UNIVERSITÉ DE GENÈVE

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

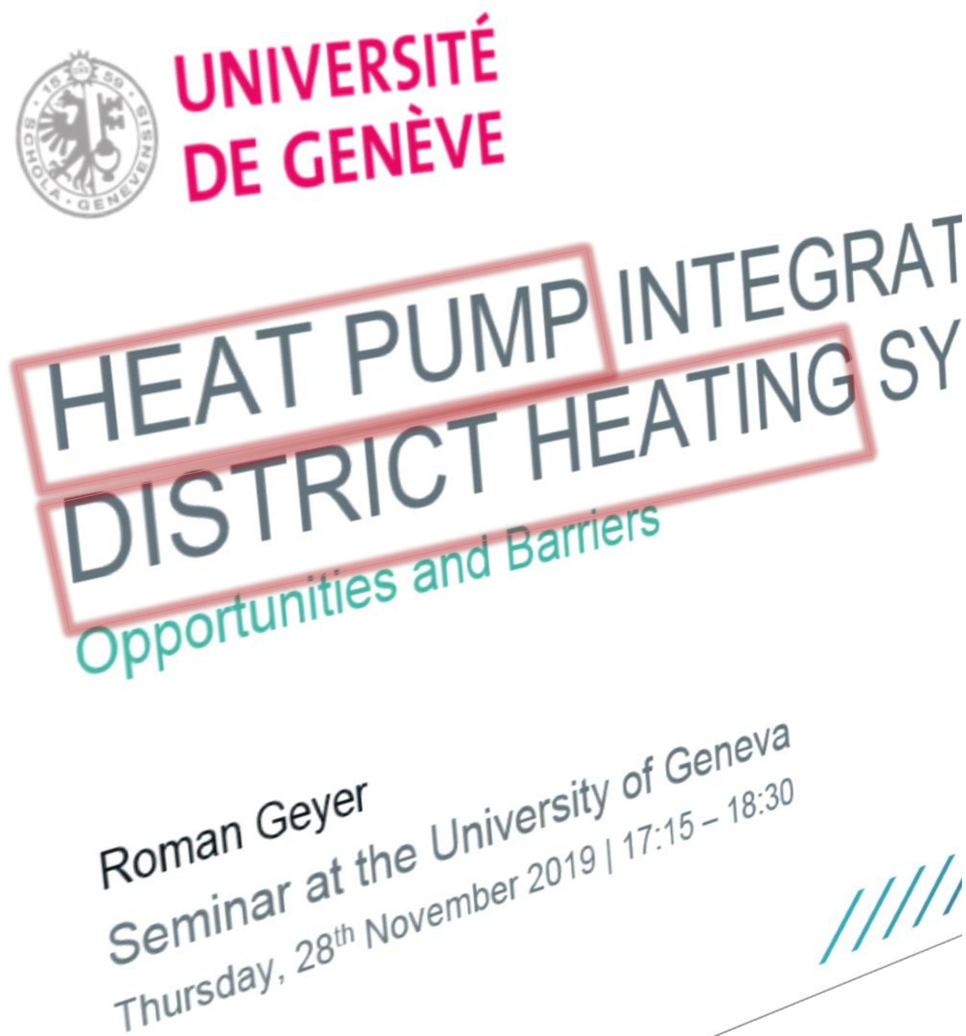
HEAT PUMP INTEGRATION IN DISTRICT HEATING SYSTEMS

Opportunities and Barriers

Roman Geyer

Seminar at the University of Geneva

Thursday, 28th November 2019 | 17:15 – 18:30



- General overview
- Basics of DH and HP
- Hydraulic integration options
- Barriers / challenges
- Possible solutions and opportunities
- Success factors
- Monitoring and Optimization
- Developments / Project Highlights
- Closing
- Discussion

SEMINARS ON ENERGY CHALLENGES

- Energy demand in Switzerland
- District heating (DH) potential
- Renewable heat integration in DH
- Low temperature DH in Geneva
- Heat pump integration in district heating systems: Opportunities and Barriers
- Role of combined heat and power in the energy transition

https://www.unige.ch/sysener/fr/colconf/seminaires/

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bmvit

1.370
employees

8 Centers

Austria's largest
RTO

System
Competence

Applied Research

Infrastructure Systems

Federation of
Austrian Industries
(through VFFI)

Next Generation
Solutions

4 Subsidiary
Enterprises

LKR, NES, SL, Profactor 51%

162,9
m EUR total revenue

Tomorrow Today

as of YE 2018

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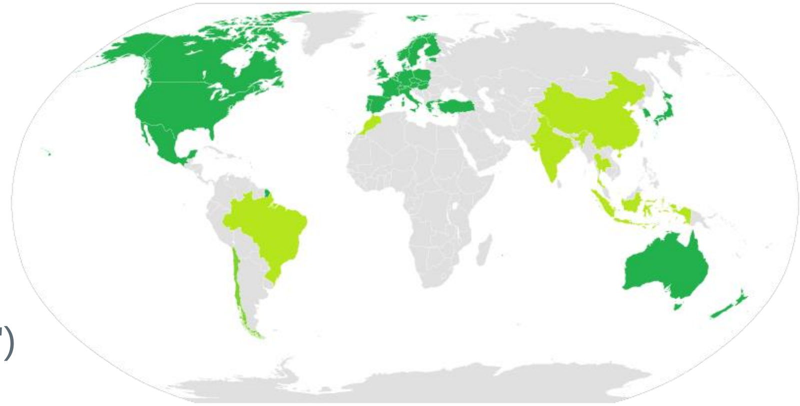
INTERNATIONAL ENERGY AGENCY (IEA)

- Founded in 1974 by 16 industrial nations to combat the **oil crisis**
  (IEA has strategic oil reserves)

- Goal: To **guarantee reliable**, **cost-effective** and **clean energy**

- Current: 30 Member States

- Important publications:
  - Key Energy Statistics
  - World Energy Outlook ("Bible of the Energy sector")



- **Cooperation platform** in the field of research, development, market launch and application of energy technologies

IEA HPT ANNEX 47

ANNEX 47 HEAT PUMPS IN DISTRICT HEATING AND COOLING SYSTEMS

Heat Pumps in District Heating and Cooling systems

- International project team:

AUSTRIAN INSTITUTE OF TECHNOLOGY · Lucerne University of Applied Sciences and Arts HOCHSCHULE LUZERN · DANISH TECHNOLOGICAL INSTITUTE · RISE

Country	Demos
AT	11
CH	10
DK	9
SE	8
UK	6
Sum	**44**

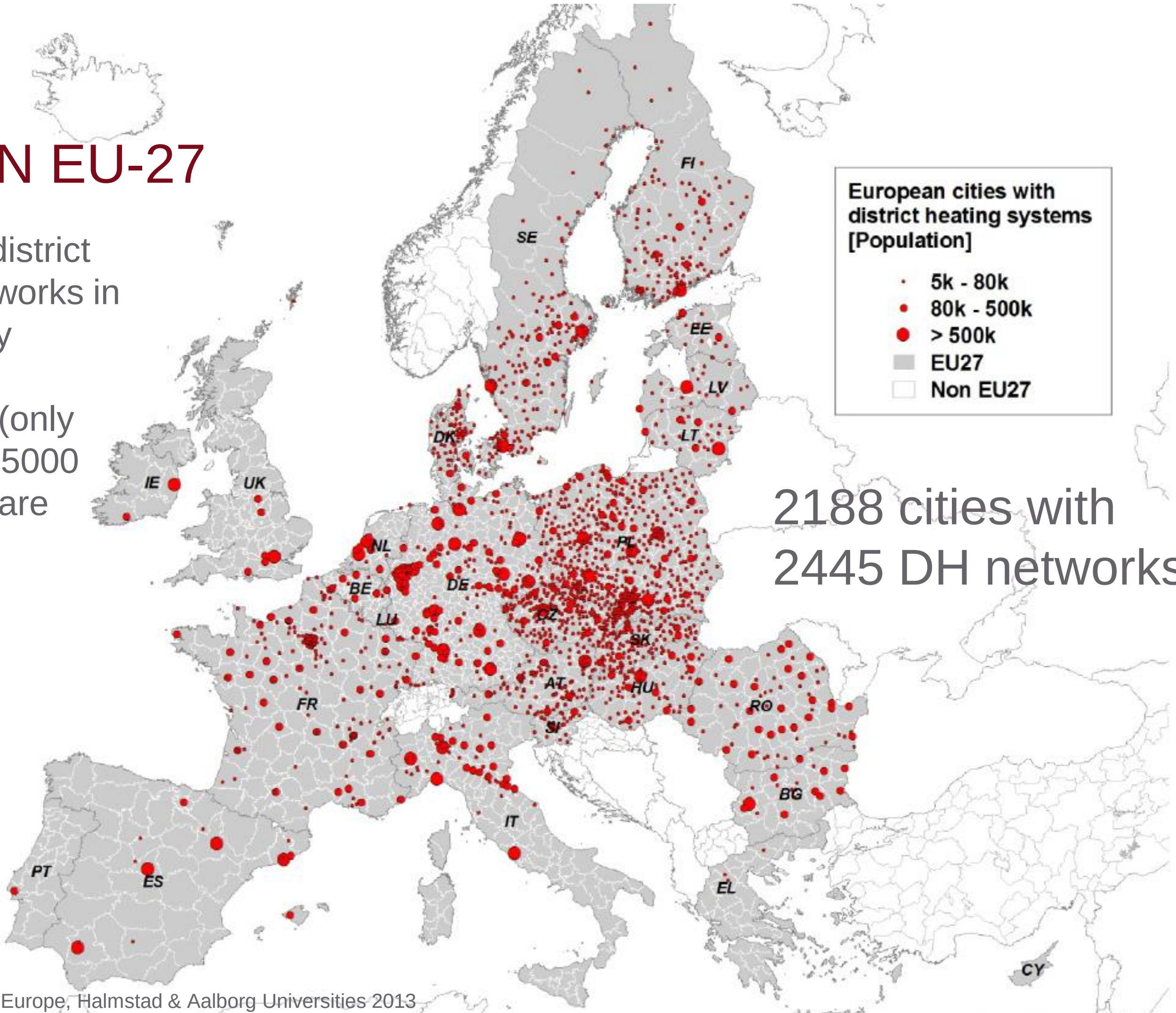
Activities:

- Task 1. Market and energy reduction potential
- Task 2. Description of existing DHC systems and demonstration and R&D projects with HPs
- Task 3. Review the different concepts/solutions
- Task 4. Implementation barriers, possibilities and solutions

https://heatpumpingtechnologies.org/annex47/publications/

DH IN EU-27

Cities with district heating networks in the EU27 by number of inhabitants (only cities with >5000 inhabitants are shown).



2188 cities with
2445 DH networks are shown

Source: Heatroadmap Europe, Halmstad & Aalborg Universities 2013

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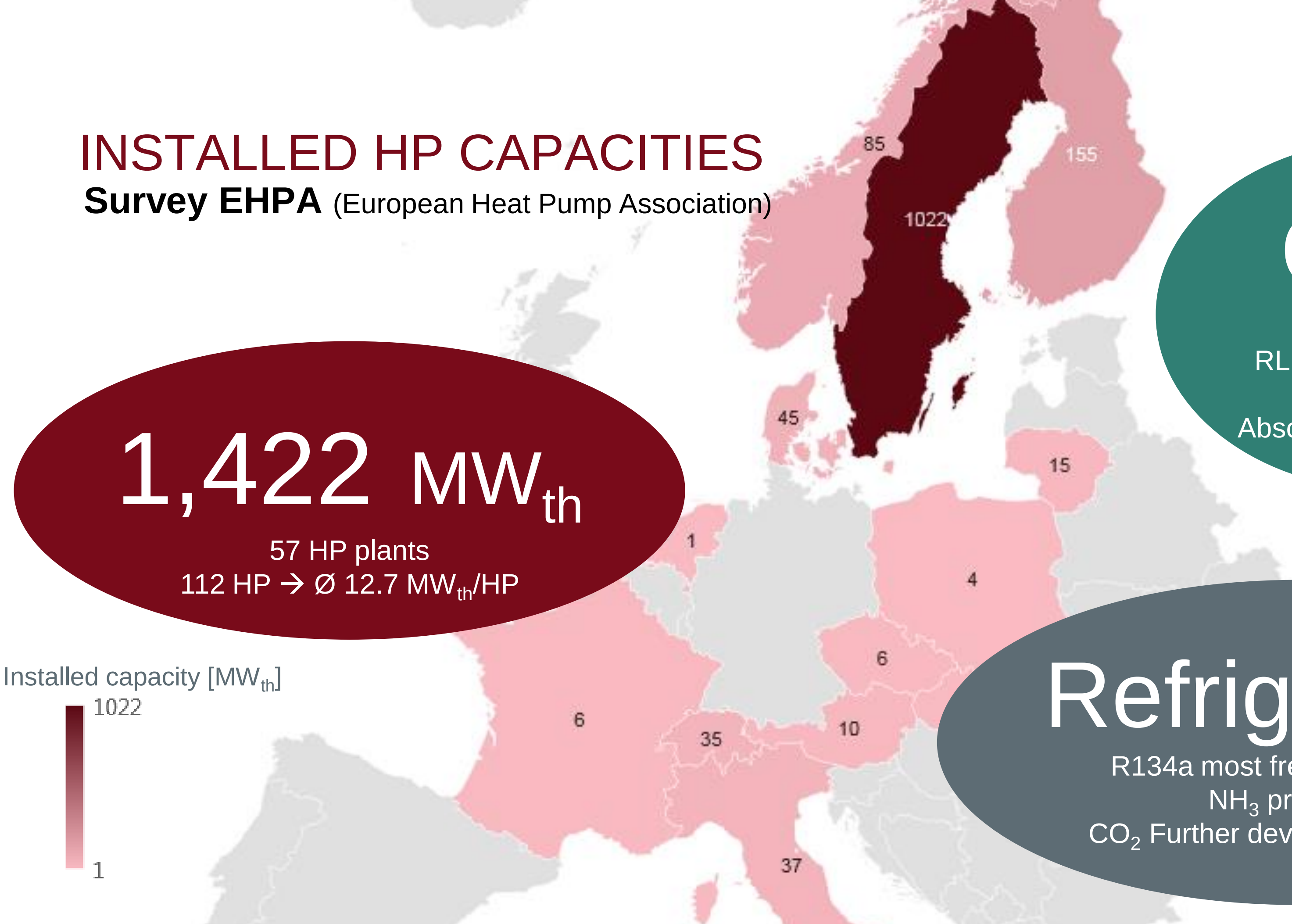
INSTALLED HP CAPACITIES

Survey EHPA (European Heat Pump Association)



1,422 MW_{th}

57 HP plants

112 HP → Ø 12.7 MW_{th}/HP

COP

Average: 3.74

RL increase: 5.4 – 6.5

LT-DH: 5.5

Absorption-HP: 1.4 – 1.7

Refrigerants

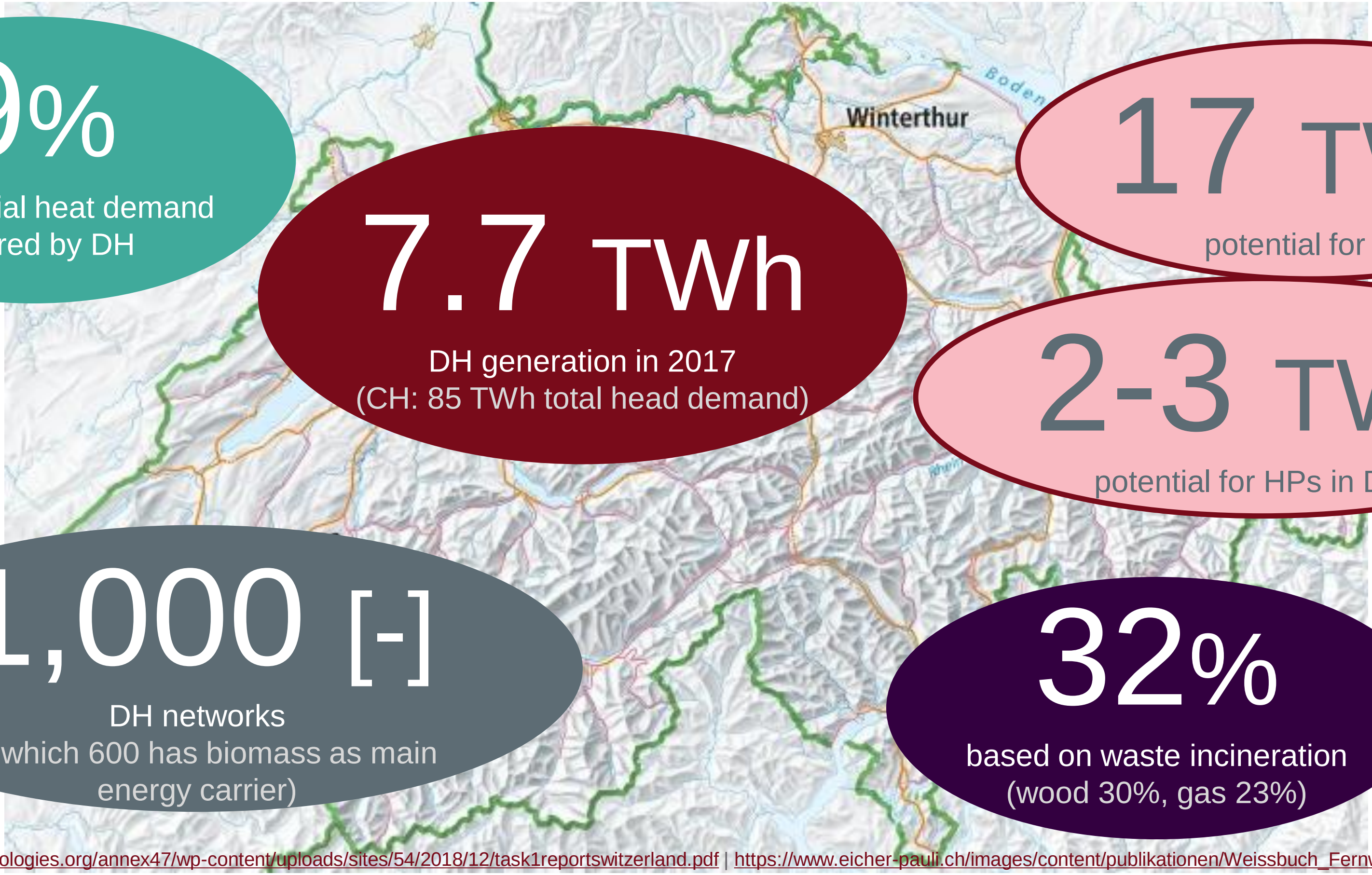
R134a most frequent (~ 70 %)

NH_3 promising

CO_2 Further development needed

https://www.euroheat.org/wp-content/uploads/2016/04/160420_1600_1730_2nd-place_Andrei-David_presentation.pdf

DH IN SWITZERLAND AT A GLANCE



9%
of residential heat demand covered by DH

7.7 TWh
DH generation in 2017
(CH: 85 TWh total head demand)

17 TWh
potential for DH

2-3 TWh
potential for HPs in DHN

1,000 [-]
DH networks
(of which 600 has biomass as main energy carrier)

32%
based on waste incineration
(wood 30%, gas 23%)

Sources:
https://heatpumpingtechnologies.org/annex47/wp-content/uploads/sites/54/2018/12/task1reportswitzerland.pdf | https://www.eicher-pauli.ch/images/content/publikationen/Weissbuch_Fernwrme_Schweiz.pdf
https://www.fernwaerme-schweiz.ch/fernwaerme-deutsch/Verband/VFS-Jahresstatistiken/Jahresstatistik_Statistique_annuelle2017.pdf

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BASICS OF DISTRICT HEATING AND HEAT PUMPS

Functional principle district heating

Why to lower temperatures?

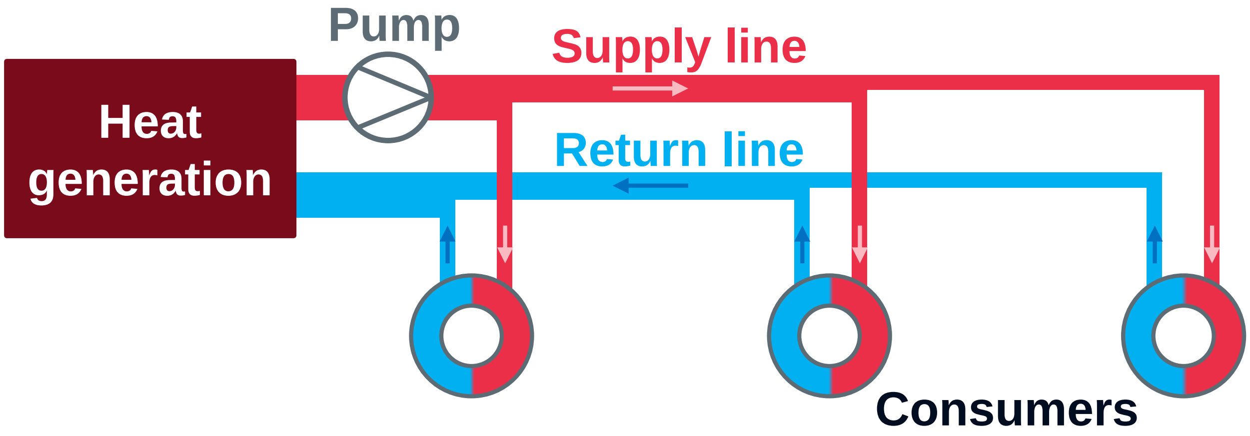
Influences of reduced temperatures

Example: CHP (Back pressure)

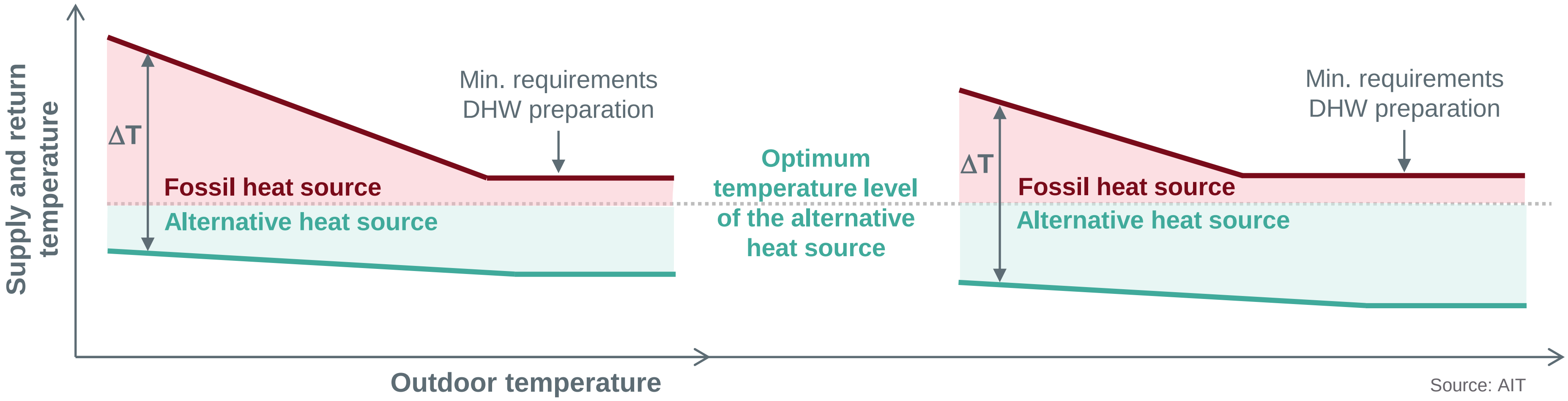
Motivation for HP integration

FUNCTIONAL PRINCIPLE DISTRICT HEATING

- (Central) Heat generators produce hot water
- (Central) Pumps ensure heat distribution in the network
- Heat is distributed by a supply line which supplies the consumers with hot water
- Cooled water is returned through the return line to the heat generator(s), where it is heated again



WHY TO LOWER TEMPERATURES?



Source: AIT

INFLUENCES OF REDUCED TEMPERATURES

Generation

Higher fuel utilization, Higher electricity yield in CHPs, Better economic efficiency, Reduction of emissions (CO_2, ...), Better integration of alternative energy producers (heat pumps, waste heat, ...), etc.

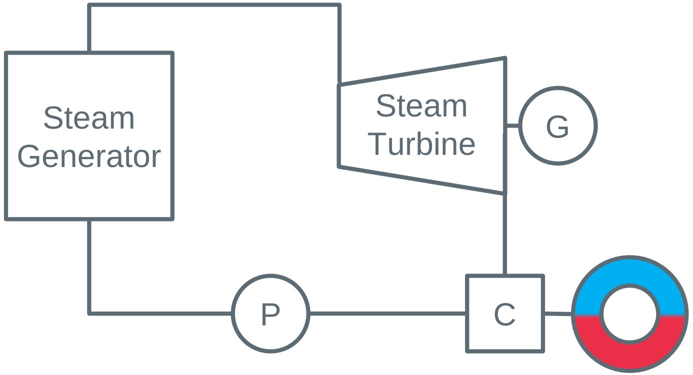
Grid

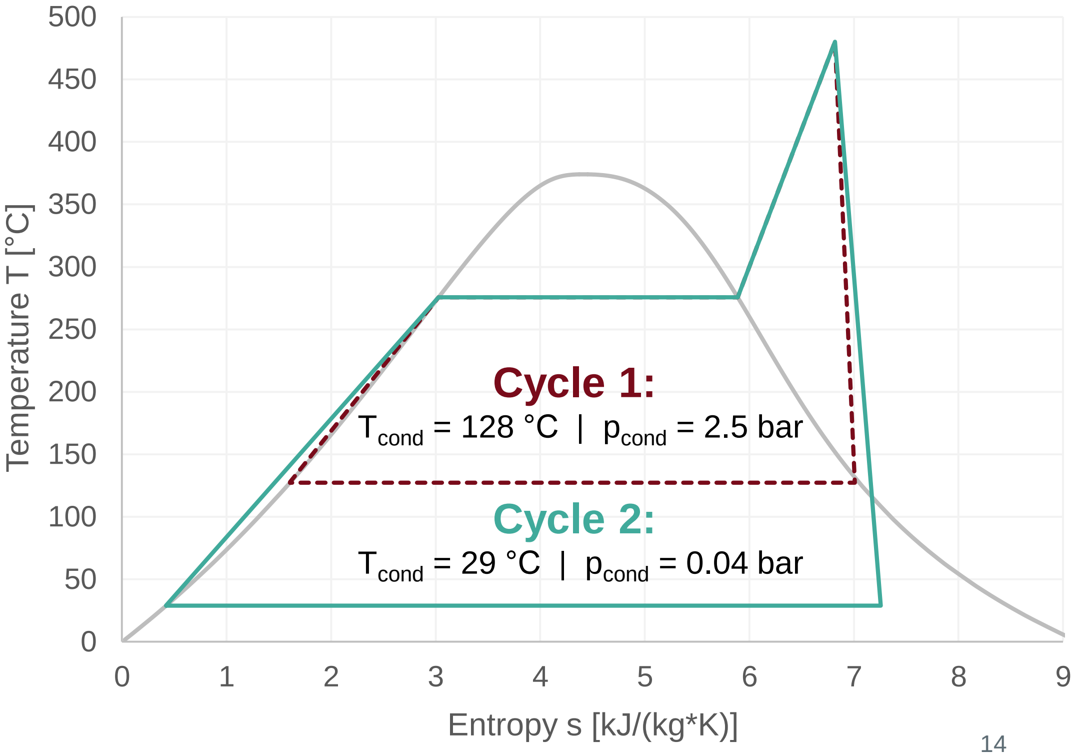
Higher transmission capacities, reduction of heat losses, reduction of mass flow and thus of pumping costs, smaller pipe dimensions for new buildings, etc.

Customers

Ecological and economical operation, optimal design and construction of the plants, economical DHW preparation (hygienically perfect and with low return temperatures), etc.

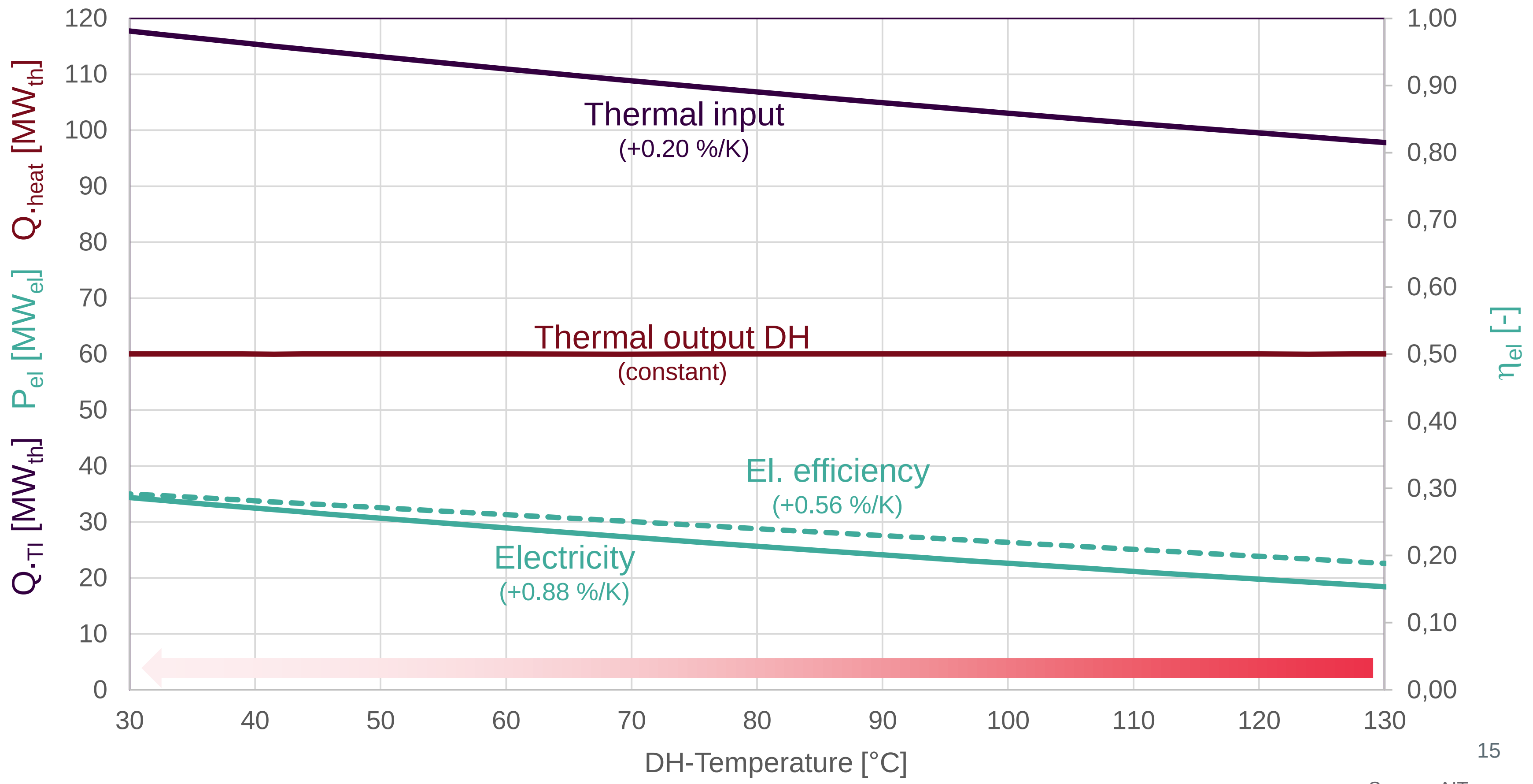
EXAMPLE: CHP (BACK PRESSURE)





Source: AIT

FIRST ASSESSMENTS



Source: AIT

MOTIVATION FOR HP INTEGRATION

The motivation to use HPs in DHC can be divided into the following areas:

- **usage** / **capture** of low temperature alternative heat sources
- **enabler** for other alternative energy sources
- link to **power** grid (balance of energy domains)
- **reduction** of the network temperatures
- increasing transport **capacities** by using the return line as a source

HYDRAULIC INTEGRATION OPTIONS FOR HEAT PUMPS IN DH NETWORKS

- External
- Internal
- Supply line
- Return line
- Transport capacity
- Sub networks

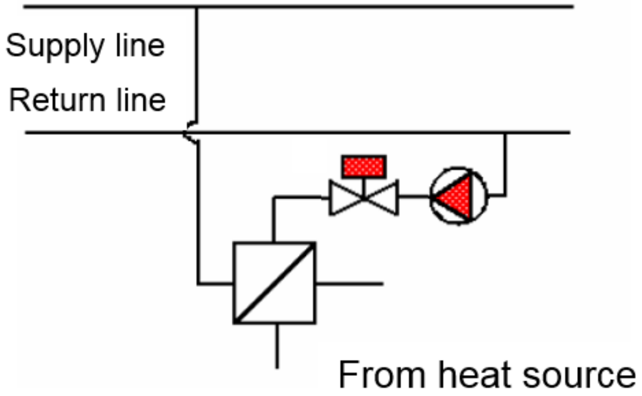
“EXTERNAL” HEAT SOURCES

- **Environmental heat**
  - Sea, Lake, Groundwater
- **Industrial processes**
  - Steel & iron and foundries
  - Pulp & paper
  - Food producers
  - Data centers
  - Drying processes (e.g. laundries), etc.
- **Existing infrastructure**
  - Other alternative energy producers (e.g. flue gas)
  - Sewers
  - Tunnel systems

HYDRAULIC INTEGRATION OPTIONS FOR HEAT GENERATORS IN DH NETWORKS

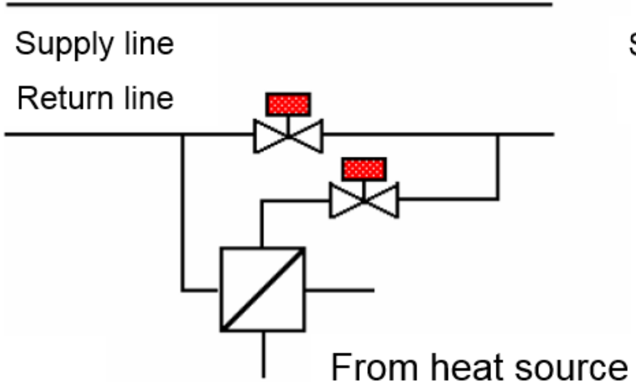
General hydraulic feed-in options

From return to supply



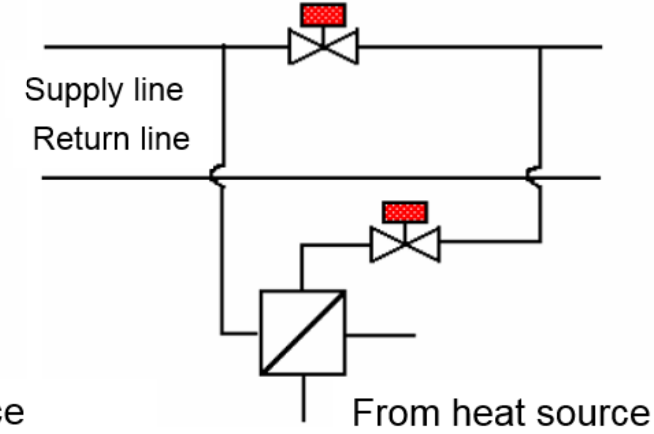
- Pump needed (Δp: SL-RL)
- „Classical“ heat generator integration
- No influence on return temperature

From return to return



- no (or small) Pump needed
- Best efficiency for heat generator
- Return temperature increases

From supply to supply



- no (or small) Pump needed
- Lower efficiency for heat generator
- Max. temperature after feed-in

INTEGRATION OF HP WITH **EXTERNAL** HEAT SOURCE IN THE DH **SUPPLY** LINE

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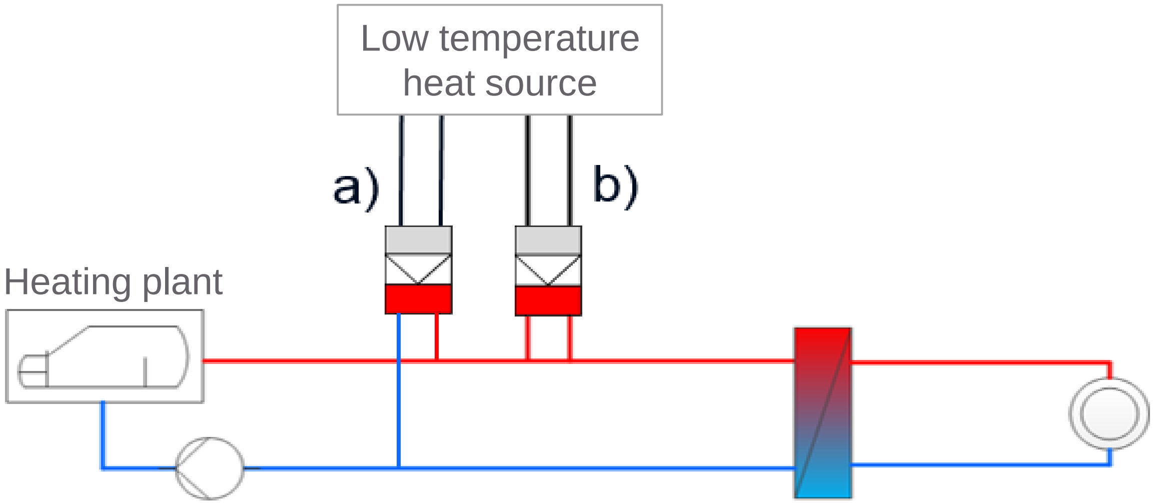
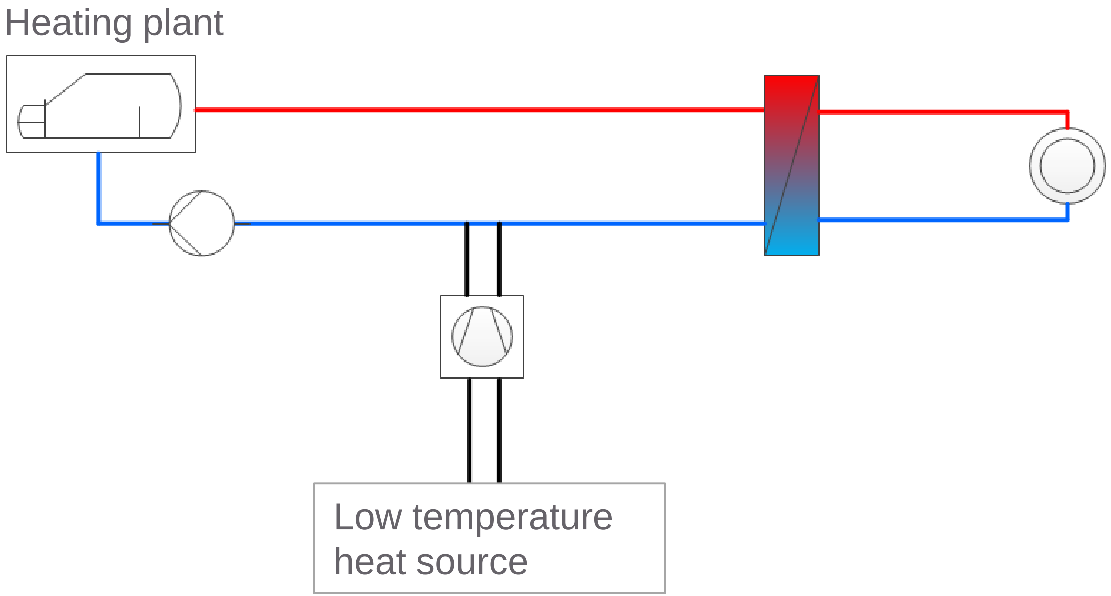
- Parallel **(a)** or serial **(b)** integration
- Integration into supply line: high temperature requirements for the heat pump
- Requirements for special Refrigerants
- Pro: Temperature boost happens close to the consumer



INTEGRATION OF HP WITH **EXTERNAL** HEAT SOURCE IN THE DH **RETURN** LINE

- Integration into return line: lower temperature of the return line → higher efficiency of the heat pump

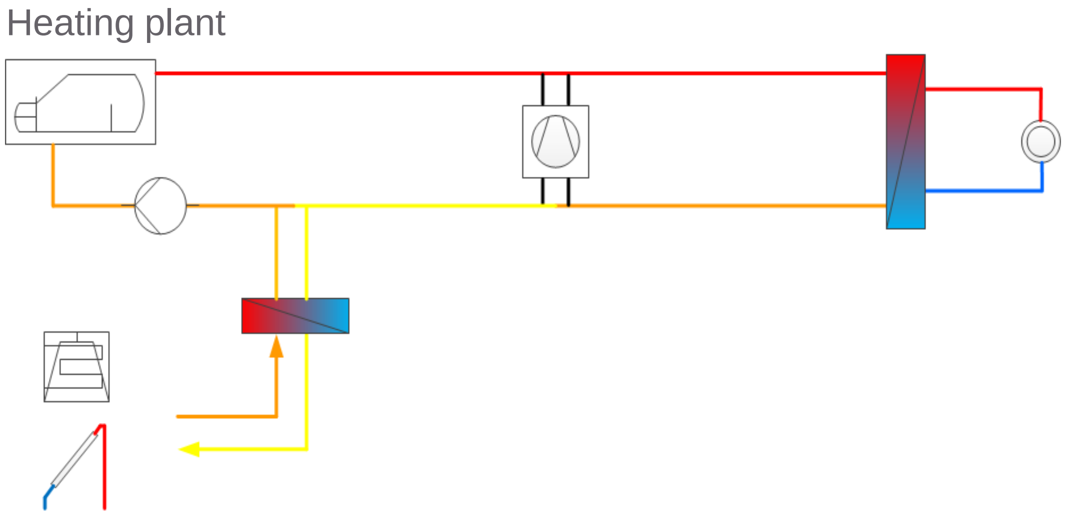
- BUT: higher return temperatures on existing heat generators



INTEGRATION OF HP WITH **INTERNAL** HEAT SOURCE IN THE DH **SUPPLY** LINE

- Note: No additional renewable energy source is brought to the DH-network by the HP (except using renewable electricity)

- Add on: return temperature reduced → additional possibility for (alternative) energy sources e.g. flue gas condensation or solar thermal

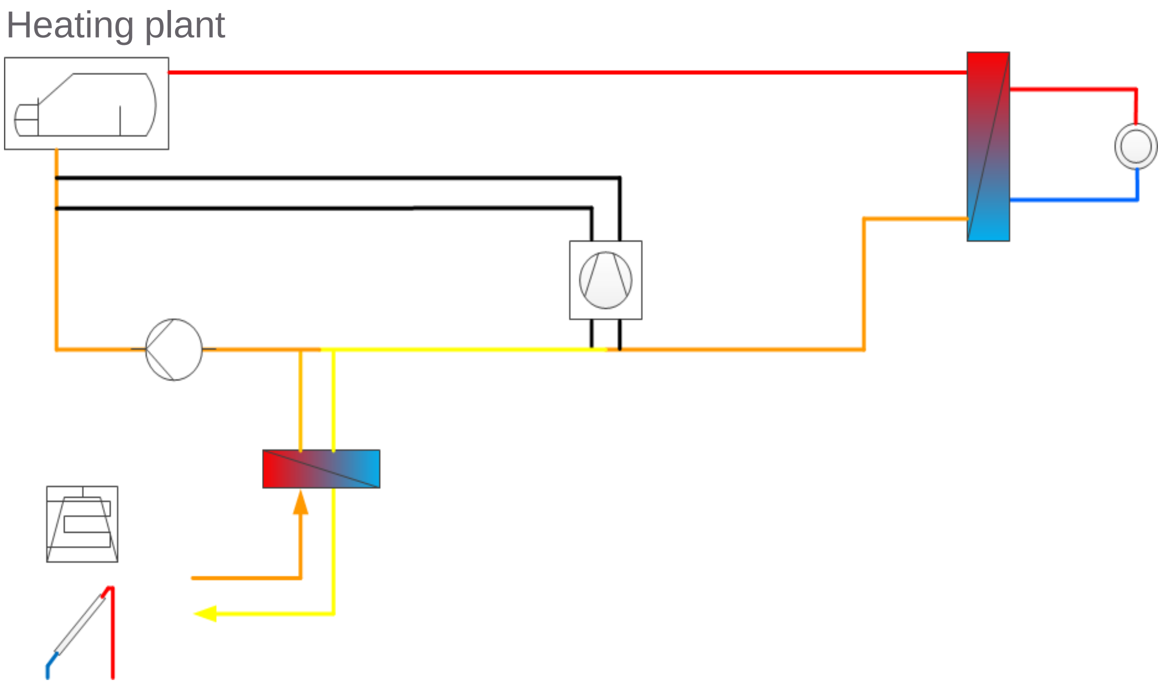


INTEGRATION OF HP WITH **INTERNAL** HEAT SOURCE IN THE DH **RETURN** LINE

- Note: No additional renewable energy source is brought to the DH-network by the HP (except using renewable electricity)

- Just return line integration leads to higher efficiency of the heat pump

- Easier integration of low-grade waste heat



INTEGRATION OF HP WITH **INTERNAL** HEAT SOURCE TO INCREASE **TRANSPORT CAPACITY**

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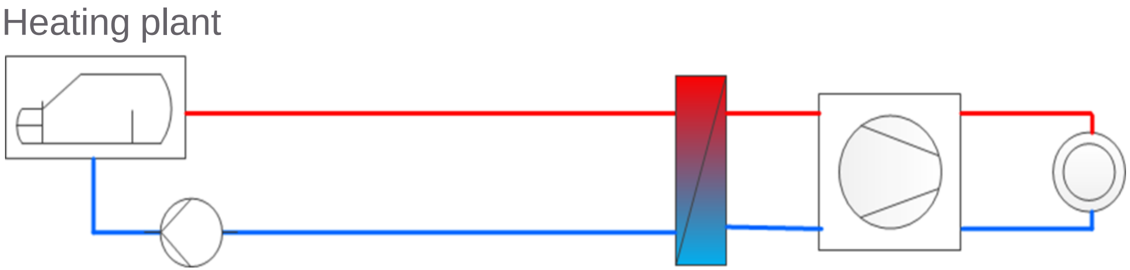
- Booster: Increasing transport capacity / temperature in secondary networks

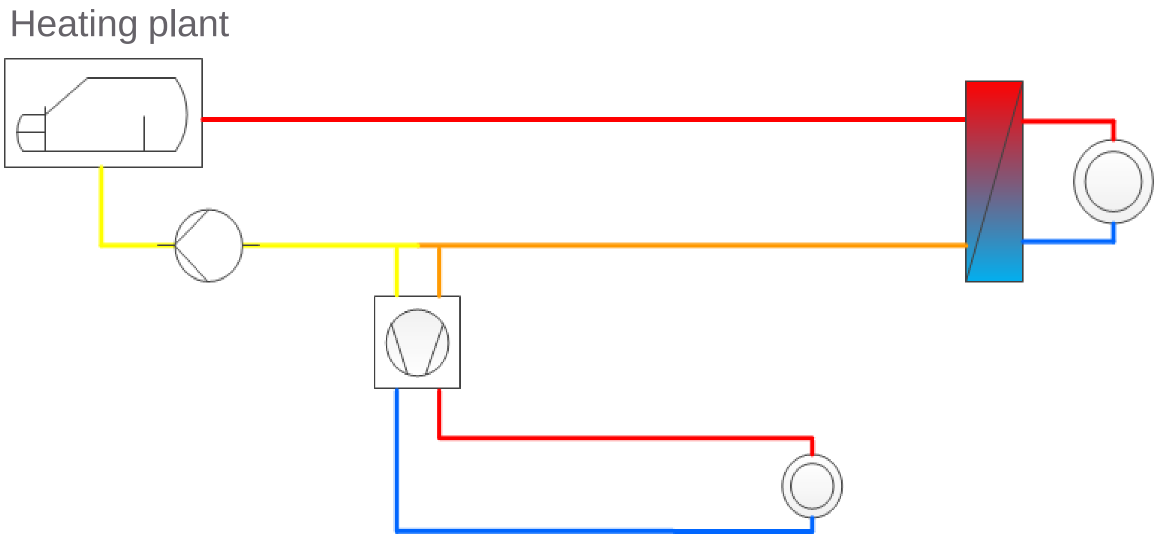
- Add on: supplying remote areas and prevent bottlenecks



INTEGRATION OF HP WITH **INTERNAL** HEAT SOURCE TO SUPPLY **SUB NETWORKS**

- Supplying sub networks

- Add on: e.g. coupling 3GDH with 4GDH (low temperature networks)



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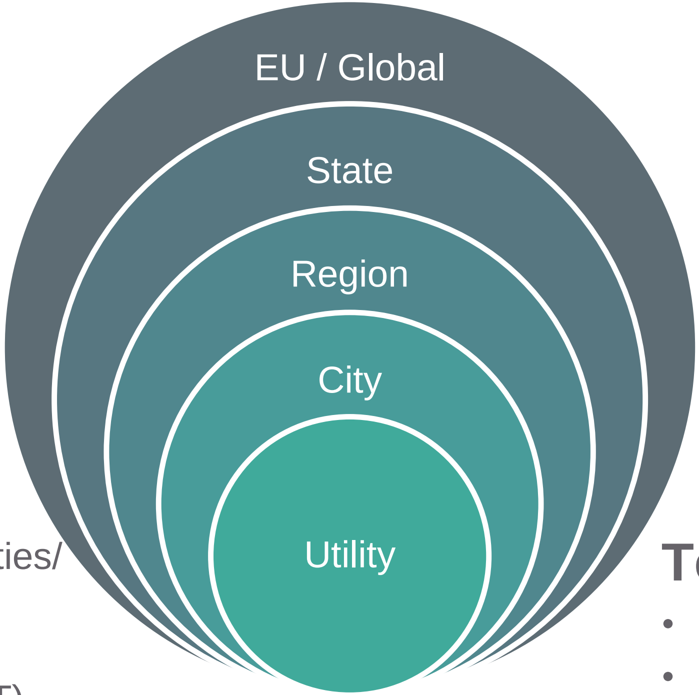
BARRIERS / CHALLENGES

Social-, economical- and technical barriers

CHALLENGES WE HAVE TO FACE

Customers

- Prosumer
- Citizens' power stations
- Service orientation and comfort (cooling requirements)
- New business and tariff models
- Supply security
- …



Society & Politics

- Demographic developments
- Decarbonization / COP21
- Energy efficiency act
- …

Market

- High volatility, pooling of flexibilities/ balancing energy markets
- Copper plate or electric fences? (e.g. electricity price zone DE/AT)
- Energy price developments (oil, gas, …)
- …

Technology & Innovation

- Digitization & Smart Home
- Energy efficiency & storage
- Electric mobility
- …

BARRIERS

Social

System change
(technology, distribution system, …)

Shifting policy
(long-term strategies needed)

Lack of confidence

Policy
(Funding other technologies but not HPs)

Lack of knowledge
(Integration, operation, …)

Fossil fuel subsidies
(do not help …)

Energy prices
(gas, el., …)

Spatial planning
(usually ignorant to available heat sources)

Technical

Availability of HP-products

Economical

Availability of technical requirements

Availability of heat sources
(location, temperature, …)

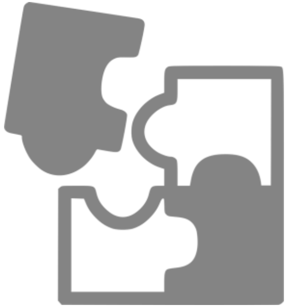
Investment costs
(HP in combination with DHC)

POSSIBLE SOLUTIONS AND OPPORTUNITIES

Holistic heat supply strategies

Sector coupling/ hybrid energy systems

Business models



POSSIBLE SOLUTIONS

… AND OPPORTUNITIES

Social

Energy policy/planning

Reduction of emissions
(air pollution, …)

Local involvement

System thinking
(closing energy cycles)

Phase-out of fossil fuel
(reduction of CO_2-emissions)

Circular energy economy
(proper system design)

Education & Instruction
(technology related)

Technical

Guidelines / Descriptions
(how to use … / install HPs)

Capacity expansion

Higher efficiency
(CHP, network, …)

Standardization
(R&D, solutions, interface)

Reduction of losses
(generation, network, …)

Economical

Fair pricing
(internalization)

Heating & Cooling
(both at same time)

Flexibility
(balancing markets)

HOLISTIC HEAT SUPPLY STRATEGIES

1 Assessment of **boundary conditions**

2 Development of **technology scenarios**

3 Decision on the **final concept**

a) Decision on the evaluation criteria and the time horizon
b) Status-Quo evaluation and scenarios (heat demand…)
c) Analyses of regulations, subsidies, political targets, energy market (especially electricity price forecast)

a) Characteristics of relevant technologies/ potential of alternative heat sources
b) Assessment of levelized heat generation costs,
c) Development of heat supply portfolio
d) Sensitivity analyses

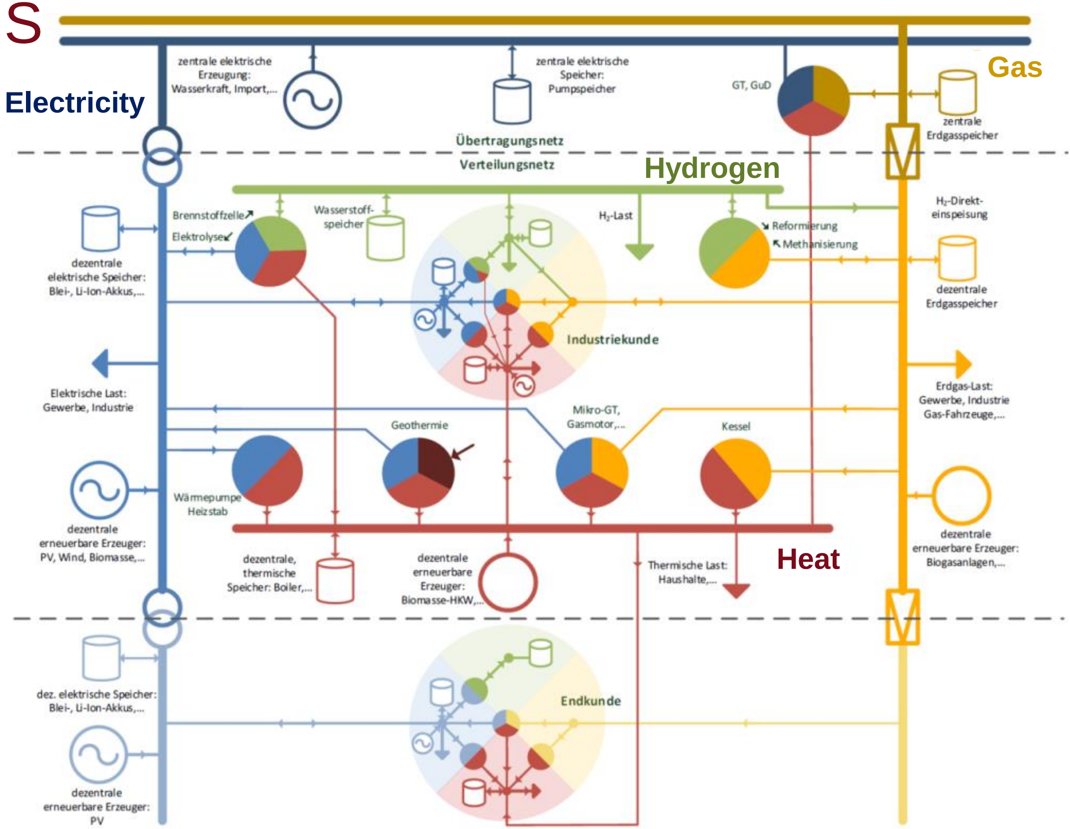
a) Selection of different variants (supply/network)
b) SWOT-Analysis
c) Multi–Criteria evaluation
d) Transition strategy & action plan for the selected variant

SECTOR COUPLING / HYBRID ENERGY SYSTEMS

The use of HPs in times of favorable electricity prices can increase the:

- **share** of renewable energy sources and the **security** of **supply** in the heating grid and
- technical **capacity** and **own consumption** in areas with a high degree of local electricity production from PV and wind energy
- **services** for power grid / energy markets

BUT: high **complexity** and very **dynamic** behavior



Source: W. H. M. Gawlik, M. Heimberger, R.-R. Schmidt, D. Basciotti, W. Böhme, G. Bachmann, R. Puntigam, K. Haider und E. Arenholz, „OPEN HEAT GRID - Offene Wärmenetze in urbanen Hybridsystemen," Bundesministerium für Verkehr, Innovation und Technologie, Wien, 2016.

BUSINESS MODELS

Innovative approaches are needed

Existing business and financing models are often unsuitable for the integration of (decentralized) heat pumps in DH networks!

- Digitization
- Regionality
- Fuel substitution
- Specific services
- System optimization
- Flexible tariff models
- Holistic system concept
- Financing and contracting
- Waste heat / cooling energy
- Set up “heat stock exchange”
- Reduction of system temperatures

1 Key Partnerships
Customers;
Energy and heat suppliers;
Manufacturers;
Authorities and municipal administrations

Data centers;
Waste heat;
Contracting companies

2 Key Activities
Acquisition;
Cross-selling;
Key accounts

Specific services

3 Key Resources
Fuels;
Infrastructure;
Human resources

Financing and Contracting

4 Value Proposition
Reliable heat distribution;
Classic DH;
Product bundles and packages;
Individual contracts for industrial and commercial customers

Lower temperature levels

5 Customer Relationships
Cost transparency;
Comprehensive service packages;
Quick troubleshooting

6 Channels
Multi-channel distribution;
Key-Account manager;
Info- and call centers;
Advertisement

Social Media (Blogs, Apps, …)

7 Customer segments
Private and business customers;
Public property;
Housing developers;
Property developers and management;
Housing and settlement cooperatives;
Authorities and municipal administrations

8 Cost Structure
Fuels; Heat generation; Staff

9 Revenue Streams
Fixed and variable prices; Additional packages (e.g. „carefree“)

New financing and tariff models; Stock exchange; Offering „Öko-Wärme” tariffs

Source: AIT

SUCCESS FACTORS

WHAT DO WE NEED?

- Strong partners: companies, institutes, start-ups, etc.
- Projects: demo, best practice, experiences, motivation
- Learning by doing: requires pioneers who are willing to "pay its dues“
- Energy spatial planning: localizing waste heat, avoiding double infrastructure
- Standardized solutions: R&D, degression of costs, economy of scale
- Price signals: to the use of fossil fuels, reduce the burden from tax and levy on clean energy

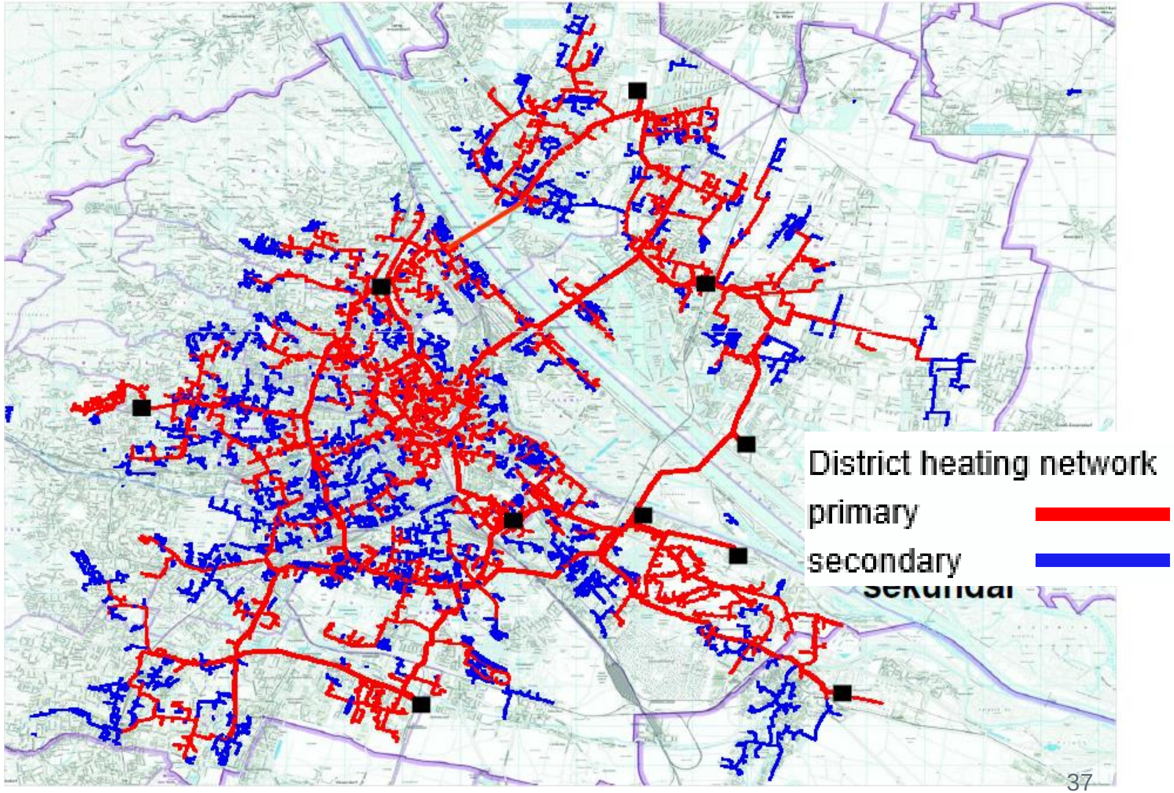
MONITORING AND OPTIMIZATION

District Boost:

Application of heat pumps in the district heating network of Vienna

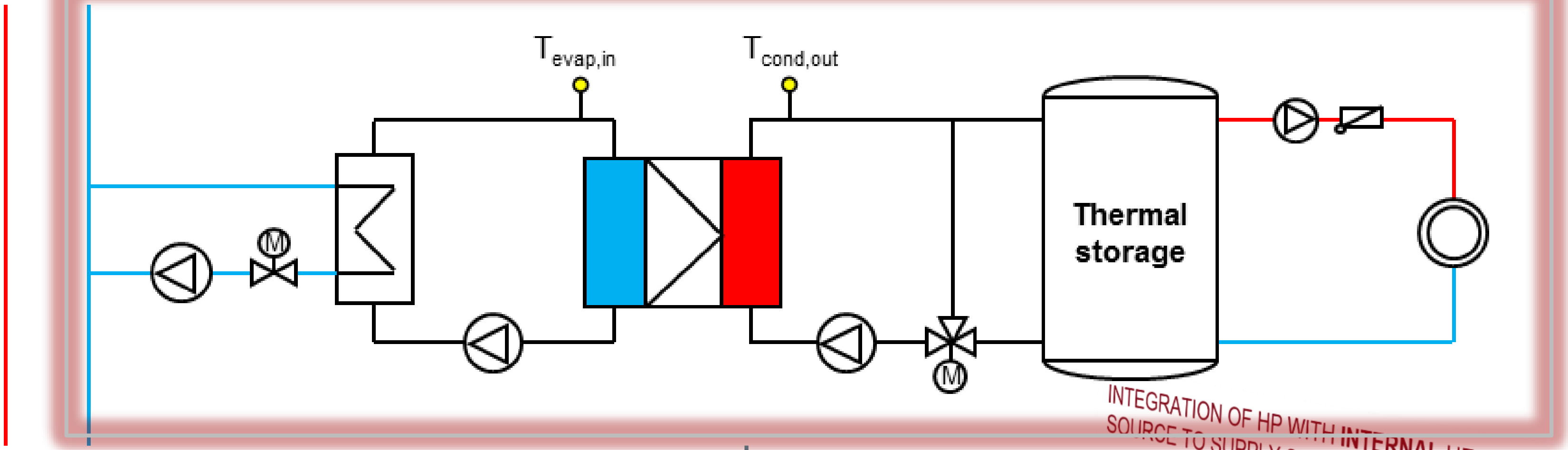
PILOT PLANT – DISTRICT HEATING NETWORK VIENNA

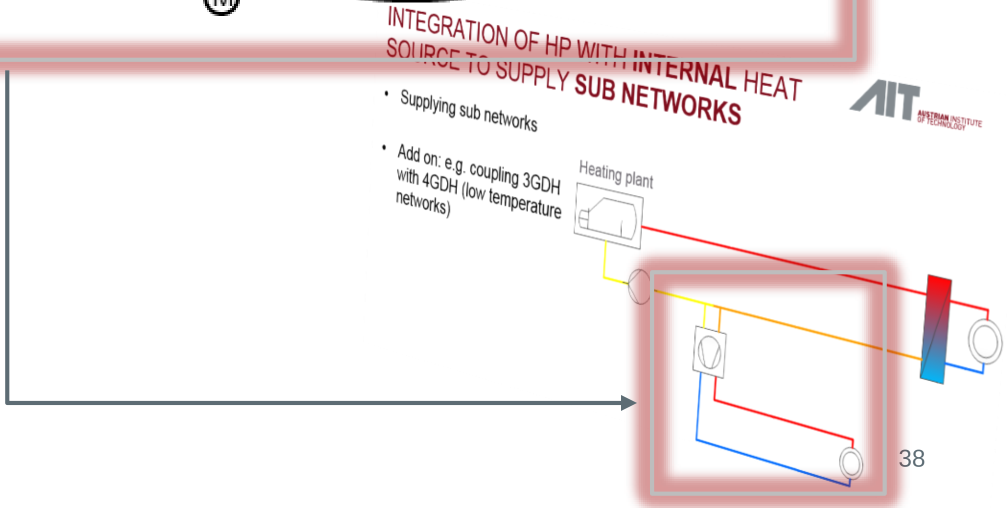
- Heat generation: ~ 6 TWh/a
- Primary net ≈ 560 km
- Secondary net ≈ 630 km
- T_{supply} prim. 80 – 150 °C
- T_{supply} sec. 63 – 90 °C



Source: B. Windholz et al., Application of heat pumps in the district heating network of Vienna, Smart Energy Systems and 4th Generation District Heating, 2017

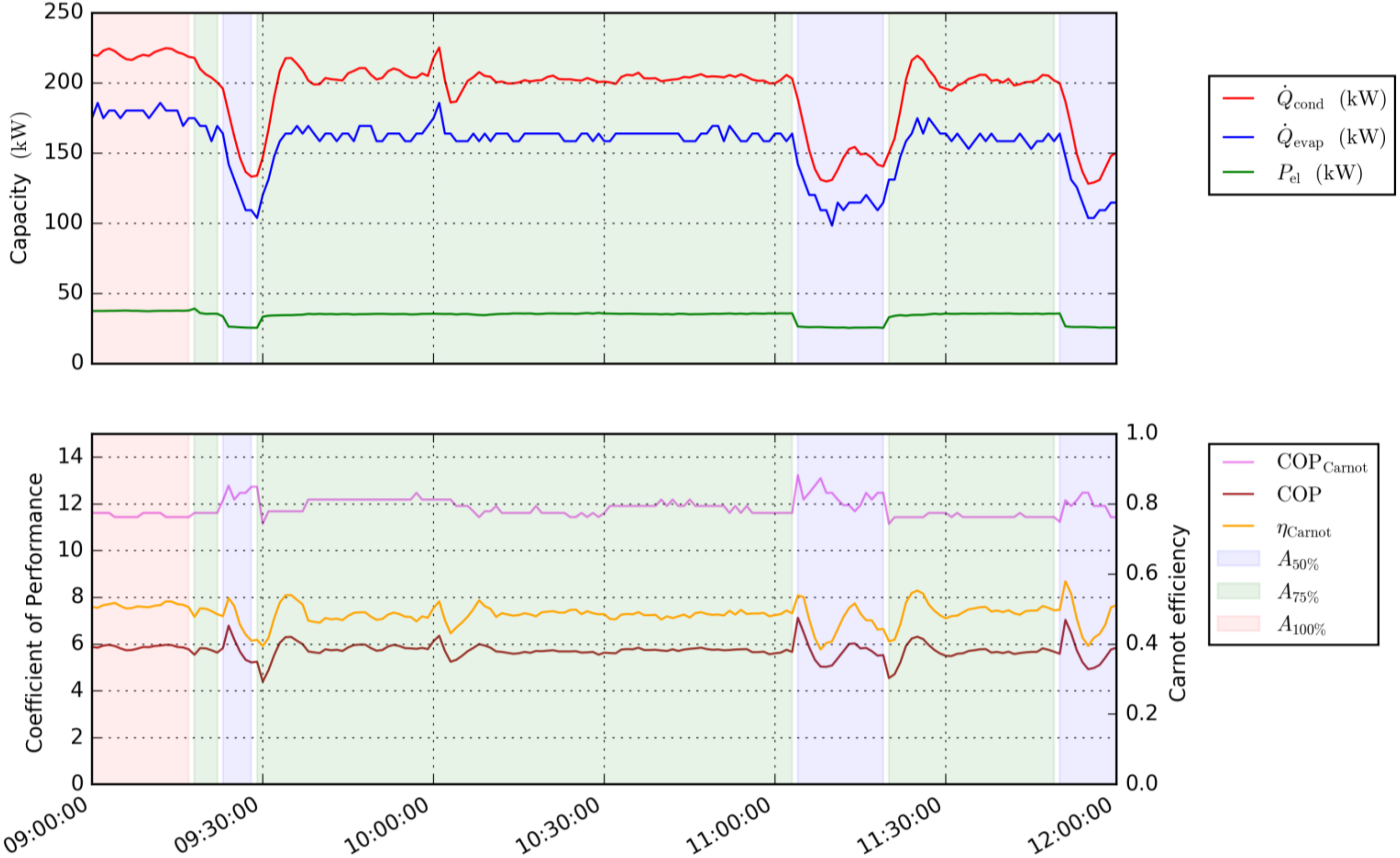
PILOT PLANT – SIMPLIFIED SCHEME





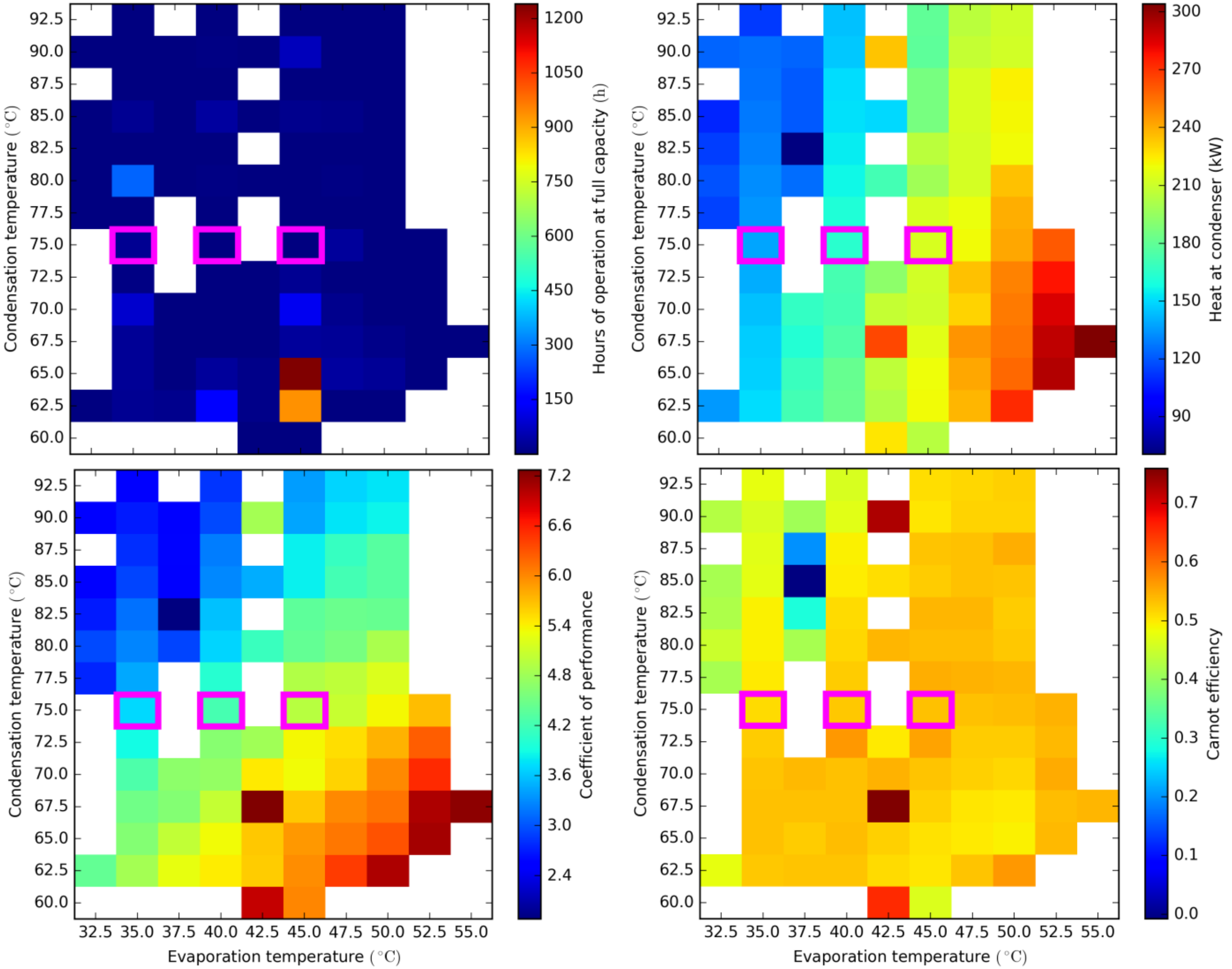
Source: B. Windholz et al., Application of heat pumps in the district heating network of Vienna, Smart Energy Systems and 4th Generation District Heating, 2017

PILOT PLANT – ANALYSIS



Source: B. Windholz et al., Application of heat pumps in the district heating network of Vienna, Smart Energy Systems and 4th Generation District Heating, 2017

PILOT PLANT – PERFORMANCE DATA



Source: B. Windholz et al., Application of heat pumps in the district heating network of Vienna, Smart Energy Systems and 4th Generation District Heating, 2017

PILOT PLANT – SUMMARY & LESSONS LEARNED

Dimensioning

Capacity and efficiency vary within operating range

→ choose most important operating points well
→ consider most unfavorable operating points

Hydraulics and general concept is good

Thermal storage allows for

- long operating times at full load and thereby high efficiency
- potentially cheaper HP due to lower peak capacity

Further optimization possible

To control faster and more accurate

→ adapt control parameters of mixing valve

To avoid starts (transient operation) and partial load

→ adapt storage management and hysteresis of capacity slide

Monitoring and optimizing is always good

→ especially in the first months after commissioning

Measured heat output was around 23 % below the manufacturer specifications!

→ Leakage identified

→ Amount of refrigerant was to little

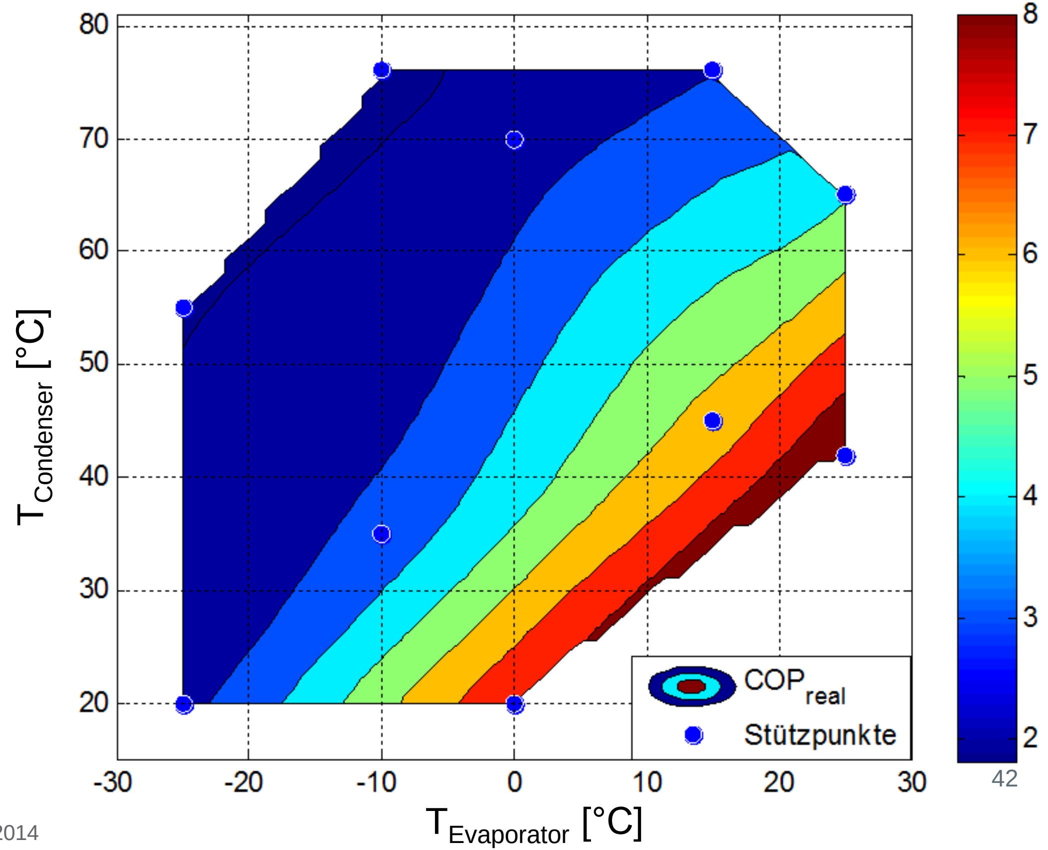
Source: B. Windholz et al., Application of heat pumps in the district heating network of Vienna, Smart Energy Systems and 4th Generation District Heating, 2017

CONSIDERATION OF EFFICIENCY WHEN SELECTING THE HEAT SOURCE

- Ratio electricity / heat price:
  - 20ct / 8ct = 2.5
  - SPF >> 2.5

Recommendations

- low network temperatures and/or high heat source temperatures
- SPF > 3.5 ... 4.0



Source: Schmidt R-R, et.al.: D2.2 Einspeiseprofile, NextGenerationHeat, AIT, 2014

DEVELOPMENTS / PROJECT HIGHLIGHTS

EUROPEAN GOOD PRACTICE EXAMPLES

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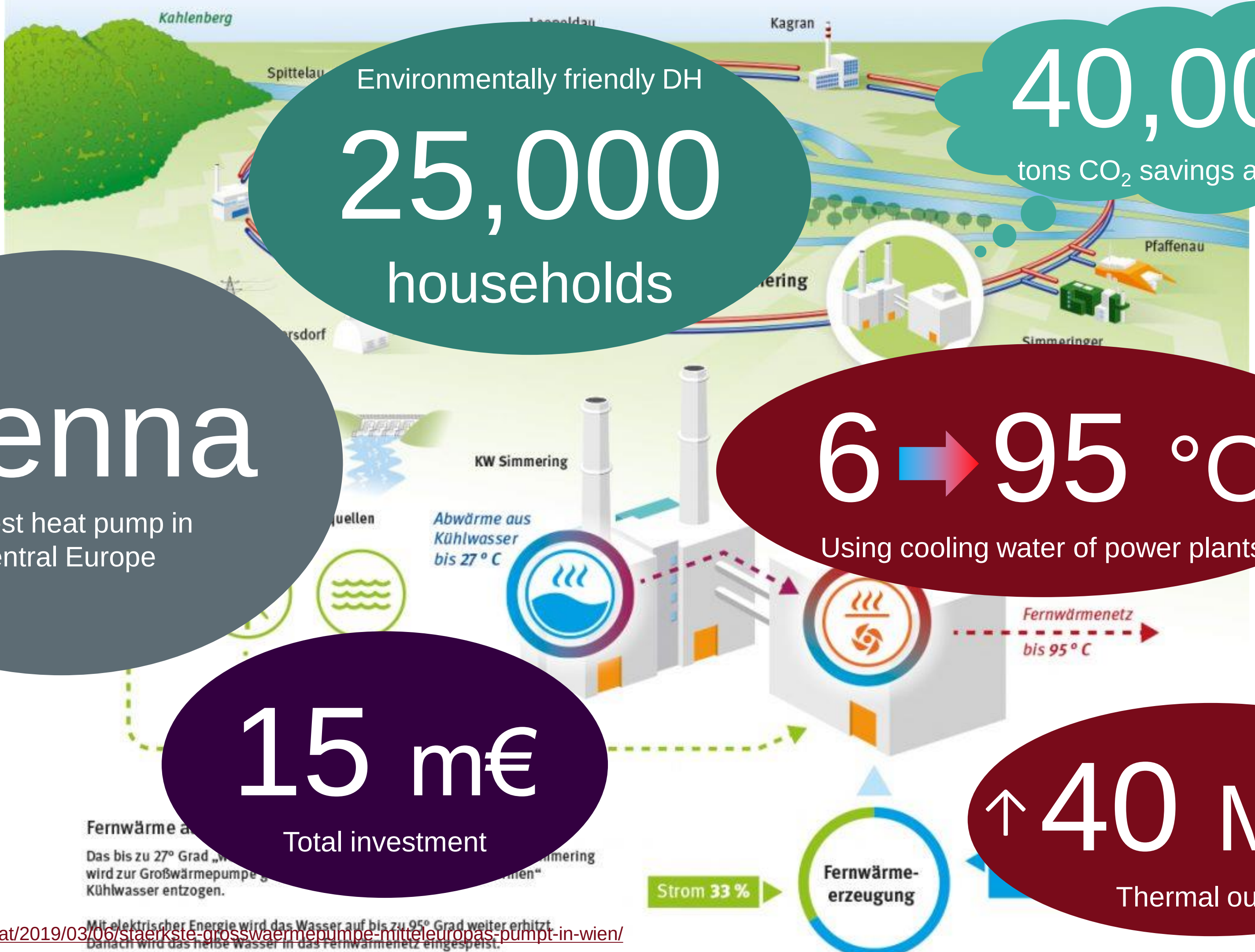
Selected examples

- Mäntsälä (FI): HP for district heating;
  Source: **Waste heat** data center; 4 HPs; COP: 3.4; $Q_{.H}$: 3.6 MW
- Mänttä-Vilppula (FI): „**steam-temperature**“ HP of up to 120 °C;
  Source: **Return line DH**; 1 HP; COP: 2.0; $Q_{.H}$: 158 kW
- Stockholm (SE): HP for district heating;
  Source: Sea water; 6 HPs; $Q_{.H}$: **180 MW**
- Drammen (NO): world's **largest** low GWP (**NH_3** (R717)) refrigerant heat pump in DH;
  Source: Fjord water; 3 HPs; COP: 3; $Q_{.H}$: 13.2 MW
- Oslo, Sandvika (NO): HP for district heating and cooling;
  Source: **Sewage** (direct extraction); 3 HPs; $Q_{.H}$: 21 MW; $Q_{.C}$: 14 MW
- Oslo, Fornebu/Rolfsbukta (NO): **first** HP-plant using **HFO-1234ze** (tetrafluoropropene);
  Source: Fjord water; 2 HPs; COP: 4.4; $Q_{.H}$: 16 MW; $Q_{.C}$: 20 MW
- Lausanne (CH): heat pump built in 1985;
  Source: **Lake Leman;** 2 HPs; COP: 4.8; $Q_{.H}$: 4.5 MW

https://www.ehpa.org/fileadmin/red/03._Media/03.02_Studies_and_reports/Large_heat_pumps_in_Europe_MDN_II_final4_small.pdf



Environmentally friendly DH

25,000

households

40,000

tons CO_2 savings annually

Vienna

Largest heat pump in Central Europe

6 → 95 °C

Using cooling water of power plants

15 m€

Total investment

↑40 MW

Thermal output

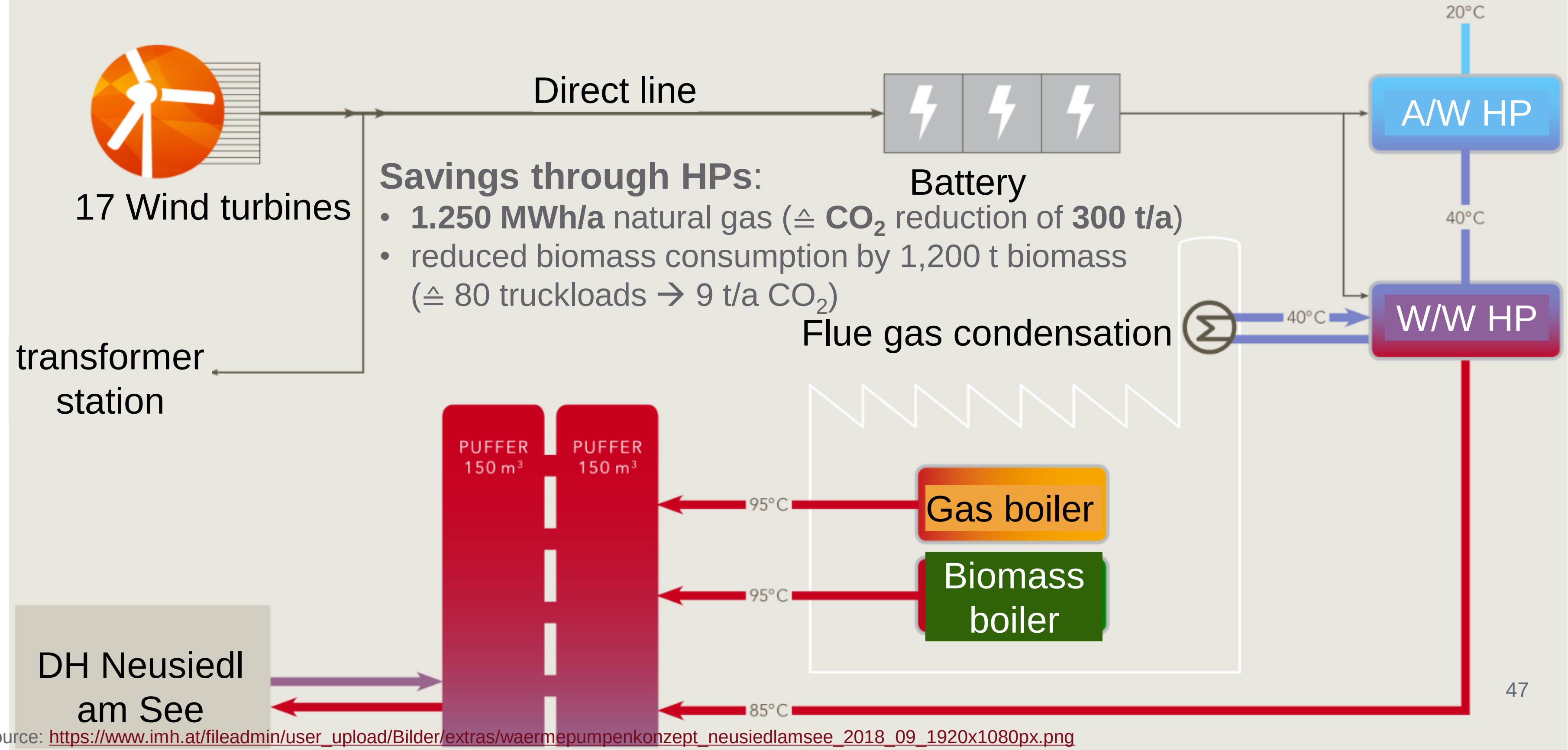
https://blog.wienenergie.at/2019/03/06/staerkste-grosswaermepumpe-mitteleuropas-pumpt-in-wien/

POWER2HEAT – SECTOR COUPLING PROJECT IN NEUSIEDL AM SEE (AT)

- Burgenland is the region with the highest wind energy supply in Austria
  (The Parndorfer Platte is one of the windiest inland regions in Europe)
- Neusiedl am See is a preferred living space with increasing heat demand
- Installation of a high-performance HP with a direct line to the transformer station
  - **winter:** flue gas condensation from the biomass boiler to supply water with 40 °C in a cold storage tank. The cold storage tank is the energy source for the water/water (W/W) heat pump → raising the temperature level to 85 °C.
  - **summer:** biomass boiler is shut down. The cold storage tank is filled with air/water (A/W) heat pump. W/W heat pumps are operated as in winter.
- Due to a storage of 300 m³ the DH can supply for 10 hours
- In case if a wind slack, a battery storage will enable the heat pumps to be operated for a short time and then shut down in a controlled manner
- HPs: Saving of **1.250 MWh/a natural gas** and thus a **CO_2 reduction** of **300 t/a** and reduced biomass consumption by 1,200 t biomass (≙ 80 truckloads → 9 t/a CO_2)

Source: https://www.imh.at/extras/epcon-award/epcon-award-2019-voting/waermepumpenkonzept-neusiedl-am-see-energie-burgenland-fernwaerme/

POWER2HEAT – SECTOR COUPLING PROJECT IN NEUSIEDL AM SEE (AT)



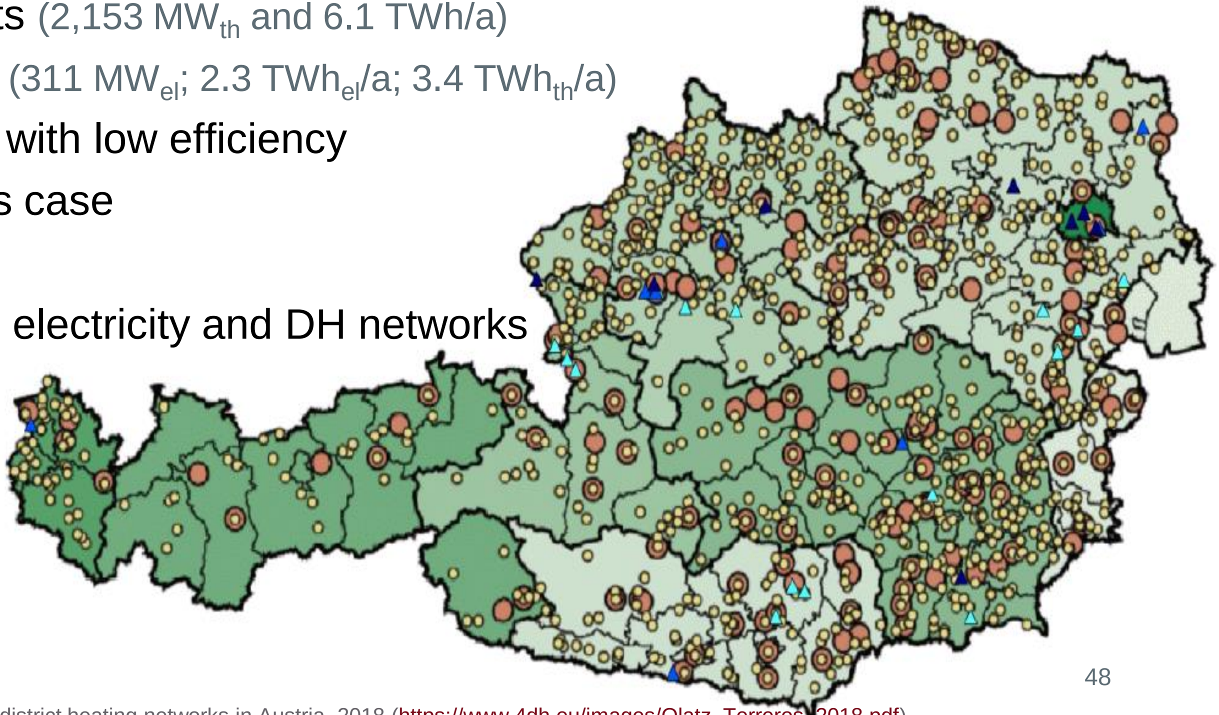
Savings through HPs:

- **1.250 MWh/a** natural gas (≙ **CO_2** reduction of **300 t/a**)
- reduced biomass consumption by 1,200 t biomass (≙ 80 truckloads → 9 t/a CO_2)

Source: https://www.imh.at/fileadmin/user_upload/Bilder/extras/waermepumpenkonzept_neusiedlamsee_2018_09_1920x1080px.png

fit4power2heat

- Austrian biomass district heating network settings:
  - 2,377 biomass heat plants (2,153 MW_{th} and 6.1 TWh/a)
  - 128 biomass CHP plants (311 MW_{el}; 2.3 TWh_{el}/a; 3.4 TWh_{th}/a)
  - old heat plants operating with low efficiency
  - highly replicable business case
- Power to heat solutions:
  - heat pumps support both electricity and DH networks



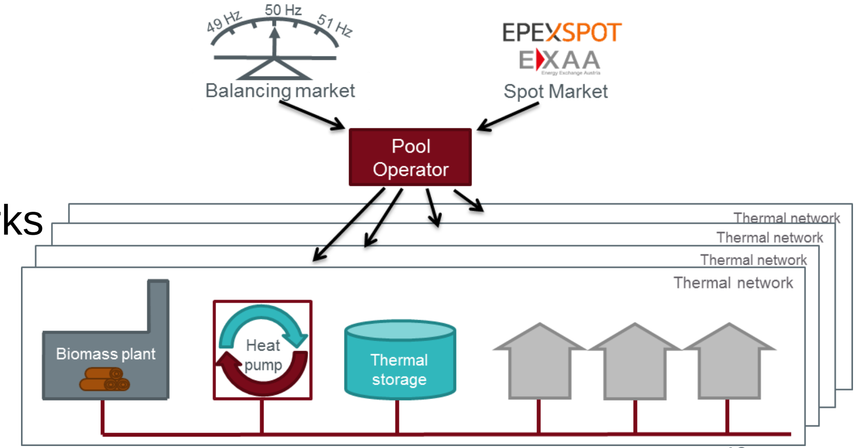
Sources:
O. Terreros, Investigating heat pump pooling concepts in rural district heating networks in Austria, 2018 (https://www.4dh.eu/images/Olatz_Terreros_2018.pdf)
https://www.biomasseverband-ooe.at/uploads/media/Downloads/Publikationen/Bioenergie_Atlas/Bioenergie-Atlas_Oesterreich_2019_klein.pdf

fit4power2heat

Project concept

- Integration of heat pumps in rural district heating networks
- Development of feasible use cases and potential business models

- Synergies between heat and electricity market
- Participation in the electricity markets:
  - Day-ahead SPOT market
  - Balancing markets (secondary and tertiary)
- Heat pump pooling over several heating networks



Source: O. Terreros, Investigating heat pump pooling concepts in rural district heating networks in Austria, 2018 (https://www.4dh.eu/images/Olatz_Terreros_2018.pdf)

fit4power2heat

Outcomes

The integration of heat pumps in rural district heating networks is technically and economically feasible.

Reduction of heat generation costs

- Some scenarios show up heat generation cost reduction up to 15 % (12,600 €/year).
- Most attractive case: combination of **day-ahead spot** and **secondary market**

- **Capacity increase** in the district heating network
- **Prolongation of the lifetime** of the existing old boilers

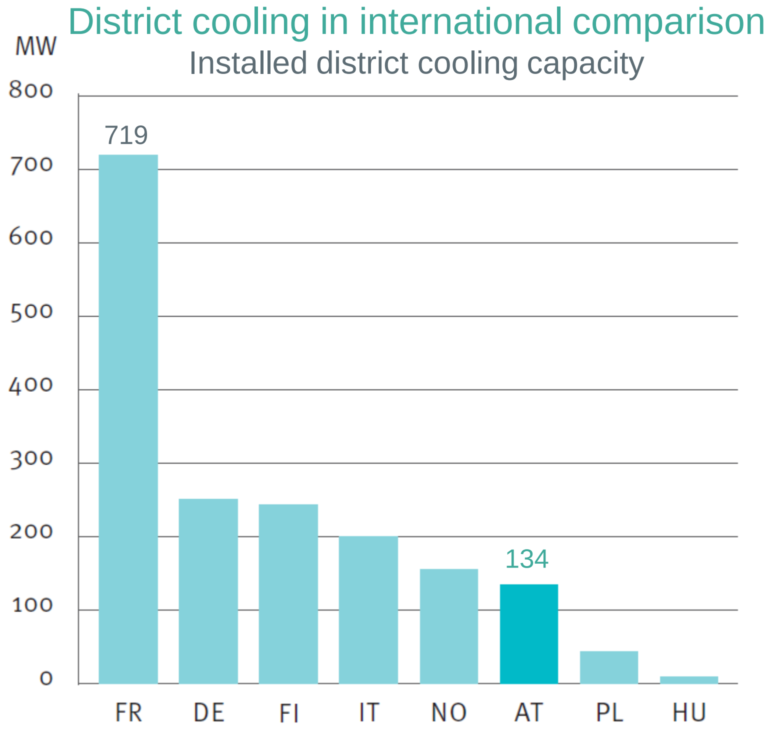
Source: O. Terreros, Investigating heat pump pooling concepts in rural district heating networks in Austria, 2018 (https://www.4dh.eu/images/Olatz_Terreros_2018.pdf)

FUTURE MARKET: DISTRICT COOLING

- Europe < 50% of all office space air-conditioned (USA, Japan ~ 80%)
- FR: largest district cooling market in Europe
- Possibility to increase efficiency (Trigeneration | CCHP)

Europe (survey)

- 22 HP systems for heating and cooling purposes
- Showcase plants:
  - Helsinki (Kari Vala), Oslo (Sandvika), Stockholm (Nimrod)



https://www.gaswaerme.at/media/medialibrary/2018/09/zasp2018_final.pdf
https://www.euroheat.org/wp-content/uploads/2016/04/160420_1600_1730_2nd-place_Andrei-David_presentation.pdf

HIGH TEMPERATURE HEAT PUMP (HT-HP)

- Project DryFiciency (12 partners)

DryF

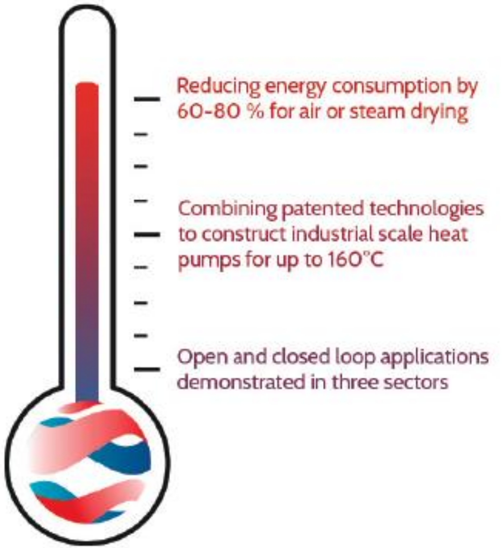
- Horizon2020 Innovation project for Waste Heat Utilization in Industrial Drying Processes
- Drying: 12 - 25% of industrial energy consumption
  - Goal: up to 80% energy saving
- Demonstration of two HT-HP (400 kW) up to 160 °C
  - Agrana
  - Wienerberger

AGRANA

Leading supplier of sugar in CE

Wienerberger

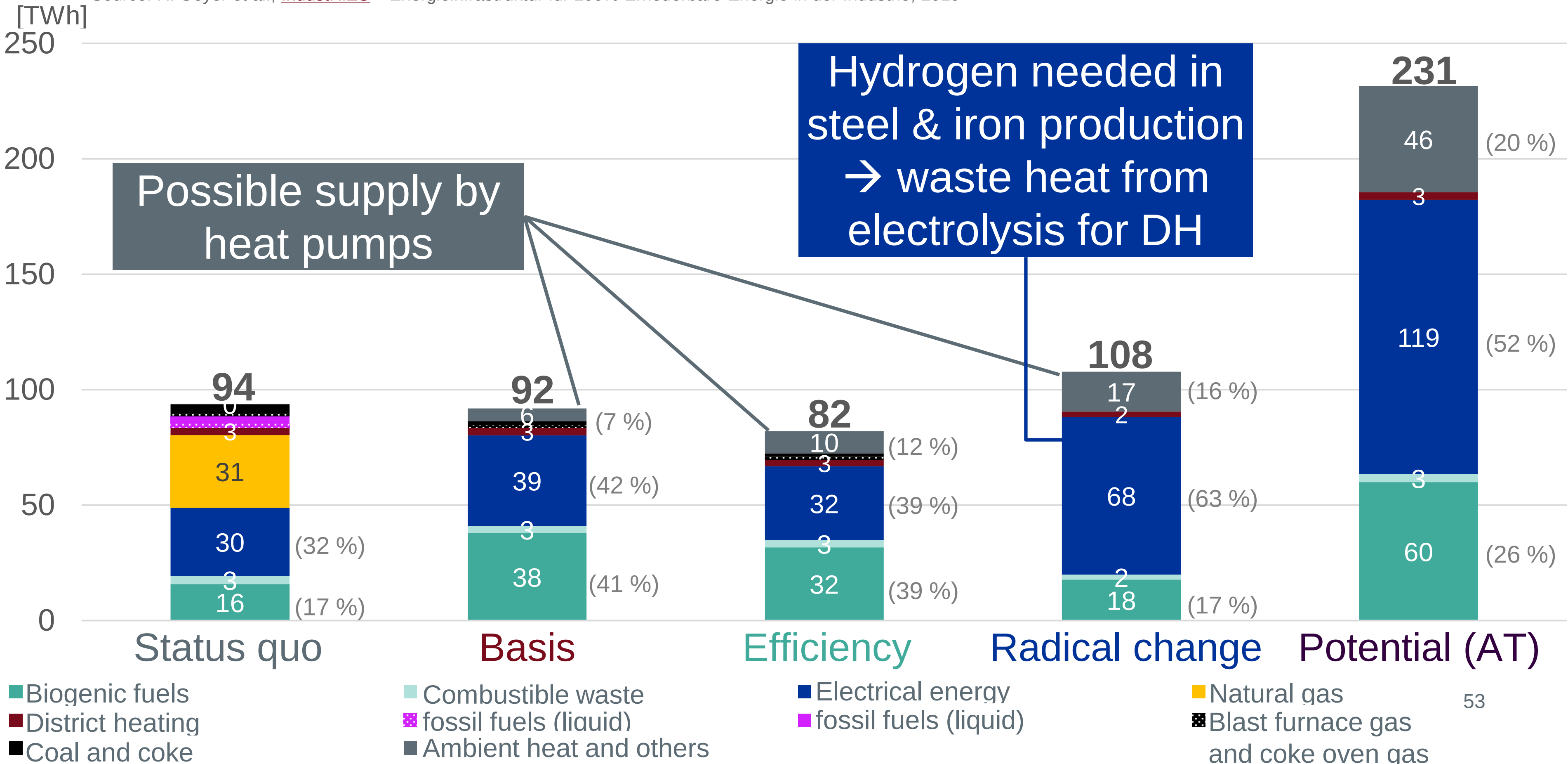
World´s largest producer of bricks.



http://dry-f.eu/
https://www.ehpa.org/fileadmin/red/03._Media/03.02_Studies_and_reports/Large_heat_pumps_in_Europe_MDN_II_final4_small.pdf

SUPPLY OF INDUSTRY BY RENEWABLES

Source: R. Geyer et al., IndustRiES – Energieinfrastruktur für 100% Erneuerbare Energie in der Industrie, 2019



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CLOSING

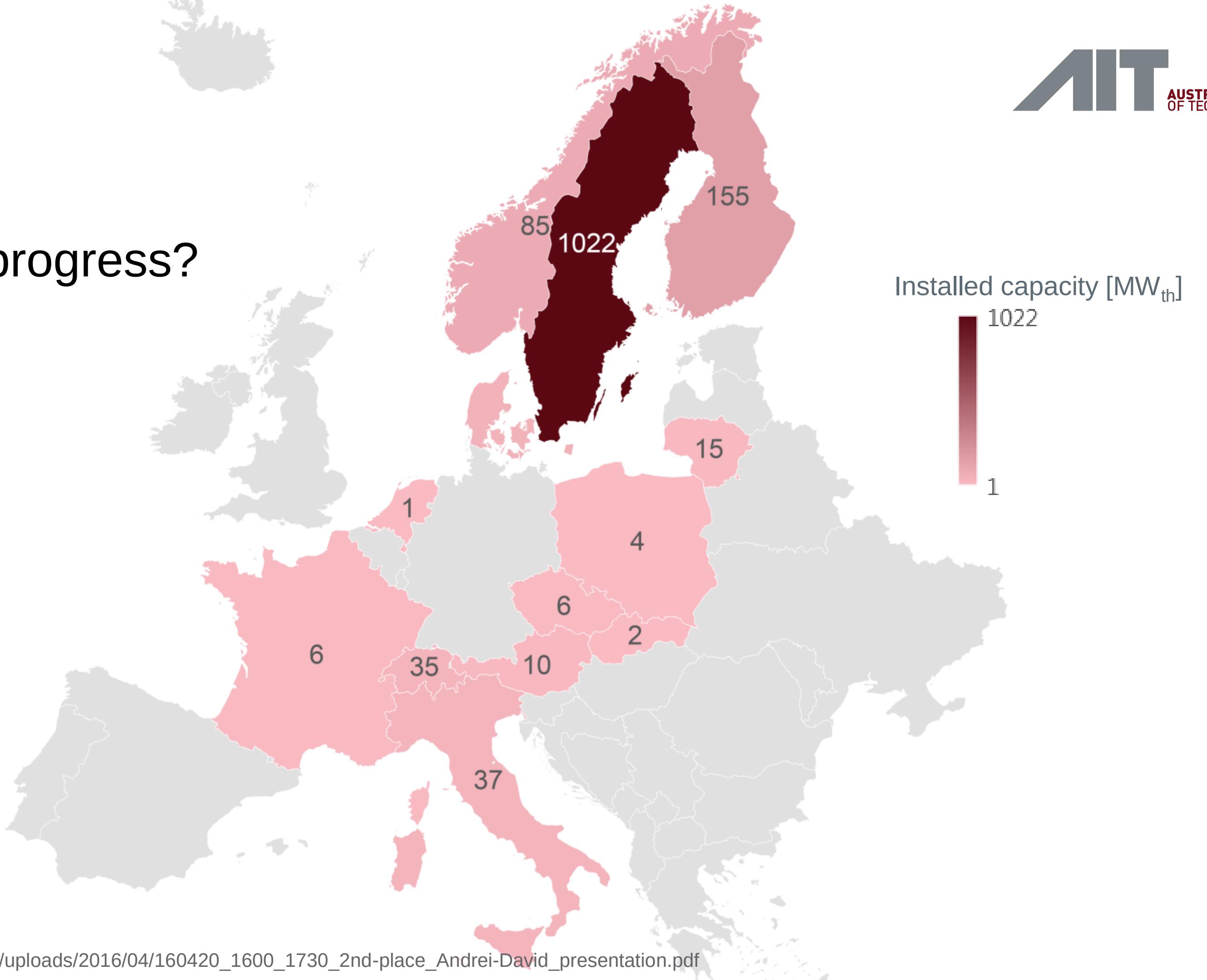
Progress

Conclusions

Key messages

Announcement

Is there a progress?



https://www.euroheat.org/wp-content/uploads/2016/04/160420_1600_1730_2nd-place_Andrei-David_presentation.pdf

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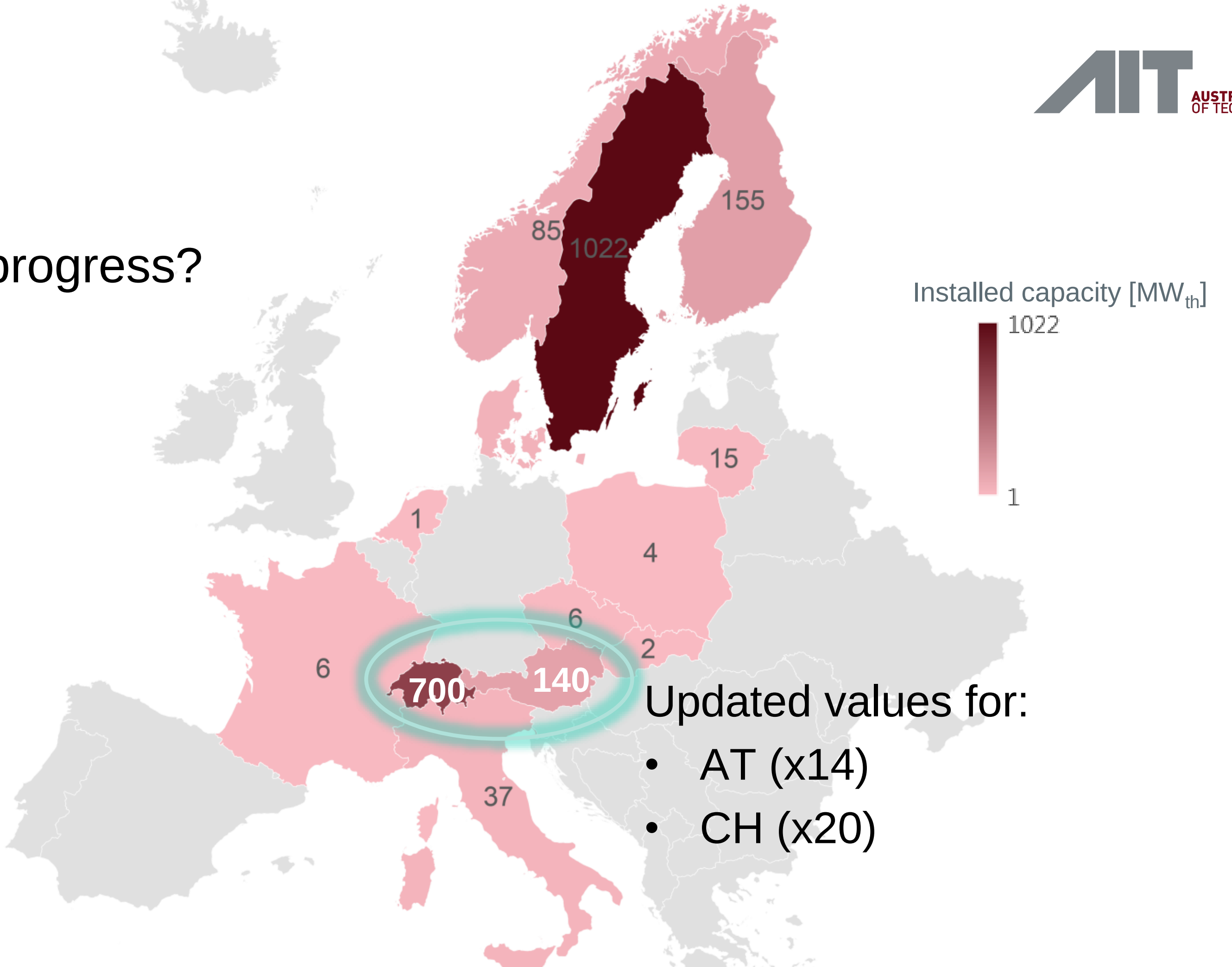
Is there a progress?



Updated values for:

- AT (x14)
- CH (x20)

https://www.euroheat.org/wp-content/uploads/2016/04/160420_1600_1730_2nd-place_Andrei-David_presentation.pdf

CONCLUSIONS

- **Heat pumps** can make a significant **contribution** to the **decarbonization** of the heat supply
  (simultaneous decarbonization of the electricity supply)
- HPs are "**enablers**" for other alternative energy sources
  (geothermal, solar thermal, waste heat, etc.)
- HP **potential** depends on **economic** and **political framework**
  (but also on DH grid type, generation mix and other local conditions)
- **New business models** and **application** possibilities are required / support HP integration
  (e.g. sector coupling, energy markets, pooling, heating & cooling, flexible tariffs, etc.)

Looking ahead:

- **Positive** signs for **heat pumps** in **DHC networks**
  (remarkable developments in recent years; e.g. Austria, Switzerland)

KEY MESSAGES FOR DEEP DECARBONIZATION

Price signals

High temperature Heat pumps

Lower system temperatures in District Heating networks

ANNOUNCEMENT

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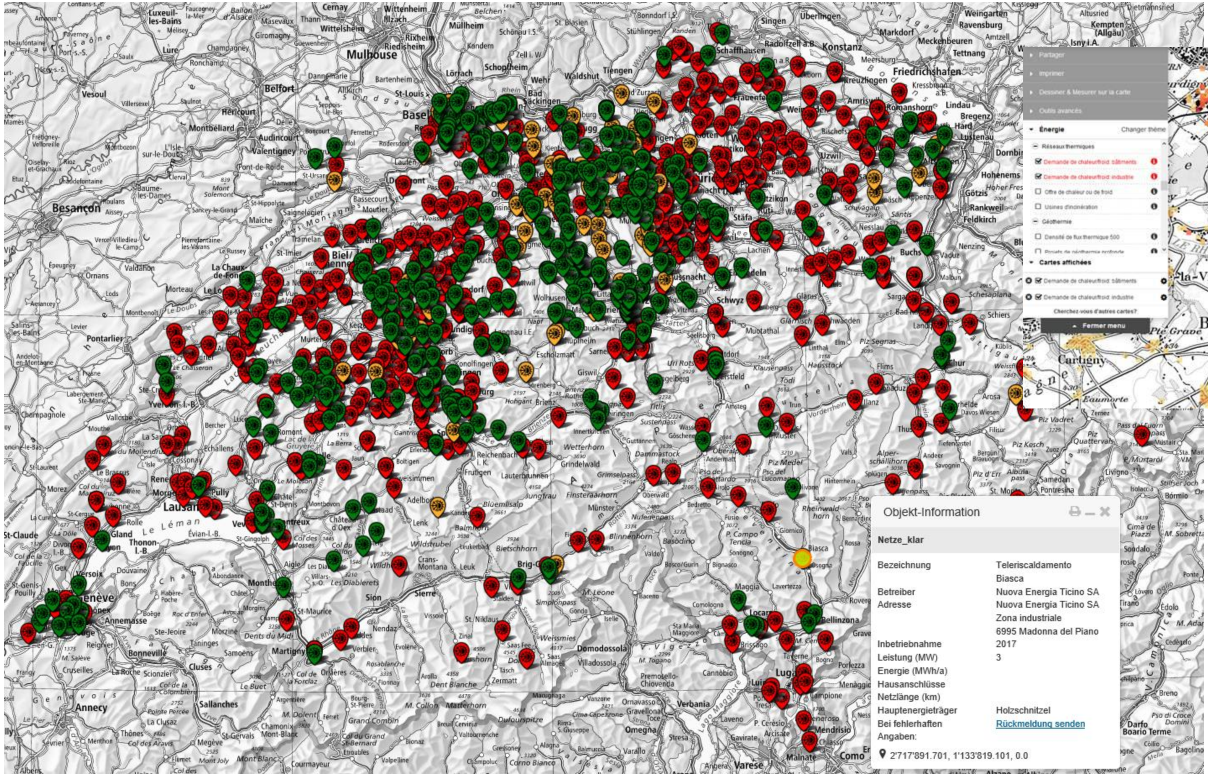
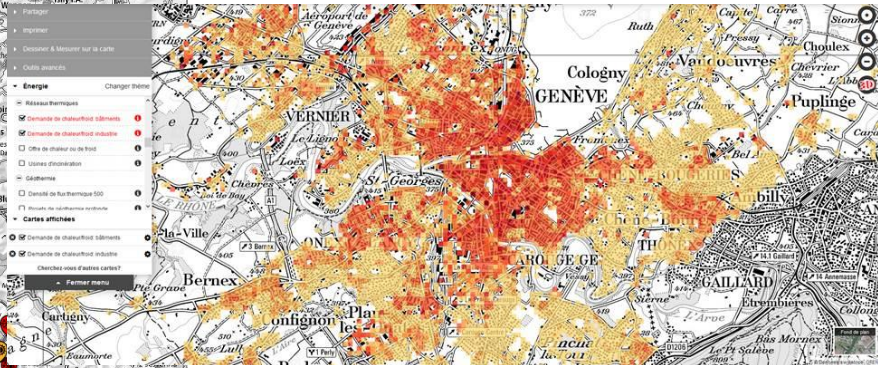
https://map.geo.admin.ch/ → category «Energy» → «thermal networks»

Hochschule Luzern





Source: https://s.geo.admin.ch/82d8014435 as of December, 18th 2019

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THANK YOU!

Roman Geyer

November 28th, 2019

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- http://heatpumpingtechnologies.org/annex47/
- https://map.geo.admin.ch/
- https://www.unige.ch/sysener/fr/colconf/seminaires/
- IndustRiES (Study how to supply the Austrian Industry by RES)
- IEA HPT Annex 48 – Task 1 Report: Case Studies of Industrial Heat Pumps in Switzerland

Acknowledgement to the University of Geneva for the possibility of this seminar

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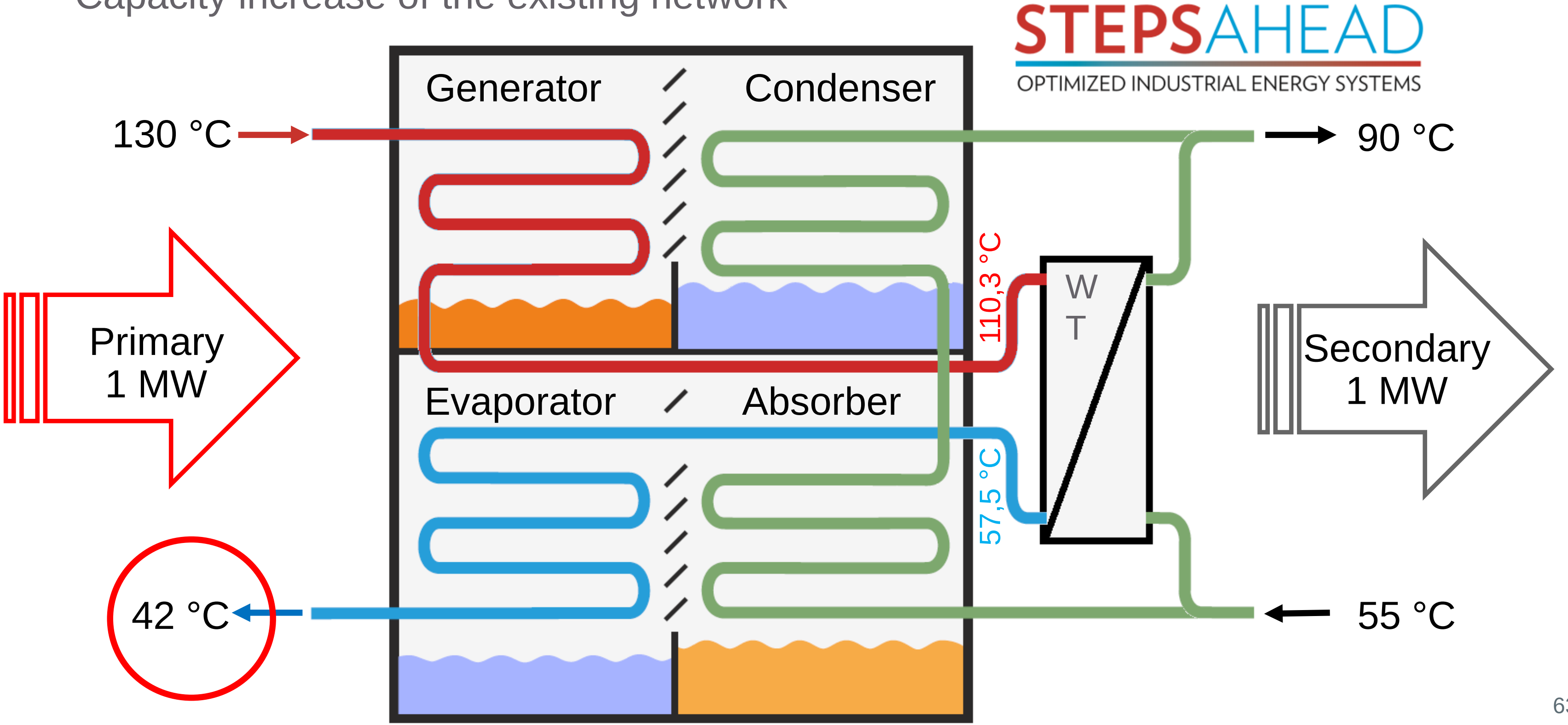
DISCUSSION

ANNEX

ABSORPTION HEAT EXCHANGER

- Reduction of the return temperature
- Capacity increase of the existing network

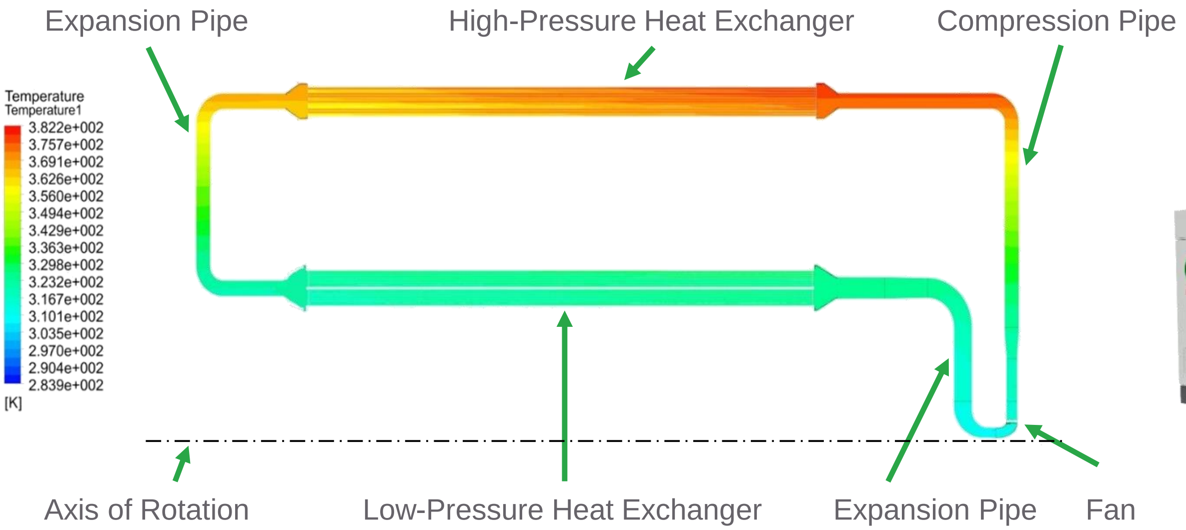


Source: Innovative Absorptionsmaschinen in Fernwärme- und Fernkältenetzen, 5FWKForum, H. Blazek, StepsAhead Energiesysteme GmbH, https://stepsahead.at/

ECOP – ROTATION HEAT PUMP

- Joule-Process
- High-Temperature 100-150 °C
- High COPs fluctuating input and output temperatures

ecop

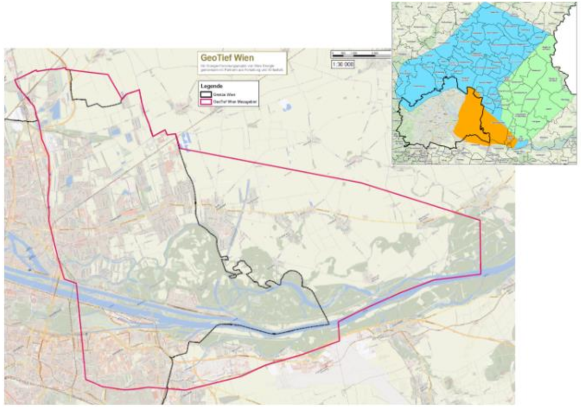


Source: Erste Testergebnisse der ECOP Rotationswärmepumpe, 5FWKForum, B. Adler, ecop Technologies GmbH, https://www.ecop.at

STRATEGIC DEVELOPMENT OF HEAT PRODUCTION

- Utilization of latent heat within flue gas (waste incineration power plant) through a high temperature heat pump (estimated capacity: 16 MW_{th})

- GeoTief Wien
  - Research project analysing the geothermal potential in eastern Vienna
  - 3D-seismic measurements in 2018 (October to end of November) in an area of about 180 km²
  - Analysing the data until 2020



Source: http://www.hp-forum.eu/wp-content/uploads/2019/05/Christoph-Segalla-Big-dreams-with-big-heat-pumps-.pdf