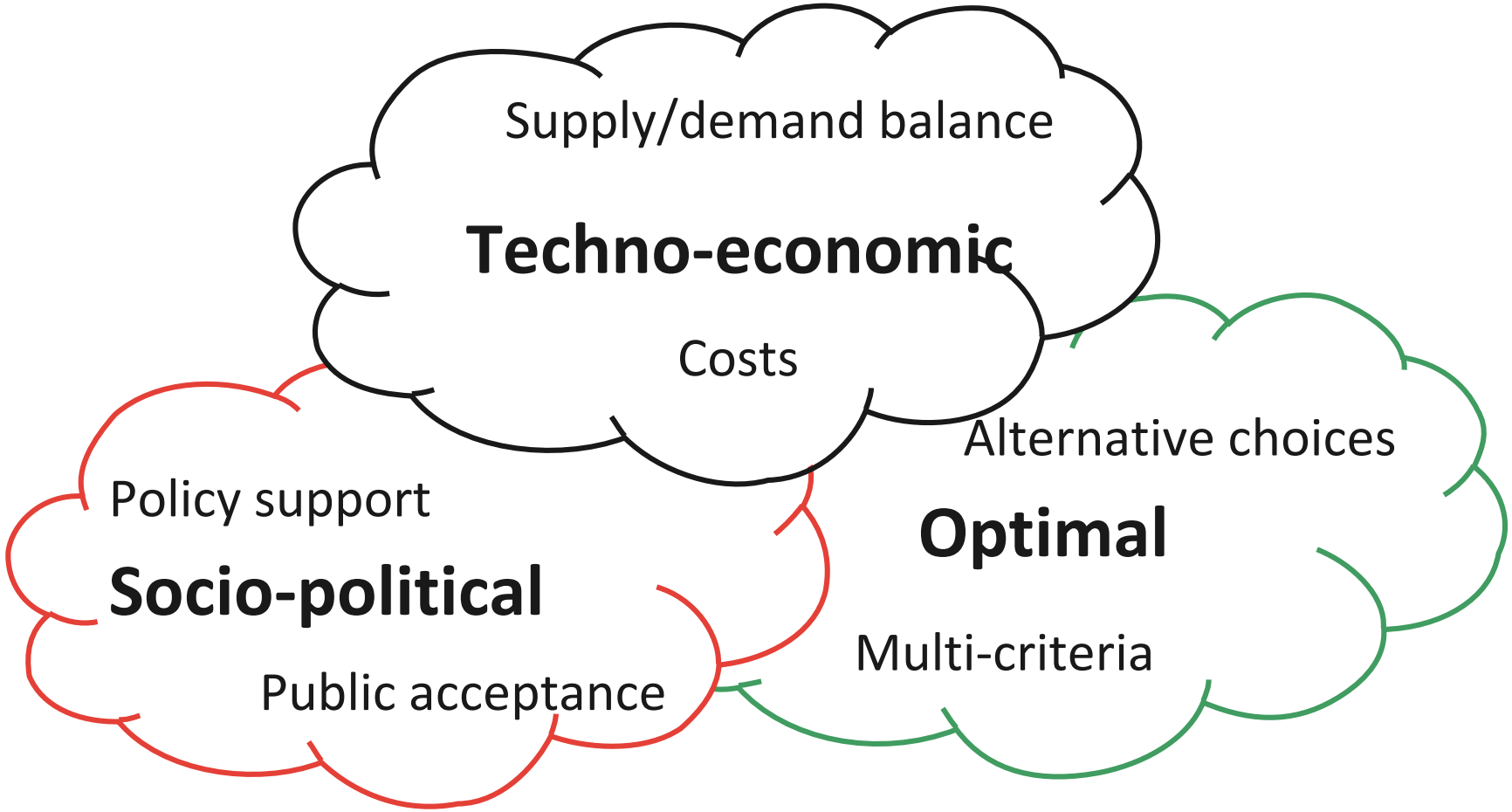
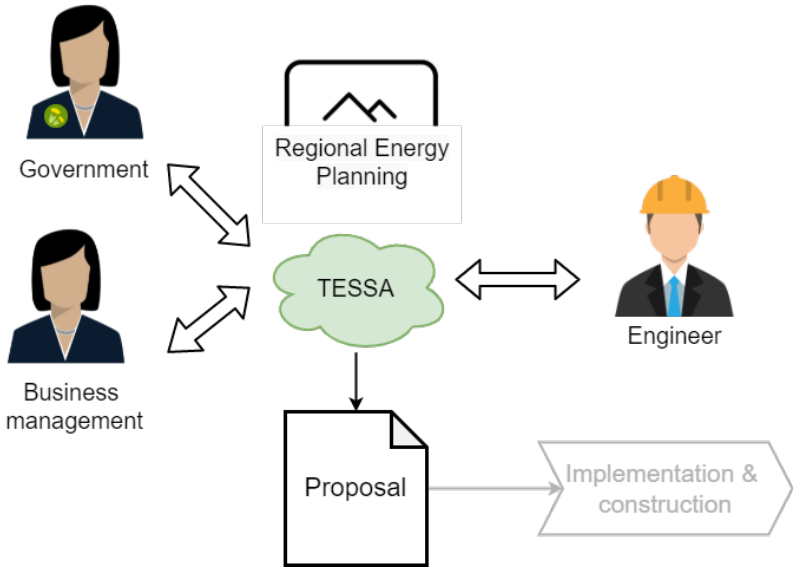


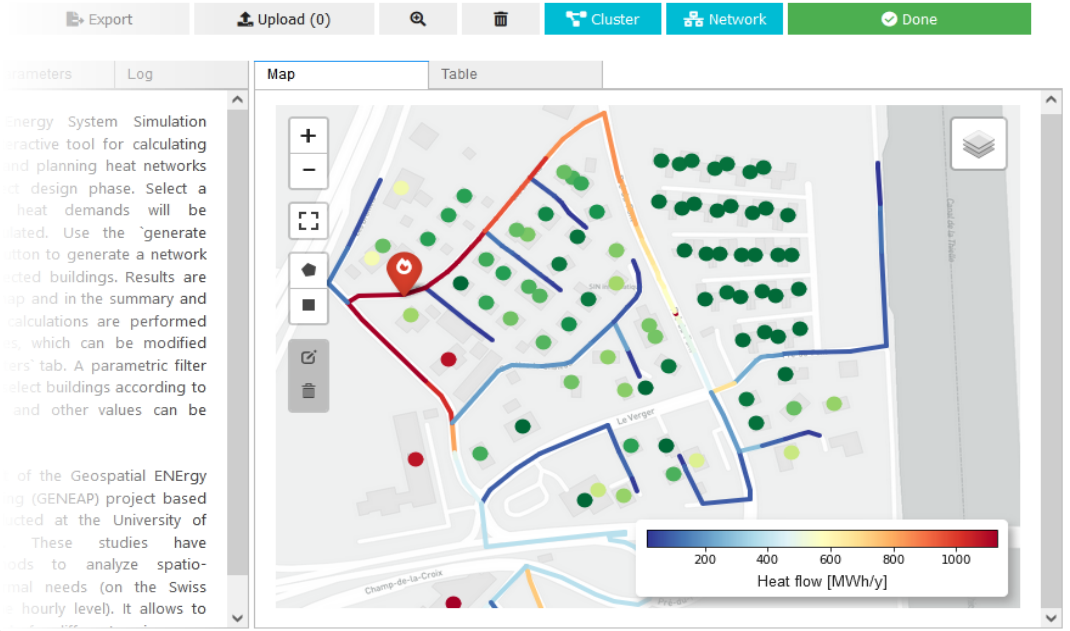
Illustration of graph of buildings overlaid on building locations (base map: OpenStreetMap).

Need to integrate more aspects of technology adoption to model future energy system



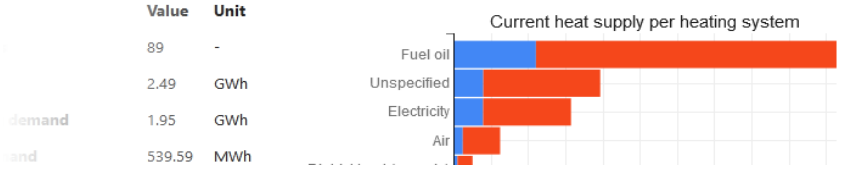
Thermal Energy System Simulation Assistant





- Interactive network modelling and exploration
- Study alternatives and stakeholder feedback

Tessa



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Innosuisse - Swiss Innovation Agency

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geoimpact
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Local Perspective (WP3)

WP 3: Technologies, design and operation of thermal grids for future energy planning

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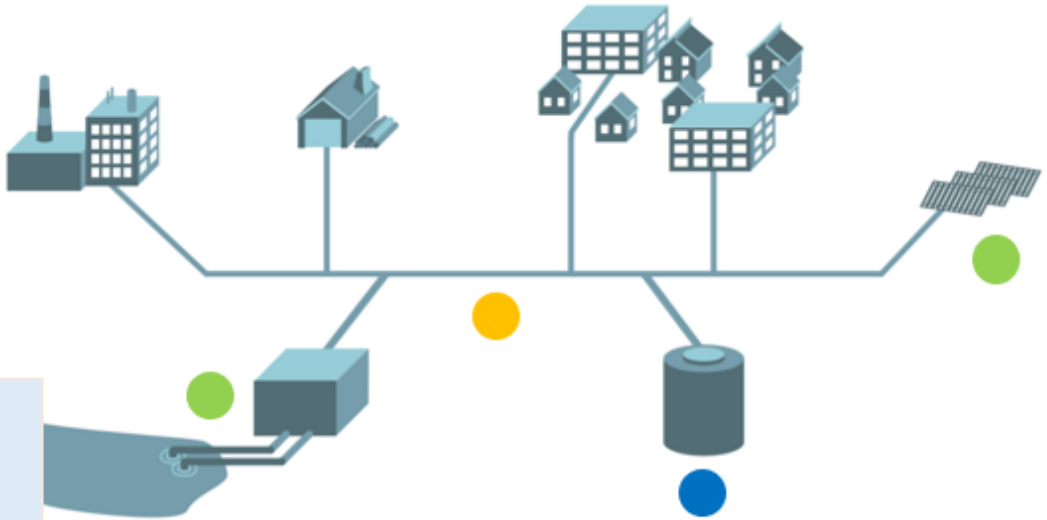
Input

WP 1

WP2/WP9

Tasks WP 3



Representative boundary conditions for **renewables and storages** on a district scale (HSLU-TES) — Task 1

Technology options for including **renewables** in thermal grids (OST-SPF) — Task 2

Technology options for **storages** in thermal grids (ZHAW, together with Empa) — Task 3

Design and **operation** of future thermal grids for heating and cooling (HSLU-IGE, together with SUPSI, Empa, LBNL) — Task 4

Task 5 — **Local energy planning** for future thermal grids (Empa)

WP 6 / WP 7

Planning Tool

P&D projects (WPPD1)

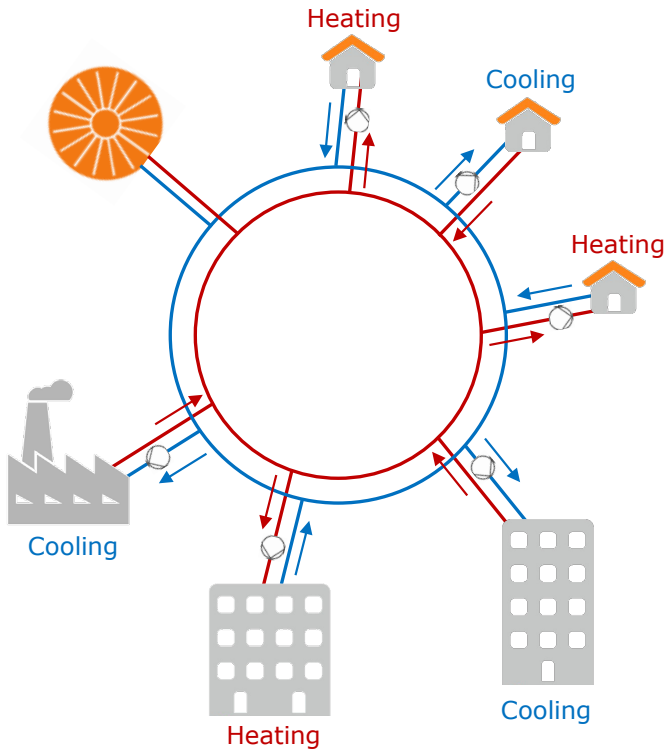
Education

Outcome

Design and optimization of thermal networks
Expected outcome

- Techno-socio-economic assessment of technology options
- Guidelines for the integration of renewables
- Control strategies for future thermal grids
- Software tool for energy planning

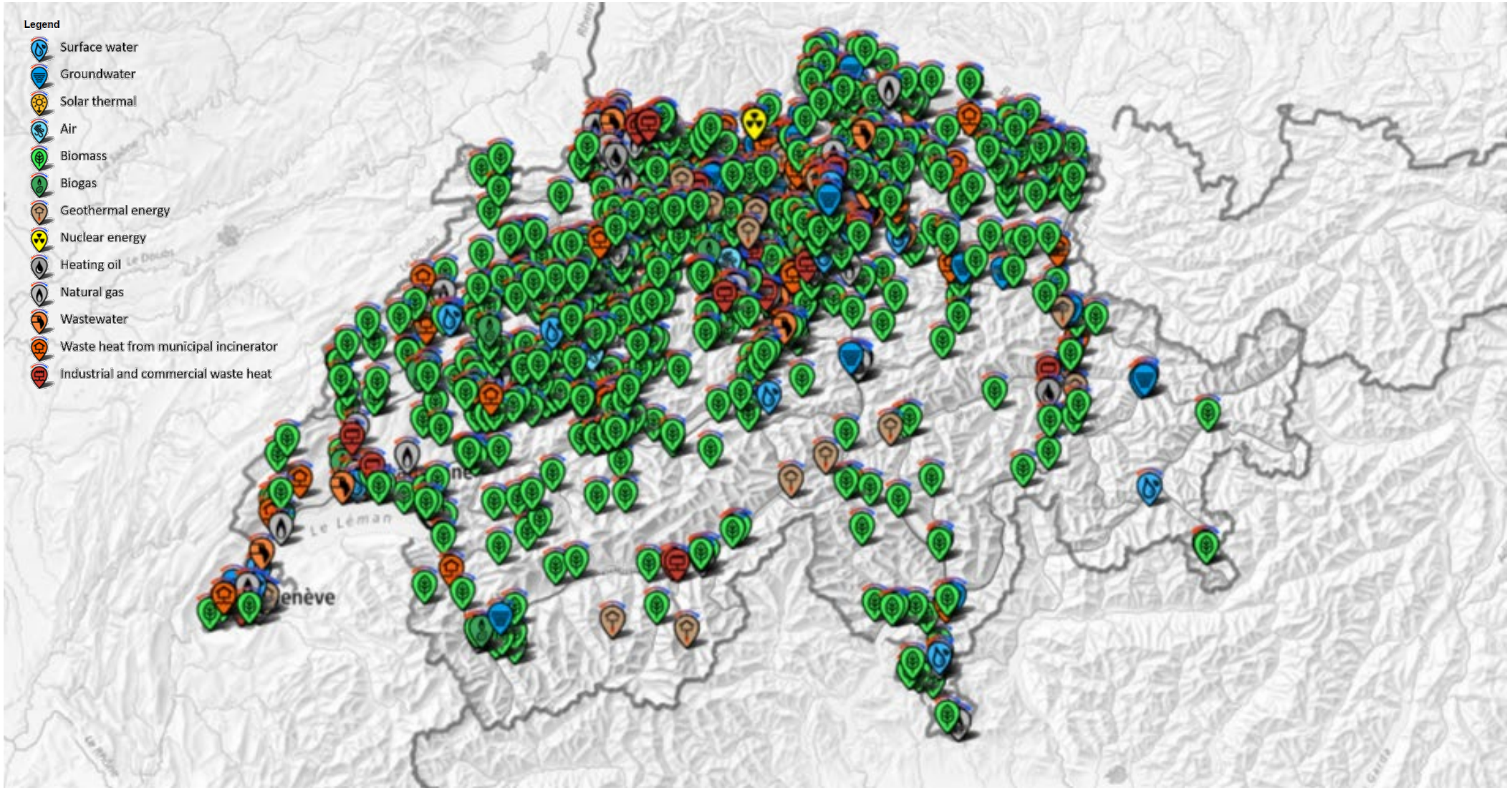
Low-temperature network



Project plan

Selection of representative districts → Renewable technology options → Thermal storage options → Grid temperature reduction → New thermal grid concepts → Model simplification and implementation

Thermal networks – current status in Switzerland



map.geo.admin.ch

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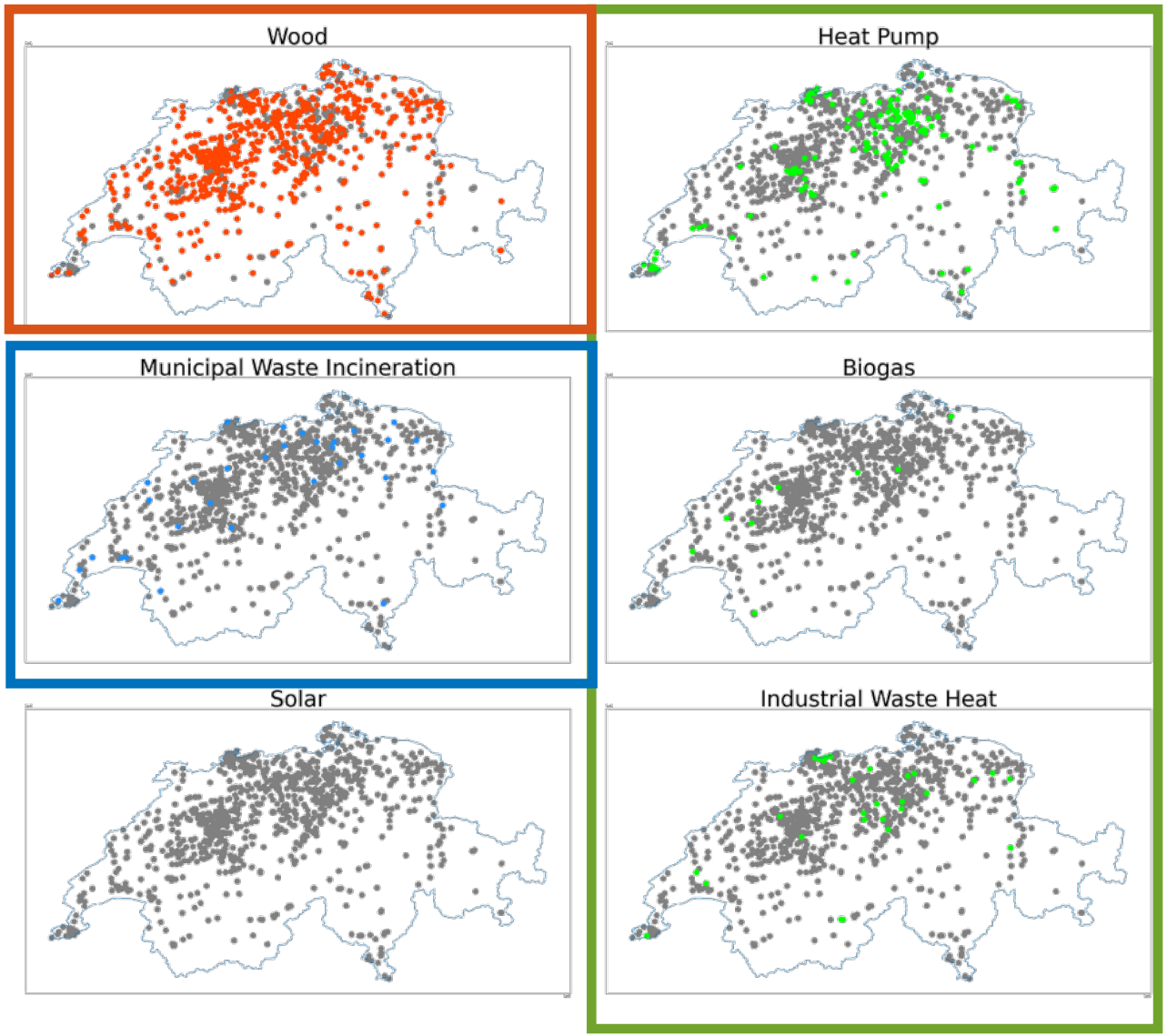
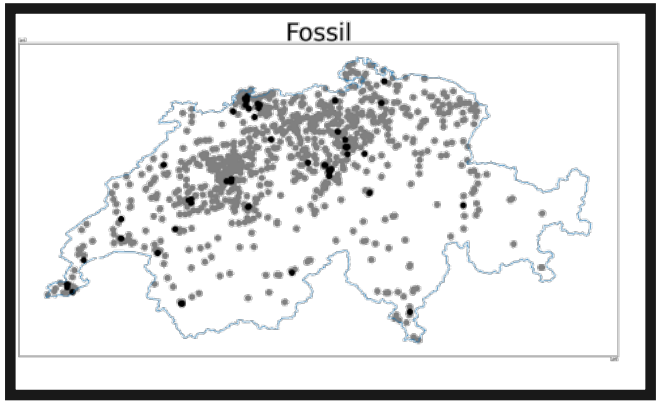
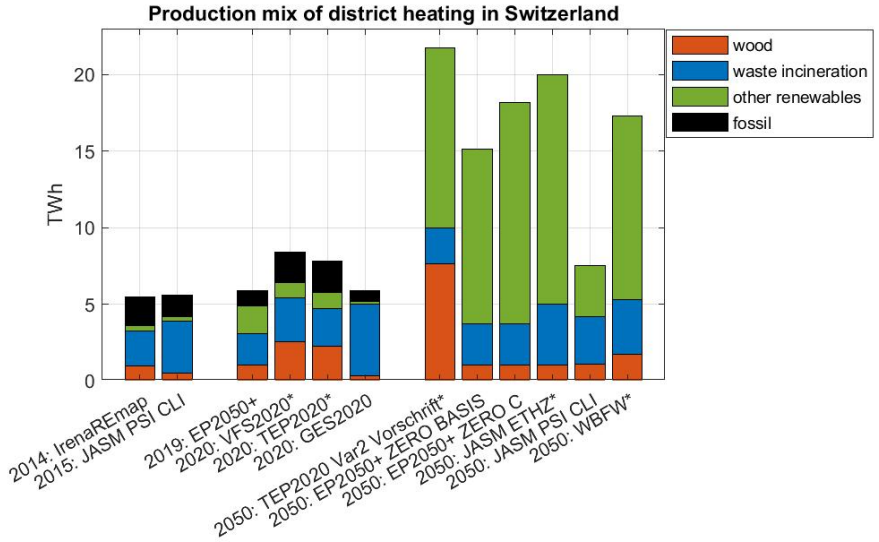
Thermal networks – current status in Switzerland

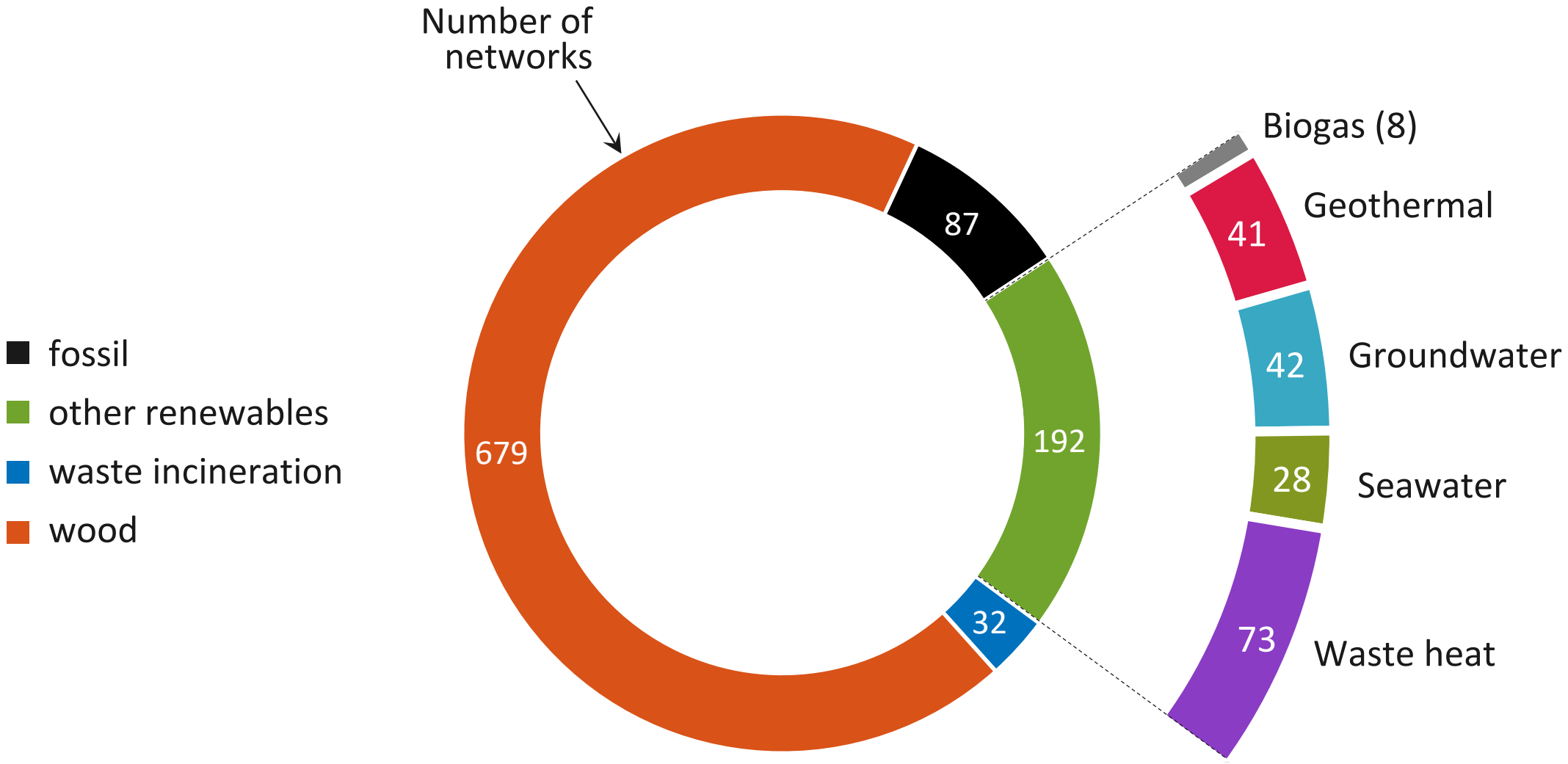






HSLU Hochschule Luzern

Thermal networks – current status in Switzerland



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Technology options for integration of renewables

SFOE projects BigStoreDH & IceGrid

- Models of generic networks & case studies
- Integration of thermal storage and renewable sources

+ DeCarbCH: Integration of solar energy

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SPF INSTITUT FÜR SOLARTECHNIK

OST

ewz

EV Altstetten/Höngg

- Combination of hot and cold network
- HP with sewage
- Waste burning

TES at EV Altstetten

iwb

Fernheizkraftwerk Volta

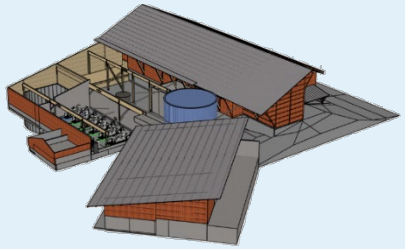
- Existing Gas and Vapor
- Fossile fade out
- Use of existing turbines

Powerplant Volta, Basel

Wärmeverbund buttisholz

WV Buttisholz

- New network with wood gasification
- Big PV Installation
- Combination of PV, HP and ground storage

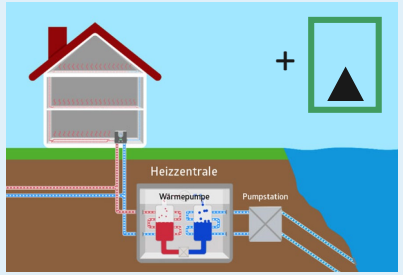


Plan for the central plant

energie360°

EV Tiefenbrunnen

- HP with lake for a "hot" grid
- Fossil peak
- Limited space
- Storage for peak shaving



Sketch of underground HP;

ENERGIE ZürichseeLinth

Energieverbund Jona

- Low temperature network
- Sewage plant
- Limited power

Grid from sewage plant Jona

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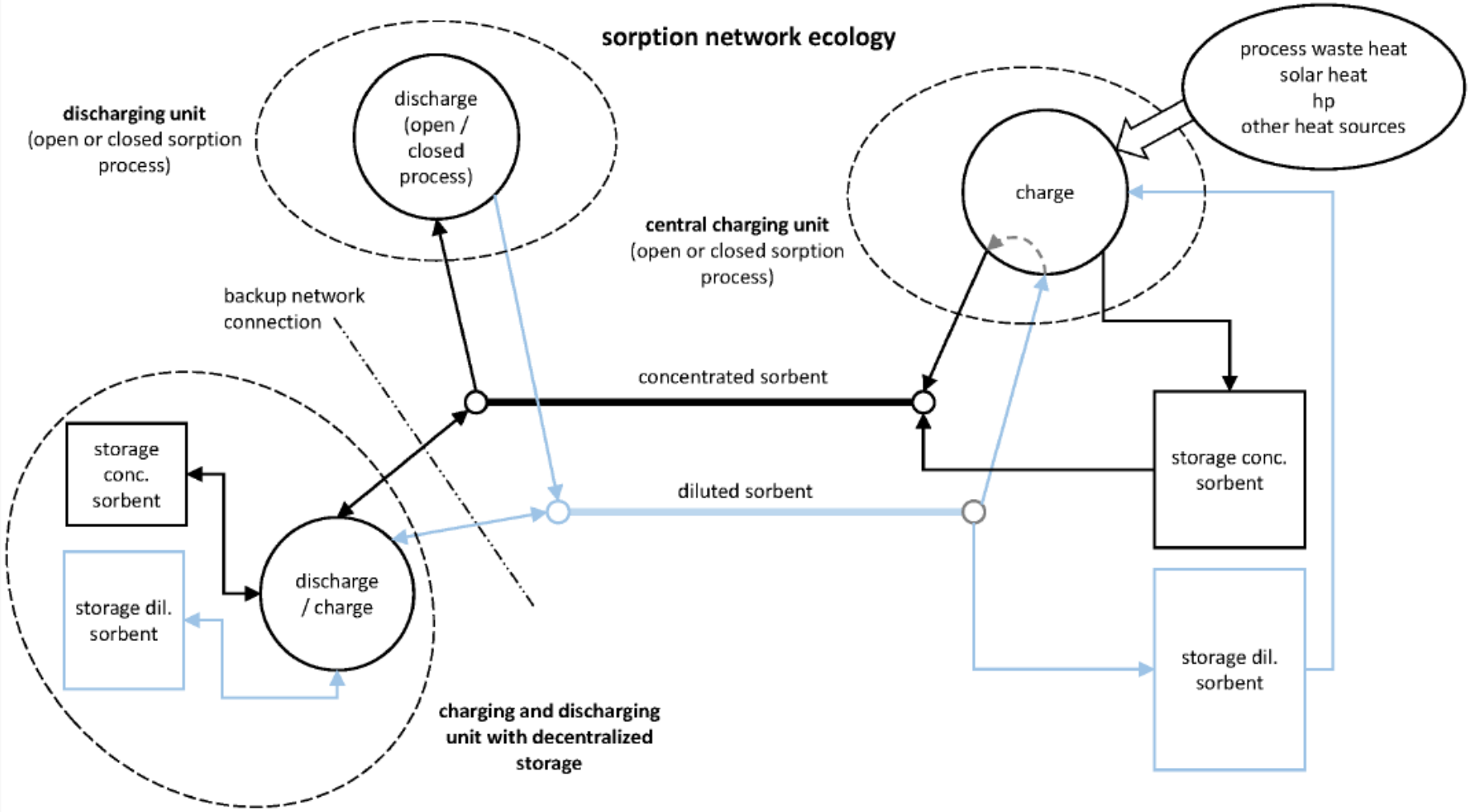
Technology options for storages in thermal grids

«**Tcology** - **T**hermo-**C**hemical Network Ec**ology** – Case study and technology potentials»



PROJECT PARTNERS:
ZHAW IEFE
ZHAW INE

PROJECT START: **01.03.2022**
PROJECT END: **28.2.2024**

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Zentrum Bautechnologie und Prozesse

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Temperature reduction strategies in existing and new thermal grids: classification and valorisation

- **Classification** in the style of Efficiency Label valid for **new** and **existing** grids (incl. grid **extension**) – **based on technology leaps**
- **Identification of actions** on users, distribution and generation levels for temperature reduction pathways from one class to another
- **Valorisation of actions** through **thermo-economic modelling** with **internalization** of externalities

University of Applied Sciences and Arts of Southern Switzerland
SUPSI

G	F	E	D	C	B	A
• Supply: 80 – 85 °C	• Supply: 70 – 80 °C	• Supply: 65 – 70 °C	• Supply: 50 – 65 °C	• Supply: 35 – 50 °C	• Supply: 20 – 35 °C	• Supply: < 20 °C
• Return: 50 – 60 °C	• Return: 50 – 60 °C	• Return: 50 – 60 °C	• Return: 30 – 45 °C	• Return: 25 – 30 °C	• Return: 10 – 20 °C	• Return: > 0 °C
• 1C-HT / 3G	• 1C-HT / 3G	• 2C-LT / 4G	• 2C-LT / 4G	• 2C-LT / 4G	• 3C-LT / 4G-5G	• 4C-LT / 5G

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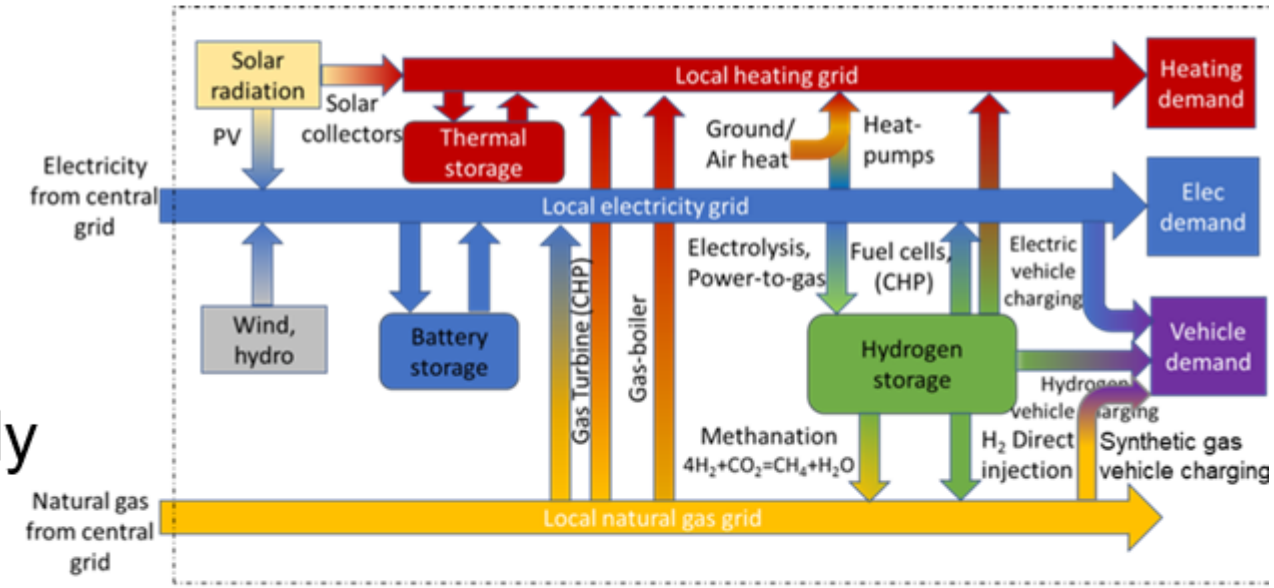
E-hub Tool

Empa
Materials Science and Technology

- Design optimization of multi-energy system
- **Objective:** cost/CO2 minimization, multi-objective
- **Scope:** Buildings/neighbour-hoods/ district/cities/countries
- **Granularity:** Hourly/sub-hourly dispatch of power, gas (CH4/H2)& heating/cooling system, Annual/multi-stage/multi-hub



Source: (Murray et. al, 2020)

Thermal networks – Research outlook

- **Identification of representative thermal network archetypes**

- **Selective project acquisition of case studies based on identified archetypes**
  - Tackle real needs and challenges of network operators and relevant stakeholders
  - Identify technical and non-technical barriers for implementation
  - Test and further develop of modeling tools

Are the real problems being addressed?

What else should be considered?

How can we help?