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# From Fossil-Based District Heating to a Resilient Energy System – Transformation in Practice

Ingo Leusbrock, Thomas Pauschinger

District heating networks are central pillars of the energy transition – and at the same time one of its greatest challenges. Many existing systems still rely on fossil fuels, while political targets and rising energy prices demand rapid new solutions. The key question is therefore: How can an existing district heating network be transformed step by step toward renewable energy sources without compromising security of supply or economic viability?

An illustrative example is provided by the city of Kapfenberg (Austria). This traditional industrial centre in Upper Styria represents the transition from a fossil-based heat supply toward an integrated, renewable energy system. Previously almost entirely dependent on natural gas – primarily supplying the city centre, public buildings, and residential housing – a roadmap has now been developed to ensure not only 100 % secure heat supply but also further expansion in customer connections. A total investment of approximately EUR 40 million is planned, aiming to reduce CO<sub>2</sub> emissions by around 15,000 tonnes per year. Key components include the utilisation of biomass and industrial waste heat, the integration of large-scale heat pumps (including the local wastewater treatment plant as a heat source), and the development of thermal storage solutions to balance seasonal fluctuations. Based on various development phases and research initiatives, transformation pathways were formulated that enable a flexible, economically viable, and long-term carbon-neutral heat supply. Kapfenberg serves as a model case demonstrating how research, sustainability, urban planning, and energy supply can be combined into an implementable transformation strategy. Such transformations were the focus of the International Energy Agency project IEA DHC TS5 in recent years.

## An International Project for the Heat Transition

The project *IEA DHC TS5 – Integration of Renewable Energy Sources into Existing District Heating and Cooling Systems*, coordinated by AGFW<sup>1</sup> (Germany), was carried out within the Technology Collaboration Programme on District Heating and Cooling (IEA DHC). Its objective was to accelerate the decarbonisation of existing district heating and cooling systems and consolidate experiences from various countries. With Austrian participation by AEE INTEC, a comprehensive methodology was developed to systematically increase the share of renewable energy in district heating networks – from strategic planning to practical implementation.

The work was structured into four Subtasks:

- **Subtask A:** State-of-the-art analysis and evaluation of technologies for renewable heat utilisation (solar thermal energy, geothermal energy, large-scale heat pumps, waste heat, and storage).
- **Subtask B:** Transformation of existing district heating networks – methods, tools, and examples for achieving high shares of renewable energy.
- **Subtask C:** Integration of decentralised generation units and renewable feed-in at network peripheries.
- **Subtask D:** Non-technical framework conditions – stakeholder engagement, policy instruments, and recommendations for action.
- Together, these four areas form a comprehensive toolbox for municipal utilities, planners, and decision-makers seeking to design climate-neutral district heating networks.

## The Path to Transformation

A central focus of the work was the question of how large, historically evolved district heating systems can be transformed step by step. Based on the analysis of international case studies, a structured approach comprising four key steps was developed:

- 1. Vision and Target Definition:** Establishment of long-term objectives (e.g., carbon neutrality by 2040) and derivation of measurable interim targets.
- 2. System Analysis and Scenario Development:** Assessment of the status quo, including analysis of heat sources, network infrastructure, and load profiles.
- 3. Evaluation and Selection of Transformation Pathways:** Integration of technical, economic, and environmental criteria to identify feasible transition options.
- 4. Implementation and Monitoring:** Prioritisation of measures, phased implementation, and systematic performance monitoring.

Experience from the project's case studies demonstrates that technical solutions are only effective when embedded within an organisationally and politically aligned overarching strategy. Transformation is most successful where urban planning, energy supply, industry, and research collaborate

on a shared roadmap – as the example of Kapfenberg clearly illustrates.

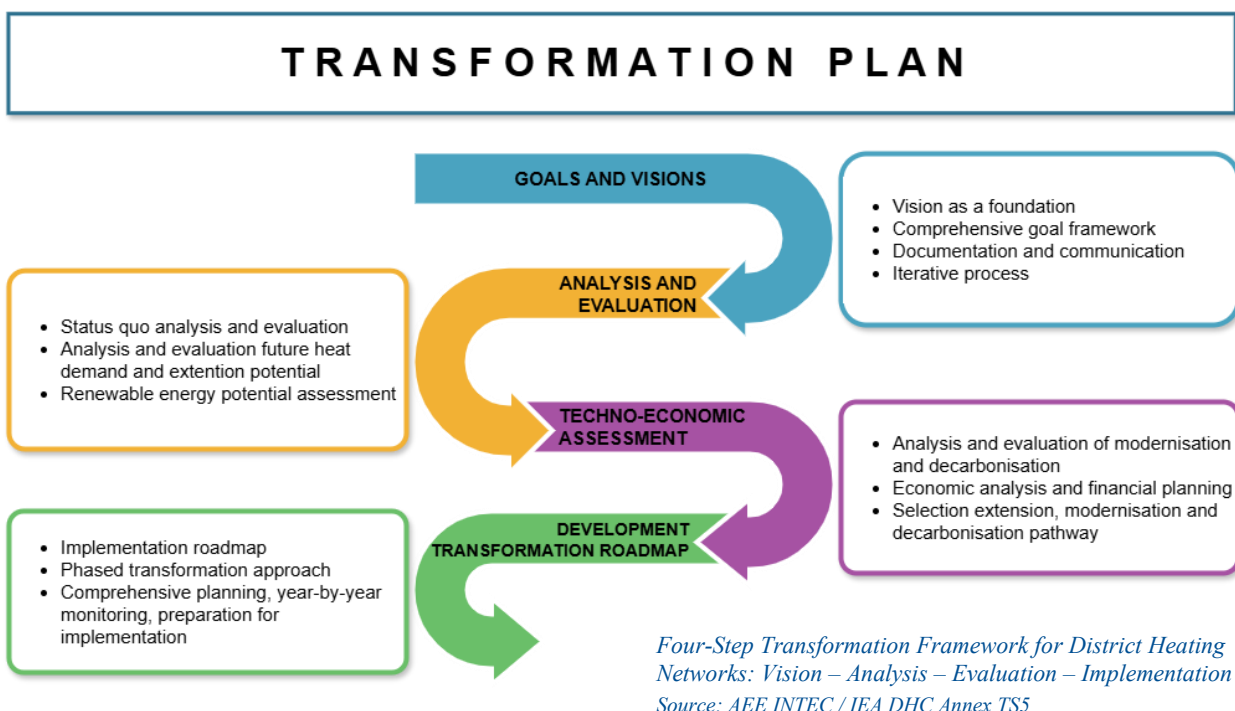
## Knowledge Transfer for Austria and Europe

The findings of Annex TS5 extend far beyond individual projects. They provide a methodological foundation for planning the heat transition in cities and municipalities, as well as for developing the national strategies currently emerging across several European countries. The Guidebook developed within the project consolidates best practices, planning tools, and policy recommendations in a practice-oriented and directly applicable format.

Particularly for Austria – where many district heating systems still rely heavily on fossil-fuelled CHP plants or biomass – TS5 offers concrete instruments for gradually converting existing infrastructures into renewable energy systems.

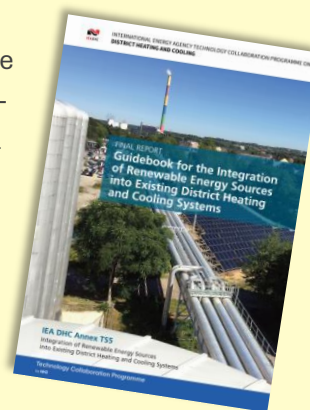
## Conclusion

IEA DHC Annex TS5 demonstrates convincingly that the transformation of existing district heating networks is no longer a distant vision, but a concretely manageable and strategically plannable process. By combining technical expertise with strategic planning and international experience, it provides a valuable foundation for shaping district heating systems in Austria and across Europe to be future-proof and climate-neutral.



## Results from TS5

How can the transition from fossil-based to renewable district heating networks be achieved? The IEA DHC Annex TS5 demonstrates how existing systems can be transformed in a structured manner – through clearly defined methodologies, practical tools, and real-world case studies. Using Kapfenberg as an example, it becomes evident how research institutions, industry, and municipalities can collaborate to gradually transition district heating systems toward climate neutrality.



Guide Book



## Overview of TS5 Deliverables – Selected Reports from IEA DHC Annex TS5

- State-of-the-Art Country Reports
- Technology and Application Factsheets
- Case Studies on the Transformation of Large DHC Systems toward Higher Shares of Renewable Energy Sources (RES)
- Case Studies on the Decentralised Integration of Renewables into District Heating and Cooling Systems

<sup>1</sup> <https://www.agfw.de/>

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## Further information and links in the e-paper

**Guide Book** (final report): <https://www.iea-dhc.org/2019-2024-annex-ts5/>

**Article**: [https://www.aee-intec.at/zeitung/nachhaltige\\_technologien-4-2025/15/](https://www.aee-intec.at/zeitung/nachhaltige_technologien-4-2025/15/)

**Ingo Leusbrock**, Head of the Cities and Networks Division, AEE – Institute for Sustainable Technologies, [i.leusbrock@aee.at](mailto:i.leusbrock@aee.at)

**Thomas Pauschinger**, International Research and Development, AGFW, [t.pauschinger@agfw.de](mailto:t.pauschinger@agfw.de)

## Sources and further information

Selected article from the journal

**nachhaltige technologien 04 | 2025**

**The Transformation of District Heating Networks**



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E-Paper *nachhaltige technologien 04 | 2025* – Transformation der Fernwärme (DE)

[https://www.aee-intec.at/zeitung/nachhaltige\\_technologien-4-2025/](https://www.aee-intec.at/zeitung/nachhaltige_technologien-4-2025/)