Summary
The Swedish Heating Market

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Värmemarknad Sverige

Excess Heat in Sweden

Mapping of potential, challenges and opportunities

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Intro

What is required for excess heat to play a larger role in future heating systems?

This summary presents the results of a national mapping of current and future excess heat availability in Sweden. The project was carried out by Profu on behalf of the government initiative Fossil Free Sweden and the research project Värmemarknad Sverige (*The Swedish Heating Market*).

The report provides an overview of the extent, characteristics and geographic distribution of waste heat, and assesses the potential for integrating this resource into existing district heating systems.

The complete report (Swedish) is published here.

Key questions addressed include:

- What is excess heat in this context?
- What is the theoretical potential today, and how might it change by 2035?
- How much of this potential can be captured in current district heating networks?
- What insights can be drawn from existing and planned excess heat collaborations?

The findings aim to support ongoing discussions about the future development of the Swedish heating market in a context of increased electrification and growing competition for bio-based resources.

Key Conclusions

- **Excess heat can play a vital role in Sweden's future heating supply,** especially as electrification advances and competition for biomass intensifies. With strategic planning and stronger collaboration, excess heat can become a central component in a sustainable and resource-efficient energy system.

- **Much excess heat is already utilized**, particularly where district heating networks are in place. Industrial excess heat currently provides about 8 percent of the energy supplied to Swedish district heating systems. Over 30 networks already source more than 50 percent of their energy from waste heat, and 18 networks exceed 80 percent.

- **Significant unused potential remains**, especially in low- and high temperature ranges. Around 16 TWh of excess heat goes unused annually: ~9 TWh at low temperatures (20–50°C), and ~6 TWh at high temperatures (>90°C).

- **Geographical mismatches are likely to persist.** By 2035, the total potential is expected to rise to about 50 TWh, primarily through medium temperature flows linked to hydrogen production, biofuel plants and data centers. However, these new flows often occur far from dense demand areas or existing infrastructure.

- **Trust and transparency are critical.** Successful collaborations rely on mutual confidence between industrial actors and energy utilities. Economic and regulatory aspects may also be crucial barriers.

- **District heating can benefit long-term.** While current systems face challenges from rising fuel costs and reduced combustion, strategic integration of excess heat could enhance long-term competitiveness. This requires adapted business models and policy support.

- **Better data and planning are needed.** Improved statistics and regional coordination can support more effective waste heat integration and energy planning.

Background

Excess heat is an emerging opportunity in the context of the energy transition. As Europe become increasingly electrified and competition for renewable resources intensifies, there is a growing need for solutions that are efficient, circular, and resource sustainable. One such opportunity lies in harnessing excess heat – energy that would otherwise be lost in industrial and service processes.

Sweden has a long tradition of integrating excess heat into its district heating systems. Today, excess heat accounts for approximately 7–8 percent of the energy supplied to Swedish district heating networks, with local examples where it covers more than 80 percent of the heating demand. Yet the potential remains far from fully utilized. Industrial transitions – such as electrification, hydrogen production and biofuel manufacturing – combined with the growth of data centers are expected to generate substantial new volumes of excess heat in many locations.

However, availability alone is not enough. Excess heat is geographically and technically challenging to harness. It is not always located where there is a heat demand, it does not always have the right temperature, and it may not be available when demand is at its highest. Technical solutions are needed – but most importantly, collaboration is essential. Industry, energy companies, planning authorities and technology providers must work together for this potential to be realized. Local conditions for this vary significantly.

Method and data sources

The mapping in this study is mainly based on a combination of previous analyses and statistics. It combines literature review with a survey, aimed at industrial actors with existing or potential excess heat flows, supplemented by interviews and information from public sources.

The data sources used include:

- **The European Waste Heat Map** (The ReUseHeat project)
- **District heating statistics** from Swedenergy
- **Public data on industrial investments**, including Nordic Hydrogen Valleys
- **Statistics from Statistics Sweden (SCB) and the Swedish Energy Agency** on energy use, population and industry
- **Websites and publications** from energy companies and industrial firms

The results are visualized at municipal level and include assessments of both current availability and expected developments to around 2035.

Excess Heat – What it is and Why it Matters

Excess heat refers to thermal energy not used in the process that generated it – such as excess heat from industrial operations, data centers, or other commercial activities. Much of this heat is currently cooled and discarded, despite its potential to be recovered and reused.

Utilizing excess heat improves energy and resource efficiency, reduces the need for new heat production, and helps free up electricity or biomass for greater climate benefits in other sectors. In a future with tougher competition for renewable resources, waste heat could become an essential part of the heating puzzle.

However, effective use depends on several key factors:

- **Temperature***

The temperature of industrial excess heat can vary depending on the industrial process and the source of the heat. Examples of heat sources include cooling water from industrial processes, exhaust gases from combustion processes, and heat from compressors and other machinery.

- **Seasonality**

Excess heat is often available at times that do not align with heating demand. Industries with high internal heating needs during winter often have the greatest surplus in the summer, when heating demand is lower. Other sources, such as data centers and wastewater treatment plants, can generally deliver stable heat flows year-round.

- **Location**

The availability of excess heat does not always coincide with areas where there is a heating demand. For example, large high temperature heat flows may be found in less populated areas with low heat demand, while low temperature excess heat is more common in densely populated areas with greater demand.

These factors affect if excess heat flows are technically and economically feasible to utilize. Unlocking the full potential of excess heat therefore requires both systems thinking and collaboration between multiple stakeholders: industry, energy utilities, technology providers, and spatial planners.

The temperature level of excess heat is crucial in determining its usability across different applications. In this report, the following three temperature ranges have been used:

Low temperature excess heat: Between 20°C and 50°C. Not sufficiently hot to be used directly and therefore requires temperature elevation using heat pumps. Examples: food industry, breweries and data centres.

Medium temperature excess heat: Between 50°C and 90°C. Can sometimes be used directly but often requires some temperature elevation to be effective in heating systems. Examples: grocery stores, textile industry and certain types of electrolysers.

High temperature excess heat: Above 90°C. Can often be used directly in distric heating networks without additional temperature elevation. Examples: steel- and iron works, petrochemical industry, and pulp and paper mills.

* Note that the definition of low-, medium-, and high temperature excess heat varies among different sources and in different situations. In this study we have used the levels specified in the list above, as they correspond well to temperature ranges that match traditional district heating temperatures.

Current and Future Potential

Excess heat is already used in Swedish district heating systems, with approximately 6.5 TWh supplied in 2023 – corresponding to around 7–8 percent of the total energy used in district heating production. This is primarily high temperature excess heat from industries such as pulp and paper mills, steelworks, and the chemical industry, which can be delivered directly to district heating networks without any need for temperature upgrades. However, it also includes recovered low temperature excess heat from sources such as wastewater treatment plants. In several networks, excess heat accounts for more than half of the supplied energy, and in around twenty networks the share exceeds 80 percent.

At the same time, the mapping shows that the theoretically available amount of excess heat in Sweden today amounts to approximately 22 TWh per year*, distributed across all temperature levels.

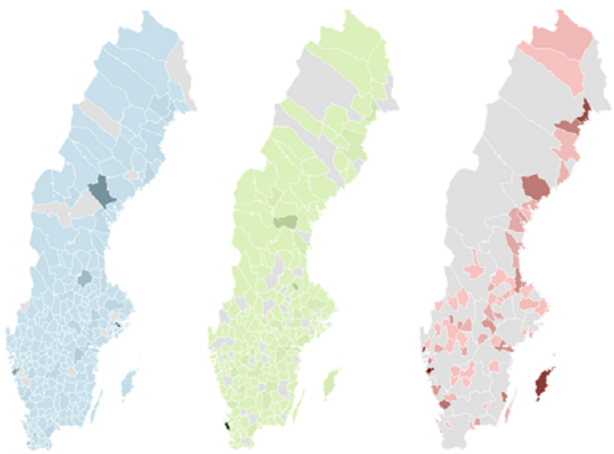

Figure 1. Geographic distribution of identified excess heat flows at the municipal level. Note that the mapping is not comprehensive, but it provides an indication of how different excess heat flows are distributed across the country.

This means that approximately 15–16 TWh of excess heat is not currently utilized each year. The untapped potential includes:

- about 8 TWh of high temperature excess heat
- about 7 TWh of low temperature excess heat
- about 1 TWh of medium temperature excess heat

There are several reasons why these excess heat flows remain unused. In some cases, there is no local heat demand. In others, technical or economic barriers hinder connection of the excess heat source to the district heating network, especially when the temperature level is low or the distance is significant. Seasonal variations and internal priorities at the heat-supplying facility also affect availability.

By 2035, the excess heat potential is expected to increase significantly. The total availability is projected to reach around 50 TWh, which exceeds today's entire district heating supply in Sweden. The increase occurs primarily within the medium temperature segment and is driven by for example:

- the establishment of new hydrogen electrolysis plants
- expansion of biofuel production facilities
- new data centers
- electrification and process changes in existing industry

In total, medium temperature excess heat is expected to increase by approximately 25 TWh, reaching 26 TWh by 2035. High temperature flows are projected to increase by around 4 TWh, though some existing flows may decrease due to energy efficiency measures and electrification. Changes in low temperature excess heat flows were not included in this mapping.

The geographic distribution of new flows largely reflects where new industrial investments are made, meaning that large volumes of excess heat will continue to arise far from areas with the greatest heat demand. Without targeted policies, coordination, and locally adapted solutions, there is a risk that substantial amounts of excess heat will continue to be lost, even as the theoretical availability increases.

* Note that 22 TWh/year is an underestimation of the actual potential today. For example, many smaller point sources of residual flows have likely been missed in this broad mapping. A limitation has also been applied whereby low- and medium temperature excess heat flows from industries that also have large high temperature flows (which are of greatest interest for external use) have been excluded from the mapping.

Why is more excess heat not utilized today?

Despite available technical solutions, several factors still limit the practical use of excess heat.

Geographical distance
In many cases, heat demand is not located where the excess heat is generated. Large industrial sources of high temperature excess heat are often situated in less populated areas with a limited local heat demand. Conversely, low temperature flows are more common in urban areas with higher demand, but where the temperature does not match district heating system requirements. Long distances to the network often make it unprofitable to build new infrastructure, especially for low temperature flows or when the energy utility's existing production is cost-efficient. In some cases, even a few tens of kilometers make the investment economically unviable.

Temperature compatibility
Swedish district heating systems are generally designed for supply temperatures between 70–120°C. To make lower temperature excess heat usable, it often needs to be upgraded via heat pumps. This requires available electrical capacity, which sometimes is a local constraint, adding both capital and operational costs. Daily and seasonal variations further complicate planning and matching system needs.

Temporal variation
Industrial excess heat availability often fluctuates. Many facilities have high internal heating needs during winter time, which limits their ability to deliver heat externally when demand is at its peak. Other sources, such as data centers and wastewater treatment plants, provide more stable flows but mostly at low temperatures. Seasonal imbalances can sometimes be managed with thermal storage, but such solutions are rarely considered economically viable under current conditions.

Business models and collaboration
Successful excess heat partnerships require long-term and transparent business relationships between industry and energy utilities. In practice, it is often difficult to establish agreements that fairly allocate uncertainties, investment risks, and responsibilities. Differences in business culture, investment horizons, and return requirements sometimes hinder cooperation, even where the technical potential is significant.

Lack of economic viability
Even when there is technical solutions and a willingness to cooperate, profitability can be a limiting factor. Costs for piping, temperature upgrades, and network or building adjustments can outweigh the economic benefit. Additionally, current subsidy schemes and pricing models are seldom designed to incentivize integration of excess heat into low-emission district heating systems.

What Needs to Happen?

The theoretical potential for excess heat in Sweden is estimated in this mapping to approximately 50 TWh by 2035, equivalent to the entire projected district heating demand within the same timeframe. However, unlocking a greater share of this potential for actual delivery requires the alignment of several conditions.

To turn excess heat potential into real benefit, coordination is needed between technology, business logic, and spatial planning. Recovery of excess heat must already be considered at the localisation and planning stage of new industries.

Technical solutions such as heat pumps, thermal storage, and temperature reduction in district heating systems can enable the integration of more heat flows, but they require sufficient grid capacity and local adaptation.

Collaboration between industrial actors and energy utilities must be built on transparency, trust, and business models that allocate costs and benefits fairly over time. Fully realizing this potential also requires that excess heat be integrated into regional and municipal energy planning.

The Swedish Heating Market

The Swedish Heating Market is an interdisciplinary research project that brings together heating customers, energy companies, heat pump providers, researchers, authorities, and industry organizations to analyze, understand, and shape the future heating and cooling market.

With a systems perspective and an inclusive, holistic approach, the Swedish Heating Market can identify and address new challenges and development pathways, as well as widely disseminate knowledge within the sector.

During 2024–2027, a fifth phase of the project is underway, with a particular focus on how the heating sector can contribute to the energy transition, and on increasing the robustness and resource efficiency of Sweden's future energy landscape. The project is led by *Profu*, an independent research and consultancy firm.

Learn more about the project and find additional publications at www.varmemarknadsverige.se.

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