HEAT HIGHWAY

Heat Highway

@ World Sustainable Energy Days
2023-03-03, online

powered by klima+ energie fonds

LAND OBERÖSTERREICH

NEFI NEW ENERGY FOR INDUSTRY

Heat Highway?

- Where the **idea** comes from.
- What the **benefits** could be.
- What our **research** is about.

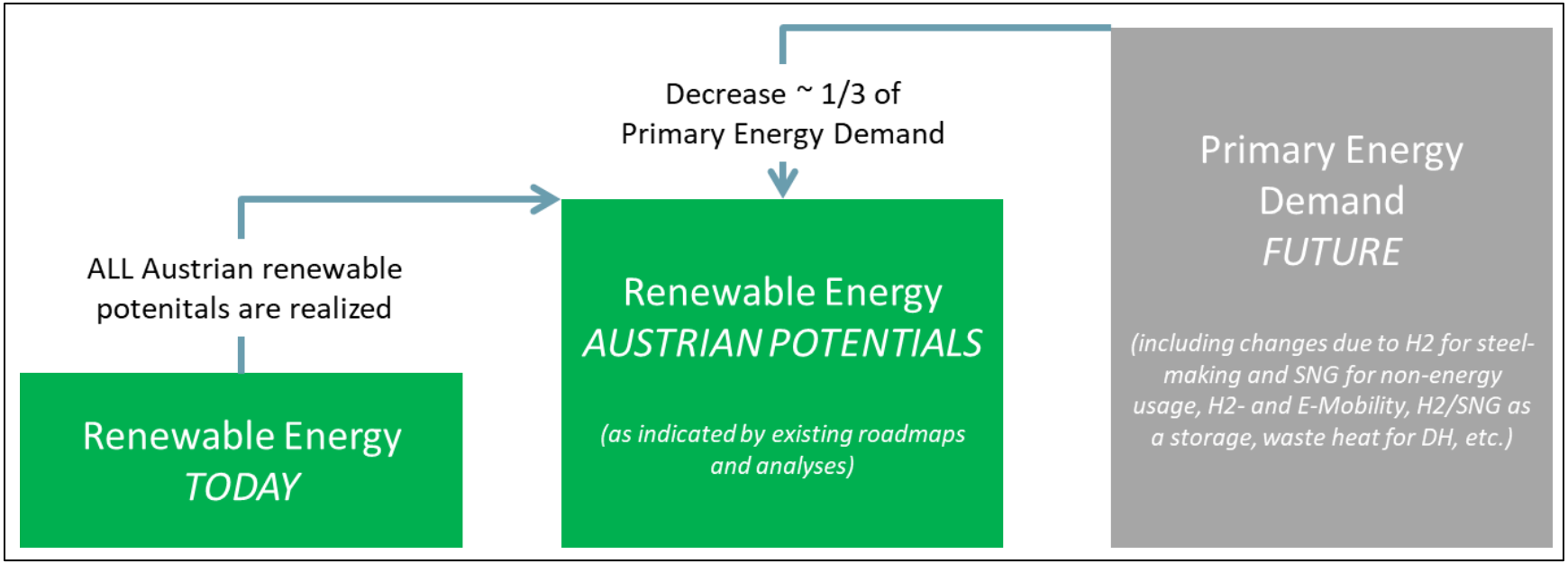
Idea & background

Focus

Heat Highway is about two major challenges:

- Implementing supra-regional district heating networks
- Utilizing industrial waste heat

Future Austrian energy demand and domestic supply

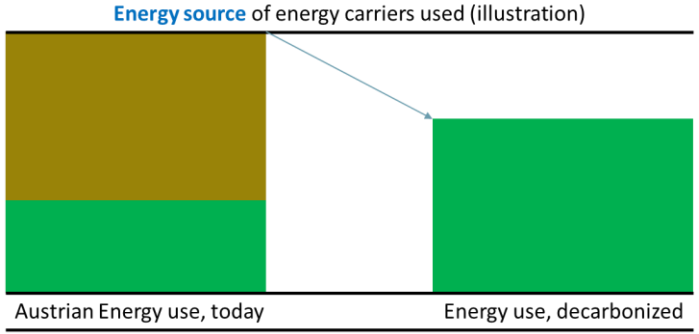


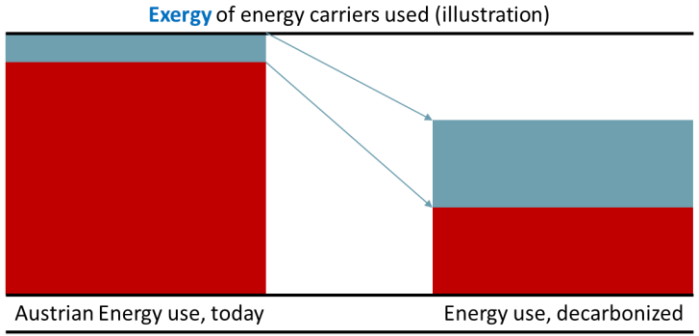
Source: Moser et al. (2018) Renewables4Industry

HEAT HIGHWAY

Exergy level of future domestic supply

- **Domestic consideration: Energy would be "scarce"** ("scarcity" in its economic sense, i.e. supply vs. demand)
- **Macroeconomic view: Austria will remain an import country**
- **Exergy is even more scarce**
  - **It must be a concern to be energy efficient in the economy as a whole.**
  - **It must be a concern to use energy at the right level of exergy.**



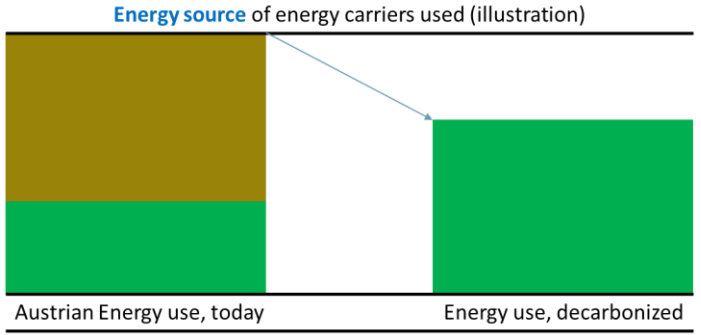


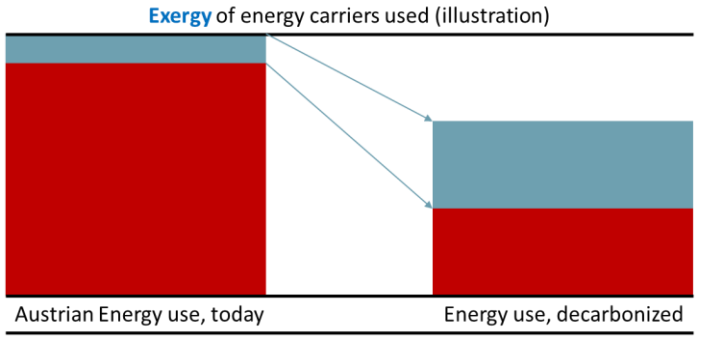
Source: Moser et al. (2018) Renewables4Industry

Waste heat utilization

- **Exergy orientation**
  - **needs heat recovery and**
  - **waste heat utilization**

- **Waste heat utilization is often “challenging”:**
  - High temperature levels of district heating
  - Other waste heat is already occupying the DH networks
  - Waste heat lies outside of the metropolitan areas
  - Waste heat is primarily available in summer





Source: Moser et al. (2018) Renewables4Industry

Demand concentration

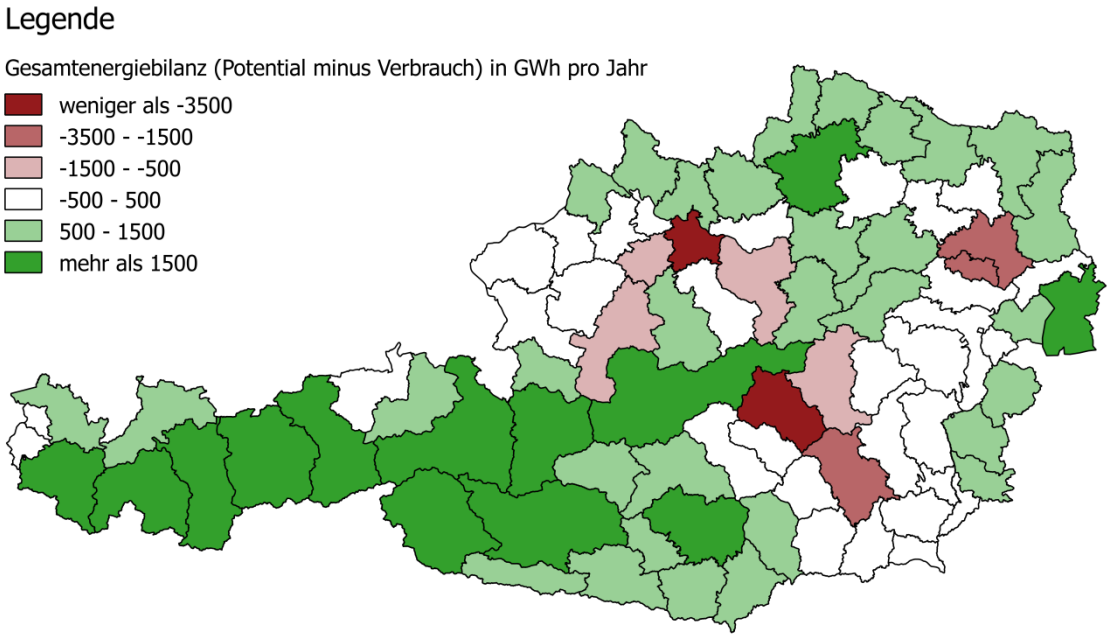
Graph shows the **balance** from:

+ Renewable Energy Supply

- Current Energy Demand

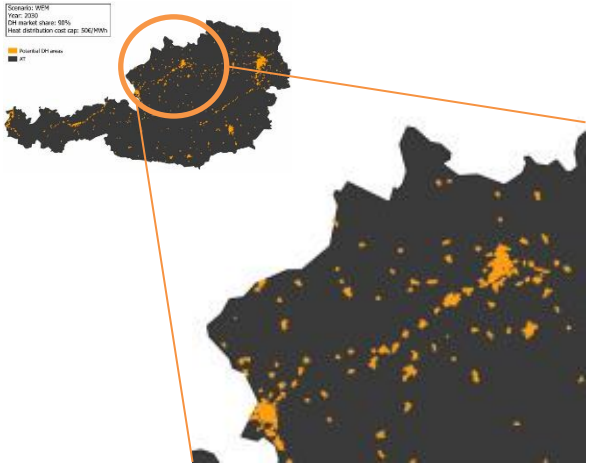
Simplified: Renewables energy potential is almost equally **distributed** (biomass, sunshine)

Demand centers around the main cities and industrial agglomerations

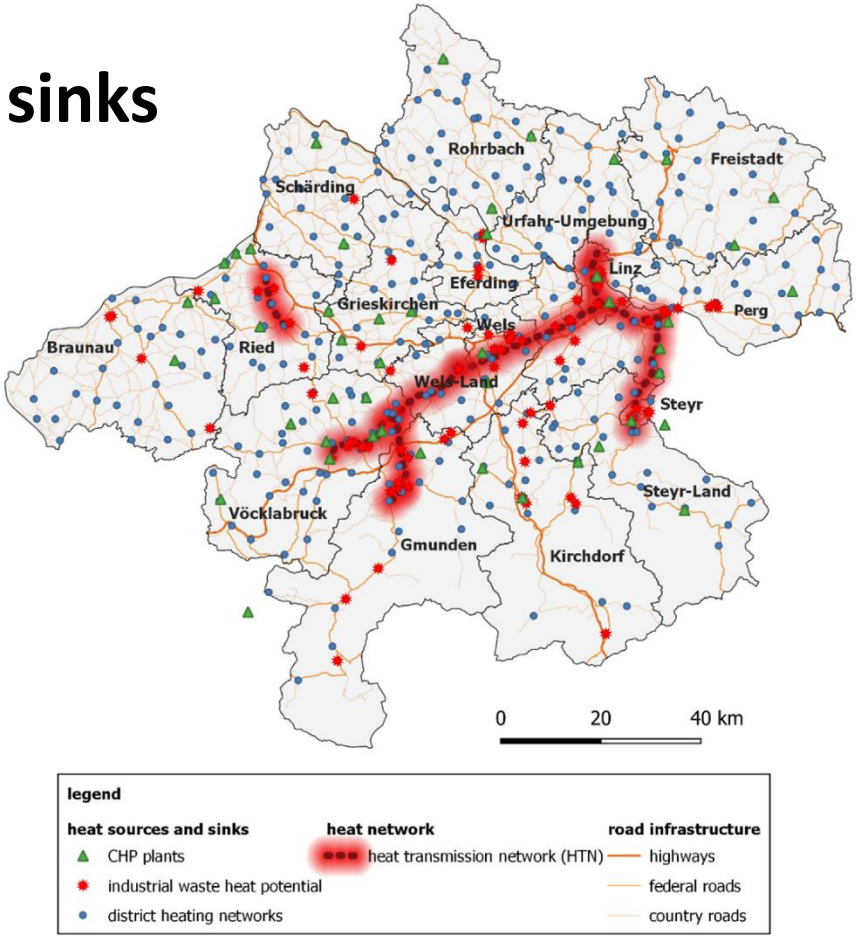


Source: Sejkora et al., University of Leoben, in: Renewables4Industry

Connecting sources & sinks in Upper Austria



Source: Fallahnejad et al. (2022) Fallahnejad. Energy Volume 259, 15 November 2022, 124920



Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Generic scheme:
Supra-regional district heating networks

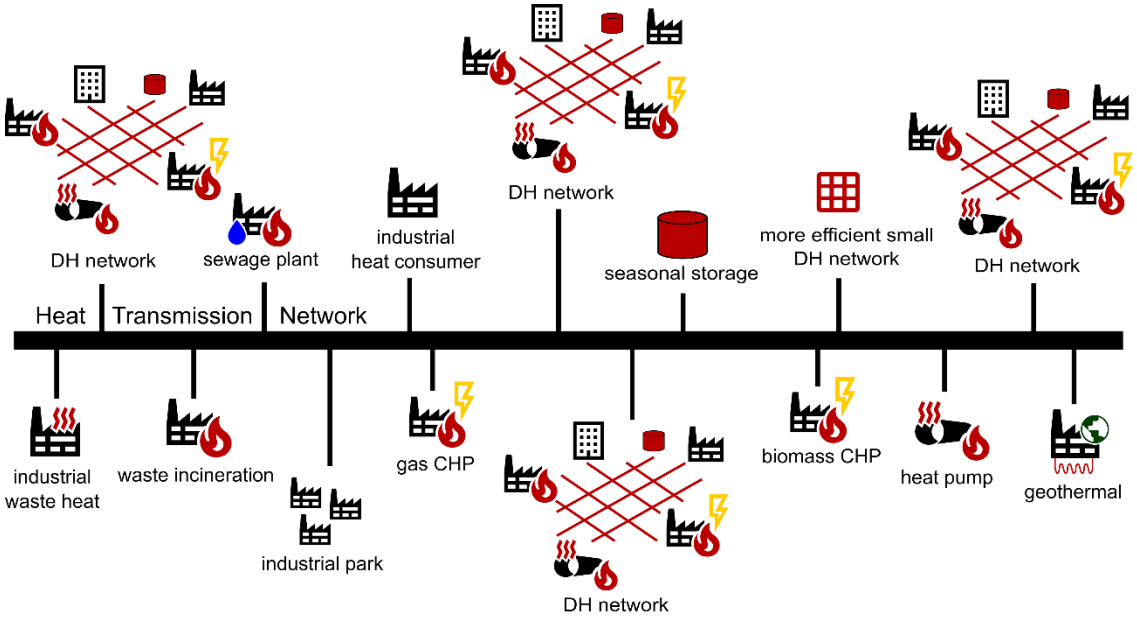
“Transfer the design of the electricity network to the heat network”

We define Heat Transmission Networks (HTN) to connect *multiple*

(i) sustainable sources,

(ii) one or more DH networks

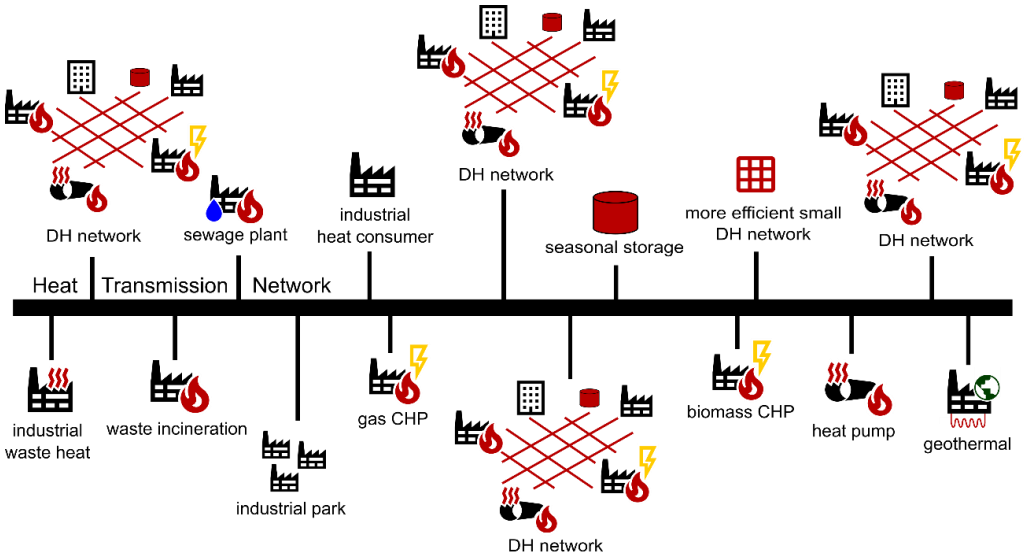
(iii) and/or storages.



Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Benefits

Supra-regional district heating networks



The approach was **backcasting from the vision**. At this point, profitability, hydraulic feasibility, etc. were not an issue.

Not a “solution for everything”, but an expansion of the possibilities of the individual actors.

What benefits can be expected, based on previous projects and experiences from other supra-regional infrastructure?

Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

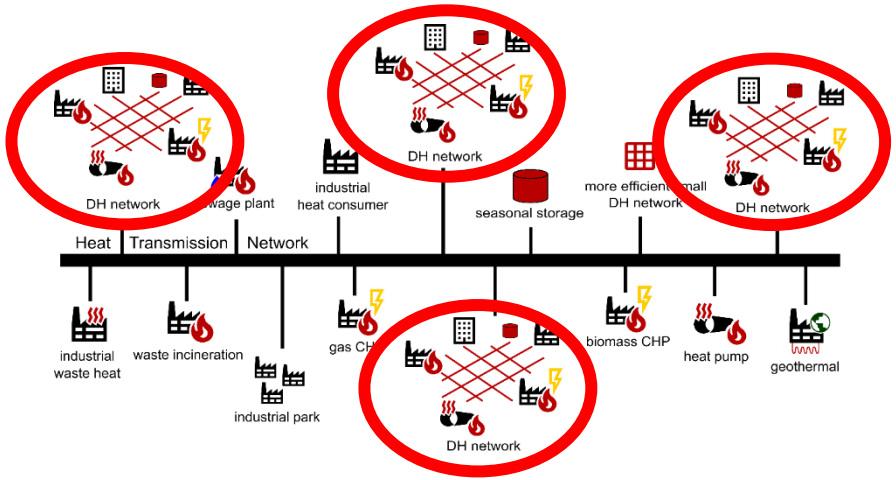
HEAT HIGHWAY

Efficiency

Use the least expensive or least-CO_2 heat source currently available

– in the various networks that are connected

– balance of loads

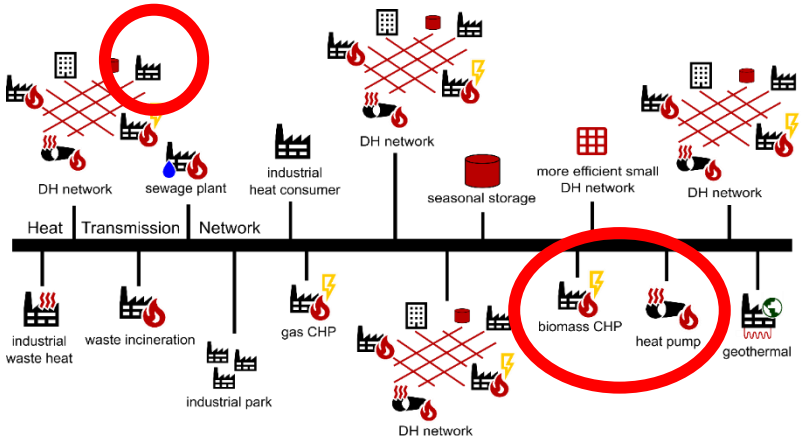


Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Efficiency

Use the cheapest or least-CO2 heat source available

– by means of more efficient generation



1. Extended amount of sinks (more full-load hours)
2. Less costs to connect (less CAPEX)

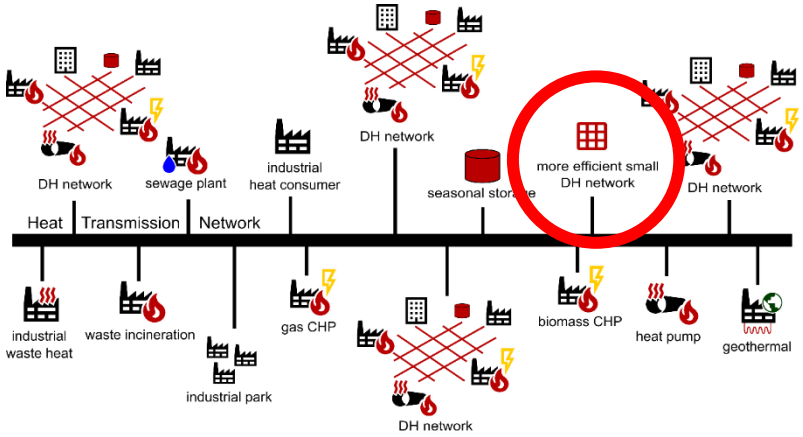
Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

HEAT HIGHWAY

Integration of new sources/sinks

Supply heat to smaller DH networks

1. **Provide an efficient source in part-load summer months**
2. **Provide the basis for new networks along in the area traversed**



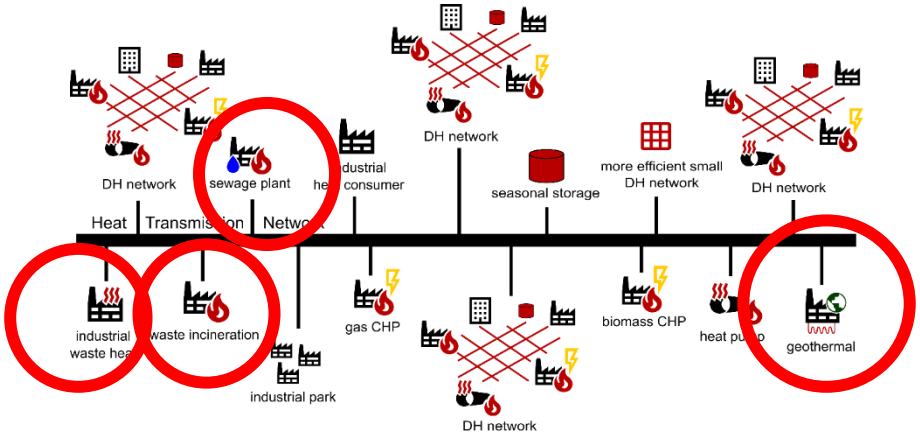
Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Integration of new sources/sinks

Integrate heat sources from the area traversed

(where the stand-alone integration is not feasible)

1. **Non-urban industrial waste heat**
2. **Geothermal**



Increase the feasibility of integration by **decreasing risks through a portfolio**

Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

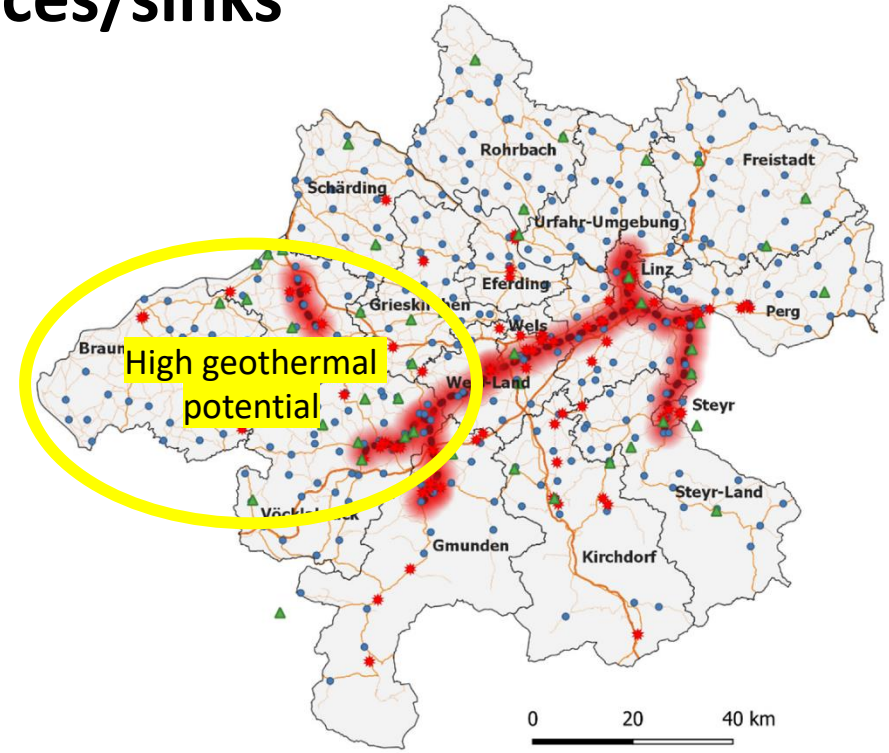
HEAT HIGHWAY

Integration of new sources/sinks

Integrate heat sources from the area traversed

(where the stand-alone integration is not feasible)

1. **Non-urban industrial waste heat**
2. **Geothermal**

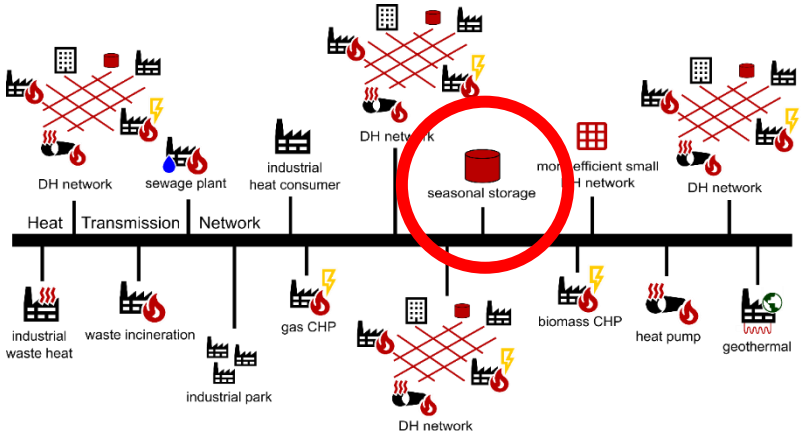


Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Use of rural land

Rural land is less expensive,
(compared to urban areas)

1. **Decrease costs of large-scale seasonal energy storage systems**
2. **Decrease costs of solar-thermal heat**



Source: Moser, Puschnigg (2021) Supra-Regional District Heating Networks: A Missing Infrastructure for a Sustainable Energy System. Energies 2021, 14(12), 3380; https://doi.org/10.3390/en14123380

Project Heat Highway

Heat Highway

Heat Highway

Interregional heat transmission networks to enable industrial waste heat usage and fossil-free industry

Program: Energy Model Region (3rd call)

“Region”: NEFI New Energy For Industry

Cooperative R&D project (category experimental development = applied research)

March 2021 – February 2024

Total costs: 2.5m Euro

Funding: Austrian Climate Energy Funds & State of Upper Austria

HEAT HIGHWAY

Project partners

1. Energieinstitut an der Johannes Kepler Universität Linz
2. Business Upper Austria
3. OÖ Energiesparverband
4. Austrian Institute of Technology
5. MU Leoben – Lehrstuhl für Energieverbundtechnik
6. FH Oberösterreich F&E GmbH
7. Ars Electronica Linz GmbH & Co KG
8. Borealis Agrolinz Melamine GmbH
9. voestalpine Stahl GmbH
10. Linz Strom Gas Wärme GmbH
11. Primetals Technologies Austria GmbH
12. eww AG
13. Energie AG OÖ Erzeugung GmbH
14. Energie AG OÖ Umwelt Service GmbH
15. Kremsmüller Industrieanlagenbau KG
16. Allplan GmbH
17. voestalpine Stahl Donawitz GmbH

LOI partners

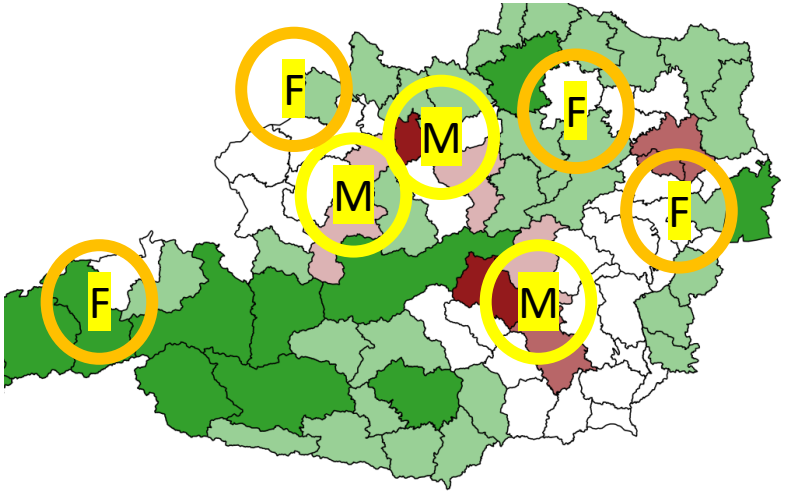
1. Land Oberösterreich
2. Land Steiermark
3. FCIO Chemical Industry Association
4. Austrian Cement Association
5. Danish District Heating Association
6. ESIM Chemicals GmbH
7. Nemak Linz GmbH
8. Starlim Spritzguss GmbH
9. Resch & Frisch Immobilien GmbH & Co KG
10. Rabmer Green Tech GmbH
11. Smurfit Kappa Nettingsdorf AG & Co KG
12. Zellstoff Pöls AG
13. ILF Consulting Engineers Austria GmbH
14. FACC Operations GmbH
15. D. Swarovski KG
16. Kelag Energie & Wärme GmbH
17. Energie Steiermark
18. Geothermie St.Martin GmbH

Heat Highway

Heat Highway investigates interregional heat transmission networks (HTN), focusing on the utilization of multiple waste heat sources.

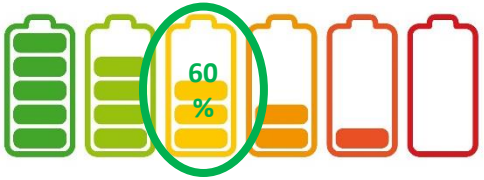
Heat Highway will go far beyond the state of the art in terms of number of players involved, interregionality and interaction. Heat Highway aims to

- develop a **multi-level toolbox** for optimizing the HTN implementation and operation,
- anticipate industrial waste heat potential from current and breakthrough processes in a decarbonization scenario,
- develop and prototype a cost-effective pipe system to significantly reduce the investment costs in HTN, and
- set up a 3D simulation based "**virtual HTN demonstrator**" for showcasing the feasibility of HTN systems despite their complexity.



Source: Sejkora et al., University of Leoben, in: Renewables4Industry

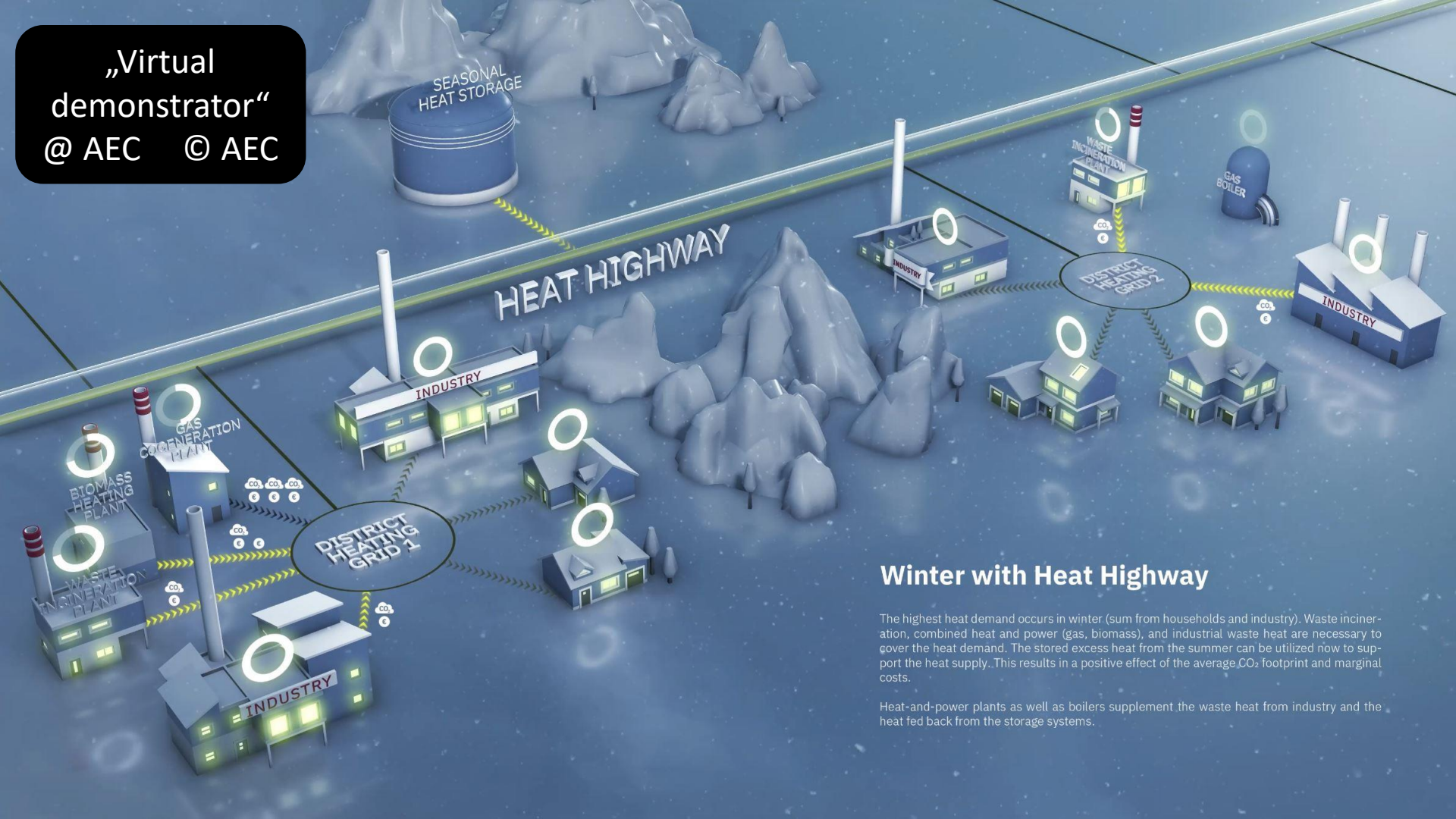
Content – results pending



„Theory“	Practice cases:
Virtual demonstrator	Current sources
Define waste heat, network codes	Future sources
Dimensions, modes of operation	Sinks
Technical assessment	Pipe routing
Summer heat sinks	Business models
Economic assessment	Investment funding application or stakeholder action plans

Graph: https://rebike.com/de/blog/e-bike-akku-richtig-laden-die-wichtigsten-tipps

„Virtual demonstrator“
@ AEC © AEC



Winter with Heat Highway

The highest heat demand occurs in winter (sum from households and industry). Waste incineration, combined heat and power (gas, biomass), and industrial waste heat are necessary to cover the heat demand. The stored excess heat from the summer can be utilized now to support the heat supply. This results in a positive effect of the average CO_2 footprint and marginal costs.

Heat-and-power plants as well as boilers supplement the waste heat from industry and the heat fed back from the storage systems.

HEAT HIGHWAY

Thank you!

moser@energieinstitut-linz.at
linkedin.com/in/mosersimon

powered by klima+ energie fonds
LAND OBERÖSTERREICH
NEFI NEW ENERGY FOR INDUSTRY