HOLISTIC ENERGY MANAGEMENT AND THERMAL WASTE INTEGRATED SYSTEM FOR ENERGY OPTIMIZATION

HEATWISE

Waste heat potential report for RISE pilot

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Executive Summary

This report is an addition to the previously submitted deliverable 3.2, and contains only the parts related to the RISE pilot.

The RISE pilot was found to have a low level of instrumentation, but using various sources, it was possible to give a conservative estimate of the waste heat potential of the building at different supply temperatures. Based on this conservative estimate, approximately 26% of the yearly energy use can be supplied with a supply temperature of 80 degrees Celsius.

List of abbreviations

Acronym	Meaning
AAU	Aalborg University (pilot)
PSNC	Poznan Supercomputing and Networking Center (pilot)
EMPA	Eidgenössische Materialprüfungs- und Forschungsanstalt (pilot)
TOFAS	Türk Otomobil Fabrikası Anonim Şirketi (pilot)
RISE	Research Institute of Sweden (pilot)
DC	Data Center

1 Introduction and methodology

This chapter describes the methodology for evaluating the building waste heat utilization potential, along with a brief description of the four pilot cases.

In this project, there are two research-oriented pilot buildings (AAU and EMPA) and three commercial pilot buildings (PSNC, TOFAS, and RISE). The main difference between research-oriented and commercial buildings is the level at which they are instrumented. The research-oriented buildings have many sensors (submeters including supply and return temperatures, flow rate, and energy use of the hot water using systems) which are necessary for carrying out the assessment of the waste heat potential using the following methodology at all levels. Normally, the commercial buildings do not have the same number of sensors, as most of these sensors are not necessary for operation. They will therefore have to be assessed using the data available, along with expert knowledge and design values.

1.1 Methodology

The methodology used in this deliverable is the same as the one applied in deliverable 3.2, and for the detailed explanation of it, see the previous deliverable 3.2

The methodology consists of six main steps, all of which can be seen summarized in Figure 1.1.

Step 1 focuses on gathering the necessary data needed to perform the analysis. Step 2 provides and overview of the different systems and subsystems in the building. Step 3 focuses on the characteristics of the use of the building and its systems, such as gross floor area, and when the building is in operation. Step 4 creates the groupings of the different temperatures at different timescales. Step 5 performs the analysis and tries to provide the necessary context to answer the questions in step 6, which mainly focuses on whether or not the building or individual systems are suitable for using waste heat.

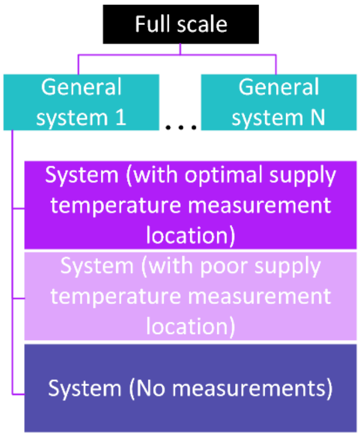
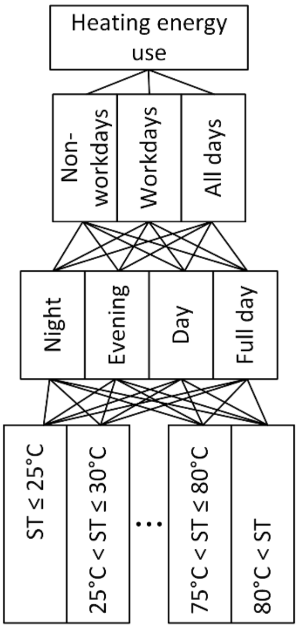
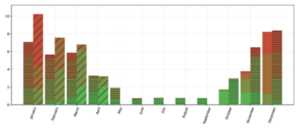
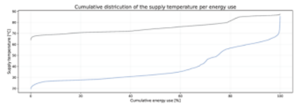
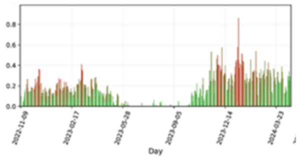
Step 1 – Gathering data	Step 2 – System overview	Step 3 – Building and System characteristics
Minimum data Heating energy use Water supply temperature 1 hour resolution **Optimal data** Minimum data points Water return temperature Water flow ≤10 minute resolution **Additional data** Other variables related to the specific system (could be air flows, outdoor temperature, etc.)		**Areas** Building gross area Gross area covered by each system **Time** All days / Workdays / Non-workdays Full day / Day / Evening / Night
Step 4 – Data grouping	**Step 5 – Analysis**	**Step 6 – Assessment of waste heat utilization potential**
	The analysis could include • Monthly energy use  • Yearly cumulative supply temperature compared to energy use curves  • Daily energy use in the different times from step 3 	Main question: Is the system suitable for using waste heat? Support questions: • Is the energy use high enough to be relevant? • What supply temperature does it need? • Is the energy use stable over the day? • Is the energy use stable over the year? • Is it possible to add the waste heat at this location?

Figure 1.1: Summary of the methodology. The figure is originally from deliverable 3.2.

1.2 Pilots

The project has five different pilot buildings located in different climates. The different locations of the pilots can be seen in Figure 1.2.

The RISE pilot is an industrial building located in Luleå, Sweden, and situated in the Boreal south climate zone. For more information on the RISE pilot, see section 2.1. For more information on the four other pilots, see D3.2 for the AAU, EMPA, TOFAS, and PSNC pilots.

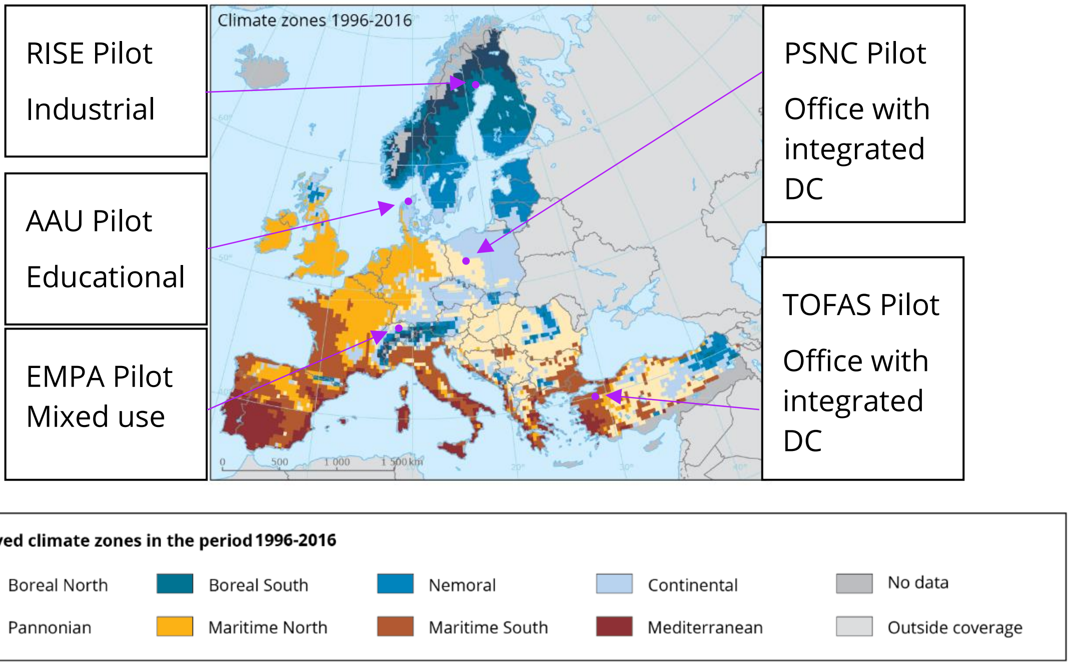


Figure 1.2: Location of the four pilots in relation to the European climate zones. The image is modified from "Ceglar, A., Zampieri, M., Toreti, A., Dentener, F., Observed northward migration of agro-climate zones in Europe will further accelerate under climate change. Submitted to Earth's Future" (https://www.eea.europa.eu/data-and-maps/figures/observed-climate-zones-in-the)

2 Results and discussion

In this section, the RISE pilot building is analyzed to find its waste heat utilization potential with its current operating conditions according to the methodology described earlier.

2.1 RISE Pilot

2.1.1 General building description

The RISE ICE Test and demo facility is situated in Luleå, Sweden (65.612167, 22.132573), within a commercial building owned by NP3. This building houses various commercial operations, including data centre operations. In 2023, the average external temperature at the venue was recorded as 2.73 degrees Celsius with only 30 days of average daily temperatures above 17 degrees Celsius, necessitating almost year-round heating.

The building seen in Figure 2.1 encompasses a closed space of 16,150 square meters (95 meters by 170 meters), which necessitates the provision of space heating and domestic hot water. The RISE ICE Test and demo facility occupies approximately 8% of the building space, taking up 983 m2 of the total area.

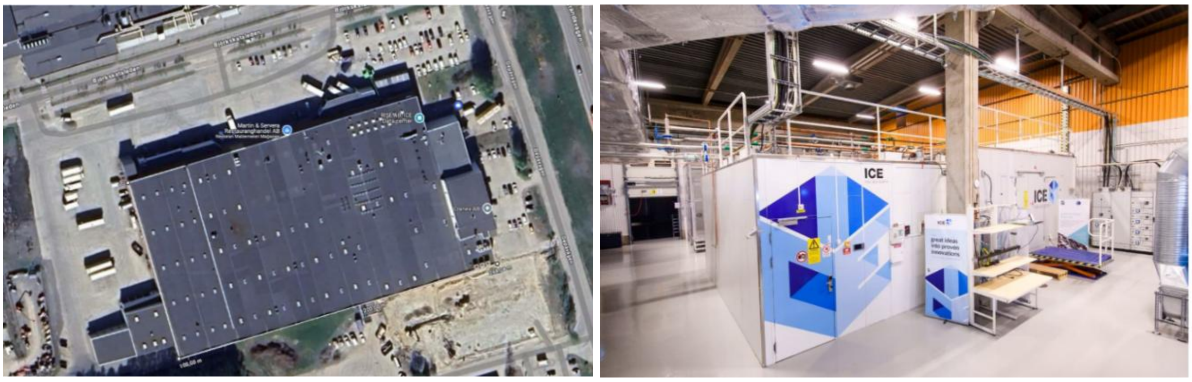


Figure 2.1: The left picture is a topview of the building housing the RISE pilot (Google maps, Imagery ©2025 Airbus, Lantmäteriet/Metria, Maxar Technologies, Map data ©2025). The right picture shows the experimental facilities housed in the RISE section.

The building has an aging infrastructure connected to the district heating network, which supplies both space heating and domestic hot water. However, it is not possible to separate the heating load distribution between the two.

The district heating grids' promised supply temperatures are plotted as a blue curve in Figure 2.2. In this curve, the grid will supply a minimum temperature of 74°C during the warmer periods of the year, and up to 115°C when at the dimensioning outdoor temperature of -30°C.

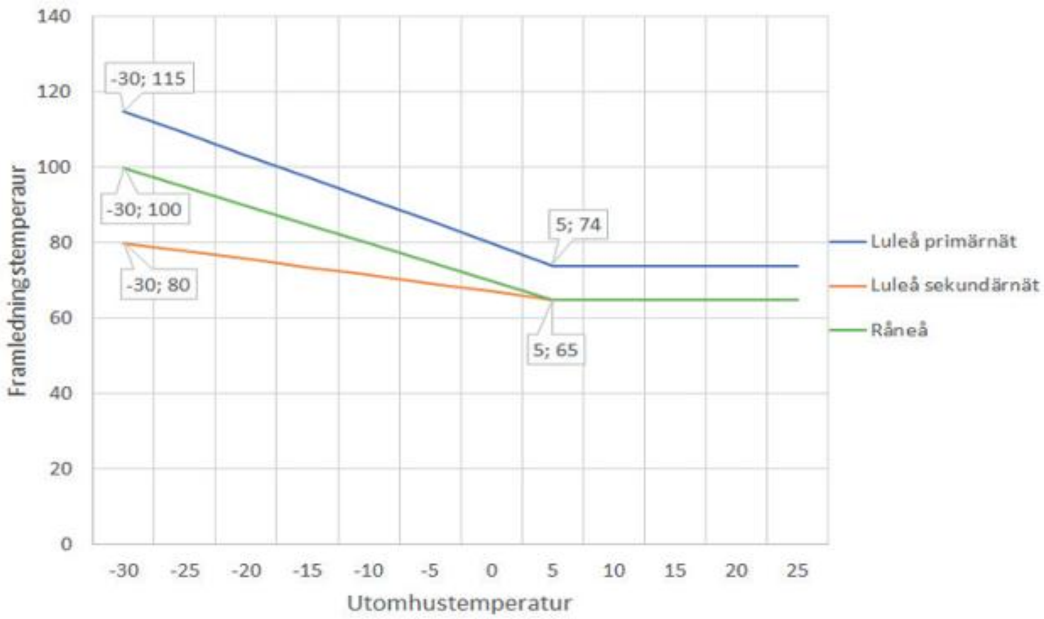


Figure 2.2: Supply temperatures in the district heating system with the RISE pilot being on the blue curve. The picture is taken from (Luleå Energi, 2021).

For 2023, the total building's annual heating energy use was 1,365,600 kWh, which equates to an average daily heating energy use of 3741 kWh and an hourly heating energy use of 155 kWh. The heating demand is significantly higher during the winter months.

2.1.2 Result

Currently, there are no temperature measurements on the main heating supply, meaning that the necessary energy at different temperature levels cannot be displayed. There is though available energy use over the year along with the outdoor temperature data as can be seen in Figure 2.3. From this it can be seen that any heating need appears to be gone once the outdoor temperature goes above 12°C with the heating energy in that case going for the domestic hot water.

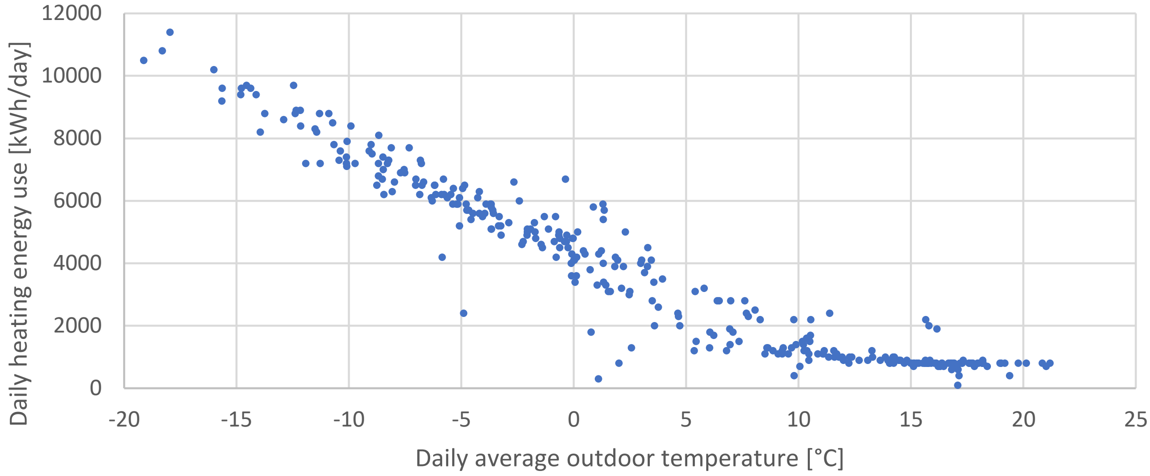


Figure 2.3: Relationship between the outdoor temperature and heating energy use.

Based on the outdoor temperature and the curve from Figure 2.2, an expected supply temperature in the district heating has been calculated and compared to the heating energy use.

This resulted in Figure 2.4 where it can be seen that to be able to supply heat at the main supply point, a minimum temperature of 74°C is needed and only 26% of the yearly energy use can be covered at a supply temperature of less than 80°C.

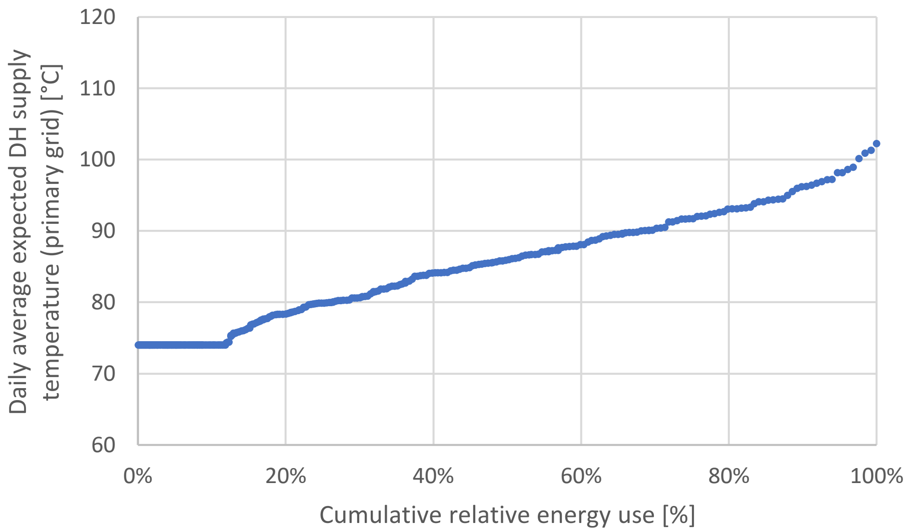


Figure 2.4: Cumulative energy use relative to the expected supply temperature from the grid.

2.1.3 Discussion

As there are currently no measurements on the individual systems, or the actual supply temperature in the building, the waste heat reuse potential of the building is the most conservative estimate, as it was seen in D3.2 that supplying directly at the HVAC systems could increase the potential significantly.

References

Luleå Energi. (2021). *Installationsanvisning Fjärrvärmecentral.* Luleå, Sweden: Luleå Energi. Retrieved from https://www.luleaenergi.se/media/n4kjdgpw/installationsanvisningar-fjärrvärme.pdf

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