German cities towards 100 % renewable energy – Heat Hub Hennigsdorf

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Abstract

The Heat Hub Hennigsdorf is a lighthouse example how cities can contribute to the German energy transition to renewable energies ("Energiewende") by setting binding targets themselves and decarbonizing their heat supply together with local stakeholders. The municipal utilities of Hennigsdorf aims at a district heating with 100 % renewable and CO_2-neutral heat in 2025 for its yearly heat demand of 120 GWh/a. Until the year 2022, the share of CO_2-neutral heat in the district heating will be increased from 50 to 84 %. To reach this target, different decentralized and renewable heat sources are on the way to be integrated into the district heating net. Biomass driven combined heat and power plants are already used to about 50 % of the annual heat load. To be able to operate the district heating with fluctuating industrial waste and solar thermal heat, the entire network has to be developed to a Heat Hub by integrating two heat storages of 1 000 and 22 000 m³. This is one of the largest funded research and demonstration projects of the German Federal Ministry for Economic Affairs and Energy (BMWi) in the field of heating networks and a model for the decarbonization of existing district heating supplies (Gintars, 2018).

Keywords: Renewable district heating, decarbonization, heat transition, solar thermal, industrial waste heat

1. Introduction

The decarbonization of the heat supply is one important pillar for the German energy transition to renewable energies ("Energiewende"). The strategy aims to reduce greenhouse gas emissions by 80 % in 2050 compared to 1990 levels. The heating area has a share of approx. 54 % of final energy consumption. Of this alone, approx. 27 % points on the final energy consumption for space heating. At the same time, the heating transition also represents an opportunity for Germany as a highly industrialized country, as it offers the possibility of generating added value to German companies. Energy efficiency and the increased use of renewable energies and waste heat creates innovations, new business models and jobs in future markets. According to the principle "Efficiency First!" the heat demand is to be significantly reduced by improving energy efficiency in the building and industrial sector as well as in trade and commerce and the remaining demand is to be covered by renewable energy sources. Even with ambitious expansion paths for renewable energies in the heating sector, it will not be possible to completely cover today's heating requirements with renewable energies. (BMWi, Energieeffizienz in Zahlen, 2019)

2. Solar Thermal as an Option not only for Cities

District heating (DH) is a great option to increase the overall energy efficiency in urban areas and an important platform to increase the share of renewable and fossil-free energies in the heat supply. Solar thermal energy from large-scale solar thermal collector areas is one possible heat source for sustainable DH, as it is emission-free, available everywhere and offers stable operating costs for decades (Epp & Oropeza, 2019). By the end of 2019, in Germany 37 solar district heating (SDH) systems were in operation with a total gross collector area of about 69 900 m² (Geiger, et al., 2020). The system sizes range from 99 m² to 8 300 m² with an average collector area of 1 890 m². With the installation of a 14 800 m² solar collector field integrated in the district heating system of the city of Ludwigsburg, the biggest SDH plant went in operation in spring 2020 (Stadtwerke Ludwigsburg, 2020). In the German SDH market, flat plate collectors are mainly used, but evacuated tube collectors have a relatively high share of 34 % of installed collector area. For SDH systems, typical values for temperatures are 70-110 °C in supply and 40-80 °C in return flow (Tschopp, et al., 2020).

Characteristic for the German market is a broad variety of applications. SDH applications range from small villages

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and rural areas, to SDH for districts and SDH for cities and urban centers. In cities and urban areas, the main heat producers are usually combined heat and power plants, heating plants, waste incineration or industrial waste heat. Depending on the system size and efficiency of the solar thermal plant, solar heat production costs below 50 €/MWh can be reached without incentives (Berberich & Mangold, 2017).

Solar thermal projects are often realized in bioenergy villages ("Bioenergiedorf"). The combination of wood chip boilers and solar thermal plants turned out to be one successful system for an efficient heat supply, the bioenergy village Büsingen is a good example (Solites, 2013). The projects are usually initiated by citizens, who cooperate with the municipality, local craftsmen, building companies and consulting engineers. Oftentimes, the citizens set up a registered cooperative to manage the energy supply and distribution, which has the aim of long-term favorable prices instead of short-term profit maximization. Furthermore, it allows a high degree of co-determination and limited liability risks.

Another typical business strategy for large-scale solar thermal systems in Germany is the change from fossil fuels to renewable energies in DH systems. Especially for DH networks with a relatively high thermal load, a solar thermal system can directly feed into the network without additional storage system. This allows for a cheap heat production but only for limited solar fraction of the entire heat demand of the DH network. One regulatory reason for this effort is the reduction of the primary energy factor of the DH network due to solar thermal integration. With a reduced primary energy factor, new customers meet the legal requirements for using renewable energies in new buildings by connecting to the DH network (BMWi, Erneuerbare-Energien-Wärmegesetz - EEWärmeG, 2018). Furthermore, DH companies as well as industries benefit from long-term cost stability of solar heat.

3. Development of the Heat Hub

Climate protection through decarbonization of the heat supply and the development of a sustainable supply system for the citizens are the main motivators for the Heat Hub Hennigsdorf. With the decision to transform their heat supply to 100 % CO_2-neutral heat until 2025, the city of Hennigsdorf is a pioneer of the energy transition in Germany. The DH of Hennigsdorf is a typical existing DH network of a mid-sized-town with 26 000 inhabitants, northwest of the German capital Berlin. A specialty of the heating network Hennigsdorf is its far geographic expansion from north to south, see Figure 1. The first boiler house was built in the mid-1960s, which heated some blocks of flats and commercial buildings with raw lignite (Stadtwerke Hennigsdorf, 2020). The city and the DH grew over the years and raw lignite was replaced by anthracite coal, heating oil and finally natural gas. About 80 % of the city are now provided with DH from seven central heating plants. The DH system is operated with 85 to 108 °C in supply and 60 °C in return flow and can currently be combined to form an entire network, but in some operating cases, it is separated into two to four sections.

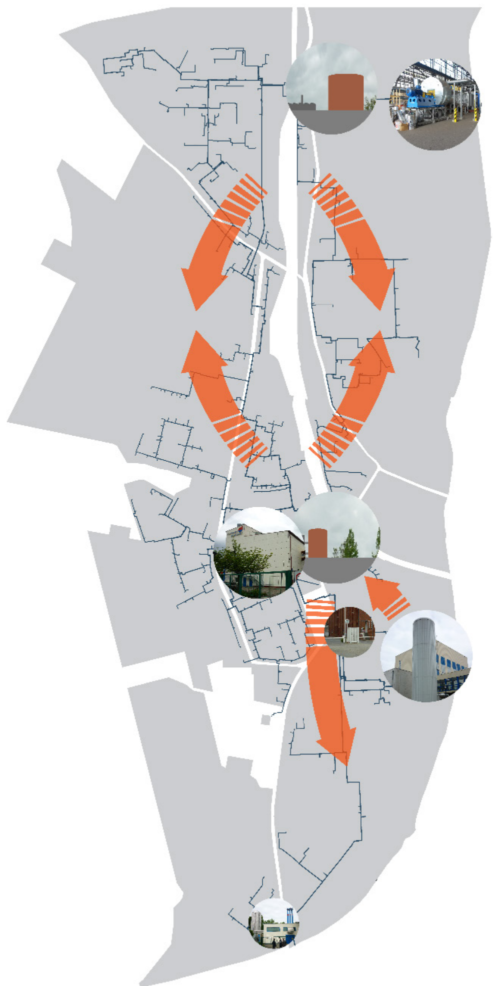


Figure 1: Overview of the city area and the heating plants (Solites)

Since 2006 the overall strategy of the city of Hennigsdorf and their utilities is to reinvest in CO_2-neutral heat production technologies. To legally separate the district heating network and the heat generation, a new municipal project company (KPG GmbH & Co. KG) was founded and the utilities began to sell its heating plants to this company. In first steps in 2009 and 2012, a woodchip combined heat and power (CHP) plant with Organic Rankine Cycle (ORC) technology and a biogas CHP were realized by the project company. At the same time, the different subnetworks of the district heating were linked and combined to one entire network. Nowadays, about half of the overall heat demand is provided by these two plants with renewable heat (Stadtwerke Hennigsdorf, 2018).

In 2015 a climate protection strategy was decided by the municipal council, which is geared to the climate protection plan 2050 of the German Federal Government aiming at a greenhouse gas neutrality of all sectors (Stadtwerke Hennigsdorf, 2018). Until 2022 the share of fossil-free heat in the DH Hennigsdorf is to be increased to more than 80 % as an intermediate step. The completion of 100 % of CO_2-neutrality is planned to be reached in 2025 (Stadtwerke Hennigsdorf, 2019).

A well-rehearsed local project team of the project company KPG, the utilities Stadtwerke Hennigsdorf, the planning company Tetra Ingenieure GmbH and project management company Ruppin Consult GmbH is completed by the research institute Solites that has comprehensive experience in consulting and realizing innovative systems like the Heat Hub Hennigsdorf. This team is supported by the management board of the utilities and the municipal council that are willing to make strong decisions for reaching their self set goals.

In a first project phase in 2016 and 2017, the project team created an overall concept for the heat supply:

- Use of waste heat from the local steelworks (implemented in 2019)
- Increase of solar thermal heat production (3 000 m² central and smaller areas decentral)
- Use of power-to-heat from renewable surplus electricity (project WindNODE)
- Realization of existing optimization potentials in the customer systems
- Realization of existing optimization potentials in the district heating network
- Dismantling of old systems that are fired with fossil oil or anthracite
- Construction of a multifunctional heat storage with 22 000 m³ and a buffer storage with 1 000 m³ of water volume
- Adaptions of the existing district heating routes to the Heat Hub
- Development and realization of a smart superior control system for the entire Heat Hub together with a comprehensive integration of sensors and actors within the district heating network

The project Heat Hub is attached to another one that regards a CO_2-neutral electricity production by wind mills in the region around the city (WindNODE, 2020). The WindNODE project, in which a total of more than 70 partners from business, science and industry from Thuringia to Mecklenburg-Western Pomerania are involved, researches possible solutions for the system integration of renewable energies. The use of storage technologies and flexible control of power consumption should enable to keep the necessary expansion of the electricity grid as low as possible while still integrating an increasing share of renewable energies into the supply system. In Brandenburg, six projects are being carried out as part of the WindNODE joint project, including the sub-project Power-to-Heat (PtH) in district heating to make the load more flexible in the power grid. WindNODE is part of the "Smart Energy Showcase - Digital Agenda for the Energy Transition" (SINTEG) funding program of the German Federal Ministry for Economic Affairs and Energy.

In addition to the implementation of numerous measures in the district heating network of Hennigsdorf like described above, the construction of a Power-to-Heat (PtH) system of 5 MW_{el} is an additional technology for achieving a CO_2-neutral heat supply.

In order to create the necessary flexibility between the deviating demand of the heating network and the different heat generations from the heating plants, the industrial waste heat recovery and the solar thermal plants, the two heat storages will be used. The PtH plant shall than use corresponding price signals from a newly generated marketing platform in times of regenerative surplus electricity to use the electricity in the heating network and thus further reduce heat generation based on conventional energy sources. Currently a PtH-system cannot be operated economically, due to German legal framework conditions.

4. Implementation of the Heat Hub

Since 2017 the project team is working in the second project phase to plan and realize the measures described above. Some of the main construction sites and already realized sub-projects are shown and described in this section.

In early summer 2019, the waste heat from the steelworks was successfully integrated in the district heating. Behind the heat exchanger in Figure 2, a walking beam furnace heats up steel billets with several gas burners. The exhaust gas leaves the furnace at a temperature of up to 500 °C and the waste heat is transferred in the tube bundle heat exchanger to the water circuit with a target temperature of 95 °C. The heat exchanger has a nominal output of

7.5 MW_{th}. Current measurement data show that even a bit more than 8 MW thermal power can be supplied. The operation of the waste heat recovery depends strongly on the dynamics of the walking beam furnace, which is a challenge for the regulation of the exhaust gas heat exchanger and the water cycle.

A great success of the project is that the utilities of Hennigsdorf were able to conclude a contract with the operator of the steelworks H.E.S. for the long-term use of the waste heat from the steelworks. Not every industrial partner is willing to do this what makes the use of industrial waste heat often quite difficult. If further heat sources in the steelworks can be used for heat recovery in the future, the use of waste heat could be expanded. The heat pipeline from the steelworks to the connection in the DH network has already been designed to double the heat transport.

Figure 2: Heat exchanger subsystem to use industrial waste heat from steelworks (picture: Solites, 17.06.2020)

To transport the heat from the steelworks to the DH, a heat pipeline of about 800 m length and a new heating plant "Nord 2" were built. “Nord 2” includes two peak load gas fired boilers and the pumps for supplying the heat to the DH. The heat pipeline from the heating plant “Nord 2” to the existing district heating net had to tunnel under the railway line, which was a particular challenge and took a few months for approval (Figure 3). Renovation and optimization work is also being carried out in other areas of the DH. Since with the industrial waste heat a main heat source will be integrated at the northern end of the heating network, the heat must be transported to the network areas with the highest heat consumption (network area “Zentrum” in the middle of the city, see also Figure 1). Therefore an additional third connection pipeline was built between the heating plant “Nord 2” and the area “Zentrum” and is planned to go into operation in autumn 2020. This solution is more economical but hydraulically more sensible than replacing the existing pipelines with a larger pipe diameter.

Another major task is the installation and programming of the monitoring system, which measures data on temperatures, heat quantities, flow rates and pressures in all heating plants of the entire system and saves them every 1 minute. The measurement concept provides for the measurement data to be forwarded from the panel PCs in the individual heating plants to a superior control system, where the data is visualized and saved for further processing. Additional data lines have to be laid for this and the superior control technology has been being installed and programmed. These tasks are currently in progress together with the construction sites in the heating plants. In the industrial waste heat plant area, its connection to the heating network and in the new heating plant “Nord 2”, the data from around 80 measuring points are captured, processed and saved to be evaluated by the plant operator, Stadtwerke Hennigsdorf, in order to optimize the operation. An overall scientific evaluation of the system is carried out by Solites.

Figure 3: Installation of the heat pipeline to tunnel under the rail trail (picture: Solites, 16.05.2019)

In early summer 2020, the first thermal energy storage with 1 000 m³ water volume went into operation and is used to optimize the operation of the biomass CHP plant in times with medium and low heat demand (Figure 4). It was built as a steel tank by welding the individual bent steel sheets together. The bottom and lid are built with dished bottoms so that the tank can withstand the over pressure of 5 bar of the DH network due to the direct integration of the storage in the kind of a hydraulic switch. For the integration of the new heat storage into the existing heating plant “Zentrum”, extensive renovation work was carried out in this heating plant. In the future, the storage facility is to be supplemented by a power-to-heat system so that excess electrical energy from renewable sources is converted into heat and stored for use in the DH network.

Figure 4: Buffer tank storage under construction (left) and finished (right) (pictures: Solites, 08.01.2020 and 16.06.2020)

For the expansion of the solar thermal heat generation, the replacement of the roof-integrated solar thermal collectors on the residential buildings of the “Cohn’s Quarter” began in autumn 2019 and will be finished in autumn 2020. A total of five roofs are equipped with solar collectors, the total collector area is 854 m² (Figure 5).

The wooden frames of the collectors integrated into the roof 18 years ago had reached their lifespan. The structural requirements, the stipulations of the design statutes for the "Cohn's Quarter" and the economic constraints posed major challenges for the development of the renovation concept for the solar roofs and the solar system technology in the basements of the houses. Since the today's solar thermal industry do not offer a sufficient number of providers with coherent concepts for maintaining the roof integration, a sheet metal roof is now being built after the existing collectors have been dismantled, on which the collectors are mounted. A detailed pre-planning enabled a cost-effective installation of the collector surfaces.

Figure 5: Replacement of formerly roof-integrated collectors on the roof of one out of five multifamily houses with large-scale solar thermal collectors on newly built sheet metal roof (picture: Solites, 17.06.2020)

Apart from the ongoing construction sites, the project team is currently working intensively on the superior control strategy for the overall system.

5. The Heat Hub

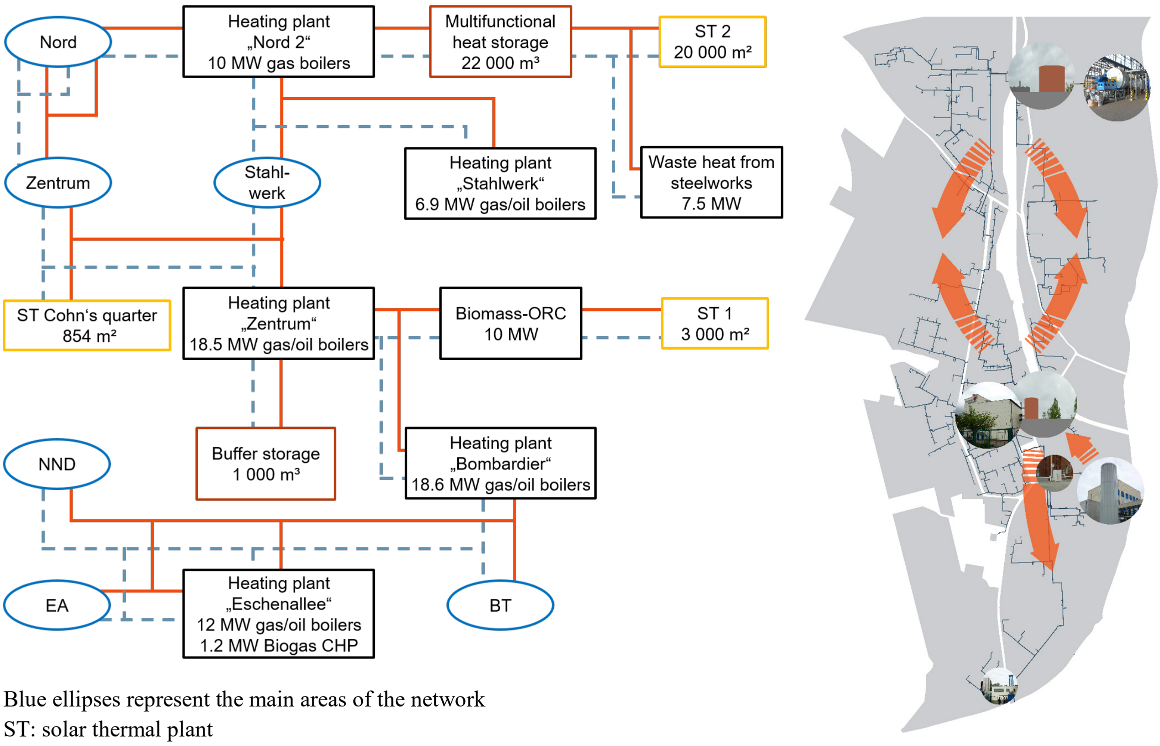
The challenges that give the Heat Hub Hennigsdorf its name lie in the integration of various decentralized fossil-free heat sources in an existing district heating network under economic conditions. For an overview of the system see Figure 6. The target is to minimize the use of fossil energy in the overall DH in the future and to enable the Heat Hub Hennigsdorf to be operated automatically. From the year 2025, the gas boilers should no longer be used. Thus even any reheating of fossil-free energy sources that deliver a supply temperature that is lower than the set supply temperature should be avoided. This is important, because the supply temperature of the biomass CHP is limited to 90 °C and the supply temperature of the waste heat depends on the dynamics of the walking beam furnace with a target temperature of 95 °C, while the supply temperature of the DH is set to 95 °C in winter. A reliably functioning of the temperature stratifications in the heat storages is therefore essential for the functioning of the Heat Hub. Then, the entire DH network must always be operated in one overall system. On the one hand this enables the heat transfer between the biomass CHP, the buffer storage in the heating plant "Zentrum" and the multifunctional heat storage near the heating plant "Nord 2" and on the other hand it secures the necessary supply temperature in the DH network. Since the transport capacity between the two storages is limited, they must be actively charged and discharged in addition to their function as hydraulic switches. It is important at what time the thermal storages are charged and discharged. For example, the operation of the biomass CHP is optimized with the network buffer storage. When the buffer storage is fully loaded, it must be decided whether the biomass CHP is modulated to lower output with lower efficiency or whether heat is transferred to the multifunctional heat storage.

A superior control system is required for such kind of system optimization, based on the current operation and the boundary conditions of all heating plants. The individual heat sources and generators are still operated by the local controls, which transfer selected measurement data and parameters to the superior network control level. The sequence of the heat generators and the charging and discharging of the heat storages is also determined by economic criteria (order of heat sources).

For the development of the superior control concept, the results of the hydraulic calculations of the DH network by the project partner Tetra Ingenieure were taken into account, which gave hydraulic limitations of the heat transfer ratios visible in individual network sections. Based on these results, Solites carried out numerical simulations with the simulation software TRNSYS. These show what shares the individual heat generators have in the overall heat supply and how these shares depend on the selected control parameters. By interacting the results of the network hydraulic simulations and the TRNSYS simulations, a comprehensive examination and optimization of the overall heat supply system for the entire DH system is possible.

A complete automation of the control processes asks for the consideration of all necessary operating cases during the planning process, what is very extensive. From the perspective of the utilities of Hennigsdorf, the decision to transfer heat between the heat storages will initially remain a manual process that is initiated by the operating personnel and not automatically by the superior control. For an automated control, further construction measures for the implementation of the control technology, renewal of the local control of the heating plant “Zentrum”, the lines for the data transmission, acquisition of further necessary measurement data and the visualization of the measuring points are necessary. According to the current planning status, this work should be carried out step by step and completed in 2023 or 2024 depending on the progress of the construction and the programming work.

An automated superior control is demanding, but also efficient compared to manual control by the operating staff. The measured data on industrial waste heat generation over the summer of 2020 and especially in the 2020/2021 heating period will provide important information in order to be able to plan and implement further automation steps.



Blue ellipses represent the main areas of the network
ST: solar thermal plant

Figure 6: Simplified hydraulic scheme of the DH Hennigsdorf with thermal capacities (left) and overview of the city area (right)

In order to verify the concept of the Heat Hub Hennigsdorf from the first project phase with the new findings from the measurement data of the operation of the already realized subsystems, Solites again carried out TRNSYS simulations, but now based on actual monitoring data of the industrial waste heat generation, the connecting pipeline and the new built heating central “Nord 2”. Therefore Solites had to evaluate the available monitoring data in detail to derive as best as possible characteristic courses of industrial waste heat supply. Charactersistic means here that the measurement data also show realistic operation in the future after the construction of the multifunctional heat storage. Then the industrial waste heat exchanger is expected to operate much more evenly, as the heat can then always be delivered to the storage. Currently, the waste heat is being supplied by the heating plant “Nord 2” directly to the DH, which cannot always take the possible entire heat output of the industrial waste heat recovery.

The TRNSYS simulations were carried out in a time step of 10 minutes over 3 years. The results of the third year are evaluated and shown here. This means that the storage volume at the beginning of the third year has a realistic temperature distribution. The simulations targeted on the volume of the multifunctional heat storage that fits best to the system regarding the amount of fossil energy reduction and at the same time the resulting overall system economics. Several storage volumes between 500 and 100 000 m³ were simulated for three different waste heat profiles that are based on the evaluation of the measurement data as described above. As this paper gives an overview of the whole project Heat Hub Hennigsdorf, all the details of the measurement data analysis and simulation results cannot be shown here.

For waste heat profile 1, the measured data was used directly that results in a yearly waste heat potential of 16 GWh/a.

In the waste heat profile 2 the monitoring data have been corrected to the target values of the flow and return temperatures specified for the upcoming system with a realized multifunctional heat storage (flow temperature of 90 ... 95 °C and return temperature of 61 °C). To approach future operation conditions, the measured mass flow from the waste heat recovery was compressed and shifted upwards, to achieve a more uniform system operation, which is expected with the realized multifunctional heat storage. This results in a waste heat potential of 37 GWh/a.

For waste heat profile 3, the mass flow from profile 2 was condensed further resulting in a waste heat potential of 42 GWh/a.

The simulation results for the share of fossil-free heat in relation to the total heat generation of the entire Hennigsdorf DH and the number of storage cycles per year are shown in Figure 7 over the storage volume for waste heat profile 3. The entire Hennigsdorf DH comprises all heating plants and a yearly heat production of 125 GWh/a. In Figure 5, each cross shows the simulation of one storage volume. The proportion of fossil-free heat increases from 73 to almost 82 %. From a storage volume of 15 000 m³, 80 % fossil-free heat can be used. A maximum is not reached up to 100 000 m³.

With waste heat profile 1, i.e. the current measurement data, a share of fossil-free heat between almost 65 and 66% can be achieved. As the analysis of the measurement data shows, the temporary hydraulic switch, which instead of the future multifunctional heat storage decouples between the waste heat circuit and the circuit in "Nord 2" leads to a reduction in the usable amount of heat in the waste heat exchanger. With the more realistic waste heat profile 2, the proportion of fossil-free heat increases considerably to 71 to almost 80 %, whereby the 80 % can only be achieved with a storage volume of 100 000 m³.

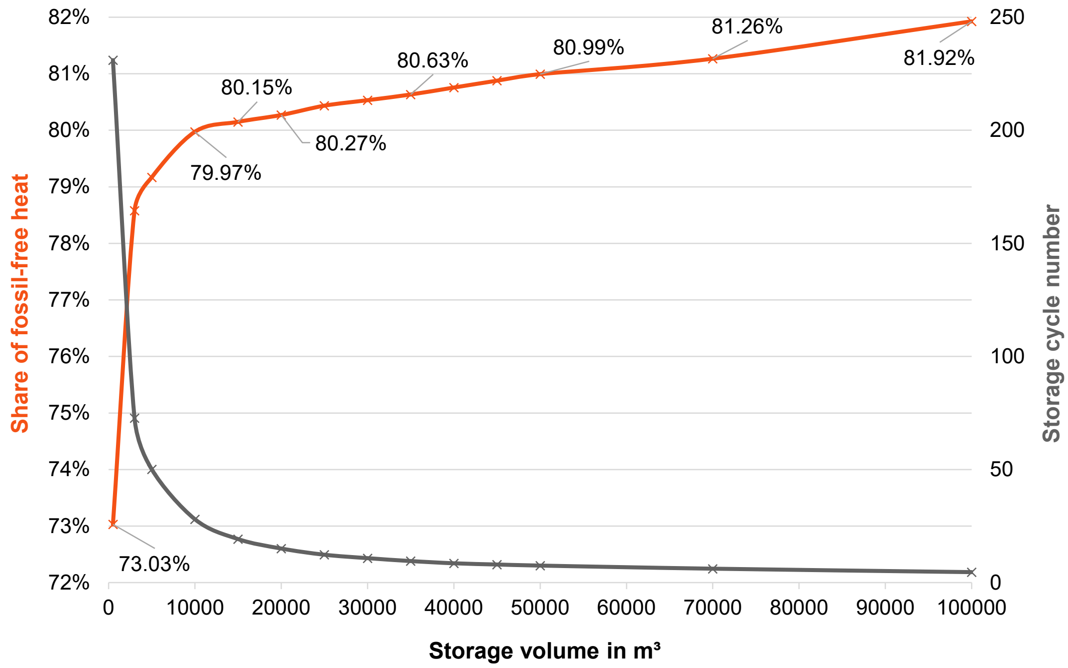


Figure 7: Share of fossil-free heat for the entire DH system and storage cycle number per year over heat storage volume of the multifunctional heat storage for the Heat Hub Hennigsdorf (TRNSYS simulations)

With waste heat profile 3 and 20 000 m³ storage volume, Figure 8 shows the monthly balance of the heat production as an example. The theoretically usable amount of waste heat is roughly the same in every month (except for a 3-week break in operation in August). In the summer months, the amount of waste heat that can be used, is mainly influenced by the storage volume. The output of the biomass CHP is also reduced in the summer months by the superior system control. The internal energy change of the multifunctional heat storage indicates that the storage has a higher energy content at the end of the month than at the beginning of the month (wide column, e.g. in April), or that the storage tank has a lower energy content at the end of the month than at the beginning of the month (narrow column, e.g. in August).

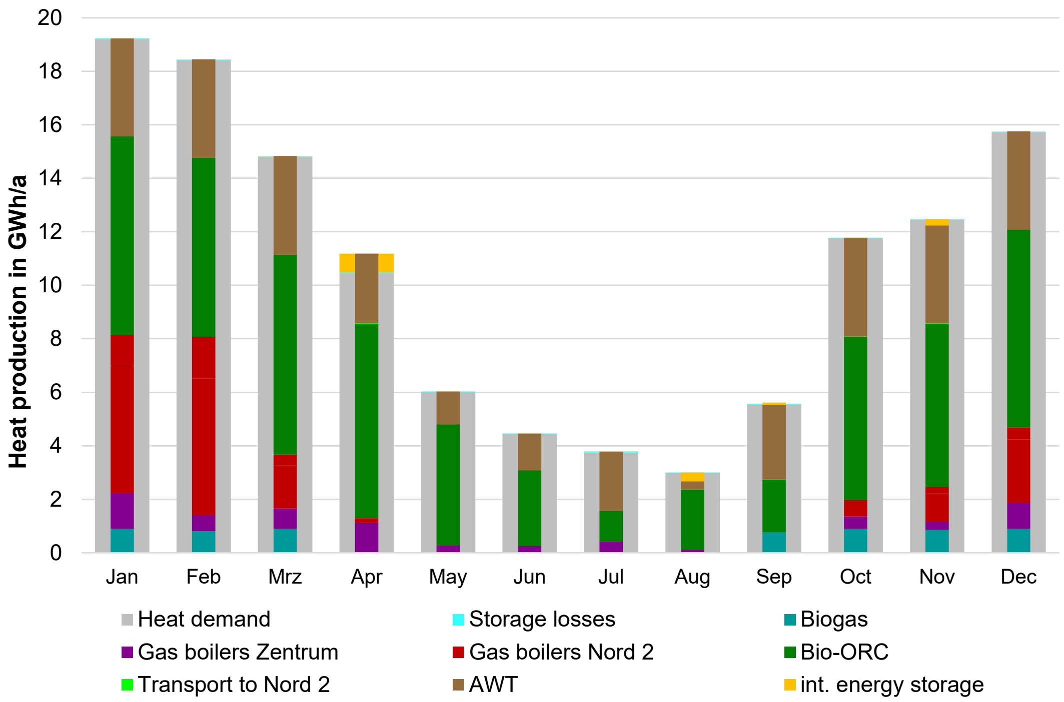


Figure 8: Monthly balance of heat production and the heat demand of the entire DH system Hennigsdorf (TRNSYS simulation with 20 000 m³ storage volume, waste heat profile 3)

The detailed view of ten temperature sensors in the multifunctional heat storage (evenly distributed over the height, T800 above and T890 below) shows that the storage volume is mainly heated in the upper layers in the winter months and is charged through to the lowest storage layer between April and September, see Figure 9. In order to achieve an optimal use of the available waste heat, the storage management and the regulation of the subsystem waste heat to "Nord 2" must follow the dynamics, especially of the waste heat supply and in the summer months.

The extensive simulations with TRNSYS show that in addition to the choosen volume of the multifunctional heat storage, the waste heat supply from the steelworks in particular has a decisive influence on the storage volume that is necessary for a fossil-free share of 80 % of the heat generation. In project phase 1, a usable amount of waste heat of 40 GWh/a was assumed with moderate supply dynamics and thus an initial volume of the multifunctional heat storage was determined to be 22 000 m³. The simulation results now show that when using the measurement data that is now available - taking into account the fact that the current operation cannot correspond to an operation with multifunctional heat storage - even a slightly smaller heat storage volume for the goal of a fossil-free share of heat generation of 80 % is sufficient. The optimal storage volume depends on the amount of waste heat available. The superior control system (with manual or automated decisions) will also have a significant impact on the operation of the multifunctional heat storage. In which dimension the multifunctional heat storage will be planned and built will be decided in the next months, accompanied by further TRNSYS simulations.

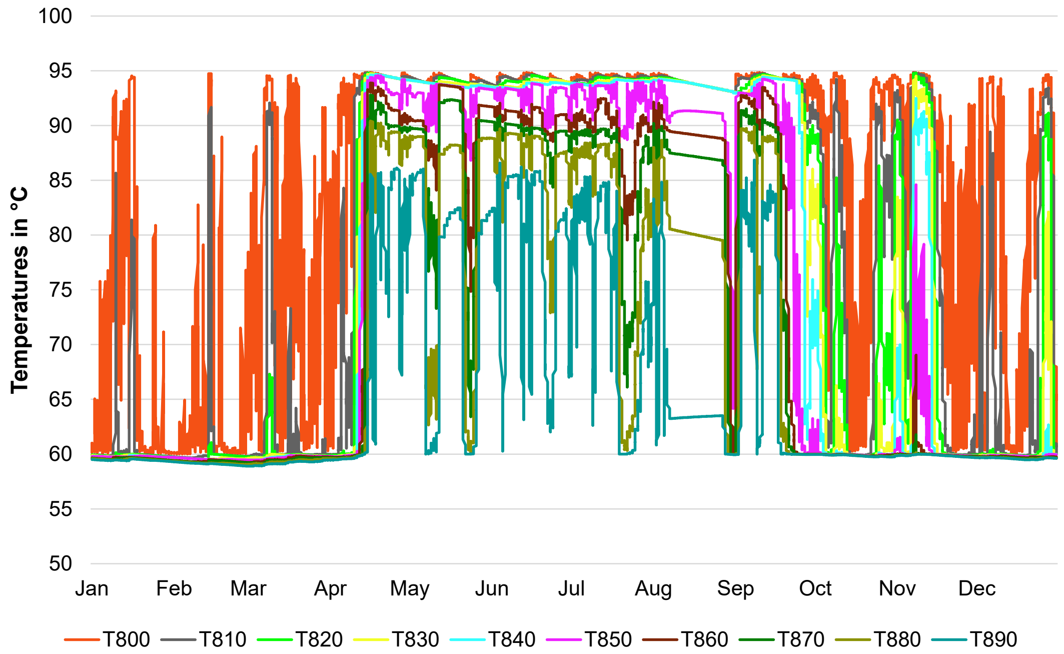


Figure 9: Temperatures inside the multifunctional heat storage over one year (TRNSYS simulation with 20 000 m³ storage volume, waste heat profile 3)

Also the superior control concept will be further developed and optimized with the help of further analyzes of the measurement data and of TRNSYS simulations. For example, the operation of the biomass CHP can be better adapted to the waste heat supply in the summer months. How the waste heat supply will develop in the future and how the walking beam furnace is operated are very important information for the control of the Heat Hub Hennigsdorf. However, these can hardly be predicted and therefore always remain an unknown variable to which the control of the overall system must react.

6. Outlook

As described in this paper, a lot of work has already been carried out, from conception to numerical and hydraulic simulations, planning, installations and construction work. There are still many tasks to be done before the city of Hennigsdorf actually has a CO_2-free heat supply. The planning of the multifunctional heat storage system is currently underway and the construction is due to be completed in 2022. In addition, a ground-mounted solar thermal collector area with 3 000 m² will be built in 2021 and the superior control system will be adapted step by step to the growing system.

Although a bunch of innovations is in the Heat Hub Hennigsdorf, until now main bottle necks were raised by the state-of-the-art and existing laws like the cost for using surplus renewable electricity of wind mills, the tunneling of a railway, project coordination with a very lot of different companies etc. Additionally, financing of this big project by a mid-sized utilities is a challenge due to risk assessment of the banks. Therefore, different subsidy schemes were combined: funding of innovative technologies by the German Federal Ministry for Economic Affairs and Energy with 3.8 Mio. Euro and credits from the Reconstruction Loan Corporation.

To achieve a 100 % fossil-free heat supply in 2025, additional heat sources will be necessary. An area for a further 20 000 m² of solar thermal collectors and the construction of two PtH systems in the heating plants "Nord 2" and "Zentrum" are possible options.

The example of Hennigsdorf shows how cities can contribute to the decarbonisation of the heat supply by setting binding targets themselves and implementing them together with their utilities. The European target of 100 % fossil-free heat supply in cities will only be reached if there are pioneers who dare to start - like Hennigsdorf!

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