DECARB CITY PIPES 2050

H/C plan

H/C Plan Winterthur
Part of D3.3

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 893509

Table of Content

Introduction

Winterthur is located in northeastern Switzerland about 20 km northeast from the City of Zurich.

Winterthur has an own utility which provides electricity, water, gas, heat and waste-water-treatment.

The first district heating was built in 1985 with the waste heat from the incineration-plant. The first H/C-plan was released in 1998. In the year 2011 it was revised the first time, since 2020 the H/C-plan undergoes the second revision.

The legal framework changed since the first and second edition. Now the Net-Zero-emission-goal is to achieve in 2040 (confirmed by voting population in November 2021).
That means GHG-emissions of max. 1t CO2 per Inhabitant in 2033. For the heat-supply remain 300 kg/person.

Facts & figures: the context

Winterthur by figures and number.

- Inhabitants: 116 000 (sixth largest city in Switzerland)
- Number of buildings: 25'089
- Building with residential use: 16'684 (66.5% from all buildings)
- Average building age: 70 years (year of manufacture 1951)
- Median building age: 60 years (year of manufacture 1961)

The heating demand of Winterthur for the year 2019 was 986 GWh from which 68% were covered from fossil sources.

To replace the fossil sources and cover 100% of the heat demand with renewable energy, there is an estimated potential of 1'670 GWh/a from waste heat, shallow geothermal energy, groundwater heat, wood and ambient air.

Process

Winterthur commissioned the PLANAR AG für Raumplanung, an extern planner team to revise its H/C-Plan. In a first step, a local working group was formed from various stakeholders (energy department, utility company and selective municipal council) to accompany the process.

The heat demand per building was collected by using the data in the appendix. By applying a general retrofitting rate and a retrofitting success per building period, we obtained the heating demand for the year 2033.

The cooling demand was determined using the statistics of the business structure (STATENT) and sector-specific cooling demand estimates.

The heat potentials were also collected.

Subsequently, the results were discussed with the local working group and adjusted.

Furthermore, the existing infrastructure for heat utilization and supply was collected and analysed. On the analysis of this basic data, an energy plan is compiled.

Based on the basic maps (heat demand density, infrastructure, potentials), the H/C-plan was developed. The areas were divided into DH-areas and areas for individual heat supply.

The draft of the H/C-plan was discussed in the local working group and with the city-council. In several rounds there happened adjustments on the plan.

With the H/C-plan, the city is pursuing the goal of using local potential supply by expanding district heating in the city. For example, with common district heating and waste-heat-use from waste-water-treatment-plants. As a part of the waste-water-heat-potential already is used in a district heating of a neighboured municipality, some coordination was made.

Framework and principles

Climate Goal

In November 2021, the population of the city of Winterthur approved the Zero-emission-goal 2040.

Gas grid

This goal forces to reduce the existing gas grid. In Switzerland the potential of biogas and power-to-gas is estimated to be 30% of the sold amount of today. In Winterthur hydrogen is not considered as a solution for room heating but only for industrial processes and trucks where alternatives are rare. In the actual H/C-Plan it is not yet part of the planning as the potential is not yet existing.

So, over the next decades, various parts of the gas network will be decommissioned (2030, 2033 and 2040). In industrial areas, where gas will be provided on a long-term basis, it shall be biogas or power-to-gas from 2040 on. This gas will be used in processes and as peak capacities in district heating.

The heat demand in the decommissioned areas will be provided by the expansion of heat networks in dense areas. On the one hand, this means that the number of connections to the existing district heating networks will be increased. On the other hand, new heat networks are to be built. In sparse areas individual solutions are foreseen.

District heating

District heating areas were defined by using the heat density. A heat-density of more than 400 MWh/ha/a (the modelled demand 2035) are suitable for DH. In the other areas the renewable solutions are heat pumps by using surface geothermal heat or ambient air.

Legal framework: mandatory connection

To obtain enough connection density to the district heating, owners can be forced by law to connect to the DH. In the last years in Winterthur only three owners had to be forced.

Efficiency

To reduce the energy-demand a retrofitting rate of at least 1.2% of the buildings per year is to achieve (actual 1%) but the more the better.

Working process

Beneath the project leader from the energy unit of the city administration, in the local working group the Stadtwerk Winterthur (city owned utility) was participating. The responsible persons of gas grid, district heating and incineration plant were present at the developing process. For the future prospective also city planner and spatial planner were involved as well as the geoinformation unit to publish the H/C-Plan for the citizens.

There were seven meetings with the local working group, two meetings with the commission in charge (Kommission für Umwelt und Energie) and one meeting with the city council board (all elected executive members).

Analyses data and aggregation

The result of analysing the data (regard the appendix) are three base maps which are regarded to develop the H/C-Plan. The available data are described in the appendix.

Heat-demand-density:

The building points of heat-demand were aggregated to hectares to show the density per hectare.

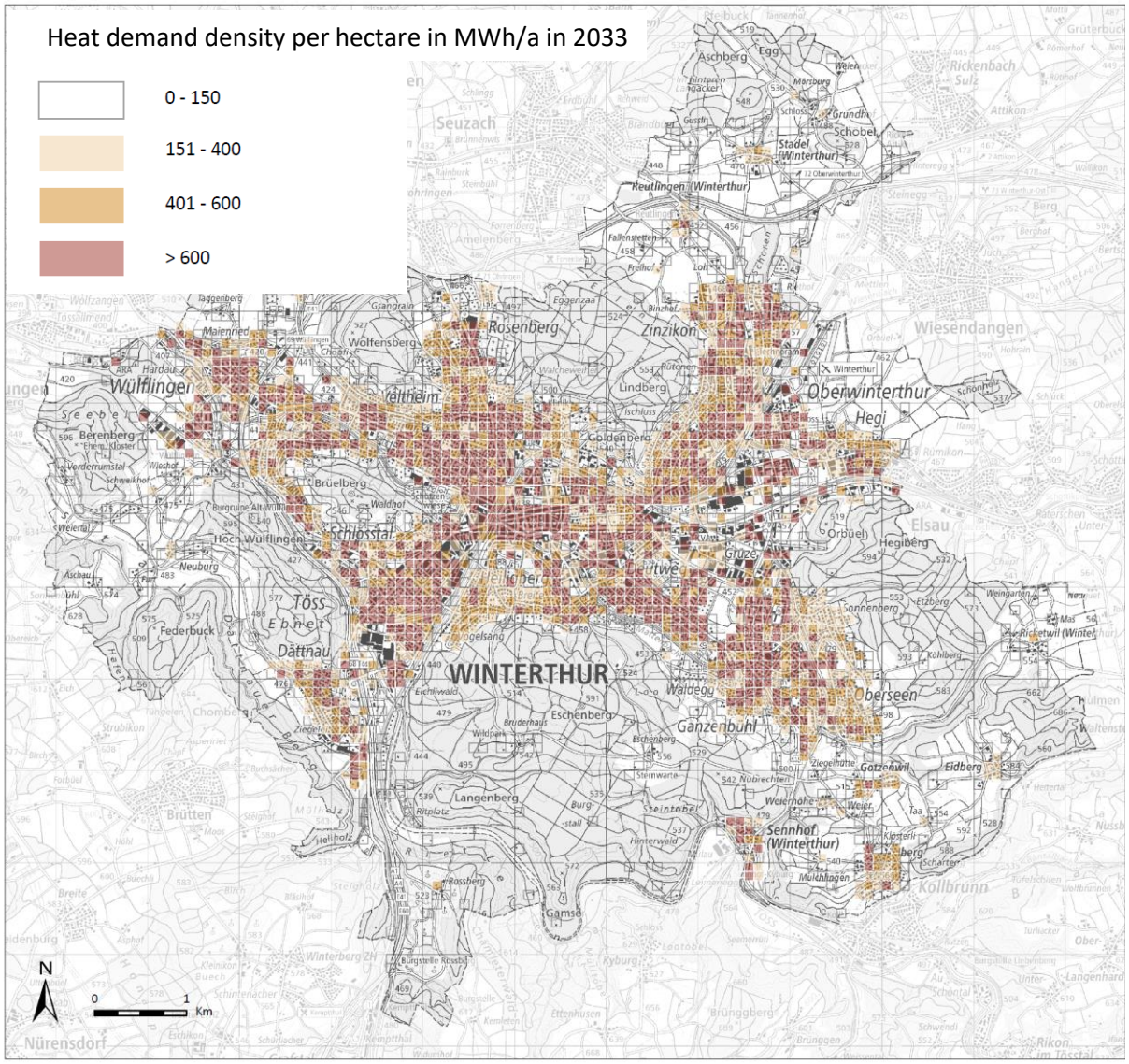


FIGURE 1: HEAT DENSITY PLAN

Cooling demand:

The cooling demand was determined via the statistics of the company structure (STATENT). Depending on the sector, the cooling demand was estimated and added up per hectare. The approach was based on broad categories and is not quantified.

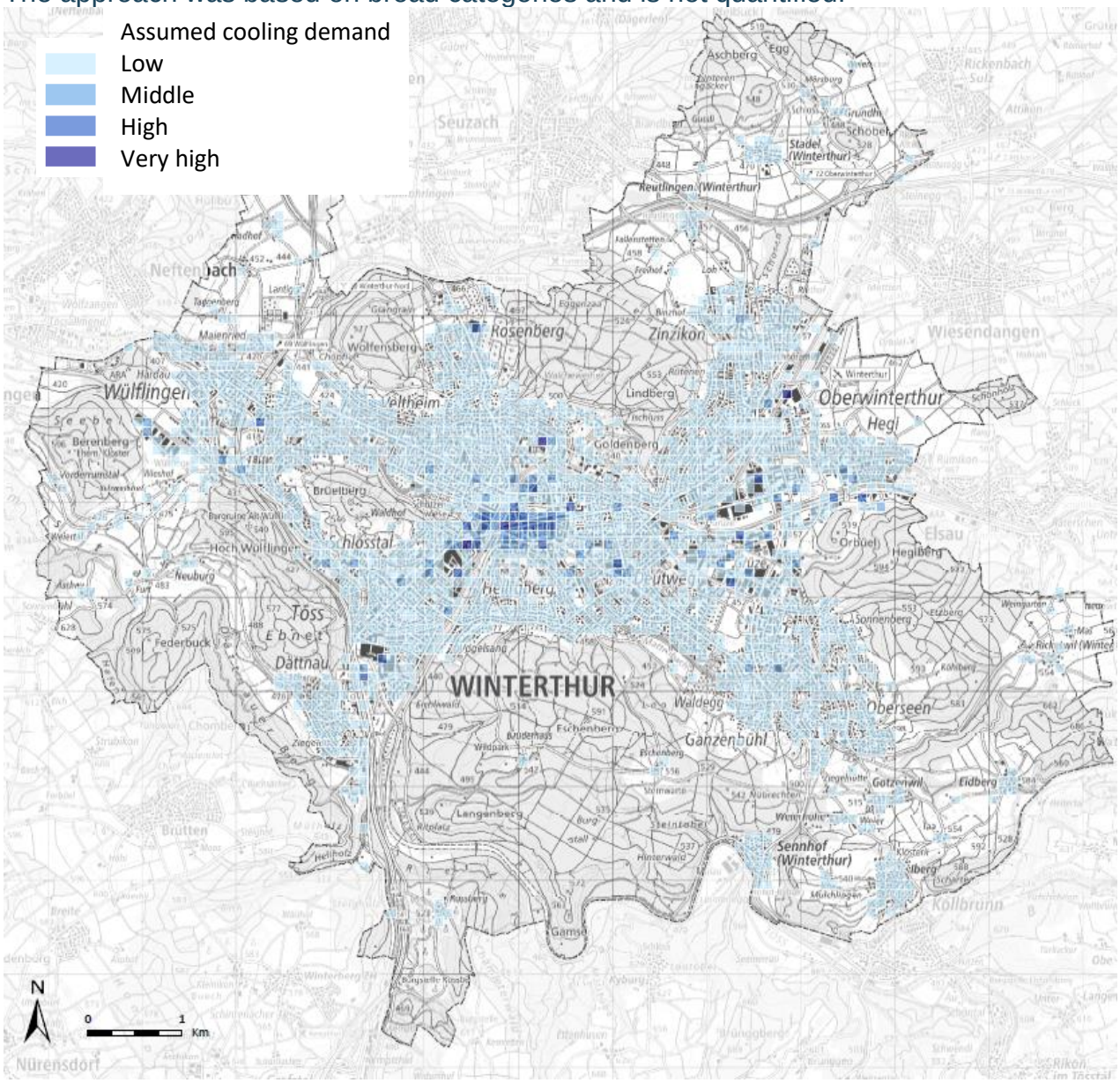


FIGURE 2: COOLING PLAN SHOWING LOW TO VERY HIGH COOLING DEMAND

Potential-maps*:*

In Switzerland the cantons provide maps where the use of groundwater and shallow geothermal energy is permitted. This data has to be put together with other heat sources like

- water-treatment-plant
- incineration-plant
- Industrial waste heat (data center)
- Existing geothermal probes

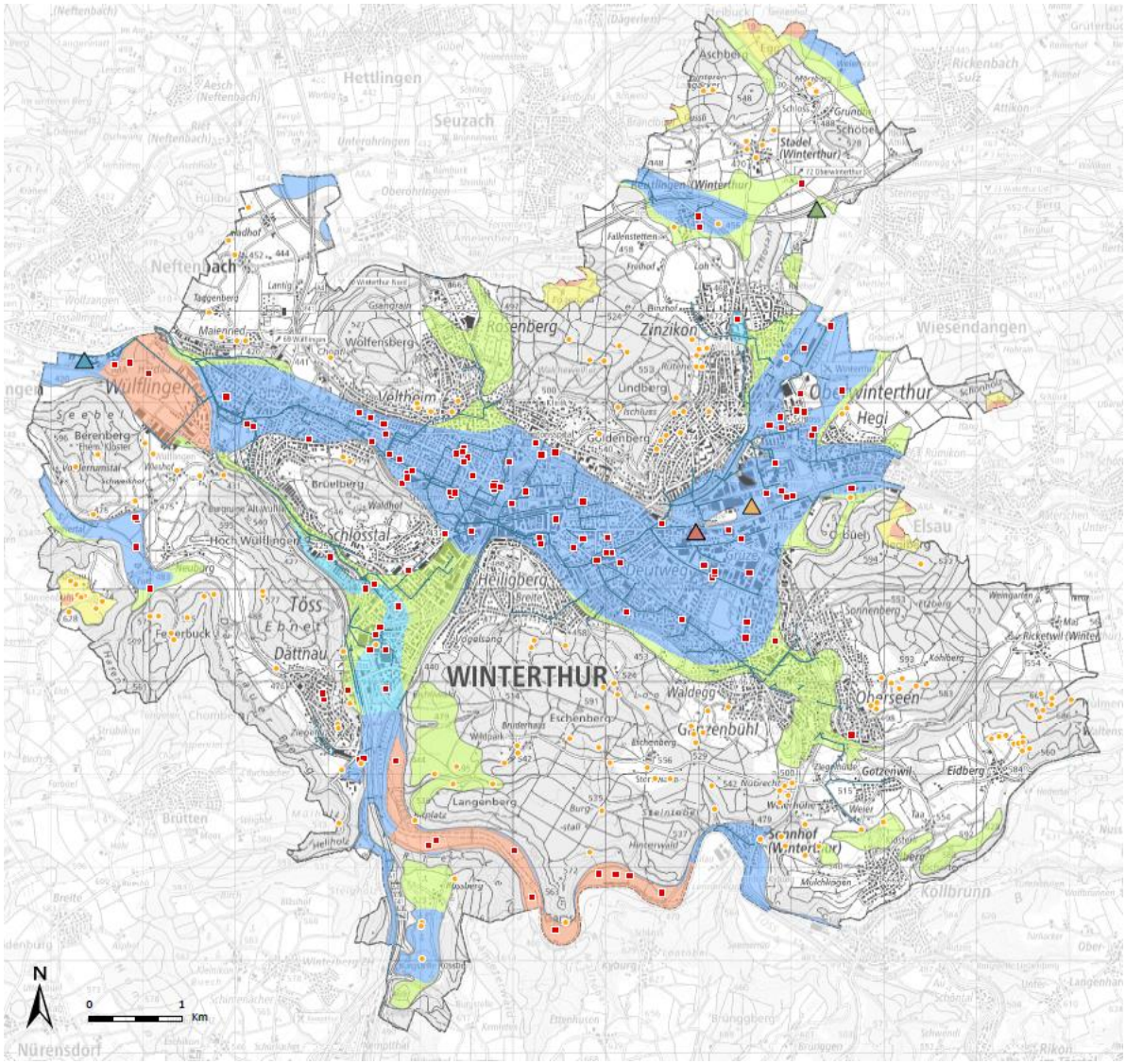


FIGURE 3: POTENTIAL MAP. GROUNDWATER PERMITTED (DARK BLUE), UNDERGROUND USE CONDITIONALLY PERMITTED (BLUE, GREEN), UNDERGROUND USE NOT ALOUD (RED), SHALLOW GEOTHERMAL USE PERMITTED (NO COLOUR)

Infrastructure-map:
The existing infrastructures in Winterthur are:

- District heating (green)
- Gas-pipes (yellow)
- Waste-treatment-plant (red triangle)
- Waste-water-treatment-plant (blue triangle)
- Biogas plant (green triangle)
- Data-center (yellow triangle)
- Sewage pipes > 800mm (blue)

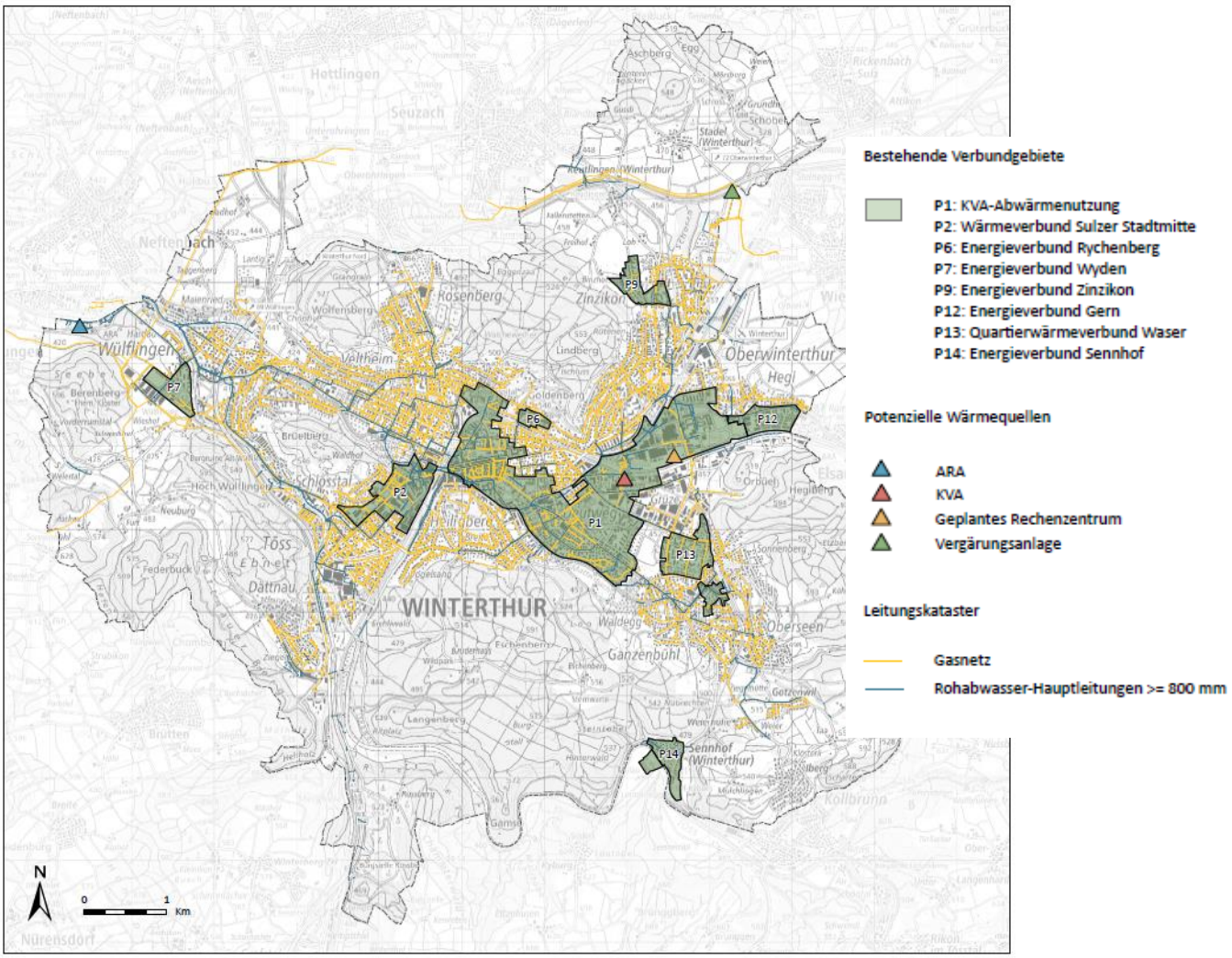


FIGURE 4: INFRASTRUCTURE PLAN

H/C planning

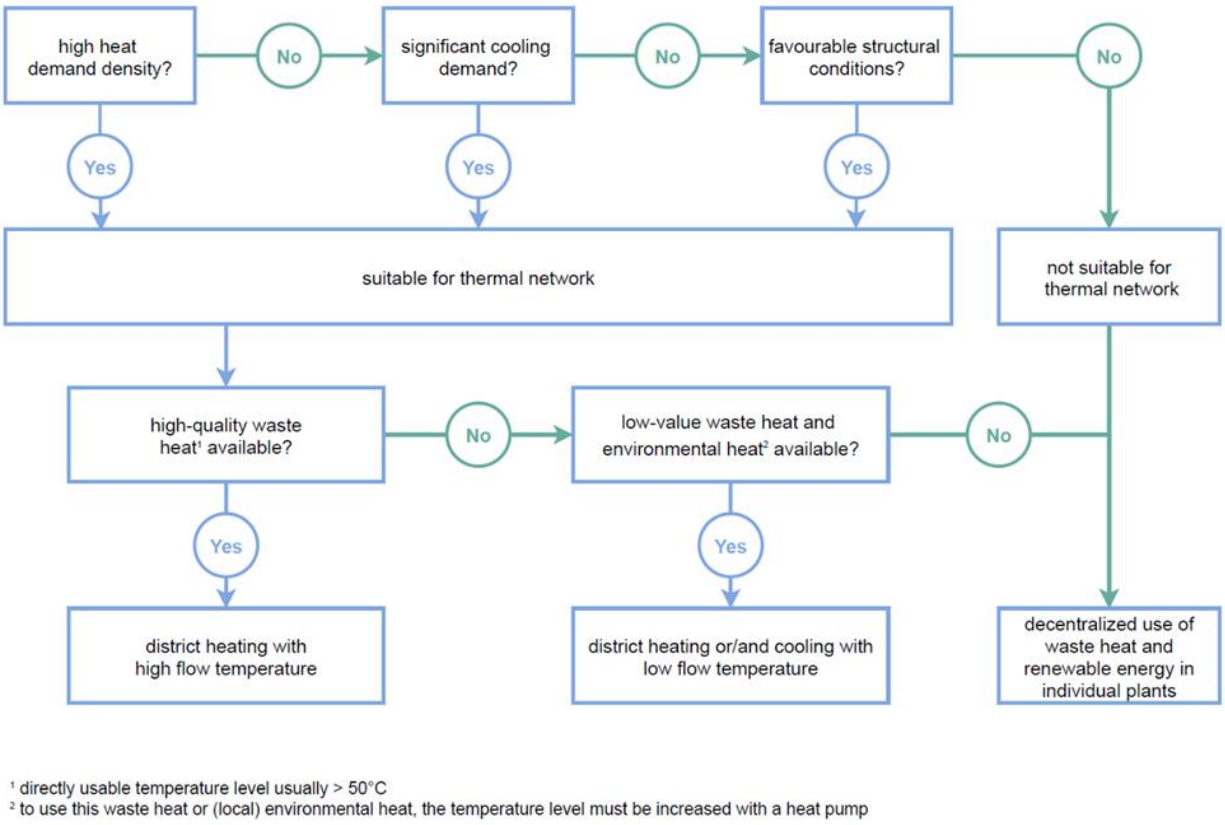
Based on the analyses the result is a H/C plan for the city. The existing infrastructure is the backbone of the planning. The future of the existing gas grid was discussed and decided to focus it on high temperature processes in industrial use and for peak capacity for the district heatings. Furthermore, the following aspects were regarded:

- Economically a district heating in urban areas in Switzerland are profitable from a heat-density of about 400 MWh/ha*a (modelled for the future) -> determination of these areas as DH-areas
- Sample of possible supply in the different areas (existing potentials)
- Subordinated: What is the dominant building-standard (high or low flow temperature needed)?
- Heat source strategy:
- To use waste heat in summer it is planned to couple different DH-networks. In summer the waste heat will provide a wider network, in winter other renewable energy-sources in peripher centres provide parts of the network.

Canton of Zurich lists the priority of heat to use:

1. Waste heat
2. Spatial fixed Environmental heat (groundwater, geothermal heat)
3. Other environmental heat (sun, air) and wood

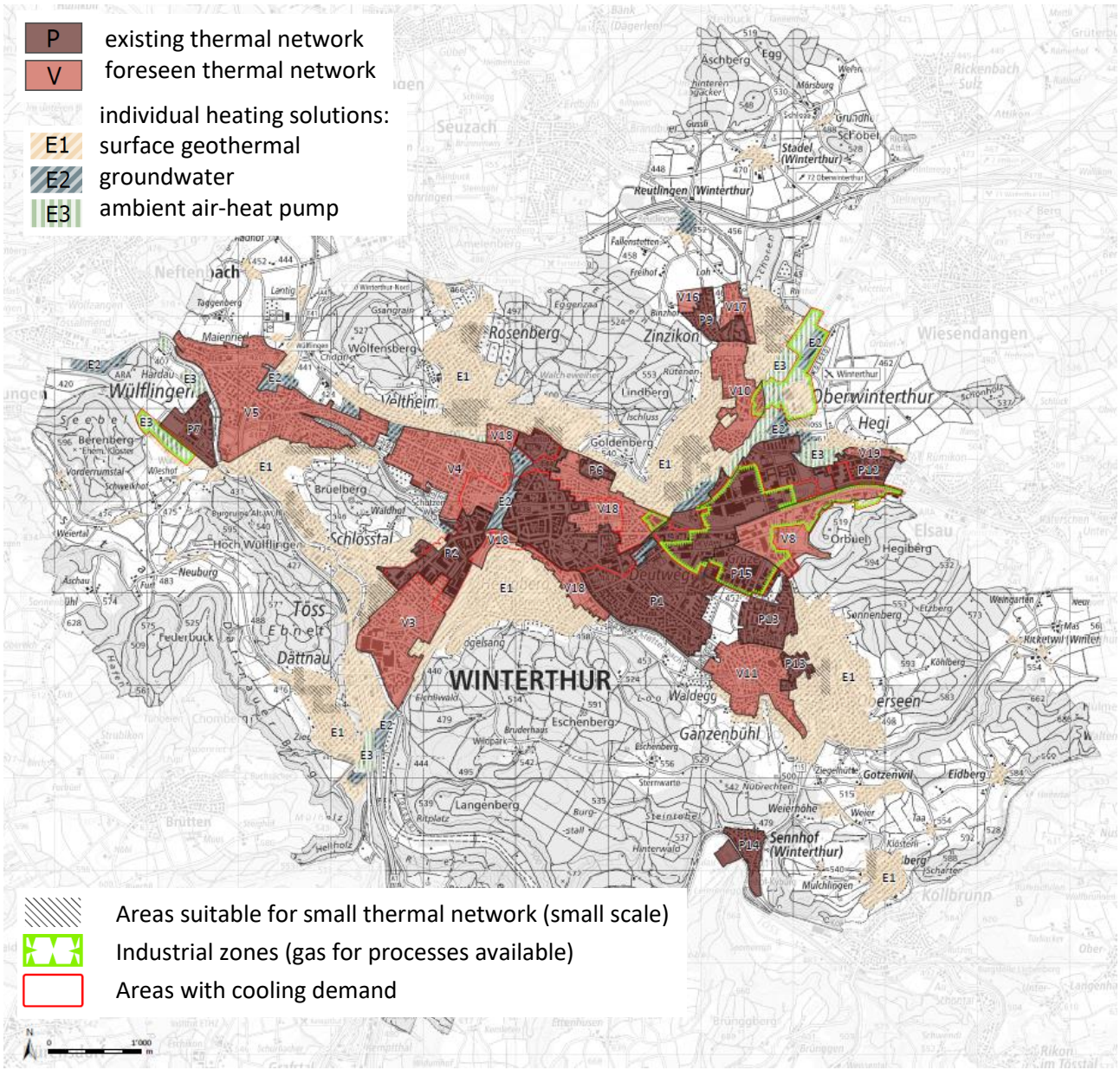
The following flow chart shows the decision finding for the areas of district heating and the level of flow temperature:



[1] directly usable temperature level usually > 50°C
[2] to use this waste heat or (local) environmental heat, the temperature level must be increased with a heat pump

FIGURE 5: DECISION SCHEME SUPPLY TYPE DEPENDING ON ENERGY DEMAND AND ENERGY SUPPLY, REGARDING THE HEAT DEMAND DENSITY.

The energy sources have not yet been definitively determined, as this requires a more in-depth study, which should be available by the end of 2022. However, the possible energy sources have been identified and recorded as options.


P existing thermal network
V foreseen thermal network
individual heating solutions:
E1 surface geothermal
E2 groundwater
E3 ambient air-heat pump
Areas suitable for small thermal network (small scale)
Industrial zones (gas for processes available)
Areas with cooling demand
WINTERTHUR
Wülflingen
Oberwinterthur
Seen
Töss
Dättnau
Rosenberg
Zinzikon
Hegi
Hegiberg
Schlosstal
Bruelberg
Eschenberg
Ganzenbühl
Sennhof (Winterthur)
Reutlingen (Winterthur)
Stadel (Winterthur)
Wiesendangen
Elsau
Kollbrunn

Next Steps

Transition:
For each area an action plan was created and is actually in consultation.

The main measure is an engineering-study to define the supply and elaborate a detailed roadmap. This study should determine the energy sources and also set a timetable for the implementation of the energy plan. And moreover, it is to check the possibility to link the DHs.

By linking various new DHs to the waste incineration district heating network, we hope to make better use of waste incineration heat in summer by using the waste heat for hot water in other networks. In winter, the external connections are fed by environmental heat, while the waste incineration plant supplies its main area with heat.

Starting with pipe-construction
The first priority is to expand the pipeline network. For the time being, the heat is still supplied by the waste incineration plant, where the fossil fuel peak coverage is being expanded. In the second priority, district heating centres with renewable energy sources will follow, which will relieve the waste incineration plant and, above all, the fossil fuel peak load.

Framework-measures:
The processes of planning - permission - construction currently require at least three to five years. This time should be shortened through better internal cooperation between the offices.

For the implementation of the H/C-plan (construction of about 100 km of pipelines and three to four control centres), the financial and human resources are currently still lacking.

Political implementation, next steps:
- Internal Consultation
- Decision municipal council
- Decision parliament
- Authorisation by cantonal departement for construction

Appendix: Data use

Availability and quality of data

1. Data available:

- **Gas**: metered per flat/building (clustered to one building-point)
- **District heating**: metered per flat/building (clustered to one building-point)
- **Fuel oil**: installed power (chimney sweeper). Demand calculated with mean full load hours
- **Heat-pump**: electricity metered. Demand calculated with mean (operating factor)
- **Wood**: installed power (chimney sweeper). Demand calculated with mean full load hours
- **Electricity heating**: installed power. Demand calculated with mean full load hours
- **Building data from building and housing register** (maintained by city, mandatory for all municipalities in Switzerland)
- **Cooling demand**: STATENT Statistics of the company structure shows the sector affiliation of companies georeferenced. With an estimation of the cooling demand per sector the cooling card is created.

2. Data missing

Good data on heat demand of processes and not residential building

11

DECARB CITY PIPES 2050

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 893509