Danfoss

Case Study

Leveraging excess heat

How the Warsaw Metro can accelerate the green transition

Contents

Danish Royal Visit and Memorandum of Understanding

From January 31 to February 2, 2024, His Majesty King Frederik X will be in Poland on his first international visit as the King of Denmark. During the visit, Danfoss, along with Polish and Danish partners, will sign a Memorandum of Understanding and launch a collaboration on utilizing excess heat from the metro stations in Warsaw. This marks the beginning of a new partnership which has the potential to be scaled and replicated across Europe to realize the untapped potential of excess heat – not only from metro stations, but also from wastewater treatment plants, hydrogen production, and many other sources.

On the occasion of the visit and the new collaboration, Danfoss has prepared a case study showing the potential of reusing excess heat from metro stations in Warsaw. While this is only an initial analysis, a potential feasibility study is currently being explored to calculate the exact potential and to identify the most promising metro stations for early application. If successful, the study is expected to be completed by mid-2025. Moreover, the case study finds great potential to utilize excess heat beyond metro stations, beyond district heating, and beyond Poland.

Excess heat: Poland's largest untapped energy source?

Every time an engine or motor runs, it generates heat. Industries, wastewater facilities, data centers, supermarkets, metro stations, and commercial buildings all generate large amounts of energy, only some of which is used to productively carry out the intended task. The rest, however, simply dissipates into thin air as excess heat. This excess heat – also referred to as surplus heat or waste heat – is a sleeping giant of energy efficiency.

Today, heating is one of the largest energy consumers, especially in the temperate and cold regions of the world. In Europe alone, space and water heating accounts for 79% of final energy consumption in the residential sector,[1] most of which is still generated using fossil-based sources, such as coal and natural gas.

However, all urban areas in Europe have access to numerous sources of excess heat. In fact, there is about 2,860 TWh per year of waste heat accessible in the EU alone, much of which could be captured with heat recovery technologies and reused to heat buildings, homes, and, water.[2] To put this number into perspective, it corresponds almost to the EU's total energy demand for heat and hot water in residential and service sector buildings, which is approximately 3,180 TWh per year in the EU27+UK.[3]

Poland has an extensive industrial sector and therefore a sizeable supply of excess heat. This means the opportunities to decarbonize heating in urban areas are readily available.

2,860

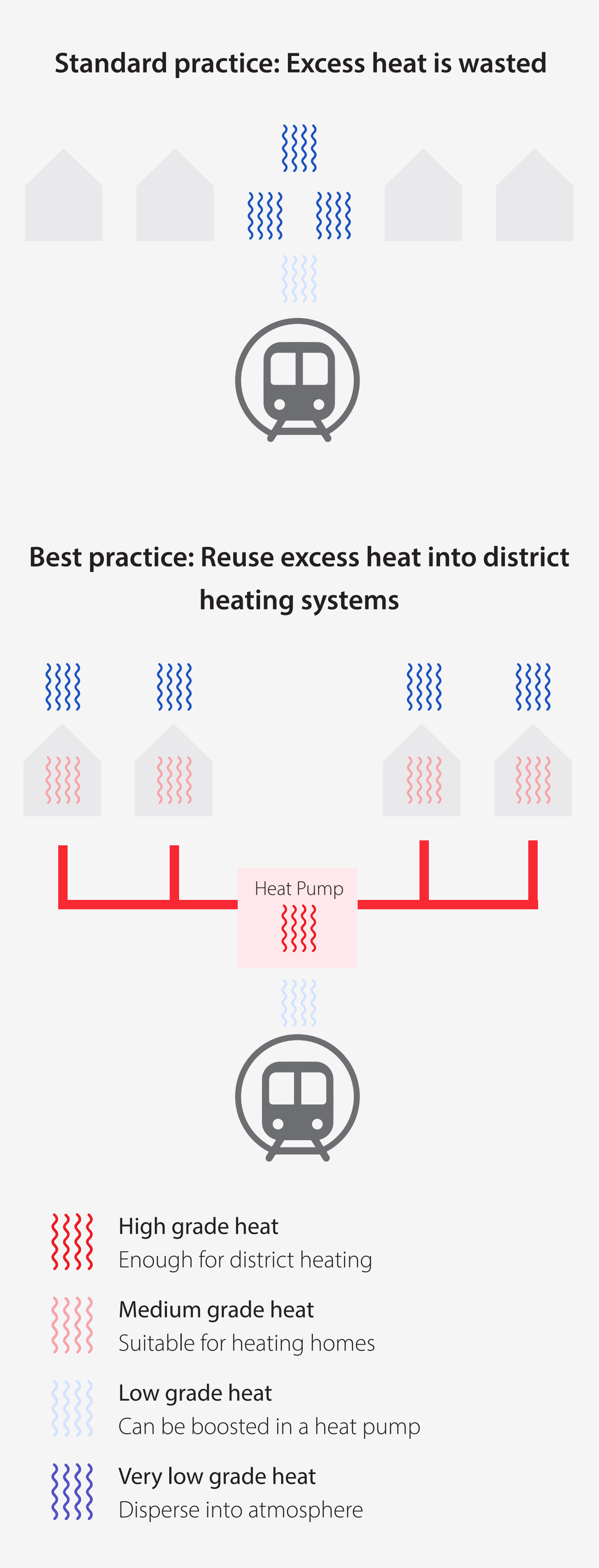
TWh/year

of waste heat accessible in the EU, almost the same as EU's total energy demand for heat and hot water.

Reusing excess heat can also lower costs for consumers, as it is often much cheaper to reuse energy than it is to buy or produce it. Similarly, excess heat can increase efficiency and replace fossil-based heating. This way, excess heat can help lower strain on the electricity grid, easing the transition to renewable energy sources.

This case paper zooms in on Warsaw, Poland to explore the potential of excess heat to reshape the energy landscape for heating in the city. It also provides an initial analysis of a new project to capture excess heat from the Warsaw Metro System and repurpose it in the city's district heating system. With forward-thinking projects like these, Warsaw has the potential to become a pioneer of excess heat capture, thereby lowering overall energy demand, boosting the local economy, and accelerating the city's green transition.

Figure 1: Putting metro excess heat to use. Metro systems have many sources of excess heat, such as motors for fans and air conditioners, or even the movement and braking of the train cars. Once this heat is created, the energy, emissions, and money have already been spent. To increase our return on this investment, we need to extend the usefulness of that heat as far as possible. Rather than simply letting it dissipate into thin air, we can capture it to heat people, buildings, and water, lowering energy demand and paving the way to fully decarbonized heating in cities.



Transforming Warsaw for a net-zero future

Poland is a powerhouse of European energy. With the fifth largest energy sector in the European Union (EU), Poland produces more than 4.2 million terajoules (TJ) of energy – double that of Belgium and four times that of Hungary.[4] However, due in part to the historical significance of the coal industry in the region, Poland also has the highest share of coal in total energy supply and demand of all International Energy Agency (IEA) member countries.[5]

To address this, the Polish government has adopted the Energy Policy of Poland until 2040 (EPP2040), a comprehensive agenda for creating a just transition to a zero-emission energy system. One key target of the EPP2040 is to reduce the country's reliance on coal, aiming "to meet heating demand for all households in a zero- or low-emission manner."[6]

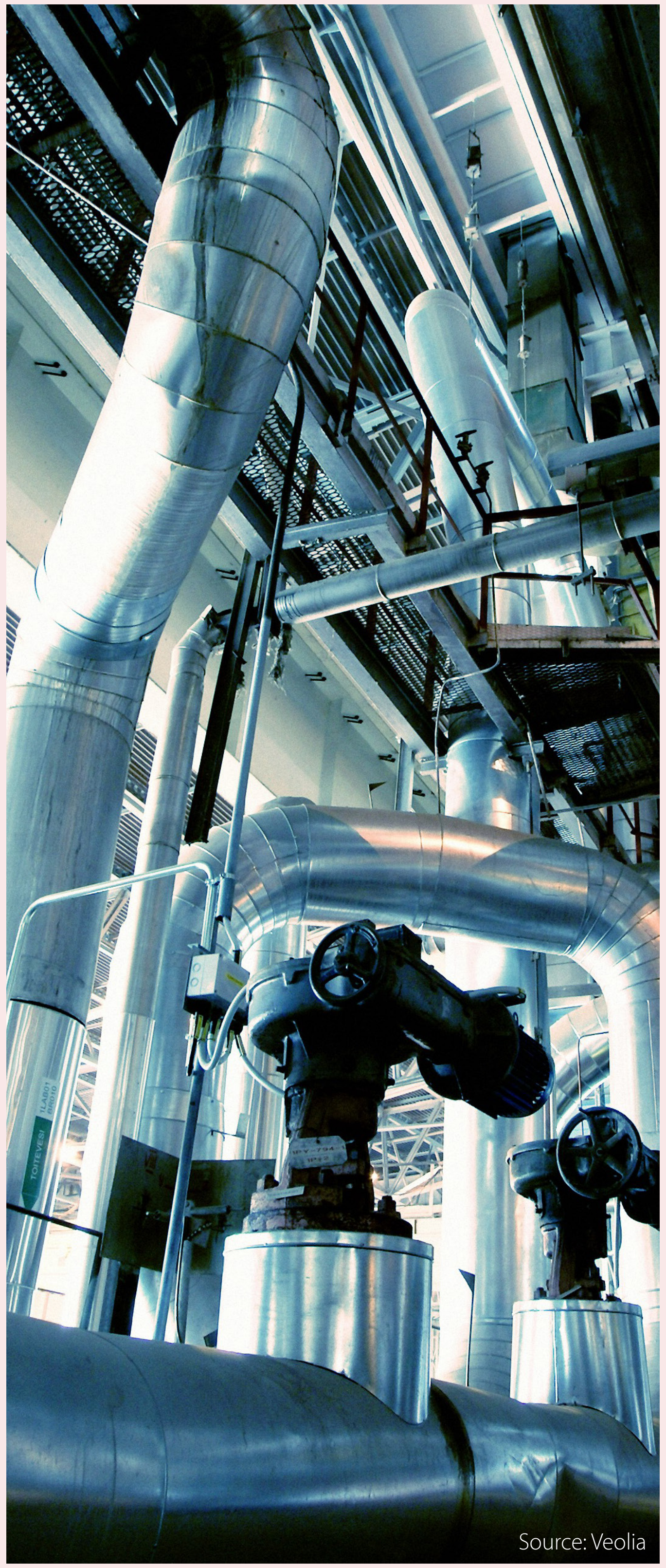
With a population of 1.7 million inhabitants, Warsaw is by far the largest city in Poland. As such, it also plays an outsized role in ensuring that Poland reaches the goals of the EPP2040. Similarly, Warsaw is a member city of the European Commission's Cities Mission, a project aiming to achieve 100 climate-neutral and smart cities in the EU by 2030. The initiative provides funding and support enabling these cities to act as experimentation and innovation hubs for the green transition. As such, Warsaw has the eyes of Europe upon it, and a golden opportunity to transform its energy system into a modernized, efficient system built for the era of renewables.

In this case paper, we take a deep dive into the opportunities of excess heat to accelerate the decarbonization of heating in Warsaw.

Europe's largest district heating system

Warsaw is heated with Europe's largest district heating system, dating back to the Soviet era.[7] Within this system there are many sources of waste heat, and amongst these are the metro stations.[8] A combined 62 GWh of heat are being wasted annually from the metro stations, and a large part can be utilized in the district energy system to heat the homes of Warsaw. Poland has Europe's most CO2e-intensive electricity mix,[9] so any effort made towards making the system more efficient can have a huge environmental impact.

Today, the district heating in Warsaw is mainly powered by two CHP plants, Siekierki from 1961 and Żerań from 1954, fueled by coal and gas respectively.[10,11,12] Siekierki can heat 55% of Warsaw's buildings, has a thermal power of 2,065 MW_t, and an electrical power of 620 MW_e. In other words, this means that the heat output is 2,065 MW and the electricity output is 620 MW electricity. Żerań can heat 43% of Warsaw's buildings, has a thermal power of 1,736 MWt, and an electrical power of 882 MW_e.


Source: Veolia

Decentralizing heating in Warsaw

In Augustówka, a district in the south of Warsaw just off the west bank of the Vistula River, three red-and-white striped smokestacks tower nearly 200 meters into the sky. A relic of the Soviet era and an integral part of the lives of each and every Varsovian, the Siekierki Power Station has been providing heat and electricity for the nation's capital since 1961.

However, at the far northern end of the city, only a single striped tower can be seen reflecting onto the Vistula, this time from its east bank. This solitary tower is home to the Żerań Power Station. Erected in 1954, Żerań is the older and smaller of Warsaw's two combined heat and power (CHP) stations.

Together, Siekierki and Żerań boast a combined heat generation capacity of over 3,800 MW. Indeed, more than a half-century after their construction, these two coal and natural gas power plants still serve as the powerhouse of Warsaw's district heating system, providing hot water and heat for both residential and industrial buildings. And during the coldest days of the Warsaw's notoriously frigid winters, the city also fires up two additional heat plants, Wola to the west and Kawęczyn to the east.

Together, Warsaw's four plants provide roughly 80% of the heat for its district heating system, a labyrinth of more than 1,800 kilometers of pipes delivering hot water to and from the city's buildings.[13] But while Warsaw's district heating system gives it a head start on energy-efficient heating, the near-total reliance on four fossil-fuel heat plants is rapidly becoming problematic; Poland aims for no more than 56% coal in electricity production in 2030,[14] compared to 75% in 2022.[15] To meet these goals, plants such as Siekierki and Żerań must in the short term be supplemented by decentralized, local energy sources, and in the long term, be phased out in favor of a heating system powered primarily by renewables. As explored in the first section, excess heat presents one of the greatest opportunities to decentralize heating networks while lowering cost and emissions. Let's look at one concrete case from Warsaw.

CASE: Excess heat capture from the Warsaw Metro System

In the vast area that makes up Warsaw's district heating system, there lie many potential sources of excess heat, just waiting to be put to efficient use. One of these are the dozens of stations of the city's metro system.[16] Every year, a combined 62 GWh of heat are wasted from the metro stations. This is the equivalent to the heating demand for the homes of over 14,000 Polish people for a year.[17] However, the majority of this metro excess heat can be recovered and integrated into the district heating system to heat the homes, businesses, and domestic hot water of Warsaw.

The excess heat is produced from the movement and braking of the train cars, motors in the air conditioning, the passengers themselves, and many other sources. This heat serves as a free energy resource just waiting to be utilized. In order to capture and distribute the excess heat in the district heating grid, it will be necessary to install heat pumps at the metro stations. Heat pumps can boost the low-grade heat from the metro stations to 90-120°C – the temperature needed in Warsaw's district heating system. Actually, heat pumps can use one unit of electricity to produce three to five units of heat. In the context of the Warsaw metro system, this means that the 62 GWh of low-grade excess heat can be boosted into 93 GWh of high-grade heat for the district heating system with 31 GWh of additional electricity.

Today, the heat is delivered mainly from burning coal and gas, which leaves a tremendous climate footprint and air pollution. If Warsaw captures and uses the excess heat from the metro, the burning of fossil fuels from Siekierki and Żerań can be reduced. Now, the main purpose of these CHP's is to produce electricity by burning fossil fuels. Much of the waste heat from this process is captured and distributed in the district heating grid. As such, it is not enough just to capture the excess heat and supply heat pumps with low-emission electricity; it is also necessary to substitute the reduced electricity production from Siekierki and Żerań with low-emission electricity.

Warsaw can save about 42,000 tons of CO2e per year by capturing the excess heat from the metro system if the electricity to power the heat pumps and supplement the reduced electricity production from the CHPs is provided with renewable energy. That is equivalent to the annual carbon footprint of about 6,300 Polish citizens.

While the calculations for this initial analysis are detailed in the Appendix, a potential feasibility study is currently being explored to calculate the exact potential and to identify the most promising metro stations for early application.[18] The study is expected to be completed by mid-2025.

Beyond the tip of the iceberg

Warsaw is proving to be a pioneer in exploring the potential of excess heat to reduce emissions, save energy, and lower cost. However, this is only the first step: the potential to capture and reuse excess heat expands far beyond metro stations and district heating networks. And both within and outside of Poland, the potential goes beyond Warsaw alone.

Beyond metro stations

According to a database from Aalborg University on excess heat sources across Europe, there are 11 data centers and 42 wastewater treatment plants within Warsaw alone where excess heat can be effectively captured.[19] Both of these are major producers of excess heat. In fact, the excess heat potential from these wastewater treatment plants is more than 20 times that of the city's metro stations.[20] And while there are some possible political challenges to overcome in capturing excess heat from these sources – challenges which we explore in the next section – this demonstrates the incredible potential of excess heat still lying dormant in Warsaw, just waiting to be tapped into.

Beyond district heating

Excess heat isn't only useful when coupled with district heating systems. As we explored in the second issue of Danfoss Impact – our whitepaper series highlighting the incredible potential of energy efficiency to transform our energy system – excess heat can be captured and reused within the very buildings and industrial processes from which it was generated. For example, excess heat from supermarket freezers can be captured and repurposed to heat the supermarket itself or the building's water supply, thereby lowering the supermarket's demand on the grid. In fact, since 2019, one supermarket in Denmark has covered 78% of its heating consumption with reused heat generated from cooling processes.[21] This same success could be replicated in the supermarkets of Warsaw.

Another alternative for excess heat deployment is industrial cluster planning, where proximity between industrial heat producers and consumers can be leveraged to further decarbonize energy systems. One project from Kalundborg, Denmark has estimated that industry production can provide heat for up to 40,000 households.[22]

Beyond Warsaw

Many cities could be prime candidates to replicate the efforts in Warsaw. Prague, for example, has the Czech Republic's largest district heating system, heating more than 230,000 households.[23] One analysis found that excess heat from the city's Central Wastewater Treatment Plant (ÚČOV) could provide heat for up to 100,000-200,000 households over the next 10-15 years.[24] And according to the dataset from Aalborg University, Prague also has excess heat potential from 53 metro stations, 12 data centers, and 62 supermarkets.[25]

In Budapest and Bucharest, district heating systems are currently undergoing major construction and renovation projects,[26,27] making now the perfect time to start planning for excess heat integration.

In fact, one study found that "windows of opportunity" are of great importance for using excess heat recovery for district heating,"[28] uncovering that in many cases, "the construction or even a plan for a district heating network can also trigger the recovery of excess heat for distribution."[29] If leaders do not act quickly and decisively, cities with plans to renovate, expand, or build completely new district heating networks could miss this narrow window of opportunity to engage industrial excess heat producers.

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Excess heat is the world's largest untapped source of energy. Still, very few initiatives have pushed for more efficient use of the vast amounts of wasted energy in the form of excess heat even though we already have the solutions available today. We urgently need policy measures to accelerate the use of excess heat across sectors, both so that citizens and businesses can benefit from lower energy costs and to ensure we step up progress in the green transition.

Kim Fausing,
President and CEO of Danfoss

Overcoming barriers to excess heat

One of the keys to broadening the capture of excess heat in Warsaw – or any city, for that matter – will be to address the economic, regulatory, and partnership barriers head-on.

Economic barriers

To further improve energy efficiency by using wasted energy, it is essential to remove both financial and legislative barriers. The current design of the energy market is, in many places, a barrier to sector integration technologies, either by hindering the participation of sector integration technologies in specific markets or by not internalizing all positive and negative externalities of respectively low- and carbon-intensive technologies. It is crucial that tax legislation is in favor of using surplus heat and that appropriate network tariff structures should be considered. Additionally, administrative barriers need to be removed to incentivize users to connect to district heating networks, which will also encourage district heating utilities to boost their efficiency.

Regulatory barriers

Excess heat must be considered as a renewable energy resource instead of waste to be disposed of. Today, there are a number of barriers that prevent market players from leveraging the potential of reusing excess heat. Regulation can remove these barriers for instance by supporting an equal treatment of waste heat and renewable energy sources used in heat networks. Indeed, policymakers must count waste heat towards renewables targets – including when used on site – and ensure that waste heat is part of energy-efficient district heating and cooling definition. It can also push for greater use of excess energy by making it mandatory for industrial actors to plan for exploiting excess heat.

Partnership barriers

More systematic use of excess heat is, at its core, an exercise that spans sectors and stakeholders. Partnerships between local authorities, energy suppliers, and energy sources such as metro systems, supermarkets, data centers, wastewater facilities, and industries can help to maximize the full potential of excess heat. These can be facilitated by central units that are given the responsibility for providing information for and matchmaking between producers and possible off takers of excess heat. These groups can also help to identify and address possible barriers in implementation of projects. This will help overcome business model barriers that complicate who should pay for what and how much they should pay.

For a full roadmap on how to create the necessary policy landscape for successful excess heat recovery, read Danfoss Impact Issue No. 2 on excess heat at whyee.com.

Source: Veolia

Appendix

Warsaw is heated with Europe's largest district heating system, dating back to the Soviet era.[30] Within this system there are many sources of waste heat, and amongst these are the metro stations.[31] A combined 62 GWh of heat are being wasted annually from the metro stations, and a large part can be utilized in the district energy system to heat the homes of Warsaw. Poland has Europe's most CO2e-intensive electricity mix,[32] so any effort made towards making the system more efficient can have a huge environmental impact.

Today, the district heating in Warsaw is mainly powered by two CHP plants, Siekierki from 1961 and Żerań from 1954, fueled by coal and gas, respectively.[33,34,35] Siekierki can heat 55% of Warsaw's buildings, has a thermal power of 2,065 MWt, and an electrical power of 620 MWe, meaning that the heat output is 2,065 MW and the electricity output is 620 MW electricity. Żerań can heat 43% of Warsaw's buildings, has a thermal power of 1,736 MWt, and an electrical power of 882 MWe.

The CHP plants have been renovated throughout the years, so it assumed that the coal-fired Siekierki has an efficiency (η) of 85% and the gas-fired Żerań has an efficiency of 90%.[36] The capacity of coal (MW_{input}) needed to deliver the specified MWh and MWe can be derived as:

$$MW_{input} = \frac{MW_t + MW_e}{\eta} \cdot 100$$

Using this equation, MWinput of Siekierki and Żerań can be derived to 3,159 and 2,909 MW, respectively. Thus, the combined thermal power of 3,801 MWt require an input of 6,068 MW energy.

The waste heat potential from the metro system is 62 GWh per year according to ReUseHeat[37] and to utilize this, heat pumps are required. To be consistent with the dataset from ReUseHeat, a COP of 3 has been applied. This means that 31 GWh electricity is necessary for heat pumps, and the total heat output from the metro stations will be 93 GWh. 93 GWh of heat to the district heating network is equivalent to 24.5 hours uptime for the two CHPs, which will require a 148 GWh input – mainly stemming from fossil fuels.

The excess heat from the metro can only be used when there is a heating demand. The heat demand is well above 500 GJ per hour when it is lowest during the summer.[38] Assuming that the 93 GWh heat from the metro and heat pumps is distributed evenly throughout the year and days, Warsaw can collect 38 GJ per hour from the metro. This means that the grid can easily take up the heat from the metro stations.

Electricity needed from alternative sources

To reach the climate goals, Warsaw must move away from coal and natural gas. The main purpose of CHPs like Siekierki and Żerań is typically to produce electricity. The excess heat from electricity production is then utilized in the district heating system to heat the city. Utilizing the excess heat from the metro stations can contribute to meeting the heat demand in Warsaw without using the CHPs.

There is, however, still a need for electricity that the CHPs meet today. The excess heat from the metro station is equivalent to 24.5 full-load hours for the two CHPs combined, over which they will produce 37 GWh electricity. Also, it is necessary to apply electricity to the heat pumps to utilize the heat from the metro stations. Assuming a COP of 3, the needed electricity input is 31 GWh per year. So, the total electricity needed is 68 GWh.

Emission factors

The direct CO_2-emissions from Siekierki are 320.2 kg per MWh.[39] The specific CH4 and N2O-emissions from the CHPs are not available, so the emission factors from DEFRA are used. A part of the fuel in the CHPs is natural gas, but the majority is coal. From a climate perspective, a conservative estimate is that half the fuel is coal, and the other half is natural gas since the emissions are lower from natural gas than from coal. This leaves us with 0.185 kg CO_2e of CH4 per MWh and 1 kg CO_2e of N2O per MWh from combustion. This adds up to a total emission factor of 321.4 kg CO_2e per MWh from combustion (scope 1). For the well-to-tank emissions (scope 3), DEFRAs emission factors are used.[40] The emissions are determined with the same conservative half/half distribution between natural gas and coal and is 45.1 kg CO_2e per MWh.

Żerań is fueled by natural gas. According to DEFRA, natural gas emits 202.3 kg CO_2e per MWh (Net CV) from the combustion (scope 1), and the well-to-tank emissions (scope 3) are 34.4 kg CO_2e per MWh (Net CV).

It is necessary to supply the city and the heat pumps with electricity from other sources than the CHPs for Warsaw to reach their climate targets. The electricity can be supplied with low-emitting sources. Of the low-emitting sources, solar is the highest emitter, with 41 tons CO_2e/GWh over its entire life cycle.[41] This emission factor is used to calculate the footprint of the alternative energy supply. In reality, the low emitting electricity will be delivered from a mix of sources, and therefore the footprint will be lower.

Climate effects of utilizing the excess heat

Warsaw has to produce 68 GWh of low-emission electricity for heat pumps and as compensation for the reduced production from the CHPs. For this case, the alternative electricity is assumed to come from solar power, since this has the highest emission of renewable energy sources.[42] With this assumption, the related emissions will amount to 2,778 tons CO_2e. The reduced electricity production from the CHPs of 37 GWh amounts to a combined CO_2e-reduction of 45,171 tons from combustion and well-to-tank. This means that the total CO_2e-reductions of utilizing the excess heat from the Warsaw metro stations can amount to 42,393 tons CO_2e. The per capita consumption-based footprint in Poland is 6.72 tons CO_2e per year.[43] Thus, the effect of utilizing the excess heat amounts to the annual footprint of 6,308 polish citizens.

References

1. Eurostat (2021) Energy consumption in households
2. Connolly, D., et al. (2013). Heat Roadmap Europe 2: Second Pre-Study for the EU27. Department of Development and Planning, Aalborg University
3. Connolly, D., et al. (2013). Heat Roadmap Europe 2: Second Pre-Study for the EU27. Department of Development and Planning, Aalborg University
4. IEA (2020). Total Energy Supply by Region – Europe.
5. IEA (2022). Executive Summary – Poland.
6. Polish Ministry of Climate and Environment (2021). Energy Policy for Poland until 2040.
7. The Guardian (2015). How Warsaw's district heating system keeps the capital cleaner than Krakow.
8. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
9. EEA (2023). Greenhouse has emission intensity in electricity generation in Europe.
10. Wikipedia (2023). Siekierki Power Station. Accessed 6 December 2023.
11. Wikipedia (2023). Zeran CHP plant. Accessed 6 December 2023.
12. WNP (2023). Inwestycje gazowe w Ec Żerań zakończone – ruszyła druga kotłownia gazowa.
13. The Guardian (2015). How Warsaw's district heating system keeps the capital cleaner than Krakow.
14. Polish Ministry of Climate and Environment (2021). Energy Policy for Poland until 2040.
15. IEA (2022). Energy Statistics Data Browser. Energy Supply – Electricity Generation by Source – Poland.
16. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
17. The excess heat from the metro stations in Warsaw amounts to 92,988 MWh per year. The average residential area per person in Poland is roughly 37m2 (Statista, 2023) and the average heat consumption is 172 kWh/m2 (EEA, 2015), or 6.378 MWh per year per 37m2 home. Therefore, the homes of 14,582 Polish people can be heated from the Warsaw metro system's excess heat.
18. NIRAS. EIFO Green Accelerator: søg tilskud til modning af dit grønne eksportprojekt.
19. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
20. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
21. Danfoss (2022). Danfoss Impact No. 2. The world's largest untapped energy source: Excess heat.
22. Intelligent Energi (2023). Kalundborg jagter bæredygtige løsningser på tværs af sektorer.
23. Prazská teplárenská (2023) I want warmth | Pražská teplárenská a.s. (ptas.cz)
24. Prague City Hall, Environment Protection Department (2021) Prague Climate Plan 2030: Prague on the road towards carbon neutrality. Pg. 54.
25. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
26. Energy Industry Review (2021). EC to Support Rehabilitation of District Heating System in Bucharest.
27. Think Geoenergy (2021). Budapest, Hungary plans geothermal district heating project.
28. Fritz et al. (2022). Usage of excess heat for district heating – Analysis of enabling factors and barriers. Journal of Cleaner Production. 363, pp. 10.
29. Fritz et al. (2022). Usage of excess heat for district heating – Analysis of enabling factors and barriers. Journal of Cleaner Production. 363, pp. 9.
30. The Guardian (2015). How Warsaw's district heating system keeps the capital cleaner than Krakow.
31. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
32. EEA (2023). Greenhouse has emission intensity in electricity generation in Europe.
33. Wikipedia (2023). Siekierki Power Station. Accessed 6 December 2023.
34. Wikipedia (2023). Zeran CHP plant. Accessed 6 December 2023.
35. WNP (2023). Inwestycje gazowe w Ec Żerań zakończone – ruszyła druga kotłownia gazowa.
36. EPA (2021). Methods for Calculating CHP Efficiency.
37. Moreno, D., et al. (2022). The European Waste Heat Map ReUeseHeat project, Aalborg University
38. Kurek, T. et al. (2021). Heat demand forecasting algorithm for a Warsaw district heating network, p. 4 fig. 1
39. Veolia Energia Warszawa (2022). Wpływ na środowisko - zanieczyszczenia wyemitowane do powietrza ze źródeł przy wytworzeniu.
40. DEFRA (2023). Greenhouse gas reporting: conversion factors 2022.
41. COWI (2023). Comparing CO2 Emissions from Different Energy Sources.
42. COWI (2023). Comparing CO2 Emissions from Different Energy Sources.
43. European Commission (2021). Consumption Footprint Platform

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