



**Driving Urban
Transitions**

EUROPEAN PARTNERSHIP

Urban Challenge

Lemgo

100% Renewable District Heating – Integration of Near-Surface Geothermal Energy on an Industrial Scale

Task definition, November 2024





1 Site Information

Lemgo is a university town with around 43,000 inhabitants in the federal state of North Rhine-Westphalia. It is the oldest and third largest town in the district of Lippe and is located 25 kilometres east of Bielefeld.

The town borders on the rural surroundings of the Lipper Bergland. The most important branches of industry are metal processing, manufacturing of dental instruments, mechanical engineering, industrial electronics and the service sector.

More information about the town of Lemgo can be found at <https://www.lemgo.de>.

2 Problem Owner

Stadtwerke Lemgo is the central problem owner of the URBAN CHALLENGE Lemgo. They operate the city's electricity, natural gas and district heating supply, as well as the water supply. The company is also responsible for public baths, parking management and the city's busses.

The company's history dates back to 1898, when the founding fathers of Stadtwerke Lemgo took over the public drinking water supply. The electric power supply began just 13 years later with two diesel engines. In the postwar period, the basics for today's combined heat and power systems was laid in 1963 with the first gas turbine.

The municipal company now operates a modern plant park with ten combined heat and power plants and a gas turbine co-generation plant, which generate electricity and heat. Two large heat storage facilities and a large number of additional plants (including large heat pumps for use of waste heat from sewage water and river water, electric boilers, solar thermal, photovoltaic and wind power plants) round off the generation portfolio.

The company is fully owned by the city and employs around 190 people. The entire inner city area of Lemgo is largely connected to the district heating network. District heating accounts for around 60% of the heat supply.

Further information on the municipal company can be found at <https://www.stadtwerke-lemgo.de/>.

3 Overall Objective

The overarching goal is to convert district heating generation in the city of Lemgo to 100% renewable energy. With the projects already implemented and those currently under construction or in planning, 50% of district heating is to be generated using renewable energy in a few year's time.

A further 25% of the required district heating continued to be generated using combined heat and power, albeit with biomethane or hydrogen. This requires extensive modifications to the power plants.

It is still unclear how the remaining 25% will be generated using renewable energy. In the URBAN CHALLENGE Lemgo, concepts are therefore being sought to close this supply gap (around 30 GWh per year). An additional challenge is that the demand for district heating fluctuates greatly depending on the season.

4 Previous Work

Just a few years ago, the majority of district heating was generated in highly efficient CHP plants, but on the basis of fossil fuels (natural gas). In recent years, these plants have been continuously supplemented and expanded in order to generate more and more electricity and heat using renewable energies.

A large-scale river water heat pump is already posing a significant contribution. The system uses the environmental heat from the river Bega to generate heat for the district heating network. The river water is warm enough for around 6,000 hours a year.

Since October 2019, wastewater heat from a sewage treatment plant has also been used to generate district heating. This large heat pump can be operated both independently and in combination with a combined heat and power plant to generate its own electricity.

This heat pump generates each year around 17.5 gigawatt hours of heat for Lemgo from the clean water of the sewage treatment plant, with a further six gigawatt hours coming from the otherwise unusable waste heat from the CHP plant via another heat pump. This amount of heat is enough to supply two thirds of Lemgo's historic town centre with renewable heat.

In addition, a large solar thermal system with a collector area of 9,200 m² generates at least 3,000 MWh of district heating from solar energy.

In total, the municipal utilities are already providing up to 20% of district heating CO₂-free, and this figure is to rise to more than 55% by 2028.

5 URBAN CHALLENGE Lemgo – Questions and Tasks of a Possible Joint Project Proposal

A solution is being sought for the generation of additional district heating (around 30 GWh per year, roughly a quarter of the total amount of heat to be generated) so that the heat demand in the city of Lemgo's district heating network can be completely covered by renewable energy in the future.

It should be noted that the potentials of most sources of environmental heat have already been largely utilized. The considerations to date are therefore moving in the direction of near-surface geothermal energy. The following questions now arise:

- *Which innovative concepts would be suitable for integrating near-surface geothermal energy into the existing district heating system on an industrial scale?*
- *Which locations would be best suited for this?*
- *How can the ground be regenerated with the planned high extraction volumes?*
- *How can the efficiency of the system be increased and the overall cost-effectiveness be improved?*

This task goes far beyond the competence profile of technical planning offices or complements them. **Experts** from research and development are therefore sought to develop answers to these questions. The answer to the questions can, for example, be provided by the research partner apart of a joint project and the questions can be dealt with scientifically¹.

The following aspects (and possibly others that you as an expert can bring in yourself) can be used to answer the overarching questions:

- Which innovative concepts would be suitable for integrating near-surface geothermal energy into the district heating system of Stadtwerke Lemgo on an industrial scale (approx. 30 GWh per year)?
- How do the identified, fundamentally possible concepts differ in terms of performance and cost-effectiveness?

¹ Development is to take place in ongoing coordination with the client, Stadtwerke Lemgo.



- How can the new, additional plant best be integrated into the existing plant portfolio? (in particular with regard to the very different seasonal heat sales)
- Which locations would be best suited for these concepts? (An initial potential analysis has already identified a site whose feasibility would need to be investigated in more detail.)
- How can the soil be regenerated – given the planned high extraction volumes?
- What measures can be taken to increase system efficiency and improve overall cost-effectiveness?
- Is dual use of the area possible? (It is envisioned that the area can continue to be used for agricultural purposes.) Would dual use have a negative impact on agricultural use due to cooling of the soil temperature?
- To what extent could near-surface geothermal energy also be used for seasonal storage? What technical or economic limitations exist? How can these be (partially) overcome?
- What other measures – apart from near-surface geothermal energy – would be conceivable to generate the missing quantities of heat?

6 Next Steps

You are an expert in one of these fields and can contribute to answering these questions?

If you are interested, please send an informal expression of interest to

mail@urbanchallenge.org. web: **www.urbanchallenge.org**

You are also welcome to use this e-mail address to contact us if you have any questions.

We would then invite you to present your ideas and project proposals in an online meeting. You will have 15-minutes for your presentation. Afterwards, there will be a maximum of 15-minutes for Q&A and a discussion of the proposed methodological approaches.

The presentation will take place virtually in front of representatives of the client and the organization team (PtJ or DUT). Power point slides can be shown, whereby the following key point should be observed:

- The presentation should focus on possible project approaches of the potential research institution (max. 5 PP slides), i.e.: How can the challenges and questions be addressed? What methodological approaches are available? What could a possible work plan look like?
- In addition, the cost of the proposed work and the possible project formats (e.g. microproject, collaborative project) should be roughly estimated (project duration, personnel costs, etc.) – max 1 PP slide
- Please limit the presentation of the institution, references, etc. to a maximum of one PP slide².

² Reference lists, Info-brochures, Annual reports or similar can be sent additionally.