Interreg North Sea | Co-funded by the European Union

WaterWarmth

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PRE-FEASIBILITY STUDY

What is a pre-feasibility study?

An aquathermal energy pre-feasibility study is a first expert review of the intended project. The main aim is to determine if it makes sense to commit to a full feasibility study. A pre-feasibility study provides an answer to the following questions:

1. What are the red lights that would make the project not feasible?
2. What needs to be studied in detail to make sure the project is feasible?
3. What are the first impressions of the public water authorities concerning the project?

While the Quickscan delivers a fast and high level assessment of a project, the pre-feasibility study is more detailed and takes longer to complete. The main difference is that the pre-feasibility study includes a site visit and a specific analysis of parameters like depth, structure of the waterbody, water quality, …

The study should be performed by an internal or external expert in aquathermal energy (see requirements at the end of the document). The deliverable of this study is a qualitative advisory report outlining the most important constraints and possible red flags. Based on this document the project owner can make the decision to proceed with the feasibility study.

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Essential parts of the study

1. Site visit

   To truly evaluate the feasibility of a possible project location it is essential to visit the site.

   Includes:

   - Pictures of current situation or schematics of future situation
   - Data collection of building(s): consumption, space availability, function/use
   - Public data collection: depth, flow and flow variations of waterbody, structure and material of the shore, bathymetry, water quality (temperature, salinity, turbidity, pollutant load)

   Excludes:

   - Specific measurement campaign

2. Thermal impact study

   To assess the suitability of the water body, the thermal impact on the waterbody must be examined. The temperature change in the waterbody has to comply with the legal limits and should be discussed with the waterbody authorities. The level of detail of the thermal study is dependent on the waterbody and heat demand.

   <u>Level 1 thermal study: non-dynamic impact study</u>

   For flowing waterbodies where the flow of the river/canal is more than 10 times larger than the extraction flow a simple non-dynamic impact study is sufficient.

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How? Calculate the temperature difference in the water body caused by the extraction of heat/cold. Use the formula:

$$\Delta T = \frac{Q}{\dot{m} * c}$$

Symbol	Explanation	Unit
ΔT	Maximum temperature difference in the waterbody after mixing	K
Q	Maximum heating capacity of the building	kW
$\dot{m}$	Flow rate of the waterbody. If available, use the 10 percentile flow rate, otherwise use average flow rate	$\frac{kg}{s}$
c	Specific heat capacity of fluid (in this case water)	$\frac{kJ}{kg * K}$

Level 2 thermal study: 1-dimensional dynamic impact study

For waterbodies with limited flow or for standing water a more in-depth thermal study is required. This analysis evaluates whether the waterbody contains enough thermal energy to stay within the legal limits of temperature differences in the waterbody.

How? The thermal impact on the waterbody is calculated using specialized software. A digital twin of the waterbody is created and the hourly temperature difference in the waterbody caused by the potential installation is calculated. This software needs to take into account the natural regeneration of heat/cold by weather, soil, … The required input is an hourly thermal load profile of building(s).

Level 3 thermal study: 3-dimensional dynamic impact study

For specific cases an even more in depth analysis of the aquathermal potential is needed. In particular when there is a risk of thermal short-circuiting or when the waterbody experiences tidal flows a 1D study will not suffice and a 3D study is required. Usually this impact study is too advanced for a pre-feasibility study and should therefore be performed in a full feasibility study.

How? Water and heat flows or accumulation of thermal impact are modelled in all directions in the waterbody using specialized software. A digital twin is created and the thermal impact on different parts of the waterbody is simulated. This software needs to take into account the natural regeneration of heat/cold by weather, soil, …

3. Concept design

From the input of the site visit and the thermal impact study a first concept for the extraction of heat/cold can be designed. One or more drawings are made to have a first impression of the general dimension of the system. These concepts are necessary to discuss the project with the waterbody authorities.

<u>To take into account when designing:</u>

- Aquathermal installations can be divided in closed loop and open loop systems. Closed loop systems consist of a heat exchanger that is placed inside the waterbody. Open loop systems consist of a water inlet and outlet, a filtration system and a heat exchanger, placed on land.
- Most waterbody authorities want to limit obstructions in the water, especially in navigable waterways.
- Sediments on the bottom of the waterbody or carried by the flow of the waterbody can cause major issues in open loop aquathermal energy system. If the depth is limited or the water is heavily polluted, take steps to prevent fouling or clogging of the filters and heat exchangers.

4. Input from waterbody authorities

In most countries a permit is required for building and operating aquathermal energy infrastructure. Therefor it is important to involve the authorities, who will eventually have to grant these permits, as soon as possible. The concept design and thermal impact need to be discussed with them and they need to evaluate whether the concept meets their requirements. The waterbody authorities should indicate the red flags that would make the project not feasible. If necessary the concept should be altered or replaced by a feasible concept.

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Optional parts of the study

1. Estimation of investment cost

   Some clients will require a rough estimation of the expected investment cost. Since this investment cost will be based only on a concept design, there will be a certain margin of error and thus one should be careful when interpreting the results. When comparing different heat pump sources, aquathermal energy will rarely be discarded because of the investment cost, but more often because of technical constraints. Therefor the estimation of the investment cost is optional in a pre-feasibility study.

Requirements for aquathermal expert

The aquathermal expert performing the pre-feasibility study can be an internal or external expert, however the following expertise and knowledge is required to perform the study successfully.

1. At least 3 years of technical expertise in aquathermal energy;
2. Profound knowledge on heating systems and sustainable heating solutions;
3. Awareness of local and national regulations on aquathermal energy;
4. Ability to present the study results in a clear manner.

Estimated cost of a pre-feasibility study: 1500 – 3000 euro (excl. VAT)