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# Welcome to Workshop 5!
# Heat transition:
# heat planning and gas-supply strategy

Dr. Max Peters

*eea Gold Event*

05/11/2021

# Welcome to Workshop 5!
# Heat transition: heat planning and gas-supply strategy

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Short introduction by Dr. Max Peters

*Kompetenzzentrum Wärmewende, KEA-BW*

(1) Søren Peter Sørensen

*Heat planner for the municipality of Aarhus (DK)*

(2) Heinz Wiher

*Energie und Technik Stadt Winterthur (CH)*

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# Short introduction into the Climate protection law of Baden-Württemberg: Obligation for municipal heat planning

Dr. Max Peters

*eea Gold Event*

05/11/2021

# This is what the “Wärmewende“ may look like in BW

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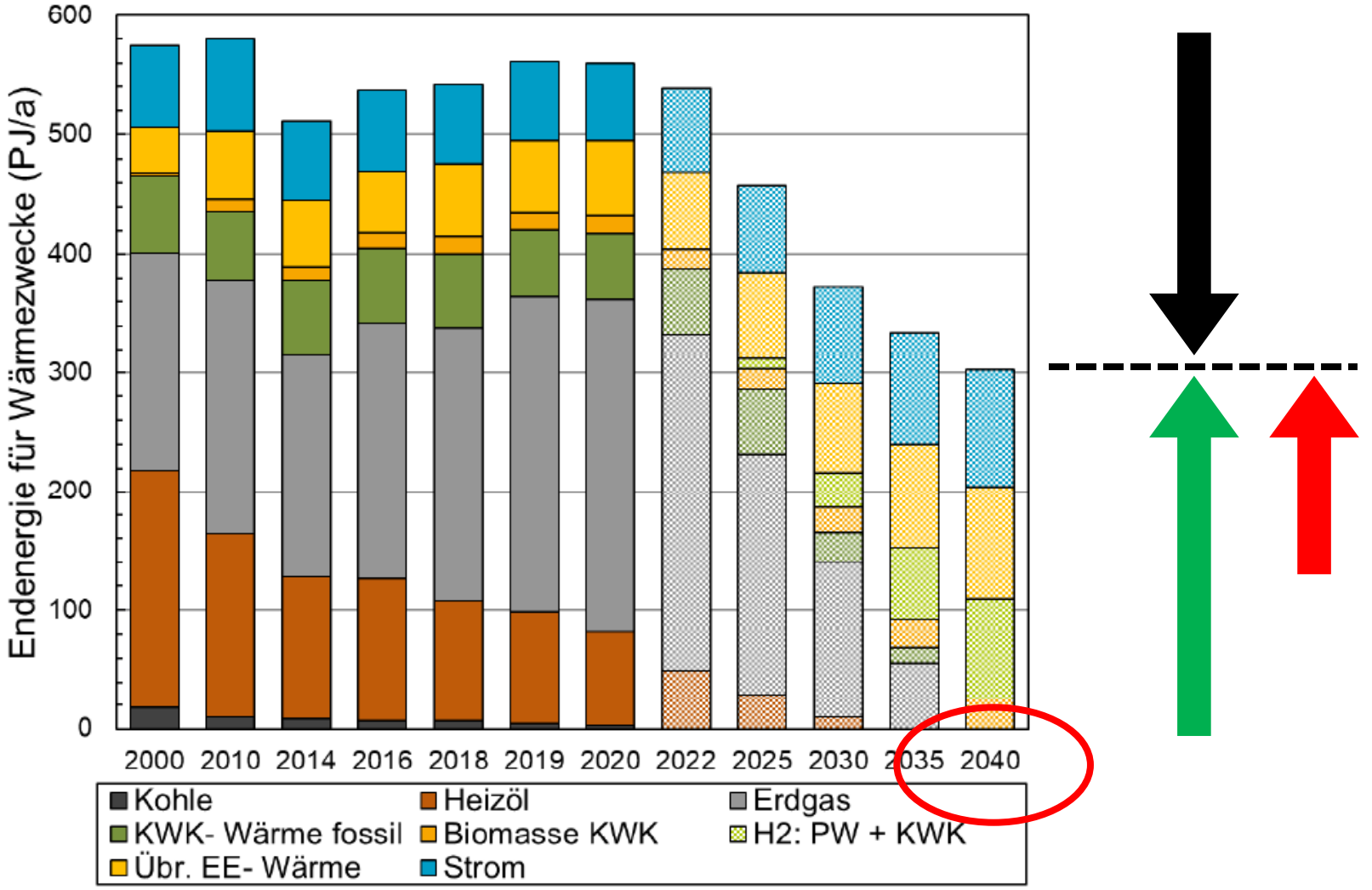


Evolution of final energy consumption for heating, domestic hot water, process heat and cooling

Source: Plattform Erneuerbare Energien BW (2021)

# Motivation for heat planning
# (as a mandatory task for a municipality)

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1. **„Energiewende durch Wärmewende“**
2. Transition of the heating sector calls for strategic planning

   Heat planning is a bottom-up process…

   …but is enclosed in higher-scale policies / frameworks
3. Heat planning is a long term task for all municipalities

   = **part of public services**

# Municipal heat planning in the climate protection law

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## § 7c

## Municipal heat planning (scope)

- For all municipalities in BW
- **Heat planning is open to technology:**

  no specific targets for individual technology
  100% renewables, local potentials

- Requests on heat plans:

  **Target: decarbonized heating sector,**
  **climate neutral building stock 2040**

  Heat plan must be publised in data base (KEA-BW)

# Municipal heat planning in the climate protection law

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## § 7d

## The municipal heat plan (obligation)

- #103 “Große Kreisstädte“ + “Stadtkreise“ (50% population BW)
- 1st generation heat plans due Dec. 2023:

  yearly support scheme (“Konnexität“):
  4 x 12‘000 € + 0,19 €/inhabitant

  (no funding: neither request nor proof of use)

  € for service providers, internal capacities etc.
- **rolling planning** from 2024 on, all 7 years (3‘000 € + 0,06 €/inhab. )

# Municipal heat planning in the climate protection law

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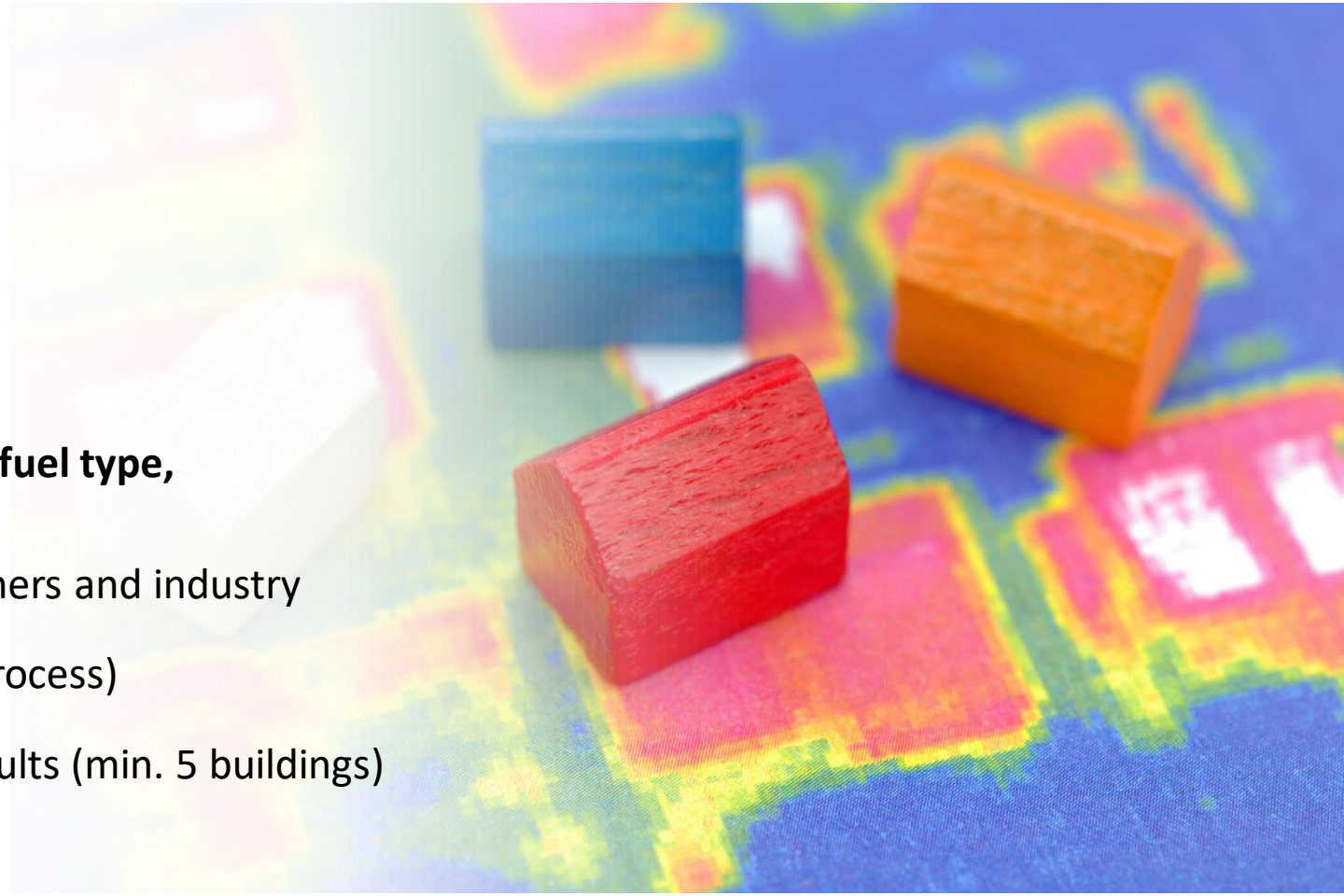

## § 7e
## Enabling power for data utilization (consumption and infrastructure data)

- For all municipalities in BW
- **Building sharp information of consumption, fuel type, age of technology/infrastructure etc. pp**

  … from utilities, grid operators, chimney cleaners and industry
- Single purpose: heat planning (delete after process)
- Publication of plans only with aggregated results (min. 5 buildings)

# Strategic overview over infrastructures, supply, demand, potentials etc.

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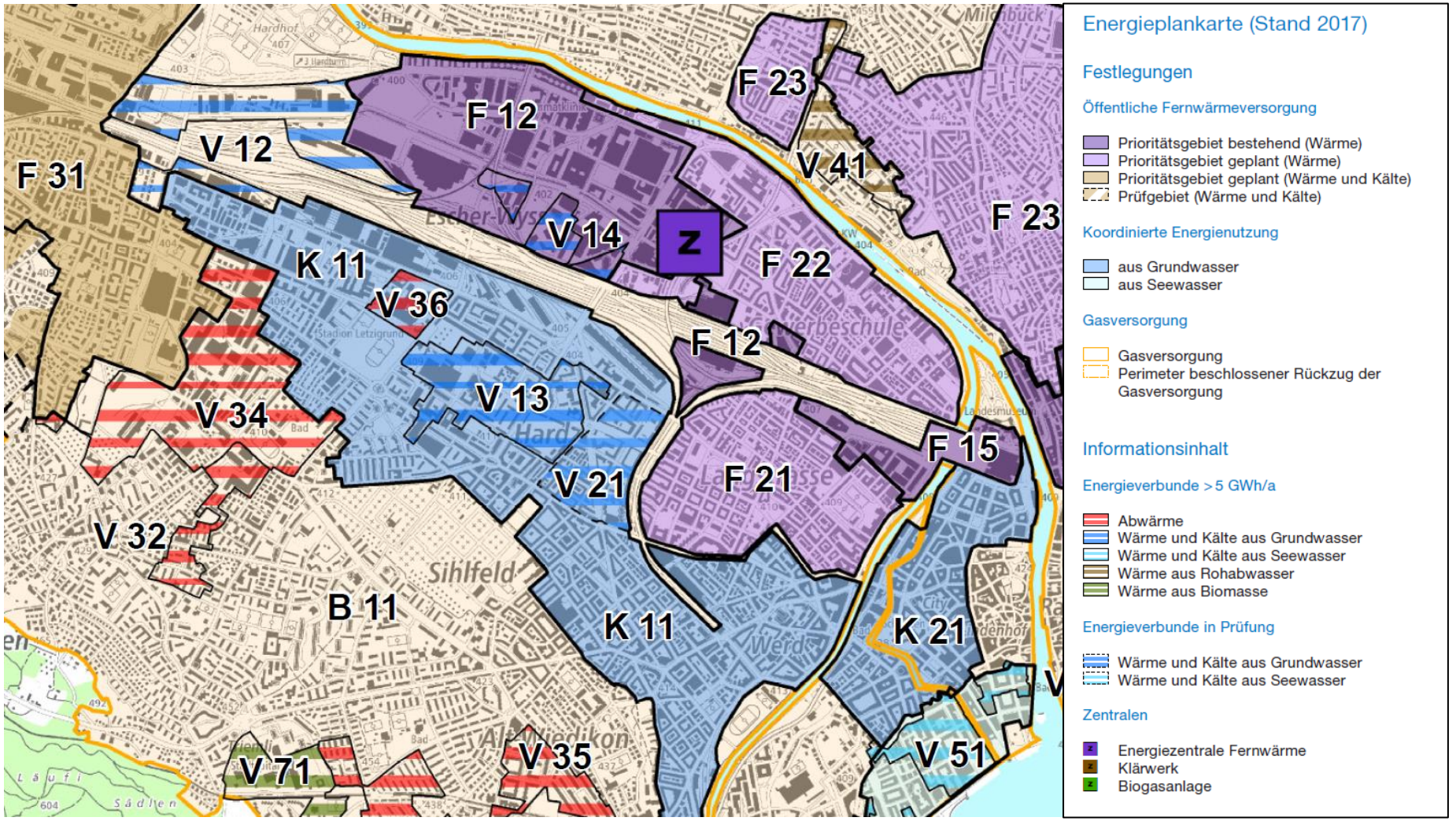


Energy plan, city of Zürich (CH), ca. 400‘000 inhabitants

Source: Stadt Zürich

# Heat planning has methods!

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1) Analyses of the inventory
   buildings
   infrastructure

2) Analyses of potentials
   renewables, surplus heat, CHP
   efficency gains of building

3) Transformation strategy
   priority areas
   DH vs. single-house heating
   future of various gas grids

4) Catalogue of measures

▶ Download guideline (UM + KEA-BW)

# Implementation of the municipal heat plan is key for sustainable city planning!

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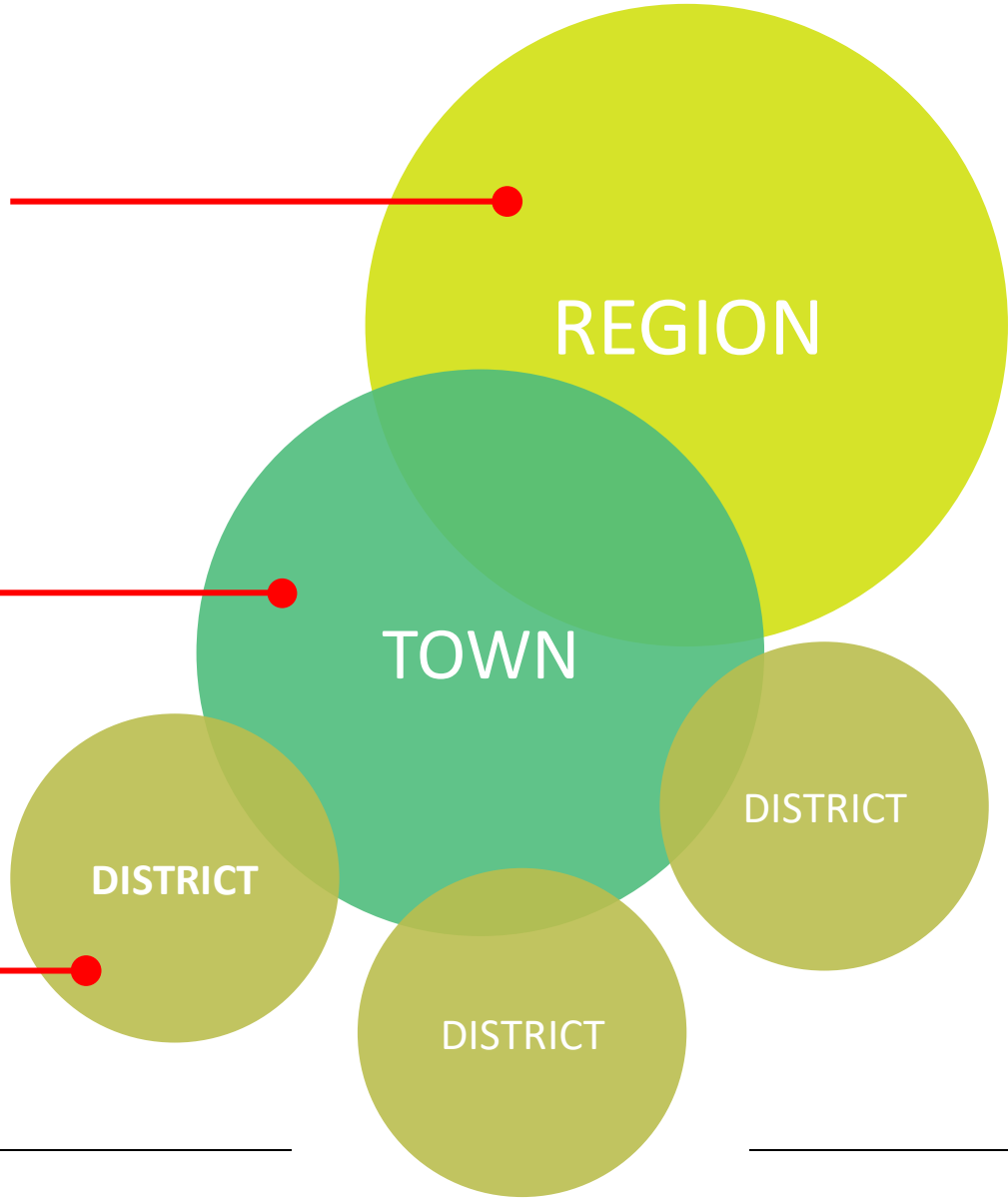
- Regional planning
  (areas, large potentials)
- Priority areas
- Heat plan in a “convoi“
  (inter-municipal heat planning)

- Zoning planning
- Land-use planning
- Climate protection concept
- ***eea***
- Urban development contracts
- Energy concepts

- District planning
- Gas grid infrastructure
- compulsory connection
  and usage
- Renovation (…)



# Municipal heat planning (and doing) within the European Energy Award (eea)

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| | | |
|---|---|---|
| 1.1.1<br>Key measure | 6 | **Climate and energy strategy**<br>The municipality has binding guiding principles comprising qualified and quantified energy and climate policy targets for local policies that are in line with or more ambitious than national targets and cover all areas of eea. |
| 1.1.2<br>Key measure | 6 | **Climate and energy concept**<br>The municipality has a climate protection and energy concept that gives concrete shape to its guiding principles. The concept is aligned with medium-term and long-term goals and strategies. It contains a quantified pathway for increasing energy sufficiency and efficiency, expanding the share of renewable energies and reducing CO2 emissions. It also contains allocated measures including the utilisation of waste heat and storing energy. |
| 1.2.1<br>Key measure | 10 | **Spatial and energy planning**<br>The municipality plans its future energy supply for its entire territory in accordance with spatial planning and the targets of climate/energy strategy and spatial/energy planning. Planning includes methods for evaluation. |

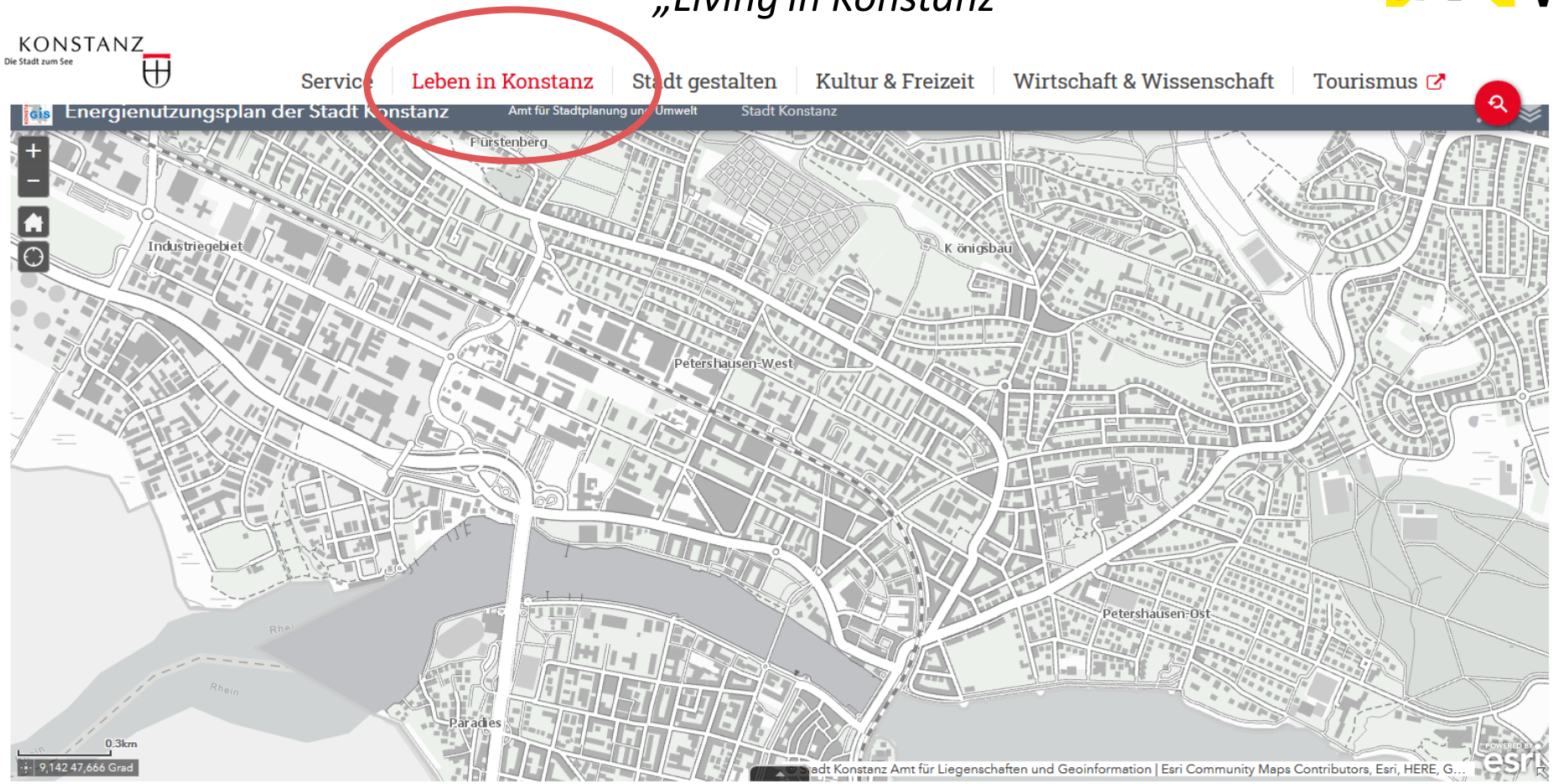
[...]

| | | |
|---|---|---|
| 3.3.2<br>Key measure | 10 | **Heating and cooling from renewable sources of energy within the municipal territory**<br>The municipality fully utilises its potential for the use of renewable sources of energy for heating, hot water and cooling systems. |

▶ Excerpts from the international Master Catalogue *eea* 01/01/2017

# Good example for information of the public

„*Living in Konstanz*“




City of Konstanz, 85‘000 inhabitants

Quelle: Stadt Konstanz

Example web-GIS: viewer on the Mayor‘s website

# Good example for information of the public

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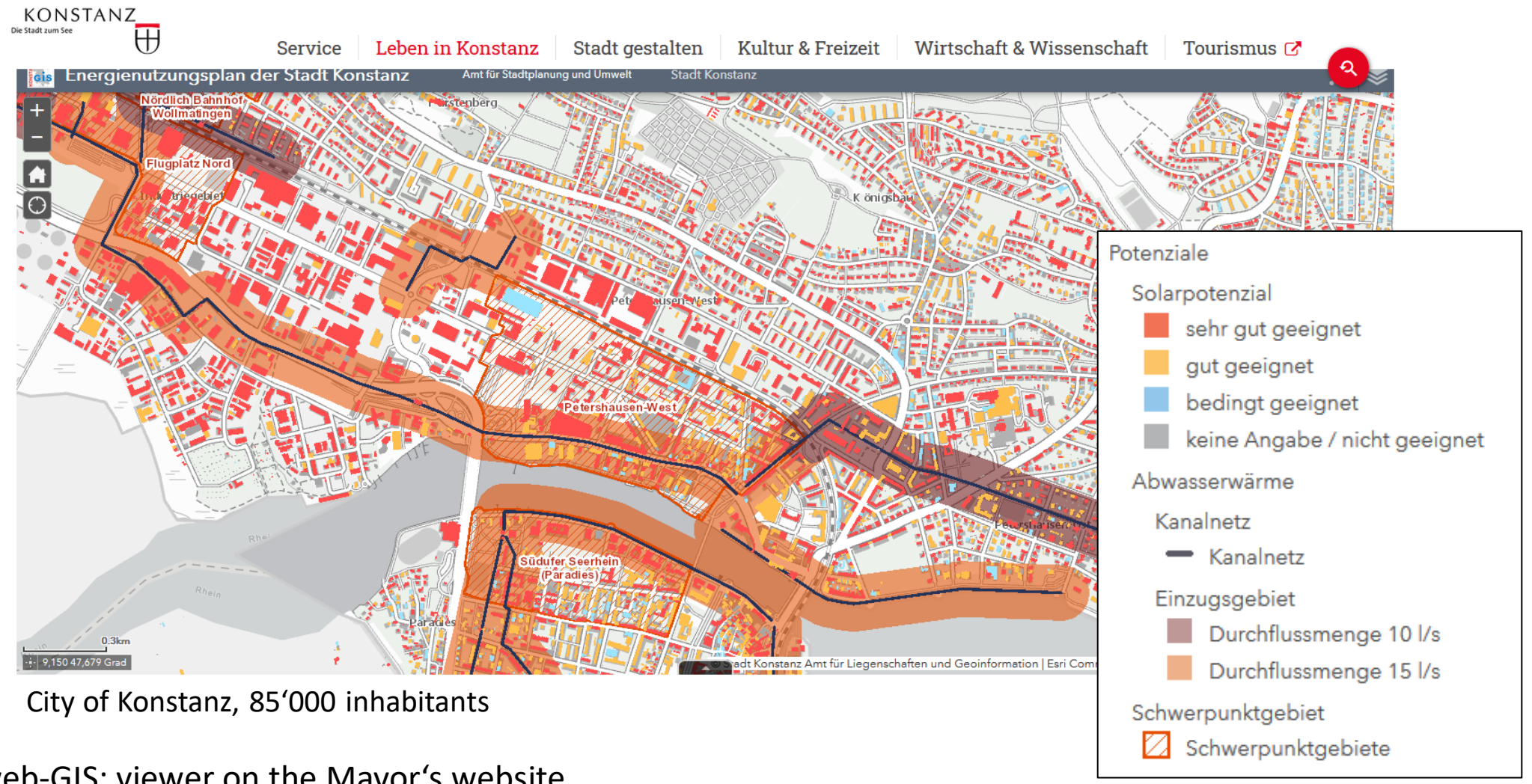


City of Konstanz, 85‘000 inhabitants

Example web-GIS: viewer on the Mayor‘s website

Source: Stadt Konstanz

# One of the first municipal heat plans in BW

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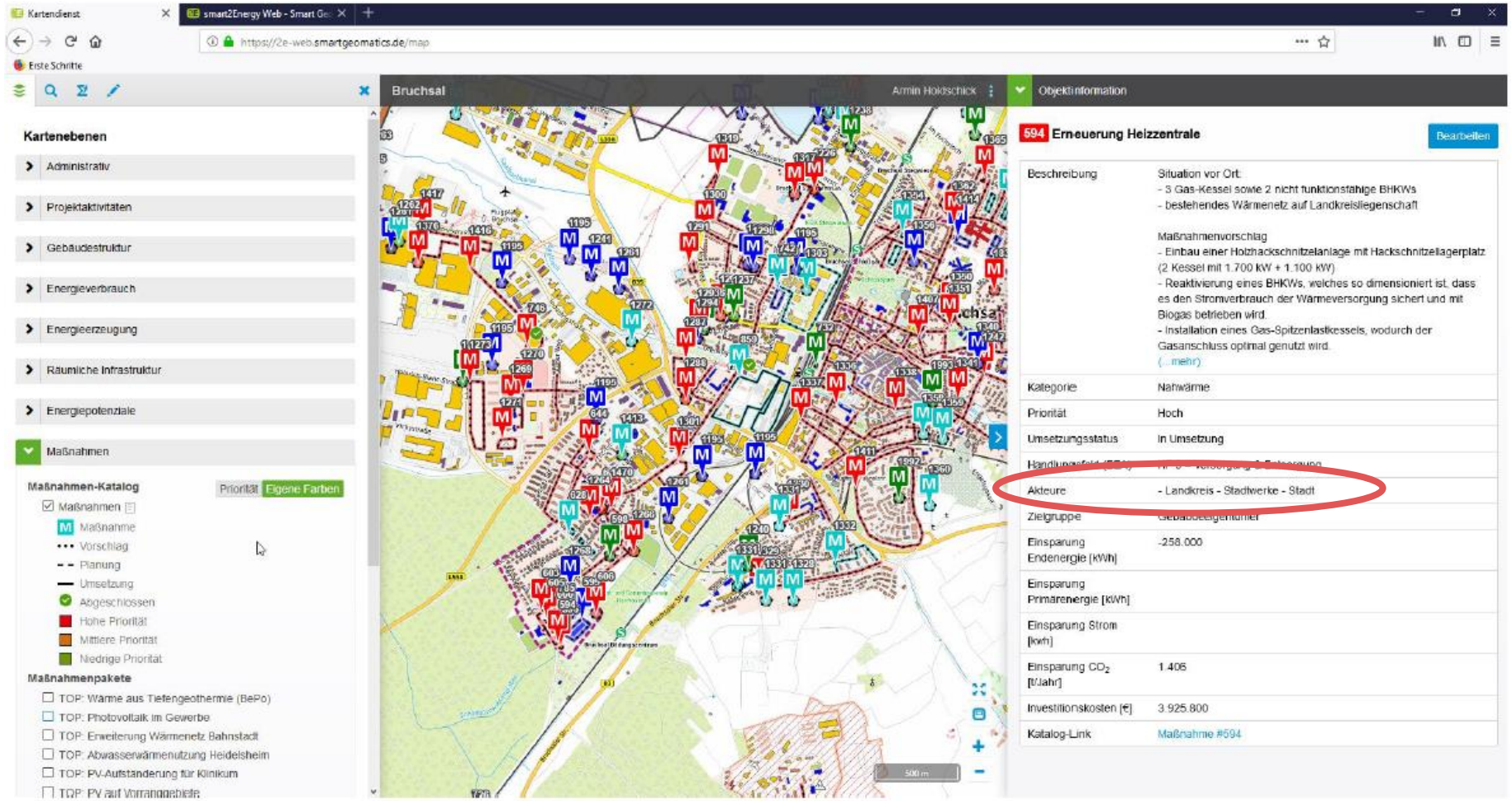
Source: Umwelt- und Energieagentur Kreis Karlsruhe (Software: Smart Geomatics)




Example city of Bruchsal: data + interface management (within the municipality)

▶ LINK Energy Plan

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# Every municipal heat plan sets the paths: decarbonization of our buildings until 2040!

## Call for integrated city + infrastructure planning.

# Questions? Comments?
# Contact us!

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Stellv. Bereichsleiter, KWK

**Denise Graef**
Netzwerke Wärmewende

**Holger Hebisch**
Wärmenetze

# Workshop 5:
# Heat transition: heat planning and gas-supply strategy

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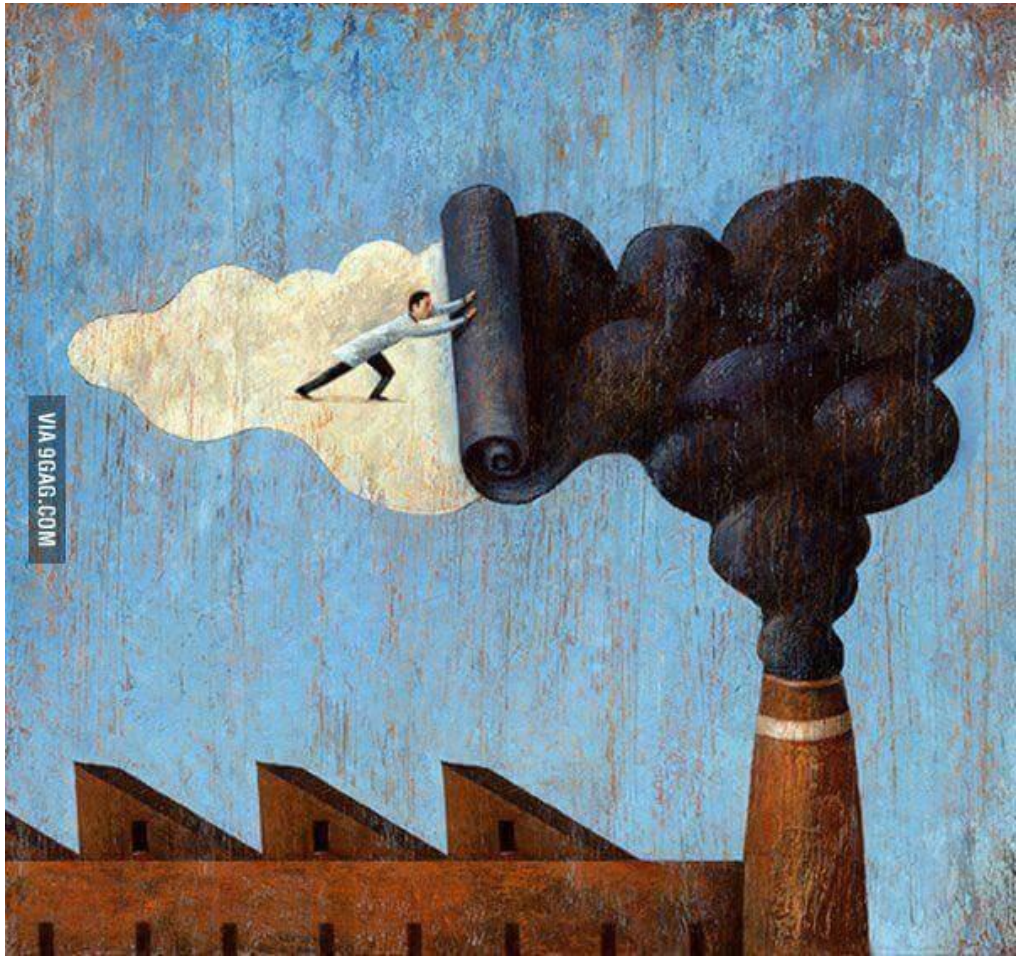
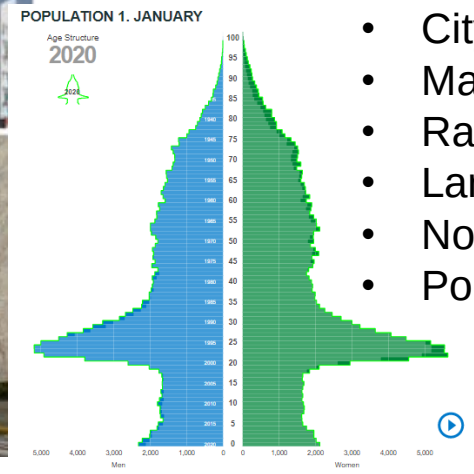
## (1) Søren Peter Sørensen

Heat planner for the municipality of Aarhus (DK)

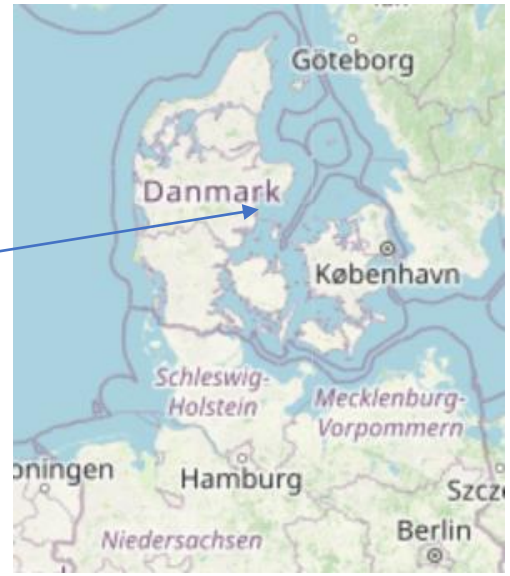


# Postcards from Aarhus 2021

## mostly about heat- and energy planning




- Denmark
  - 5,8 Mio. inhabitants
  - Capital = Copenhagen (1 Mio.)
  - Social Democratic Party = PM
  - Member of EU (50% like it)




- Aarhus
  - 350.000 inhabitants
  - Second largest city in Denmark
  - From Vikings to students
  - University of Aarhus
  - Regional University Hospital with 10.000 employed
  - Harbor and a very small airport 40 km outside the city
  - City growth = 3.000 inhabitants every year
  - Mayor from the Social Democratic Party - election in 10 days
  - Railway Station and new light rail
  - Large net of busses, 30% already on electricity
  - No. 8 in the national football league, no. 1 in basket
  - Population pyramid with many students

# Short presentation

Søren Peter Sørensen

- Grew up in Nordslesvig – border district, absolute Danish
- But *nach der Wende in 89* often in Berlin and Hamburg, also Bremen, Heidelberg, Freiburg, Alsace
- Latest visit to Berlin 2 weeks ago – today huge respect for how the Germans deal with their history.
- Cand. Scient. in geography, 67 years
- Heat Planner at the regional level from 1981 – 1988
- Chief for the technical department in a small municipality (12.000 inhabitants) 1988-2003
- Chief for the technical department in the city of Silkeborg (90.000 inhabitants) 2003-2018
- No longer chief, but..
- Energy planner from 2019 in the municipality of Aarhus (325.000 inhabitants), a kind of come back.

- Living on a small farm outside the city with cattle in the summer (8,3 hectares-4 is forest)
- Converting from and old oil burner to heat pump (geothermal heat), existing heat boiler based on wood and the heat accumulation tank remains, total costs about 17.000 euro, probably 3.600 euro from the government. New oil- or gas-burners is **not** allowed in Denmark.
- Electric capacity must be upgraded to the heat pump and 2 electric cars (2-300%)

email: mojnsps@icloud.com

# The Danish Climate Act

Climate Act (kefm.dk)
Link to an unofficial translation.

- *The purpose of this Act is for Denmark to **reduce greenhouse gas emissions in 2030 by 70%** compared to the level of emissions in 1990, and for Denmark to achieve a **climate-neutral society by 2050 at the latest**, taking into account the Paris Agreement target of limiting the global temperature rise to 1.5 degrees Celsius.*

- Danish Ministry of Climate, Energy and Utilities since 2007 Home | en.efkm.dk (kefm.dk)
- The Danish Climate Act is a direct result of the national election in June 2019
- Broad political agreement confirmed in Dec. 2019
- 13 different climate partnerships gave in spring 2020
  *Recommendations to the Danish Government*
- Climate Act passed in the Danish parliament (Folketinget) in June 2020.
- Autumn 2020 the Government formed the Danish Council on Climate Change (DCCC)

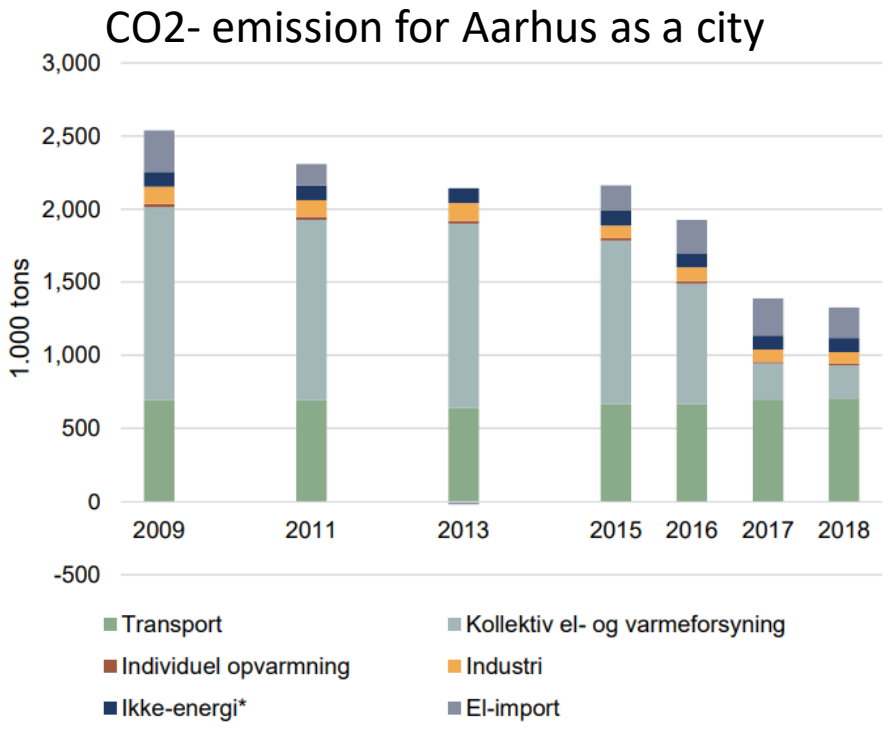
Link to The Danish Council of Climate Change Klimarådet (klimaraadet.dk)

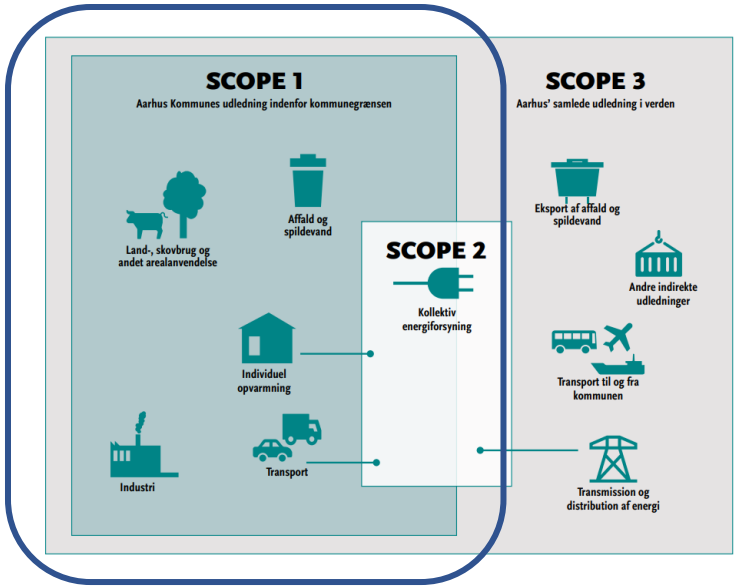
- 2021 political settlements on different topics –
  the negotiations about the agricultural sector reached a result 3 weeks ago.
- March 2021 the DCCC criticized the *hockey stick*
  *– an image of the main approach from the Government:*
  *let's wait with most efforts to 2029, maybe it would be easier*

# Climate goals and topics in Aarhus

- Aarhus $CO_2$ neutral in 2030
  (more ambitious than the national Climate Act: 70% i 2030)
  - The geography / the city
  - The municipality as a *"company"/organization*

- So far, we only consider Scope 1 & 2
- "$CO_{2e}$-gab" i 2030 = 600.000 tons $CO_{2e}$ /year.
- Transportation is the challenge in Aarhus
  - Electric cars, busses, trucks?
  - Charging stations.
  - Many city planners don't like cars in the city at all
  - Compensation from outside like sea-based windmills?
  - Life cycle analyzes in building permits from 2023
  - Carbon Capture and storage?



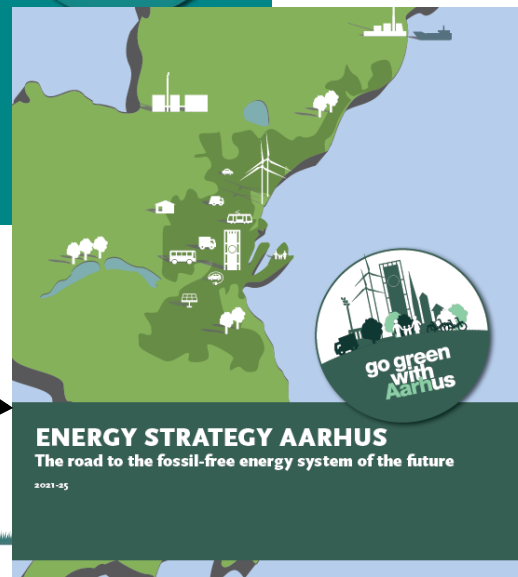



# 4 new official Climate Plans in Aarhus



Our City Council is very, very ambitious.
These 4 plans were confirmed in May 2021
The City Council have granted 13-14 Mio. euro in 2020
and 14-15 Mio. euro in 2021 to climate projects and activities.

- Climate Strategi 2020 - 2030
- Climate Action Plan 2021 – 2024
- Catalog with 65 projects 2121 - 2024
- Energy Strategy


*3 plans are not translated to English or German – yet*
*The Energy Strategy is just translated to COP26*

# Reflections about energy and $CO_2$ in local planning process – a necessary approach

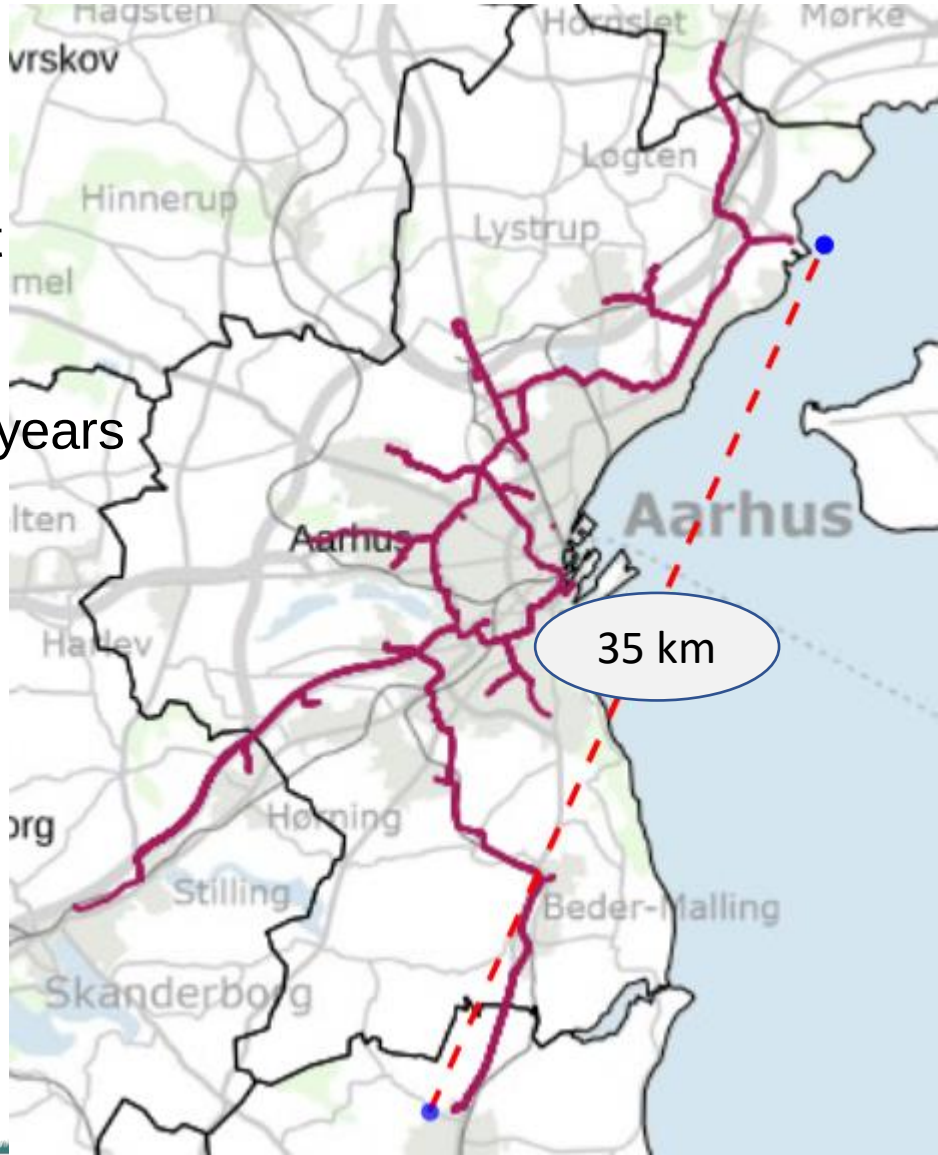

*Methods and calculations are not new, but nobody make these reflections in Denmark today.*
*The planners are a lot more interested in* ***aesthetics****.*

- Energy
  - Determine the ***energy frame*** for the building
  - Calculate the total gross-energy needs for
    - District heating and/or
    - Heating Pumps
  - Determine the main energy supply
  - Calculate the total gross-energy needs for electricity including households and electric cars 100%
  - Consider reserving space to energy plants like bigger heating plants, or electric pipes and transformation plants, solar cells and maybe also local batteries
  - Calculate the total the energy consumption in the new district and calculate $CO_2$ emission from energy
  - Maybe also calculate emission of $CO_2$ from the building process (Life Assessment Analysis LCA)?

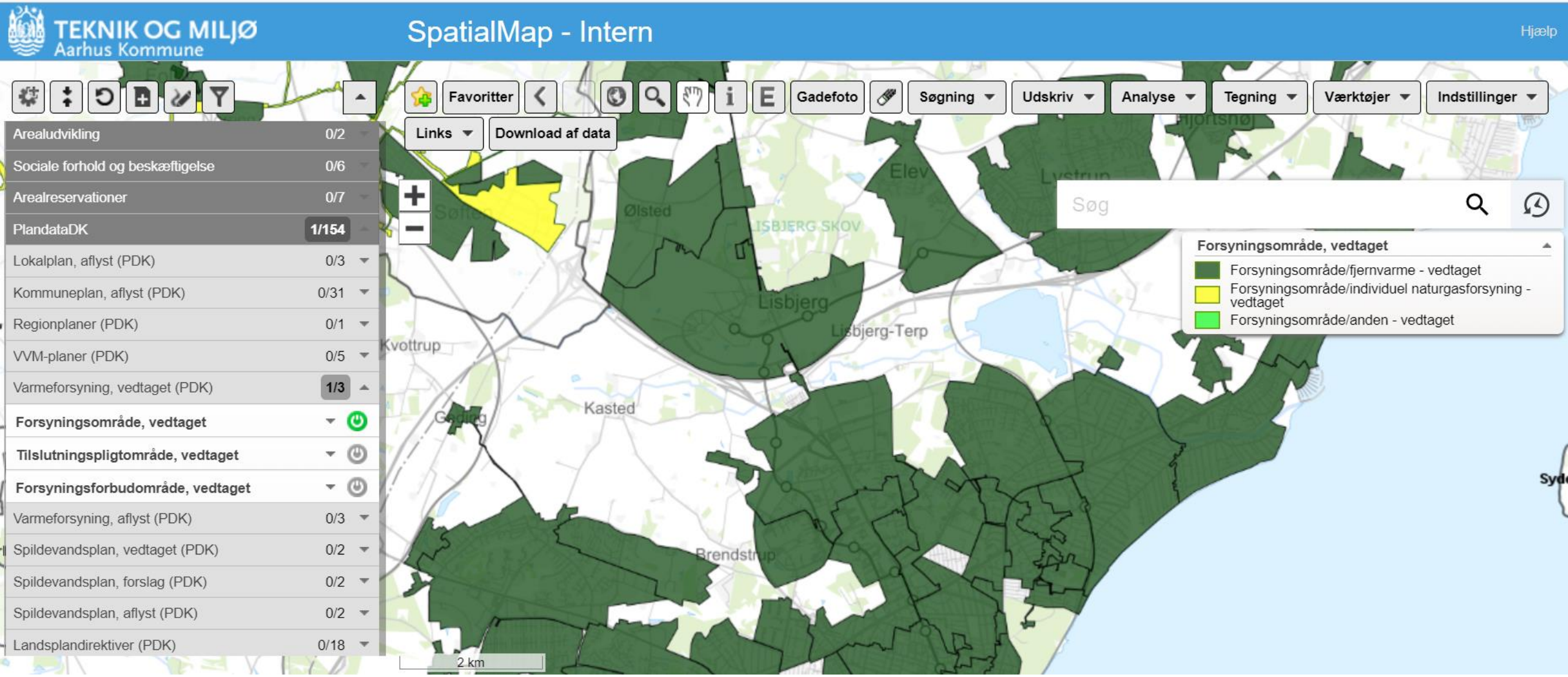
- Other topics
  - Photovoltaic potential on the rooftops
  - Charging structure for electric cars
  - Reserving parking spots (only?) for electric cars?

# Energy Plan

- 90% are connected to district heating in Aarhus
- Mainly based on biomass (tree from overseas, local waste)
- *Connection obligation* is no longer a legal possibility since 2019
- Heat pumps are becoming strong competitors to district heating
- Heat pumps are more energy-effective, but noisy and they don't contribute with any kind of outdoor aesthetics
- Aarhus is preparing a new Energy plan showing
  - where district heating is an option for the next 2,3,5 and 10 years
  - where heat pumps are the only solution
- Assessment of the need for electricity to
  - Consumption in all the households
  - Heat pumps
  - Charging all electric cars in 2030
- The photovoltaic potential
- The energy potential from windmills
- The energy potential from surplus heat



# Our energy plan - preview



# Municipal energy plan for Aarhus

- 15 – 20 new layers in our electronic map system - look at SpatialMap 4.2.1 (aarhuskommune.dk)
  - Existing energy supply for every building (Housing and Building Register, look at BBR)
  - Approved, but not realized energy projects (district heating)
  - Districts with existing connection obligations
  - Dividing the hole municipality in energy districts with homogeneous energy supply.
  - Proposing heat supply for new urban planning areas 2022-2023
  - Proposing heat supply for new urban planning areas 2024-2026
  - Proposing heat supply for new urban planning areas 2027-2032
  - Proposing heat supply for new urban planning areas later than 2031
  - Proposing new and necessary plants and grids for the future electric system

- A short report with economic and technical assumptions, data sources, links and key figures
  - Heating needs in 3 (?) different types of houses (villas/row houses/appartement blocks)
  - Need for electricity to the household in different housing types
  - Need for electricity for heating pumps
  - Need for electricity for cars

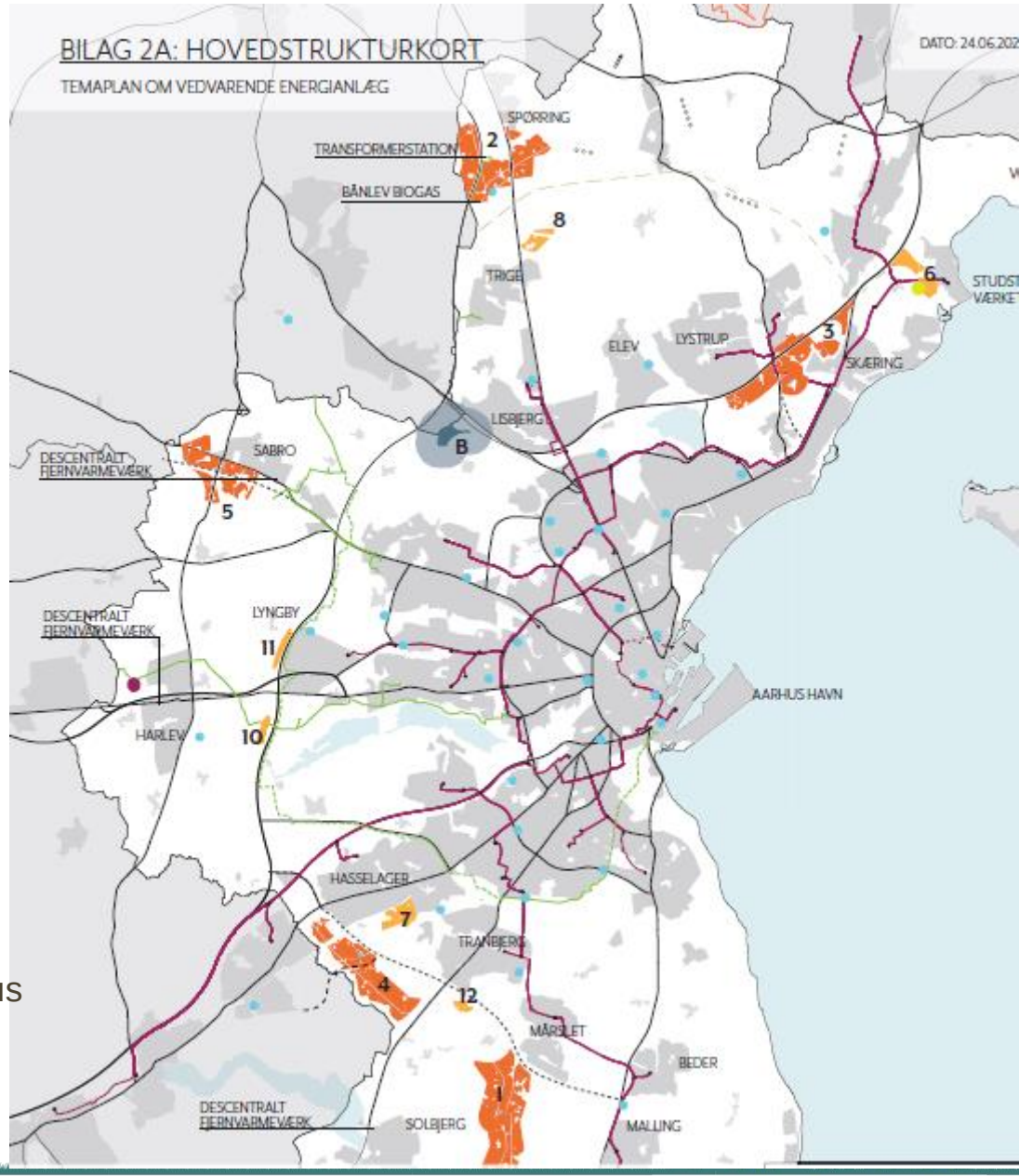
- Other topics
  - Photovoltaic potential from existing rooftops, mostly large store/business/production buildings
  - Surplus heat potential from large shopping centers, IKEA, companies

# Photovoltaics on the grounds

1 acre = 4047 m2 = 0.40 hectares
1 hectares = 2,5 acres

- Today 600 hectares with PV in Denmark
- Applications for 24,000 hectares more in DK
- Creates national and local discussions and demands for a national strategi.
- Local plan for renewable energy in the municipality of Aarhus
  - 8 large windmills (3-5 MW each)
  - 1150 hectares with photovoltaic (1 hectare = 1 MW)
- No longer need for economic support to PV

Plant of 100 acres 50 km north of Aarhus owned by Goggle, who also have another plant nearby in the same size.



# Photovoltaics on rooftops – an IT-program like Goggle's Sunroof in USA

Aarhus is cooperating with a governmental department to develop a new digital tool:

Calculate total and local electricity production from existing and planned rooftops.

Look or click at the product from google [Project Sunroof]

# Thanks for your attention and participation

- Denmark and Aarhus are small, means just a little in the global perspective
- We like the idea of being in the front, that others can learn from us.
  but many papers and laws are NOT translated
- Currently we concentrate on *putting our own house in order*.
- Forgetting that most products and materials are coming from abroad (scope 3).
- In my view Denmark soon will have to adopt and find a majority for a public tax on $CO_2$ like the official *Danish Council on Climate Change* also have suggested
  (building materials, energy, products, flights, meat…)
- Remove the ***hockey stick***
- Community elections 16. November 2021

- The months and years ahead will be filled with dialog, coffee, cake and cooperation

# EXTRA: The main laws and regulations at the municipality level in DK

- Danish Planning Act
  - National Planning
  - Coastal and retail Planning
  - Metropolitan Planning
  - Regional visions
  - Municipality plans
  - Local Planning
  - Rural Area Administration
  - Climate adaptation: prevent flooding

- Building Act and Building Regulations
  - Energy Classes/frames, low energy houses
  - New sustainability Class voluntary 2021-2023 including Life Cycle Assessments
  - LCA mandatory from 2023 with a target for maximally (?) 8.5 kg $CO_2$ /$m^2$/year

- Heat Supply Act
  - Collective heat supply facilities
  - Possibility for a comprehensive heat supply plan for the community
  - Approval of projects
  - Requirements for positive community finances

- Comments:
  - No legal demands for public heat planning
  - No legal demands for public electricity planning
  - No legal demands for public planning on climate mitigation
  - No legal grounds for connection obligation since 2018 to collective heat supply
  - No possibility to demand photovoltaic on rooftops

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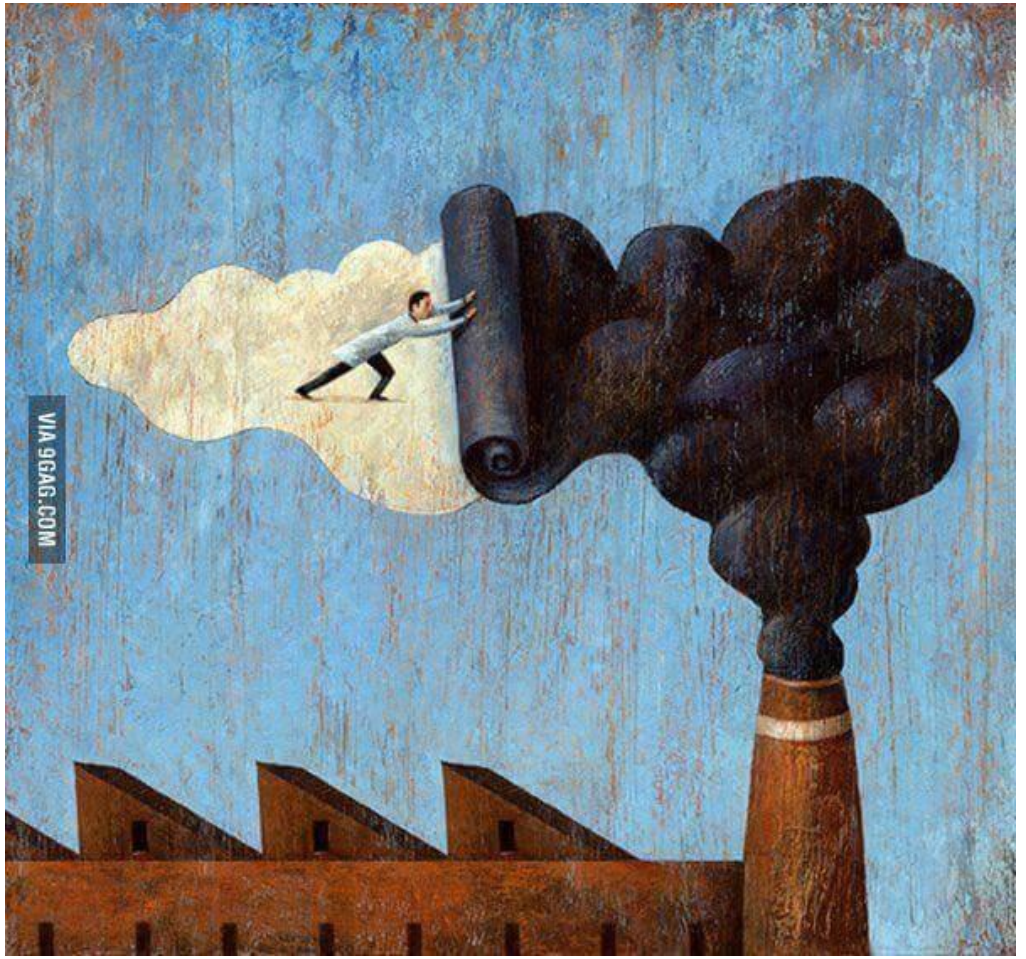
**Wärmewende**

(2) Heinz Wiher

Energie und Technik Stadt Winterthur (CH)



PLANAR
RAUMENTWICKLUNG

Stadt Winterthur

Energiestadt GOLD
Winterthur
european energy award

*5 November 2021, European Energy Award Gold Event, Ravensburg*

# Winterthur Municipal Energy Planning
## 2021 revision

*www.planar.ch*

# Agenda

1. Winterthur’s climate goals
2. Potentials
3. Transformation of the heat supply
4. Current status of energy planning
5. Outlook

# 1. Winterthur's climate goals

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Forschung / Beratung / Evaluation / Recherche / Conseil / Evaluation / Research / Consulting / Evaluation /

Umwelt- und Gesundheitsschutz Winterthur

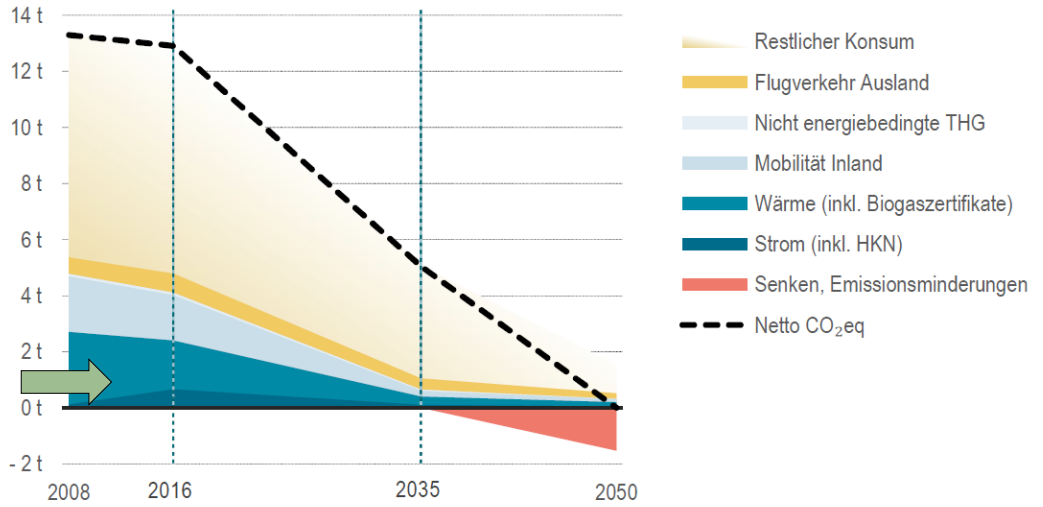
## Energie- und Klimakonzept 2050

### Grundlagenbericht

Schlussbericht
1. März 2021

econcept AG / Gerechtigkeitsgasse 20 / CH-8002 Zürich / www.econcept.ch / +41 (0)44 286 75 75

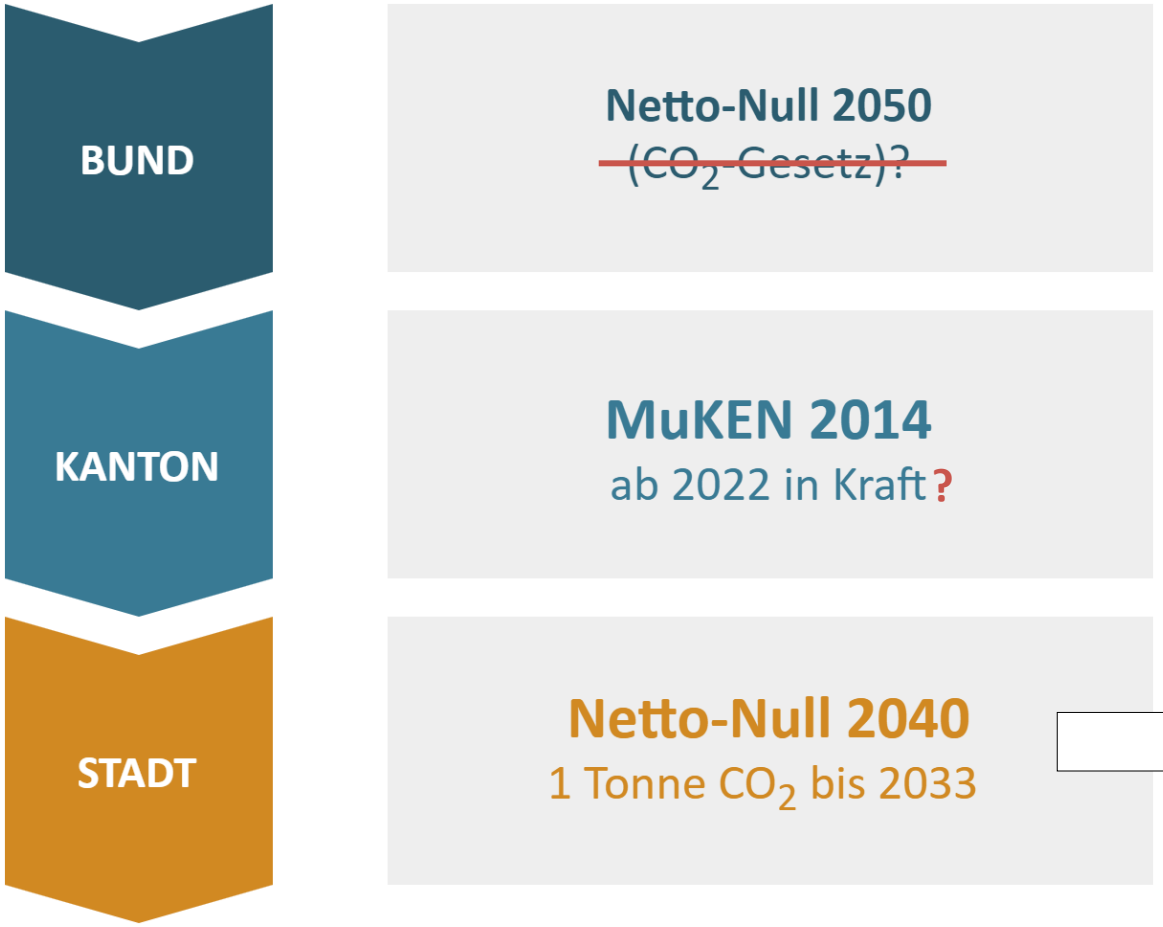
**Absenkpfad NN2050 ($CO_{2eq}$)**




econcept

Abbildung 14: Absenkpfad für das Szenario NN2050 für Treibhausgase sowie Bilanzwerte 2008 und 2016. Die gesamte durch die Stadt und ihre Einwohner/innen verursachte Menge Treibhausgase entspricht der Fläche unter der Kurve. Je kleiner die Fläche, desto besser für das Klima.

# 1. Winterthur’s climate goals

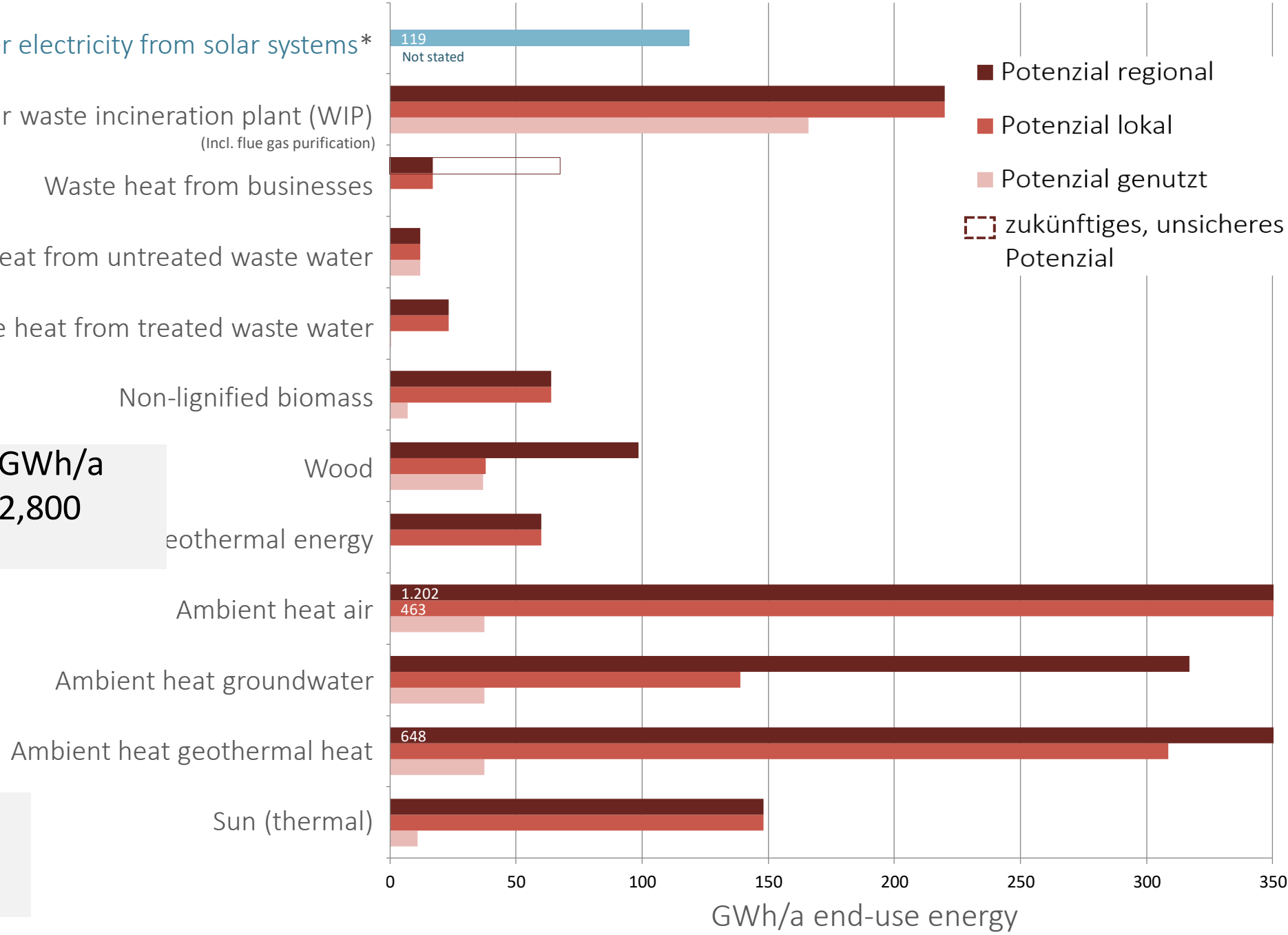



Heating of buildings: 300 kg $CO_2$/(inhabitant*yr)
(equivalent to 100 litres of fuel oil)

# 2. Potentials

Heat demand approx. 900 GWh/a
Potentials approx. 1,000 – 2,800 GWh/a

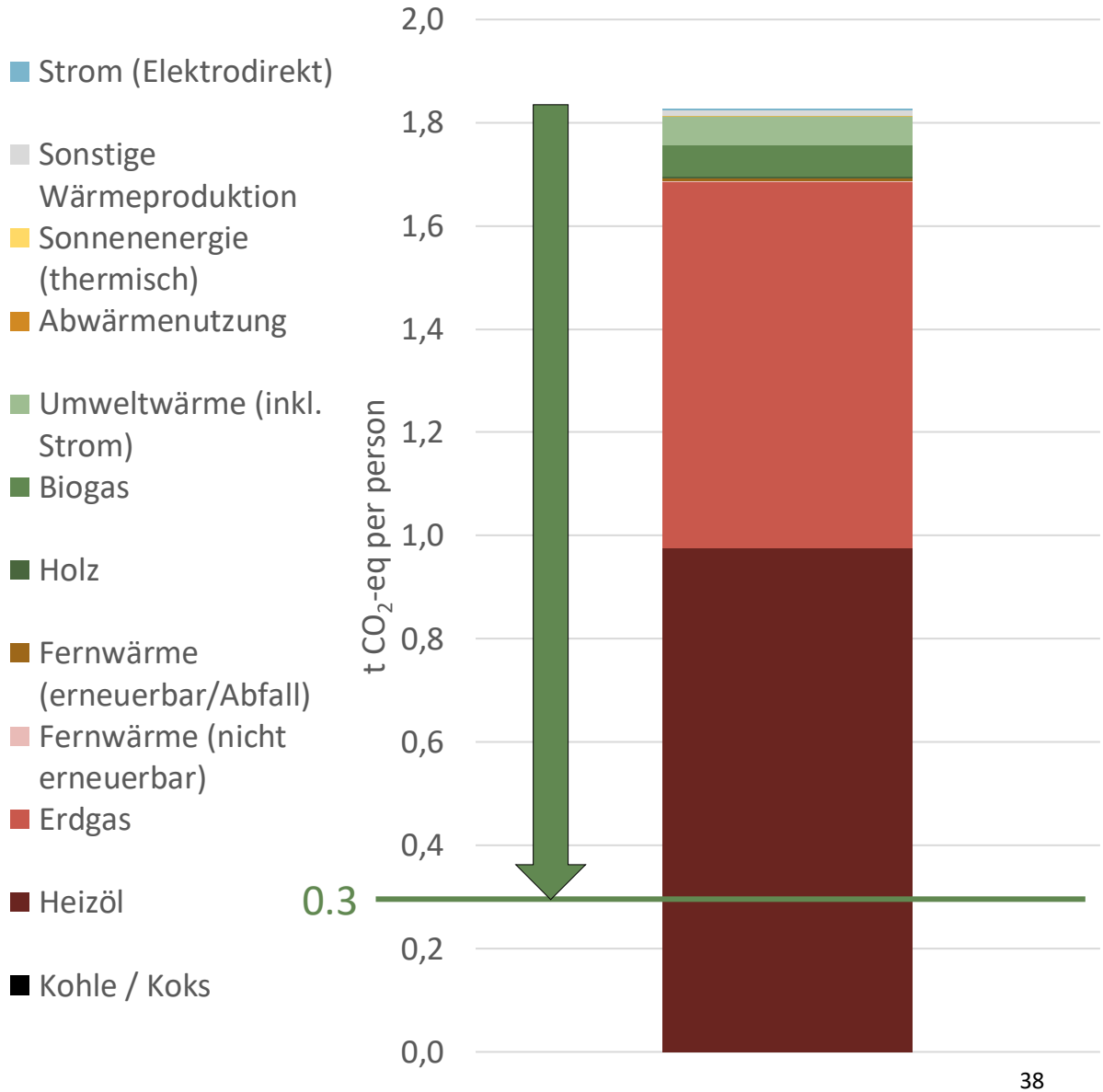
Available potential




* for operating heat pumps

# 3. Transformation of the heat supply

2019 greenhouse gas emissions from the heat sector




Fuel oil down to 0% by 2033
Eliminate gas from heat supply,
by 2033 max. 10% natural gas, 30% biogas*

* Relative to 2019 heat demand

# 3. Transformation of the heat supply


| | |
|---|---|
| Potential | Adequate availability |

| | |
|---|---|
| Time factor | 11 years of transformation time<br>Extension of existing networks<br>Establishment of 7 new network areas |

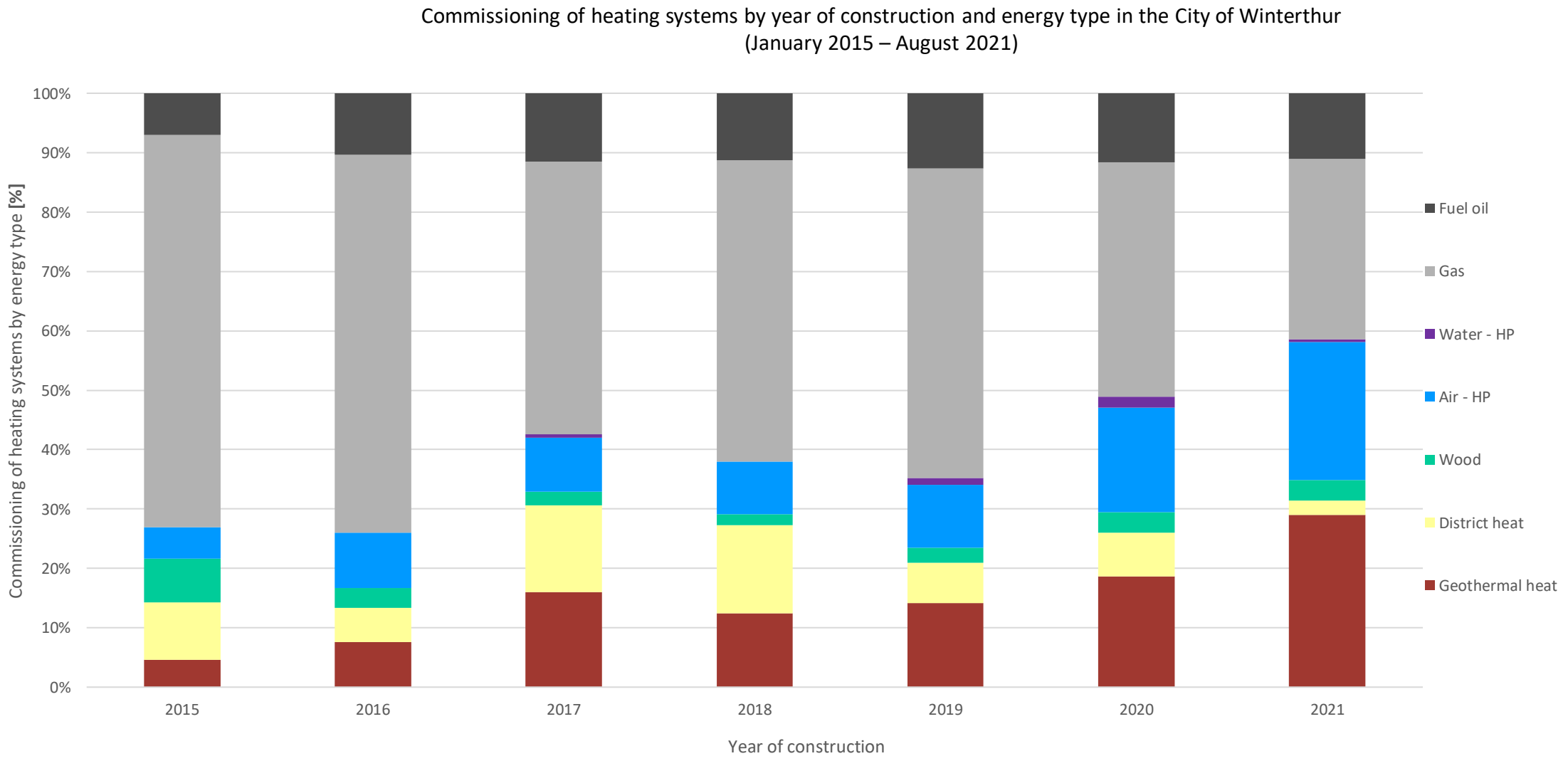
| | |
|---|---|
| Costs | Network amortisation period: 30 years |

Dependent on:
- Financial means
- Human resources
- Political support
- Legal framework

# 3. Transformation of the heat supply

| | |
|---|---|
| Legal basis | $CO_2$ law and cantonal energy law |
| Financial support | Available subsidies from the Canton of Zurich and the City of Winterthur |
| Consultancy and communication | Information on available consultancies and subsidies |

# 3. Transformation of the heat supply



# 4. Current status of energy planning

| | |
|---|---|
| Fundamentals | 2033 heat demand density<br>Potentials plan<br>Infrastructure plan |
| Approach | Zoning<br>Gas zones |
| Outlook | Subsequent steps |

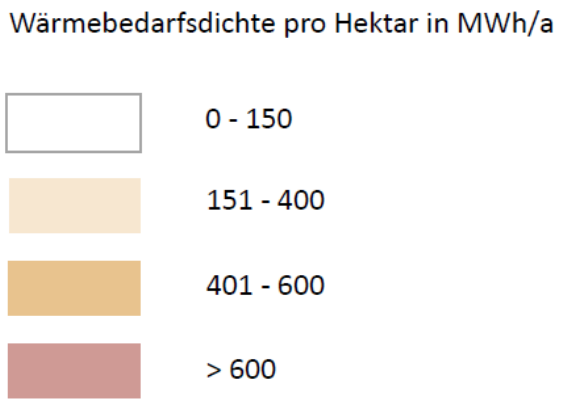
# 4. Fundamentals

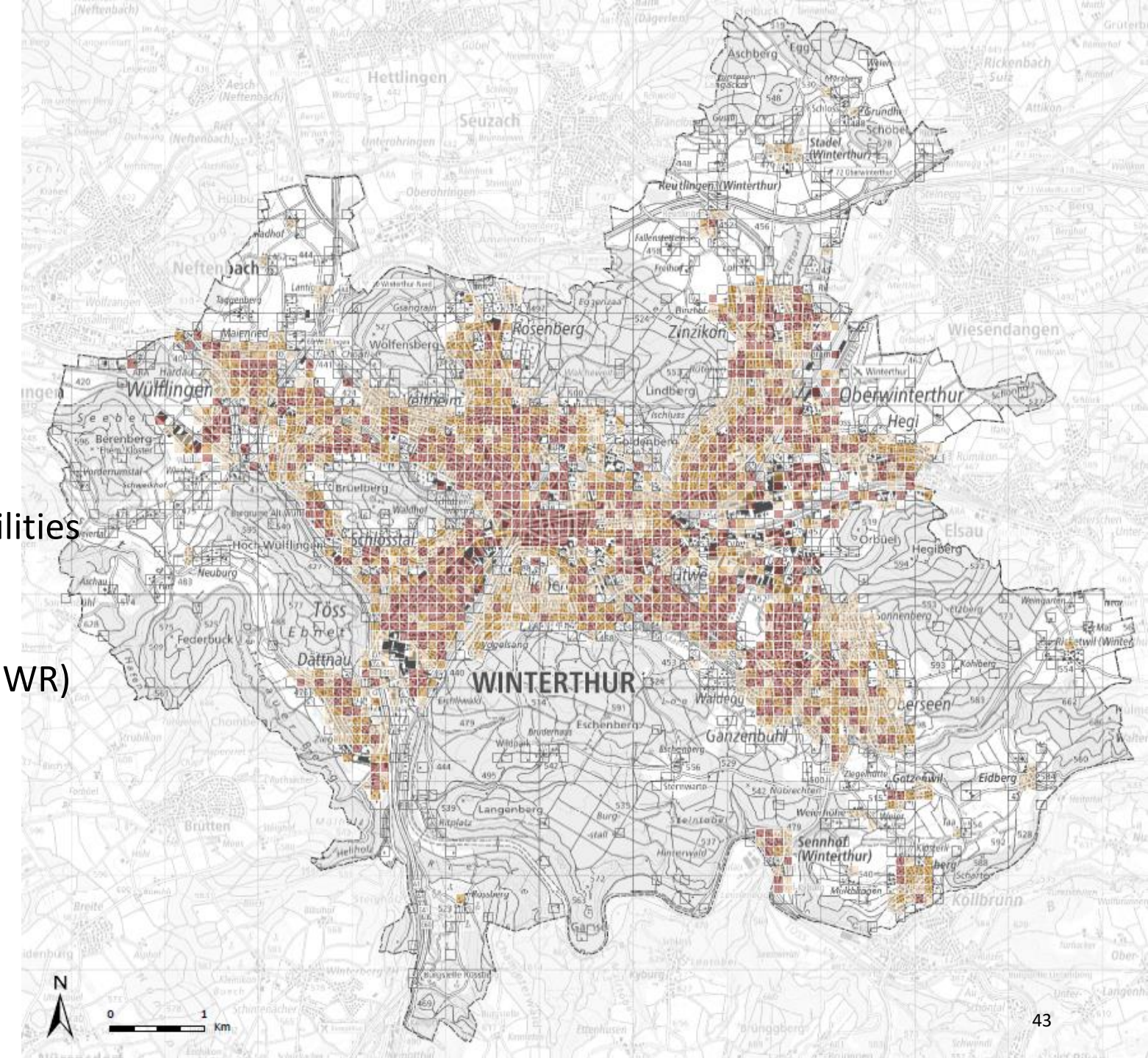
**Map of 2033 heat demand densities**

- From 150 MWh/a: regeneration of geothermal probes
- From 400 MWh/a: network solution

Data basis

- Values measured by the municipal utilities (gas, WIP, spring water supply)
- Installed burner capacity
- Register of buildings and dwellings (GWR)



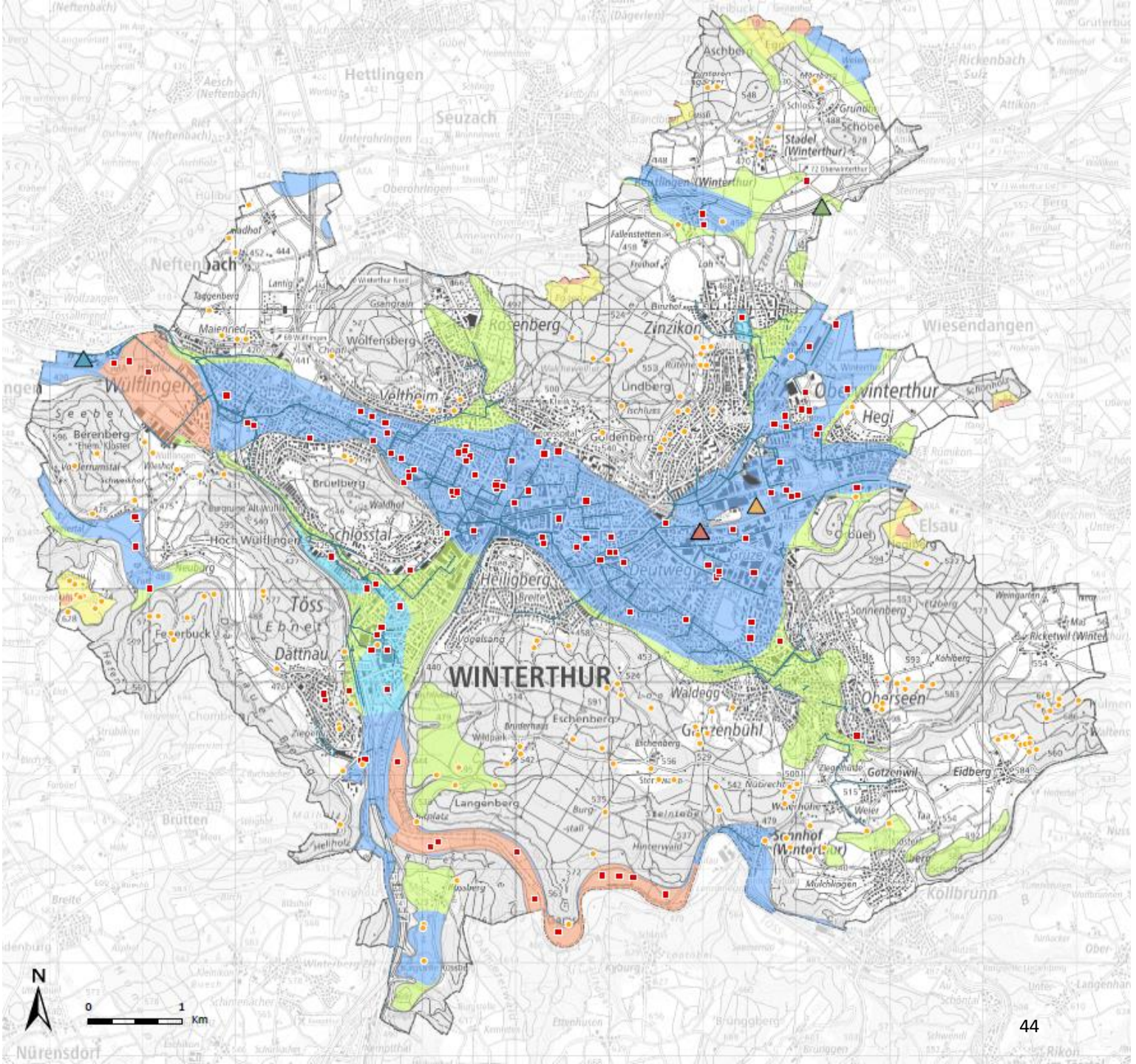



# 4. Fundamentals

## Map of potentials

- Red: geothermal heat may not be used
- Blue: groundwater heat may be used (from 150 kW -> networks needed)
- Other*: geothermal probes permitted

* incl. areas not shown in colour

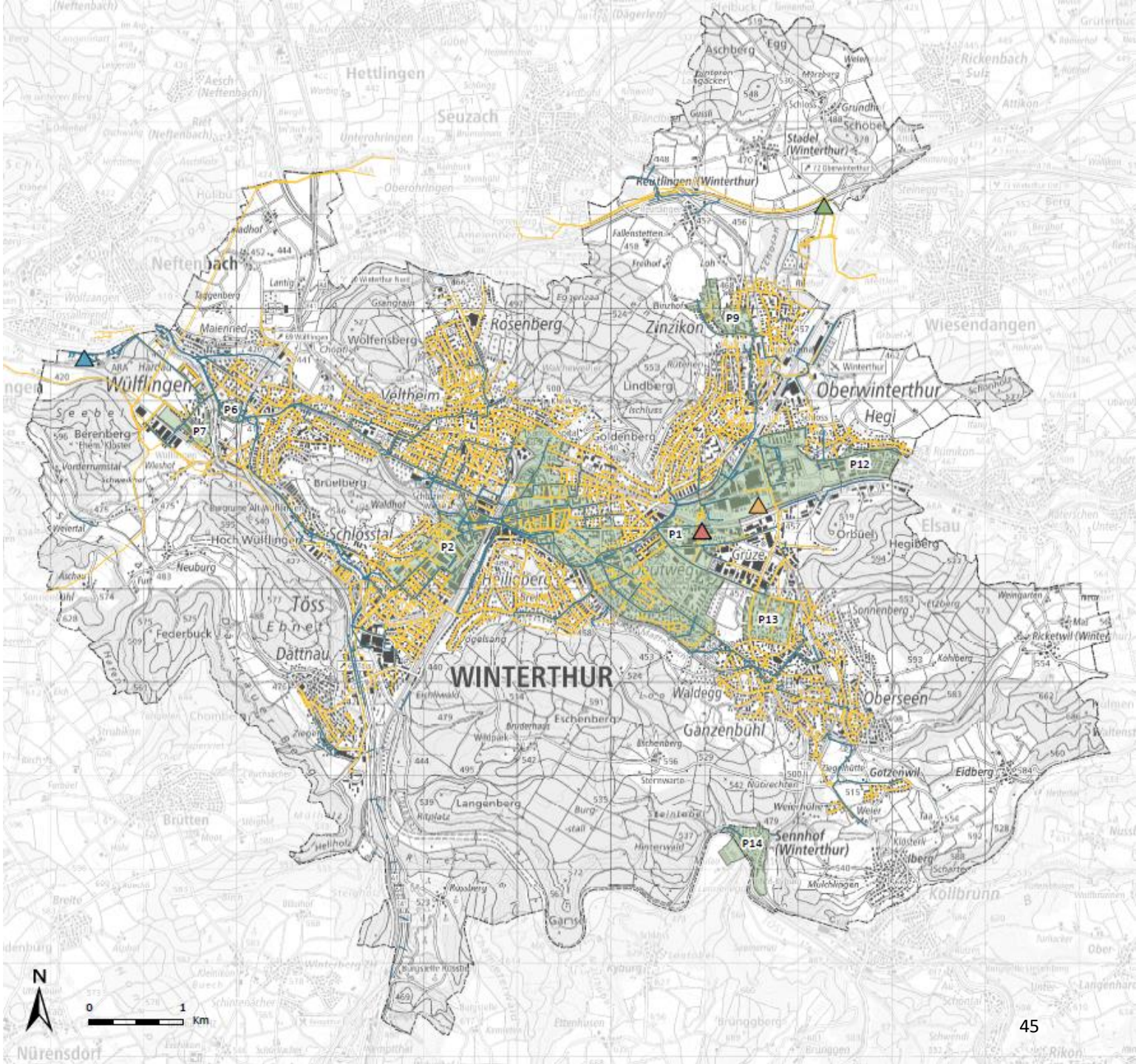


# 4. Fundamentals

## Infrastructure map

Existing networks

- P1: Use of WIP waste heat
- P2: Sulzer city centre heat network
- P6: Wässerwiesen waste heat network
- P7: Wyden wood network
- P9: Zinzikon wood network
- P13: Waser wood network
- P12: Gern wood network
- P14: Sennhof wood network



# 4. Approach

## Gas zones:

## Scenarios for 2033 energy source mix and greenhouse gas emissions

| Building refurbishment rate | Fuel oil | Natural gas | Biogas | Renewable energies | Greenhouse gas emissions (t/inhabitant*yr) |
|---|---|---|---|---|---|
| 1% | 0% | 0% | 30% | 70% | 0.32 |
| 1.2% | 0% | 0% | 30% | 70% | 0.32 |
| 2% | 0% | 10% | 30% | 60% | 0.31 |

Gas use for processes only

# 4. Approach

## Gas zones

# 4. Approach

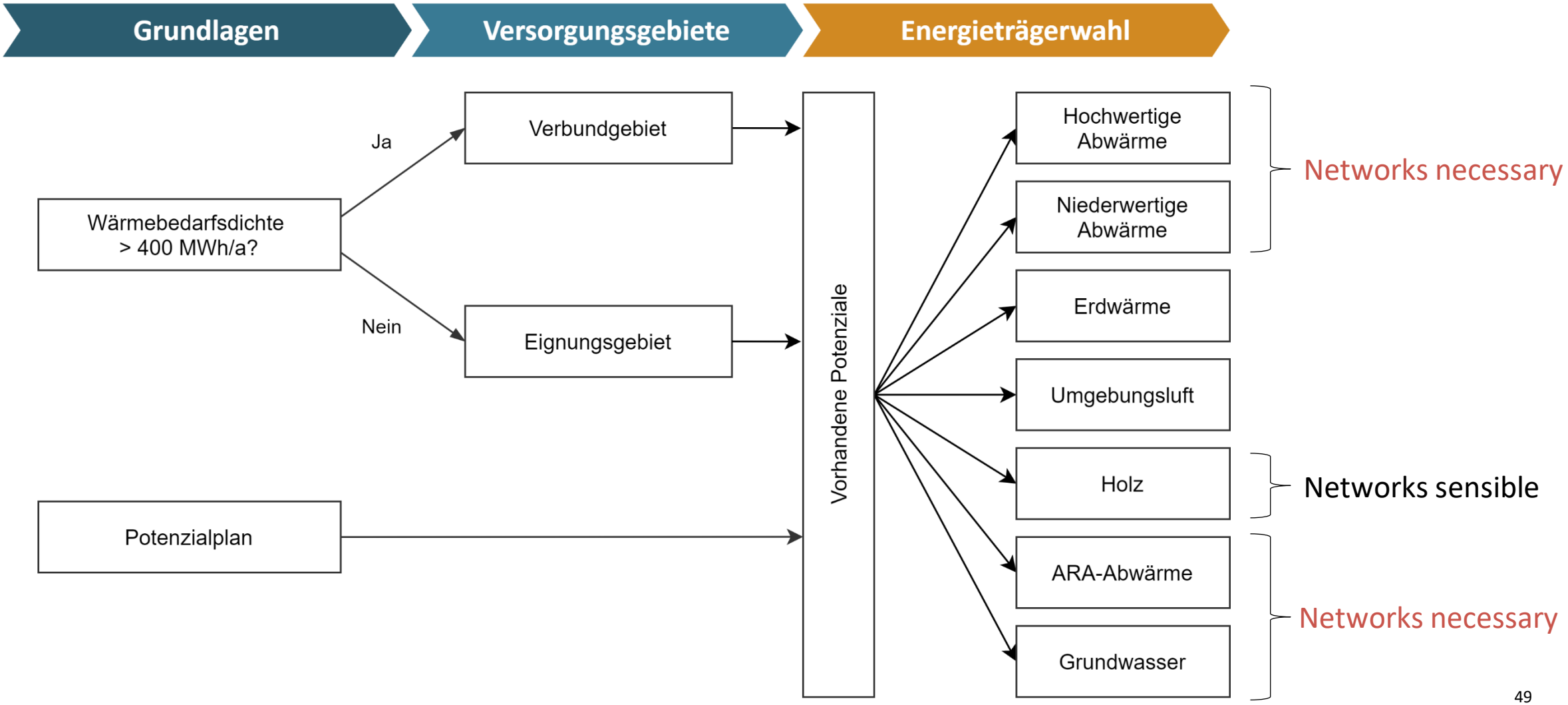
## Gas zones

- Remaining gas zones
  - Niederfeld, Oberwinterthur, Grüze industrial estates
  - Network coverage of peak demand

- Last gas supply for heating purposes
  - In suitable areas and currently existing network areas end of 2033
  - In remaining areas (planned networks) end of 2040

# 4. Approach

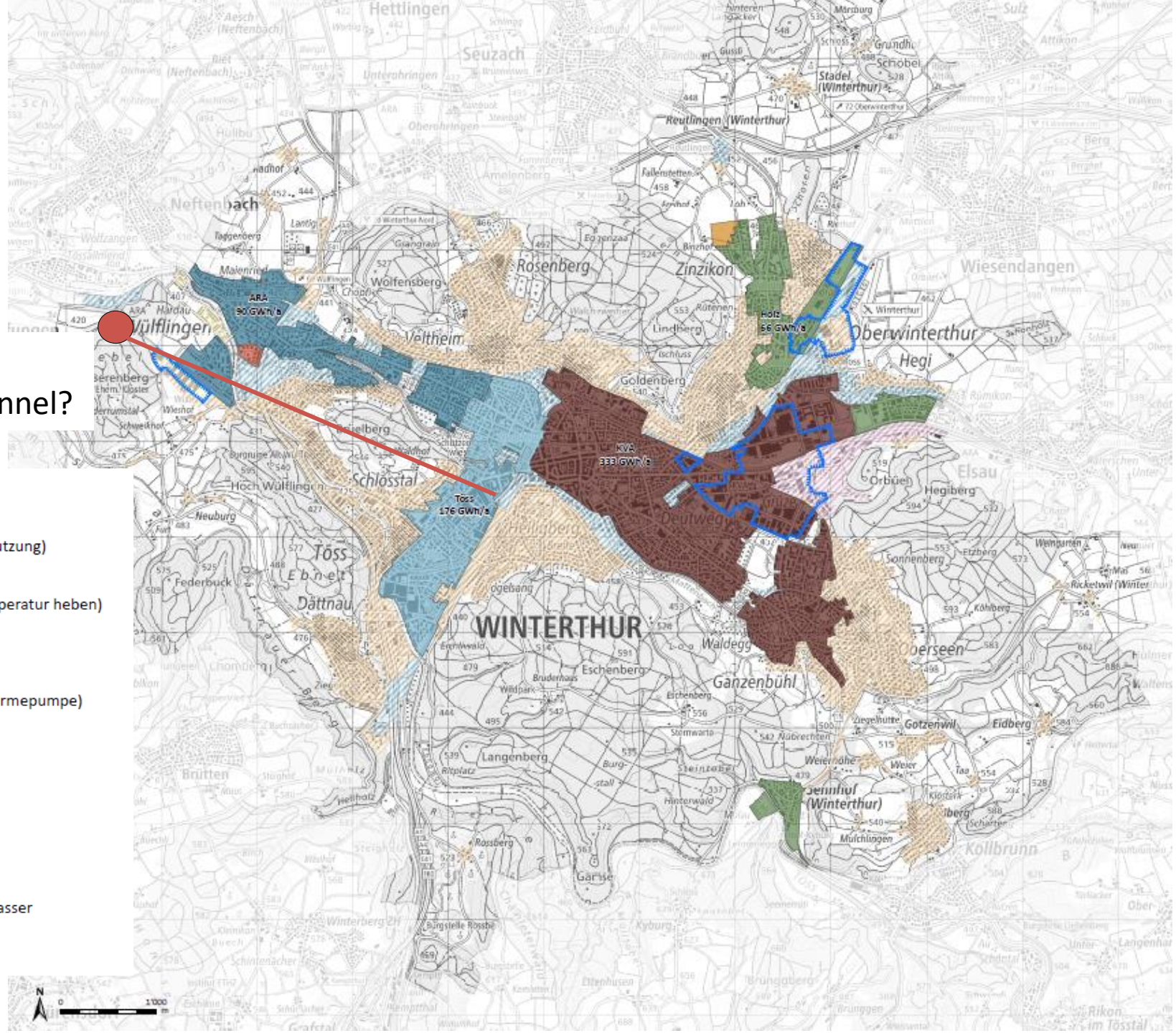
## Zoning



# 4. Current status of energy planning

Draft energy plan as per 8 July 2021

- Back-up for Waste Incineration Plant with connection to the Heiligberg tunnel?

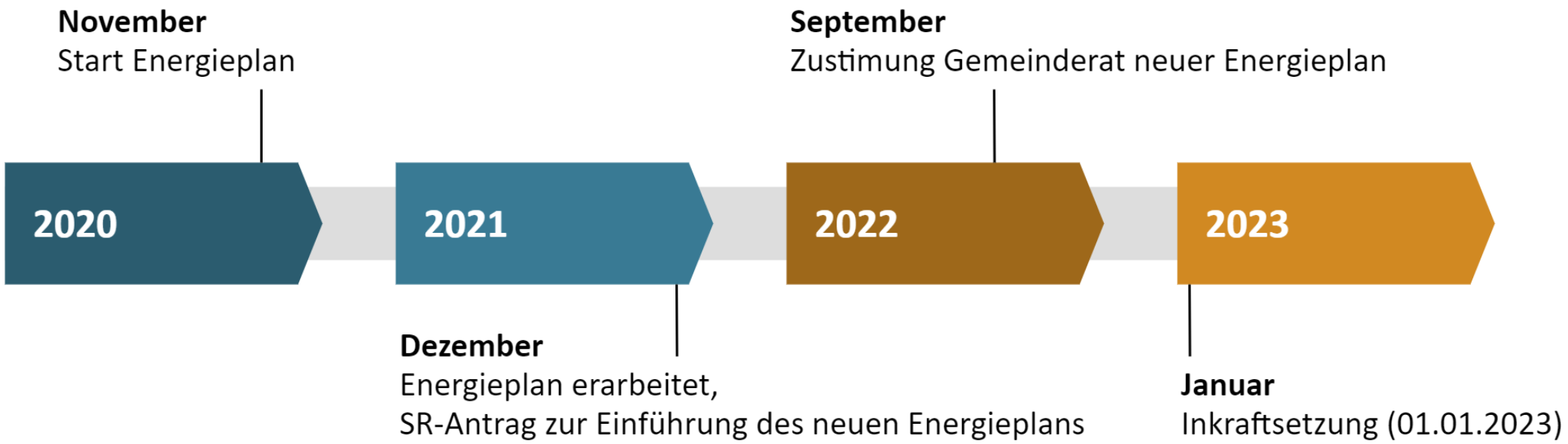



| Verbundgebiet | Eignungsgebiet | Wärmequelle |
|---|---|---|
| | | Hochwertige Abwärme (Direktnutzung) |
| | | Niederwertige Abwärme (mit Wärmepumpe auf Nutztemperatur heben) |
| | | Erdwärme |
| | | Umgebungsluft (Luft-Wasser-Wärmepumpe) |
| | | Holz |
| | | ARA-Abwärme / Grundwasser |
| | | Grundwasser |
| | | Oberflächengewässer / Grundwasser |

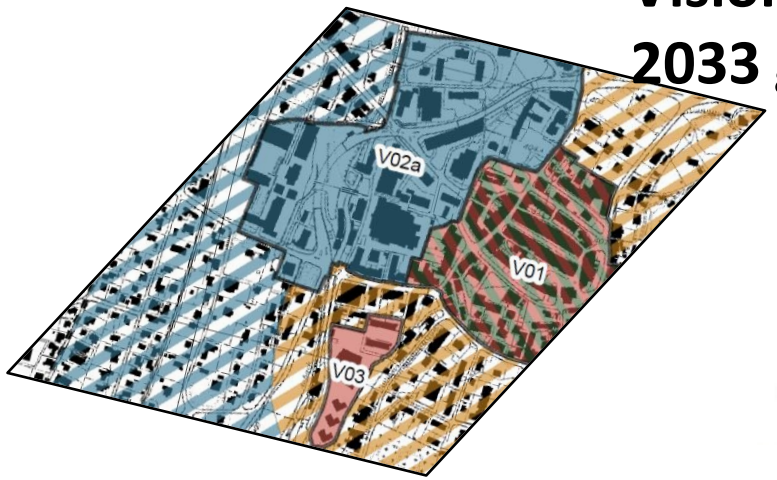
# 5. Outlook – municipal energy planning

- Idea of coupling networks with a view to utilising WIP energy optimally
  - More in-depth study required (engineering firm)
- Complete the energy plan (coordination with municipal utility) -> vision for development
- Action sheets (implementation tool)
  - Per zone
  - Creation of the requisite framework conditions: structural/organisational
- Implementation in the online Winterthur municipal plan

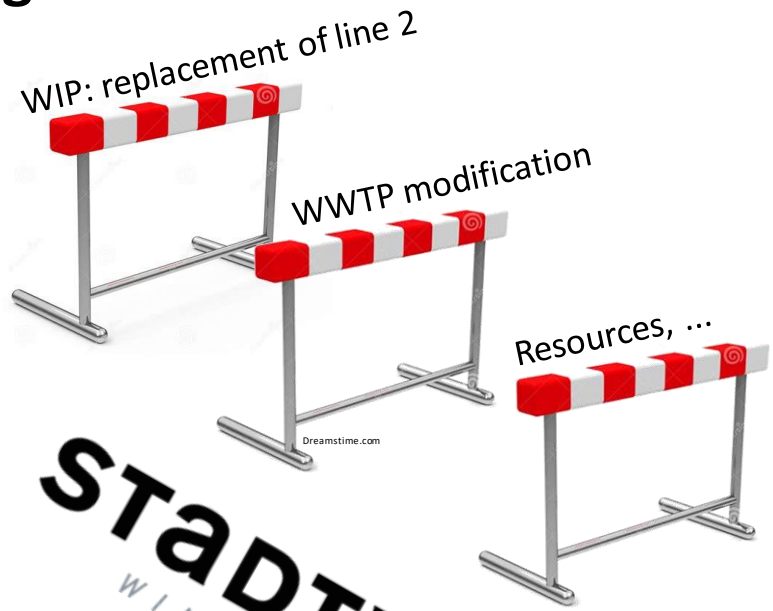
# 5. Outlook – municipal energy planning



# 5. Outlook – requirements for implementing the energy plan




## Vision of the 2033 goal




STADTWERK WINTERTHUR

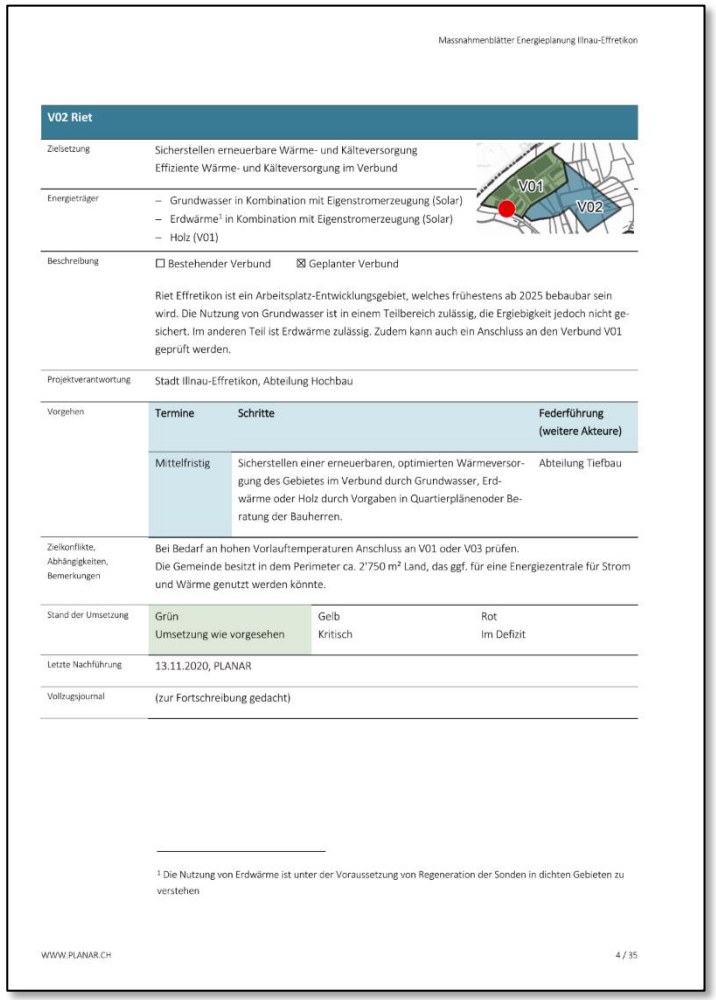
100% renewable heat supply for Winterthur

Stadt.mein-coburg.de

Energiestadt GOLD Winterthur european energy award

Stadt Winterthur

# 5. Outlook – implementing the energy plan



Massnahmenblätter Energieplanung Illnau-Effretikon

**V02 Riet**

| | |
|---|---|
| Zielsetzung | Sicherstellen erneuerbare Wärme- und Kälteversorgung<br>Effiziente Wärme- und Kälteversorgung im Verbund |
| Energieträger | – Grundwasser in Kombination mit Eigenstromerzeugung (Solar)<br>– Erdwärme[1] in Kombination mit Eigenstromerzeugung (Solar)<br>– Holz (V01) |
| Beschreibung | ☐ Bestehender Verbund ☒ Geplanter Verbund<br>Riet Effretikon ist ein Arbeitsplatz-Entwicklungsgebiet, welches frühestens ab 2025 bebaubar sein wird. Die Nutzung von Grundwasser ist in einem Teilbereich zulässig, die Ergiebigkeit jedoch nicht gesichert. Im anderen Teil ist Erdwärme zulässig. Zudem kann auch ein Anschluss an den Verbund V01 geprüft werden. |
| Projektverantwortung | Stadt Illnau-Effretikon, Abteilung Hochbau |

| Vorgehen | Termine | Schritte | Federführung (weitere Akteure) |
|---|---|---|---|
| | Mittelfristig | Sicherstellen einer erneuerbaren, optimierten Wärmeversorgung des Gebietes im Verbund durch Grundwasser, Erdwärme oder Holz durch Vorgaben in Quartierpläneoder Beratung der Bauherren. | Abteilung Tiefbau |

| | |
|---|---|
| Zielkonflikte, Abhängigkeiten, Bemerkungen | Bei Bedarf an hohen Vorlauftemperaturen Anschluss an V01 oder V03 prüfen.<br>Die Gemeinde besitzt in dem Perimeter ca. 2'750 m² Land, das ggf. für eine Energiezentrale für Strom und Wärme genutzt werden könnte. |

| Stand der Umsetzung | Grün | Gelb | Rot |
|---|---|---|---|
| | Umsetzung wie vorgesehen | Kritisch | Im Defizit |

| | |
|---|---|
| Letzte Nachführung | 13.11.2020, PLANAR |
| Vollzugsjournal | (zur Fortschreibung gedacht) |

[1] Die Nutzung von Erdwärme ist unter der Voraussetzung von Regeneration der Sonden in dichten Gebieten zu verstehen

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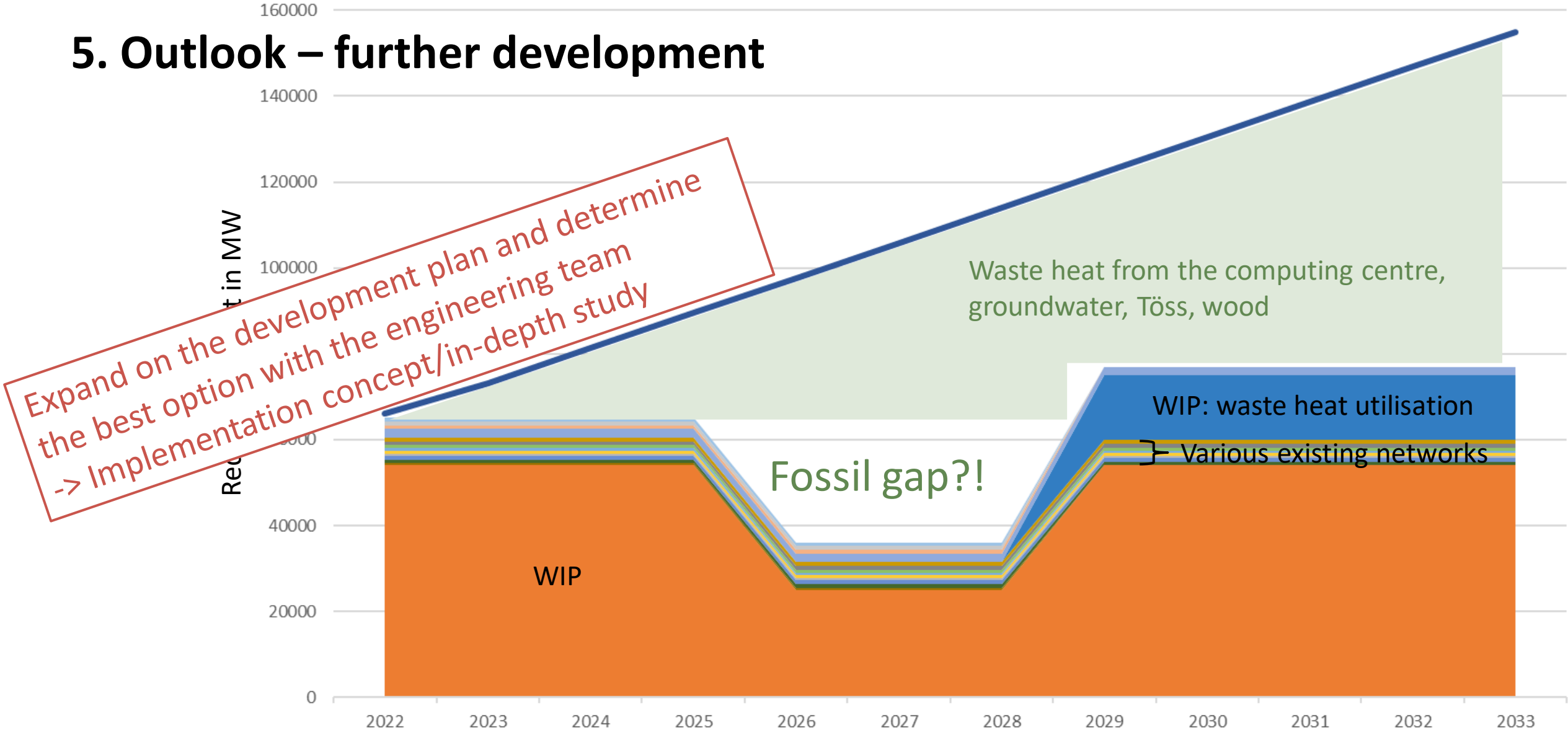
Action sheets on the network zones

- Gather as much information as possible (WIP works, WWTP, project plan)
  Approach, milestones, conflicting goals

Action sheets for implementation

- **Create optimal framework conditions**
  E.g. coordination with civil engineering, finance, ...
  Monitoring of implementation and impacts

# 5. Outlook – further development

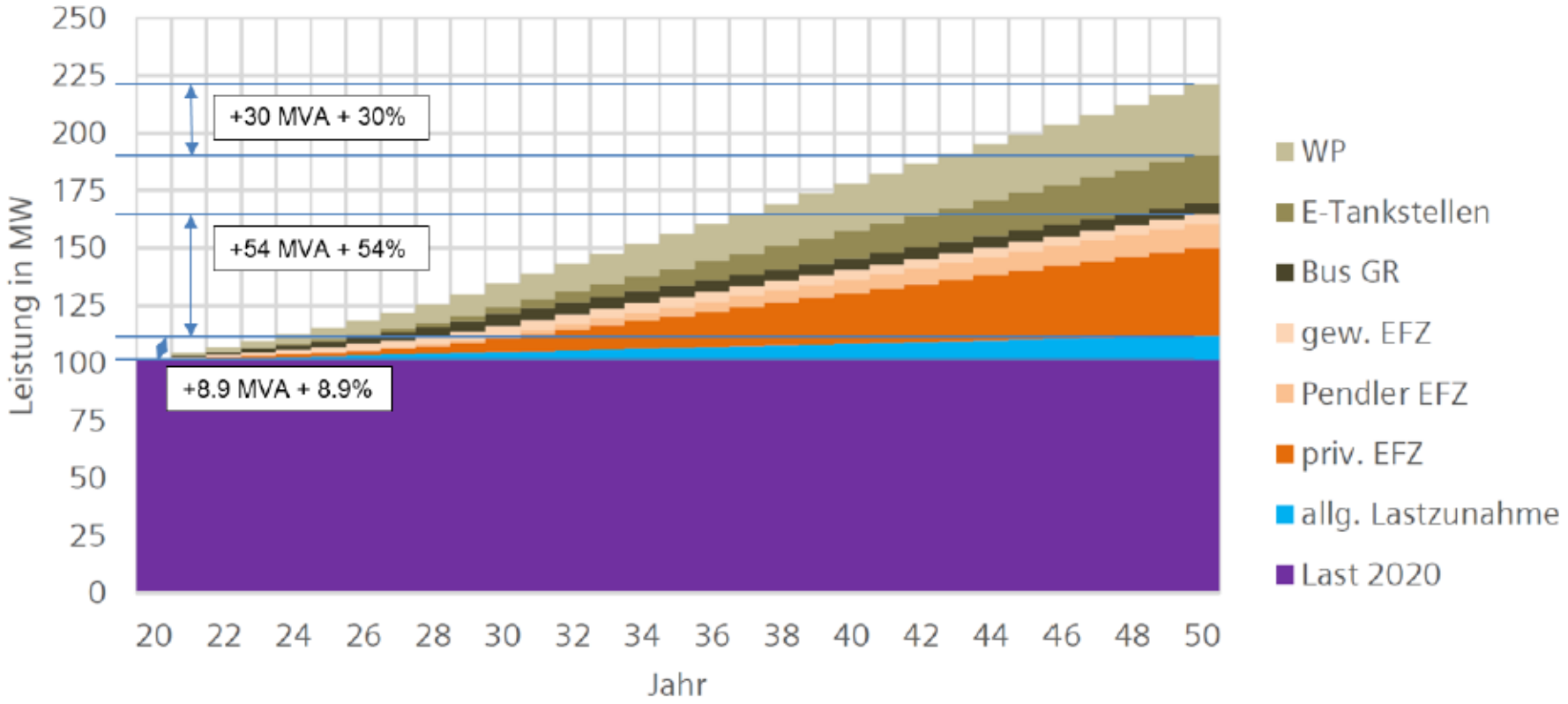


# What does the energy plan mean for the public utility

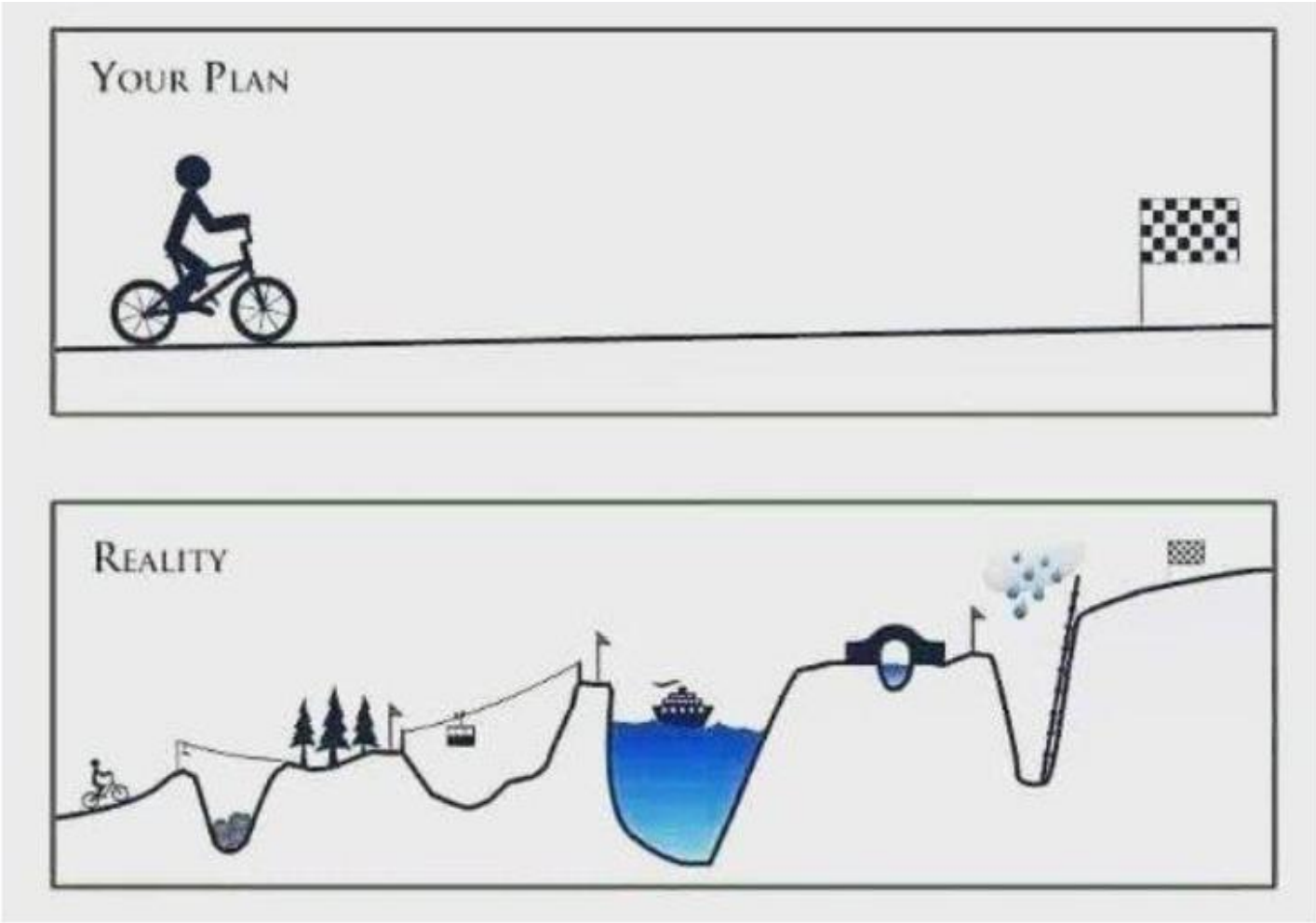
- Reduction of the gas network by ca. 100 km and 3000 connections
- Providing temporary transitional solutions
- Construction of heat networks of ca. 100 km and 2000 connections
- Construction of ca. 5 heating centers
- Grid reinforcement in the power grid (+ 7000 geothermal probes)

# Increase in electricity load due to heat pumps and e-mobility

- from the Siemens study on load increase until 2050 in Winterthur
- for the heat pump capacity, an additional load of 30MVA, and for e-mobility of 54 MVA was determined



# Conclusion: difficult but not impossible



## Thank you for your attention!

*You can't do that.*
Someone came along who didn't know that and *just did it.*