



**Driving Urban  
Transitions**

EUROPEAN PARTNERSHIP

# Urban Challenge

## Borkum

### **Evaluation of Possible Expansion Options for Climate-Neutral District Heating on the North Sea Island of Borkum**

Task definition, November 2024





## **1 Site Information**

At just under 31 square kilometres, Borkum is the largest of the East Frisian Islands. Parts of the island and the adjacent mudflats belong to the Lower Saxony Wadden Sea National Park. The entire island also corresponds to the municipal area of the town of Borkum.

As a state-approved North Sea health resort, the town has numerous spa facilities and is heavily influenced by tourism. There are more than 300,000 tourists per year for 5,000 inhabitants, with an average of around 2.5 million overnight stays per year.

On 05.04.2023 the city council adopted the Borkum 2030+ living space development as a holistic strategic development framework ([www.lebensraum-borkum.de](http://www.lebensraum-borkum.de)). Further information on the island and the town of Borkum can be found at: [www.borkum.de](http://www.borkum.de) und [www.stadt-borkum.de](http://www.stadt-borkum.de).

## **2 Problem Owner**

The central problem owner of the URBAN CHALLENGE Borkum is the Nordseeheilbad Borkum GmbH with 160 employees. The company not only operates the electricity, water and heat supply with its municipal utility segment. It is also responsible for the operation of tourism facilities, the port and the island's airfield.

Further information on the company can be found at [www.nordseeheilbad-borkum.de](http://www.nordseeheilbad-borkum.de) and <https://stadtwerke-borkum.de/> The municipality of Borkum (100% owner of the Nordseeheilbad Borkum GmbH) is involved in all key decisions.

## **3 Overall Objective**

Climate-neutral tourism is one of the political guidelines of the city's policy and administration. In particular, the aim is to decarbonize the heating and cooling supply on the entire island.

The use of deep geothermal energy is to be a key component and prerequisite for this. The location is geologically favourable due to its position in the North German Basin, and corresponding potential studies and preliminary work have been carried out.

Additional components could also be the use of heat from the North Sea by means of large heat pumps for the provision of heat, the use of geothermal sources for electricity generation (by means of an ORC process) and seasonal heat storage (e.g. by means of an aquifer storage facility).

With these and possible other components, the heating and cooling supply in the town of Borkum is to be converted towards climate neutrality at the lowest possible cost. The technical possibilities and potential, the legal and regulatory framework as well as national and European transformation scenarios must be taken into account during this conversion in order to avoid bad investments.



## 4 Previous Work

As part of the EUROPAN competition, programmatic and spatial future perspectives were developed for the historic spa district (see <https://www.europan.de/wettbewerb-e17/standorte/e17-borkum/>). The future prospects form the guidelines for future heating and cooling requirements<sup>1</sup>.

In addition, two feasibility studies were commissioned and carried out to substantiate the conversion of the grid-based energy infrastructures, one focusing on the possibilities of using deep geothermal energy and the other one on scenarios for expanding the district heating network.

This preliminary work confirms the high potential for geothermal energy. At a depth of 3,500 meters, thermal water with a temperature of 135°C and high yields are expected.

Based on the promising results of the feasibility study, the aim is to drill the first test well. This is expected to take place in 2027/2028, assuming a positive funding decision. The necessary exploration permit from the responsible mining authority has already been obtained.

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

The potential heat production from deep geothermal energy is largely constant throughout the year, while the heat demand varies greatly from season to season. Depending on the design of the geothermal project and the components of the district heating system, the following questions therefore arise:

- *How should the peak demand (supply gap) be covered in winter?*
- *How should any surplus be used in summer?*

This task goes well beyond the competence profile of technical planning offices or complements them, as the focus of the work is not on the evaluation of standard system components, but on particularly innovative technology components and their integration.

**Experts** from research and development are therefore sought to develop answers to these questions. The research partner can take on the task of answering the questions, e.g. as part of a joint project, and the questions can be dealt with scientifically<sup>2</sup>.

The following aspects (and possibly others that you as experts can contribute yourself) can be used to answer the overarching question, whereby the overarching objective is to achieve the most cost-effective district heating price possible:

- Modeling (technical & economic) of the grid-bound energy system (heat, electricity, possibly cooling) on the island of Borkum (using open source software)
- Technical and economic evaluation of different district heating options, taking into account different possible yields of deep geothermal energy (technical and economic)
- Evaluation of possible additional components in the district heating system (in particular electricity generation from geothermal energy using the ORC process, use of heat from the North Sea using large heat pumps, integration of cooling supply into the energy system, seasonal storage (incl. high-temperature aquifer storage if necessary), peak load generators if necessary), in each case technically and economically
- Identification of any additional technology components, evaluation of the various options (technical and economic), depending on the available heat quantities from deep geothermal energy

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<sup>1</sup> Further background information on the urban development of the spa district can be found at: [https://lebensraum-borkum.de/wp-content/uploads/2022/09/VU\\_Kurviertel\\_Druck\\_210907.pdf](https://lebensraum-borkum.de/wp-content/uploads/2022/09/VU_Kurviertel_Druck_210907.pdf)

<sup>2</sup> Development is to be carried out in ongoing coordination with the client (Stadtwerke Borkum) and the municipality of Borkum.



- Optimization of the overall system with regard to cost-optimized energy supply for end customers (different proportions of power-bound and non-power-bound energy supply)<sup>3</sup>
- The following framework conditions should be taken into account: Restriction of the power supply from the mainland to the island through the existing three submarine cables; interfaces to other sectors (in particular mobility), possible changes in heating and in particular cooling requirements due to climate change

However, the following aspects should not be part of the project plan:

- Survey of energy consumption (current status) – information is already available or is part of municipal heat planning
- Development of planning tools and simulation environments; the issues should rather be dealt with using existing (open source) tools and instruments

## 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 slide<sup>4</sup>.

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<sup>3</sup> In close coordination with the municipal heat planning of the municipality Borkum

<sup>4</sup> Reference lists, Info-brochures, Annual reports or similar can be sent additionally.