Policy brief, April 2022

Setting the scene for auctions in the heating sector

Overview of designs, results and lessons learnt

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Policy brief, April 2022, Setting the scene for auctions in the heating sector

Authors: Robin Blömer, Anna Billerbeck, Jenny Winkler (Fraunhofer ISI)
Reviewed by: Vasilios Anatolitis (Fraunhofer ISI)
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1 Introduction

Auctions are quite common in the European Union (EU) for the support of renewable electricity, but are very rare in the heating sector. There are currently only few existing auctions for heat generation plants in place, e.g. auctions for innovative combined heat and power plants (CHP) in Germany or heat generation in Lithuania. Also in theory, the prerequisites, design options, and success factors for auctions in this field are yet mostly unexplored. This policy brief will address these points and outline potential starting points for expanding the use of auctions in the heating sector.

The heating sector accounts for about 50% of the European total final energy consumption.[1] Hence, the decarbonisation of heating is crucial for achieving net-zero greenhouse gas emissions. At the same time, the sector is diverse and ranges from individual heat generation to district heating (DH) systems that supply whole cities. The application of heat also varies; from water and space heating to industrial process heat. These heterogeneous structures have different perquisites for auctioning schemes.

While auctions for renewable heat could in theory be introduced in almost all parts of the heating sector, some areas seem to be more suitable than others. This is especially the case for DH systems as they can integrate large shares of renewable heat, e.g. from solar thermal or geothermal plants as well as from large-scale heat pumps or even waste heat from industry. Thus, auctions can be used for funding new networks or the expansion of existing DH grids, with the condition that a large proportion of renewable heat is integrated. Some Member States (MS) already organise public auctions for the construction of new DH systems.

Furthermore, auctions could also be introduced for renewable heat plants in existing DH grids. Auctions for CHP plants already exist in several MS, mostly to determine a feed-in premium paid for feeding into the electricity grid. These CHP plants feed in most cases also into the local DH network. In a similar fashion as for CHP, feed-in into the DH networks from renewable plants could also be subsidised and auctioned.

Unlike electricity and gas networks, DH networks are not unbundled and in many MS there is no regulation regarding third party access (TPA) to DH networks. However, TPA for different plant operators would be a necessary condition for introducing auctions for renewable heat in existing DH grids to have competition between different actors.

Requirements like TPA as well as other essential framework conditions for auctions in the heating sector are addressed in this policy brief. Different auctioning schemes for heating are examined with a focus on the overall regulation, the auction design, eligible technologies, and allocation mechanism. The outcomes of the auctions are also analysed to identify best practices and formulate recommendations for successful auctioning schemes. The results of the policy brief lay the basis for the design of efficient auctions in the heating sector. Methodologically, the policy brief builds on a comprehensive literature and document analysis and was supplemented with interviews.

The policy brief is structured as follows: Section 2 describes auctions in the heating sector from a theoretical perspective. Section 3 focuses on already established auctions for CHP and looks into examples in Germany, Poland and Slovenia. Section 4 discusses auctions for heat generation plants based on exemplary auctions in Estonia, Lithuania and the Netherlands. Section 5 looks into auctions for DH systems with examples from Ireland and Germany. Section 6 concludes.

[1] Heat Roadmap Europe 2017, https://heatroadmap.eu/heating-and-cooling-energy-demand-profiles/

2 Auctions in the heating sector

In this section different options for auctions in the heating sector are descried from a theoretical perspective. Due to the diversity of actors and technologies, also diverse types of auctions could be used in the heating sector. Hence, auctions in the heating sector could (in theory) be introduced for (1) central heat, i.e., DH, (2) decentral heat in buildings or (3) process heat for industrial processes. Along these three areas, possible options for auctions are listed and described in the following.

(1) Auctions for central heat, i.e. DH

- Auctions for new CHP plants: Actors addressed by the auction would be the CHP plant operators. Support could be provided for either produced electricity, produced heat or both. Several MS have introduced auctions for CHP plants to determine a feed-in premium paid for feeding into the electricity grid (see section 3).
- Auctions for new renewable installations in DH grids: Addressed actors are renewable energy plant and/or heat pump operators and support is paid for either produced heat or installed capacities. So far, there are only very few examples for auctions for new renewable installations in DH grids (see section 4).
- Auctions for the development and construction of new DH grids: Both development and construction could be auctioned together or separately, (i.e. the different steps with first development/planning and second construction). Addressed actors are companies that construct DH grids or DH operators (possibly subcontracting constructors). Support can be paid as investment support based on number of connected consumers, heat demand, trench length, etc. Requirements for technical specifications (e.g. low temperature heat, renewable energies etc.) should be part of the auction design. There are few examples for auctions for new DH grids (see section 5).
- Auctions for the expansion and modernisation of existing DH grids: Again, both planning and construction could be auctioned jointly or separately. Addressed actors are companies that plan and construct DH grids or DH operators. Support can be paid as investment support and requirements for technical specifications should be part of the auction design.
- Auctions for the dispatch in DH networks: in analogy to electricity markets, also dispatch for heat plants in district heating systems can be organised based on auctions. Currently, such processes are currently only used in few countries the organisation of dispatch could become more complicated in the future with more third parties active in the heat provision, the auction design for these auctions also seems interesting. The heat producers of a specific DH grid are in this case the auction participants and the auction winners gain the right to produce and dispatch their plant at a certain point in time (see section 4).

(2) Auctions for decentral heat in buildings

- Auctions for new decentralised heating appliances in new buildings: Addressed actors would be companies for building construction, homeowners, etc.. Support can be paid as investment support. Requirements for technical specifications (e.g. renewable energies etc.) should be part of the auction design. In some MS, new development areas, including the heating system for new buildings are auctioned (see section 5). Thereby, bidders can present different options, i.e. DH or decentral options (e.g. heat pumps).
- Auctions for decentral heating appliances in existing buildings: Addressed actors would be companies for serial renovation, or homeowners, etc. Support can be paid as investment support and, again, there should be requirements for technical specifications (e.g. renewable energies etc.).

(3) Auctions for industrial process heat

- Auctions for new process heating appliances: Addressed actors are industrial companies aiming at installing new heating technologies. Investment support or operational support could be paid.

The next sections present exemplary auctions in different countries. However, not all theoretical auction types are implemented in practice. This means that in the following, the auction types for which examples have been found will be presented in more detail.

3 Country examples for auctions for combined heat and power plants feeding into electricity grids

One way to reduce greenhouse gas (GHG) emissions of the energy supply is the increase of energy efficiency. This can be achieved by cogeneration technologies, i.e., CHP plants, which produce electricity and utilise the by-product heat. CHP generation offers great potential to efficiently supply households and industrial consumers with electricity and heat. In the Cogeneration Directive[2], the EU Commission identified that this potential is underused and introduced measures that aim to exploit it. The Energy Efficiency Directive (EED)[3] specifies that CHP plants should only receive financial support if they meet the high-efficiency criterion[4] and are favourable in a cost-benefit analysis.[5]

The EED is the basis for financial subsidies for CHP plants in the EU MS, however, the specific design differs in terms of prequalification, type of financial support (e.g. feed-in tariff or market premium) and the award process. In this section three exemplary support programs, i.e. in Germany, Poland and Slovenia, which use an auction to allocate the financial support to CHP plants are presented and compared.

3.1 Germany: Auctions for new and modernised plants

Germany provides financial support for CHP plants in the framework of the CHP law[6]. Whereas smaller CHP plants (<500 kW_{el}) receive a fixed feed-in tariff, bigger plants must participate in a pay-as-bid auction in order to receive financial support. In these auctions, the level of the financial support is determined, which is then paid to awarded plants as a fixed market premium.[7] The auctions are similar to the auctions for renewable electricity plants in Germany.[8] The support for CHP is financed via a CHP levy that consumers pay per consumed electricity. In 2021 this levy was 2.54 €/MWh. Energy-intensive companies pay a reduced levy.[9]

Auctions for big CHP plants are split into two groups. The first group includes new and modernised CHP-plants with a power between 500 kW_{el} and 50 MW_{el}. The second group includes so-called innovative CHP-plants (iCHP), with low GHG emission, based on renewable heat capacity and an electric power between 1 and 10 MW_{el}. Both groups are not allowed to use coal.

In case of an awarded bid, the generated electricity must be fed into the grid completely, i.e., self-consumption is not allowed (for both types). For the generated heat a full feed-in is not mandatory, but most plants feed their heat into the local DH system. All awarded plants receive the subsidy for 30,000 full load hours, with a maximum duration of 30 years. Since 2021 the annual full load hours for the payment is capped, i.e. in 2021 and 2022 to 5,000 h/a; in 2023 and 2024: 4,000 h/a and from 2025 onward to 3,500 h/a.

If a plant that receives the support is not in operation within 48 months after the auction a penalty of 18 €/kW_{el} must be paid. This penalty increases by 16 €/kW_{el} for two months of additional delay, up to a maximum of 66 €/kW_{el} after 54 months. If the project does not operate by this time the funding expires.

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[2] Cogeneration Directive (2004/8/EC); https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004L0008&from=EN

[3] Energy Efficiency Directive (EED; 2018/2002/EU); https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L2002&from=EN

[4] High-efficient according to Appendix II EED: Primary energy saving (PES) > 10%,

$$PES = \left(1 - \frac{1}{\frac{\eta_{heat,CHP}}{\eta_{heat,Ref}} + \frac{\eta_{electrcity,CHP}}{\eta_{electricity,Ref}}}\right) \cdot 100\%,$$

Ref. values: https://eur-lex.europa.eu/legal-content/DE/TXT/HTML/?uri=CELEX:32015R2402&from=EN (p. 20)

[5] See Art. 14 (11) EED

[6] German CHP-Law; German: Kraft-Wärme-Kopplungsgesetz, https://www.gesetze-im-internet.de/kwkg_2016/index.html#BJNR249810015BJNE000404123

[7] https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Ausschreibungen/KWK/Ausschreibungsverfahren/start.html

[8] See e.g. http://aures2project.eu/wp-content/uploads/2020/04/AURES_II_case_study_Germany_v3.pdf

[9] See https://www.netztransparenz.de/KWKG/KWKG-Umlagen-Uebersicht/KWKG-Umlage-2021

A call for bids is published twice a year by the German energy regulator (BNetzA), informing bidders about the ceiling price for CHP (currently 70 €/MWh) and iCHP (120 €/MWh) as well as the tendered volume in MW. The CHP law sets the capacity to be tendered from 2018 until 2025 to 150 MW_{el} for CHP and 50 MW_{el} for iCHP, however, there is a mechanism that reduces the amount, if two consecutive auctions are undersubscribed.

The bids must include the planned installed capacity and the fixed premium (€/MWh), which the bidders want to receive as feed-in tariff (pay-as-bid). Bidders with the cheapest bid are awarded until the whole auction volume is allocated. Figure 1 presents the auction results for the CHP and the iCHP auctions since 2017. In the last years, the results of the CHP auctions show an increase in the awarded bids towards the ceiling price. Many auctions were undersubscribed, underlining that there is a low degree of competition. An interesting result can be observed in the auction from December 2018, as more capacity was awarded compared to the planned tender volume, which happened because the highest awarded bid exceeded the quantity. In the following auction, the tender volume was reduced by the same amount. For the auction in June 2021, the tendered amount of the CHP auction was reduced from 75 MW_{el} to 59 MW_{el}, because the two auctions before were undersubscribed, at the same time the bids reached a record high of 112 MW_{el}. This high degree of competition has led to a decrease in prices. A similar development can be seen in the iCHP auctions. In the beginning, most of the auctions were undersubscribed, but in recent auctions the tendered volume was almost reached by the participating bids.

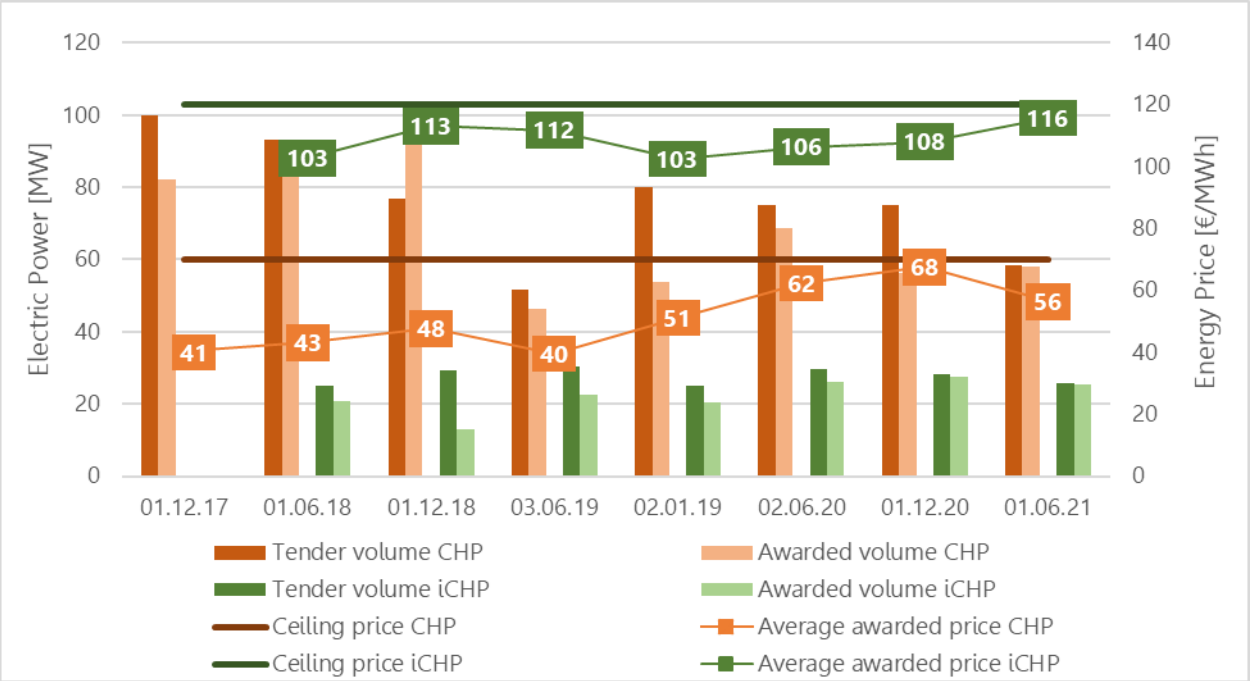

Figure 1: Results CHP and iCHP auctions Germany

So far, only very few CHP plants are obliged to be operational. In 2021, the few CHP plants that were awarded in 2017 should have started operation. In 2022, the plants from 2018 auctions should be operational. Thus, it is not possible to draw any comprehensive conclusions with regards to realisation rates and thus the effectiveness of the auction.

Especially in the context of the iCHP auctions where a certain share of renewable heat is required in the DH system in order to participate in the auction, the organisation of support is very complex. Direct support for heat from renewables would probably be more effective to increase their share in DH, than support via electricity feed-in from non-renewable CHP plants. Nevertheless, if promotion of heat feed-in from CHP is not possible in the national context this solution can contribute to reaching higher renewable energy shares in district heating.

3.2 Poland: Auctions for new and refurbished plants

Since 2019 Poland subsidises CHP plants similarly to Germany (see section 2.1). Smaller units (<1 MW_{el}) receive a fixed market premium and large ones (1 to 50 MW_{el}), that are newly build or substantially refurbished, can participate in a national auction to also receive a fixed market premium. The CHP scheme has some special design elements, like the mechanism to carry over budget to the subsequent auction, if an auction is undersubscribed. Successful bidders receive the subsidy for 15 years and are obligated to start operation within four years for gas-fired and five years for solid fuel and biomass plants. The support scheme is financed through a CHP levy per consumed electricity. Companies in energy-intensive industry have to pay a reduced levy between 20 and 85%.[10]

Awarded CHP plants are subsidised for their generated electricity fed into the grid. Criteria to be qualified for the scheme are specific emissions of less than 450 kg CO_2/MWh_{el}, achieving a high efficiency according to the EED and feeding at least 70% of the heat production into a DH network. Although all energy carriers are eligible, coal-fired CHPs need to demonstrate that no other fuel is economically feasible.

In the auction, bidders bid the premium, they want to receive and the forecasted annual electricity production. The Polish Ministry of Energy publishes technology-specific reference prices, which are calculated as levelized costs of electricity (LCOE) based on forecasts, including fuel and CO_2 price development and utilisation times. These reference prices are used as a ceiling price for the bids. In the first auction in 2021, the ceiling price for the premium was 34.1 €/MWh_{el} for gas-fired plants, 42.6 €/MWh_{el} for solid-fuel plants, 64.4 €/MWh_{el} for biomass plants and 12.9 €/MWh_{el} for other plants.[11] The auction volume is published by the regulator and contains two limitations, firstly a maximum amount of electricity to be produced and secondly a total budget to be spent. Each is considered over the duration of 15 years.

The support is allocated based on the premium per MWh, whereby the lowest bids are awarded first, and the payment is made according to the bids (pay-as-bid auction). The subsidy is allocated until one of the auction limits (budget or electricity infeed) is reached or 80% of the total bid volume of electricity is accepted.[12] The goal of this endogenous adaption mechanism is to create competition in the auction, even though it is undersubscribed. This can lead to lower prices that go along with lower volumes, but can cause other problems like strategic dummy bids or disincentives to participate in future auctions (and thus in the long term does not contribute to competition or low strike prices).[13] Figure 2 shows the results of the CHP auctions in Poland since 2019.

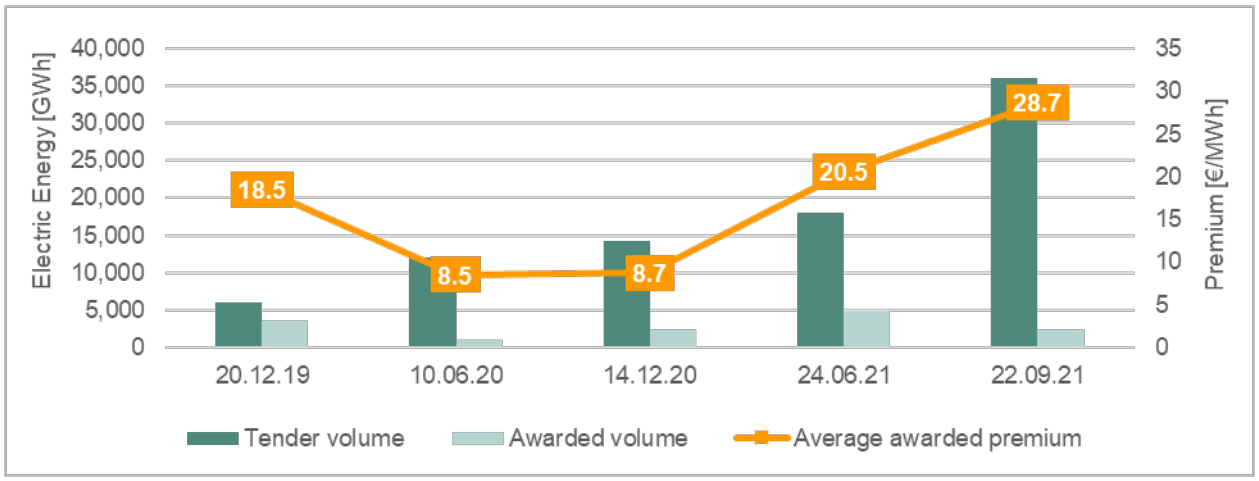

Figure 2: Results CHP auctions in Poland [14]

[10] https://ec.europa.eu/competition/state_aid/cases1/201930/278679_2084477_98_2.pdf
[11] https://www.teraz-srodowisko.pl/aktualnosci/premia-kogeneracyjna-2021-rozporzadzenie-9237.html
[12] https://www.teraz-srodowisko.pl/aktualnosci/ogloszenie-URE-premia-kogeneracyjna-wrzesien-2021-10676.html
[13] http://aures2project.eu/wp-content/uploads/2020/06/AURES_II_Policy_Brief_End_Rationing.pdf
[14] https://www.ure.gov.pl/pl/efektywnosc-kogenerac/energia-z-kogeneracji/aukcje-chp/8201,Podstawowe-informacje-i-wzory.html

The results show that so far all auctions have ben undersubscribed. In the first auction in 2019, 61% of the electricity production budget were allocated, but this decreased to only 6.5% in the most recent auction in September 2021. For the financial budget a decrease from 30% in 2019 to 4.8% in September 2021 can be observed. Whereas the awarded amount does not show a general trend, the tendered amount continuously increases, because the undersubscribed amount is carried over to the next auction as laid down in the design of the auction scheme. The endogeneous rationing still implies that only 80% of received bids are awarded. The premium shows a dip in 2020, with prices below 9 €/MWh_{el} and steep growth in 2021 towards the reference value of gas-fired plants (34 €/MWh_{el}).

3.3 Slovenia: Auctions for new plants

Slovenia also subsidises new CHP plants through auctions. The scheme combines renewable electricity generation and high-efficient CHP in one auction. For CHP plants, it is mandatory to emit less than 600 kg CO_2/MWh_{el}, have a metering system and a capacity between 500 kW_{el} and 20 MW_{el}. The generated heat can either be self-consumed or fed into DH systems.

The auction starts with the call for tenders twice a year and is awarded based on the proposed electricity price, which is paid as a market premium for the infeed of electricity. For biomass CHP this market premium is fixed over the whole duration. For conventional CHP it consists of a fixed component over the support duration and a dynamic component, which is determined on a yearly basis based on the forecast of natural gas prices. The financial support for renewable electricity plants is limited to 15 years and for CHP plants to 10 years.

For each technology participating in the auction a reference value for the electricity price is calculated by the Slovenian Energy Agency and used as a ceiling price for the bids. The calculation of the reference value is described by the decree introducing the procedure and includes all relevant assumptions for a cost forecast for each technology. It considers revenues from heat sales, operation costs, and annual fixed costs divided by the expected full load hours, to determine the required price for electricity.[15] The reference value for CHP plants is calculated assuming natural gas as fuel with a price forecast published by the agency.

The auction is not held for a fixed amount of electric production nor a generation capacity, but a certain financial volume. The selection of the bids is based on the lowest electricity price until the total fund is allocated. From 2019 to 2021 the fund volume for each biannual auction was 10 mil. €. The successful bids receive the subsidy as a pay-as-bid market premium for the infeed of electricity. A selected project must be ready to feed in electricity within three years after it was selected. For complex projects, an extension of this deadline can be requested by the authority.[16]

The auction is separated into two rounds with an individual budget. The first round is divided into two groups. The first group only includes renewable electricity generation and has a budget of 8 mil. €. In the second group of the first round, CHP from renewable sources is eligible and the budget is 1 mil. €. After these two auctions, the first round is finished. In the second round, all unsuccessful bids from the first round and conventional CHP can participate. The budget is 1 mil. € plus the remaining budget from the first round, if it was not fully allocated (see Table 1).

Table 1: Auction structure Slovenia

Round	Group	Technology	Budget [mil. €]
1	1	RES-E	8
	2	RES-CHP	1
2	-	Fossil CHP + Round 1	1 + remaining from round 1

[15] See: https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina?urlid=201674&objava=3198 and https://www.agen-rs.si/documents/10926/93127/Metodologija_CEPN_RSEE/6e54da68-7aba-4c04-992f-a75eef3e9ea8;

$$Cost\ forecast\ per\ technology\ \left[\frac{€}{MWh_{el}}\right] = \frac{Operating\ cost\left[\frac{€}{MWh_{ch}}\right]}{\eta_{el}} - \frac{Revenues\ from\ heat\ sale\ €- Annual\ fix\ costs\ [€]}{Expected\ full\ load\ hours\ [h] * P_{installed}[MWh_{el}]}$$

[16] Public call for tenders: https://www.agen-rs.si/poziv2021julij

The results of the CHP auctions are illustrated in Figure 3. Even though the total budget was 10 mil. €, the volumes allocated to CHP from biomass and fossil fuels show high volatility. This might be explained by the design of the auctions: The budget for CHP and consequently the awarded volume, depends on the results from the renewable electricity auction. In the auction in December 2018 only a few CHP plants got awarded. In the auction in June 2019 not enough bids were submitted to hold the group one auction, hence, the budget was passed to the group two, which was beneficial for fossil fuel CHP plants.

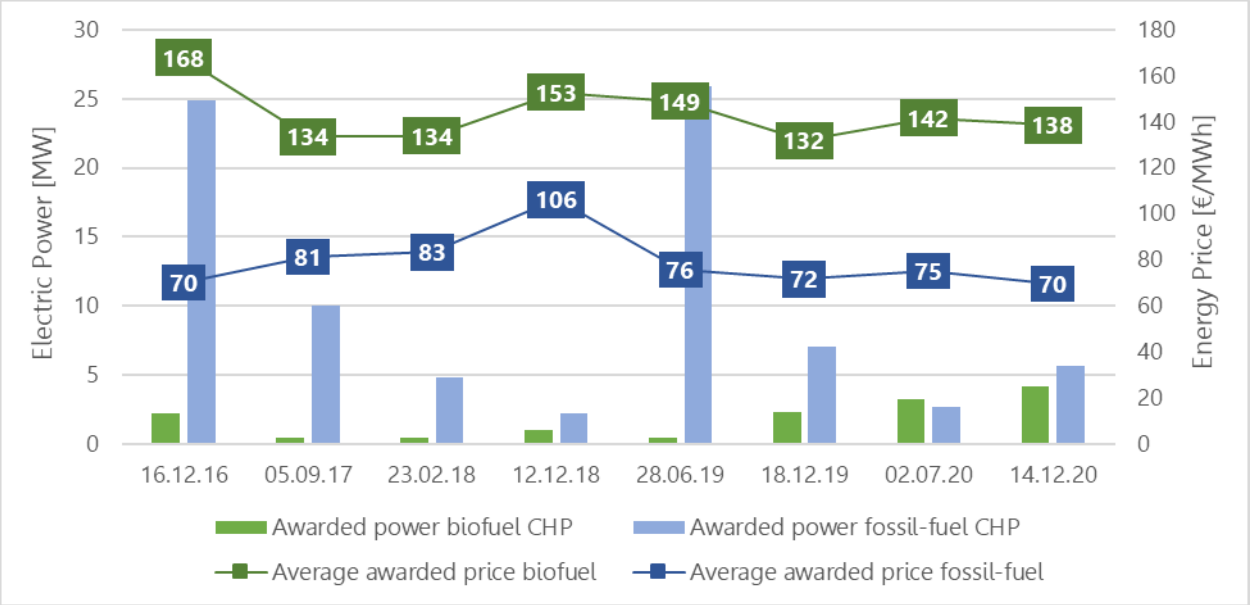

Figure 3: Results CHP auctions in Slovenia[17]

3.4 Summary of auctions for combined heat and power plants

The three auctioning schemes for CHP plants share a lot of design elements: auctions are held twice a year; use of ceiling prices and subsidy is paid for the electricity fed into the grid as paid-as-bid.

Nevertheless, there are some differences: Poland and Germany both hold auctions just for CHP, but Slovenia uses multi-technology auctions for renewables and CHP plants. Besides, Germany additionally holds a separate auction for innovative CHP systems. Another difference can be observed in terms of the auction volume. Germany auctions a certain capacity (MW_{el}), in Slovenia a financial budget is used (10 mil. € total subsidy) and Poland sets a financial budget and an electricity infeed. The three countries also follow a different logic regarding the mechanisms for undersubscribed auctions. In Germany, the auction volume is reduced, if two auctions in a row are undersubscribed. This can lead to higher competition, but also less capacity installation. In Poland non-awarded volumes are shifted to the next auction, i.e. undersubscription of one auction leads to a high tender volume in the next auction. At the same time, a maximum of 80% of the bid volume is awarded in each auction. The duration of the financial support is also different. While Slovenia and Poland have a limit of 10 and 15 years, the German program guarantees a subsidy for 30,000 full load hours.

The awarded bids in Germany and Slovenia in December 2020 of 68 €/MWh_{el} and 70 €/MWh_{el} respectively, show a similar level. However, in Slovenia, this was the lowest price, while in Germany 68 €/MWh is the highest price so far. To compare the prices from Poland on the resulting market premium of around 9 €/MWh_{el} in the 2020 auction the average wholesale electricity price of 52 €/MWh_{el} has to be added, resulting in a price of 61 €/MWh_{el}. This price is slightly below the others, but the more recent auctions show higher prices, that exceed the prices in Germany and Slovenia.

[17] https://www.agen-rs.si/javni-pozivi-ove-spte

4 Country examples for auctions for heat plants feeding into district heating grids

While CHP auctions usually support renewable electricity generated and fed into the electricity grid (i.e., MWh_{el}), there are also some examples where heat generated and fed into DH grids is subsidised (i.e., MWh_{th}). The main goal of these auctions is to increase the share of renewables in the heating sector in a financially efficient way. In this section auctions for heat generation feeding into DH networks are discussed.

Unlike electricity and gas networks, DH networks are not unbundled and in the majority of the MS there is no regulation regarding third party access (TPA) to DH networks. However, TPA for different plant operators is a necessary condition for introducing auctions for renewable heat plants in DH grids. TPA is therefore addressed in this policy brief in a short excursion. Even in the MS where some regulation regarding TPA exist, TPA is not well developed. Thus only a few examples for auctions for heat generation plants cloud be found. In this policy brief we present the design of the Estonian obligation to auction new heating capacity, the monthly auctions for heat supply in DH systems and the auctions for new heat generation in Lithuania and lastly, the auctioning scheme SDE++, which includes heating technologies, applied in the Netherlands.

Third party access to DH networks for independent producers

The DH market is not required to be unbundled by European legislation. Therefore, DH networks are often operated by a single vertically integrated supplier with a monopoly market position. However, first regulations in the European legislation are addressing unbundling of generation with TPA to DH networks. The revised Renewable Energy Directive (RED II)[18] includes in Art. 24 (4) two options in order to increase the share of renewable energies in DH and cooling networks: (1) either by the implementation of measures aimed at increasing the share of renewables and from waste heat and cold in heating and cooling networks by one percentage points per year, or (2) by granting producers of renewable or waste heat and cold access to the grid (i.e., third party access), if specific conditions are met. So far, around half of the European countries introduced some regulation of TPA.[19]

There are two options to open DH networks for third parties.[20] The first is called "network access model" and gives third parties the possibility to use the DH network to generate and supply heat to their own customers. This concept opens the generation and end-user supply side for competition. The other option is the "single buyer model", which opens just the generation side for competition, while the supply is still organised by one operator. Therefore, third party producers are entitled to feed heat into the DH network, while the grid operator is obliged to accept and pay for the heat. Thereby, negotiated access and regulated access can be distinguished. In the case of negotiated access, the operator and the third party agree on the conditions of the heat generation as well as the dispatch order in a freely formed contract. Regulated access implies that the operator is obligated to guarantee access to a third party if it fulfils certain conditions.[21] Besides, there may also be regulations regarding the dispatch, e.g. priority purchase of renewable heat.[22]

In July 2021 the European Commission has published a proposal to update the RED II, within the framework of the European Green Deal.[23] The current draft includes an obligation to implement TPA for renewable sources or waste heat for DH systems with a heating capacity above 25 MW_{th}. Exemptions to TPA, analogue to those in the current RED II, are still possible.

[18] Renewable Energy Directive (RED II, 2018,2001/EU) https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0557&from=EN

[19] Bacquet, A., et al. (2022): Overview of District Heating and Cooling Markets and Regulatory Frameworks under the Revised Renewable Energy Directive: DHC Trend - Final report. (2022 forthcoming).

[20] Bacquet, A., et al. (2022): Overview of District Heating and Cooling Markets and Regulatory Frameworks under the Revised Renewable Energy Directive: DHC Trend - Final report. (2022 forthcoming).

[21] https://www.sciencedirect.com/science/article/abs/pii/S0301421519304203 https://www.sciencedirect.com/science/article/abs/pii/S0957178720300837

[22] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=DE

[23] https://ec.europa.eu/info/sites/default/files/amendment-renewable-energy-directive-2030-climate-target-with-annexes_en.pdf

4.1 Estonia: Auctions for heating plants

With a market share of around 70%, DH is the most important heating technology in Estonia. At the same time, Estonia relies on a rather strict regulation, specified in their national District Heating Act[24]. Regarding pricing they follow a cost principle, allowing the DH operators to set prices that cover all their costs and a margin to get a return on their equity. Besides, there is an obligation that the maximum price must be approved by the Estonian Competition Authority (i.e. ex-ante price control). Another important regulation is the obligation to grant TPA to DH networks. Thereby, if there is a need for additional heat generation capacity, it must be auctioned according to the DH Act.[25] Specifications for the auction process are regulated in the "Procedure for organising a tender for the purchase of heat and tender evaluation methodology"[26].

When a DH system operator identifies a need for new heating capacity, he must contact the Estonian Competition Authority, which must approve it. After the approval, the operator must publish a notice about the planned project, including the required fuel, capacity and expected annual production. Companies can express their interest to implement the project by contacting the operator. If no company is interested, the operator himself will invest. In case one company is interested, the contract is awarded to this company. If more than one company is interested a call for tenders is organised. The call must include the required heating capacity, the annual amount of heat including a forecasted load curve and the duration of the contract, which is typically 12 years. Additionally, the call for tenders includes the eligible fuel and heating technology and the qualification criteria, like economic, technological, and organisational conditions of the bidders. Lastly, the decision criteria for the selection and the deadline (minimum 30 days after publishing) need to be included. In accordance with the regulation, the selection criteria must, among other criteria, include a price-criterion, i.e. it must be ensured that the supply of heat to customers is based on the most favourable price.[27] Further criteria are particularised by the tendering DH operator. All bids are evaluated based on the selection criteria and the best is selected.

Two exemplary notices about planned projects from the cities Kuressaare[28] (Capacity 0.5 MW_{th}; annual production 1,200 MWh_{th}) and Järva-Jaani[29] (Capacity 3.5 MW_{th}; annual production 12,000 MWh_{th}), did not receive any expresses of interest and the network operators build the heating plants themselves. In the last 10 years, almost all projects have resulted in this outcome, which might be explained by an unattractiveness to invest (for independent third party producers), because of a lack of investment security.[30]

4.2 Lithuania: Auction for heat supply

In Lithuania DH plays a key role in the heat supply, with a share of more than 50% in the residential sector, whereby around 70% is provided by renewable or waste heat.[31] At the same time, the DH market is quite regulated in their national Heat Law[32]. DH operators are obliged to connect all heating plants of independent heat producers that were installed to replace plants fired by fossil fuels.[33] Besides, there is an obligation for priority purchase of heat from renewable sources, hence, operators are obliged to purchase all heat from renewables generated by independent producers. However, this obligation only applies if the heat is cheaper than the heat from the operator and if the heat satisfies environmental and quality requirements as well as standards for security of supply. In 2017, there were 15 DH networks where part of the heat was purchased from independent heat producers.[34]

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[24] Estonian District Heating Act, https://www.riigiteataja.ee/en/eli/520062017016/consolide
[25] See para. 14 District Heating Act
[26] Procedure for organizing a tender, https://www.riigiteataja.ee/akt/101072011012
[27] See para. 13 of the Procedure for organizing a tender
[28] http://www.kuressaaresoojus.ee/?cat=13
[29] https://jarvahaldus.ee/teated/
[30] Statement from national district heating expert.
[31] Euroheat & Power, Country by Country report 2019, https://www.euroheat.org/cbc/2019/
[32] Lithuanian Heat Law, https://www.e-tar.lt/portal/lt/legalAct/b9f611e03d8b11e89ba7f73323f8faa4
[33] Jonynas (2020): Renewables for district heating: The case of Lithuania; https://doi.org/10.1016/j.energy.2020.119064
[34] Euroheat & Power, Country by Country report 2019, https://www.euroheat.org/cbc/2019/ and see list of independent

In DH systems with at least one independent heat generator, a monthly auction is held, determining which generator will operate to cover the forecasted heat demand. The auction is held two months before the delivery month and is organised by the energy exchange operator Baltpool[35] for each DH system individually. It includes a ceiling price that is calculated based on the heat generation cost of the DH network operator for every month.

The bids of the independent heat generators are also regulated by the national Heat Law. It differentiates between two types of bidders in heating auctions. The first group includes plants that either receive a subsidy from the EU, state or municipal or belongs to a group of associated undertakings within the meaning of the Law on Competition.[36] This group is regulated concerning the prices they can bid in the heating auctions. Their bids must not exceed the comparable cost of heat production. This value is calculated, following a procedure established by the National Commission for Energy Control and Prices.[37] Actors, which fulfil neither of these criterions (around 19 of 41)[38], can bid without any additional regulation, but the overall ceiling price.[39]

After the forecast of the heat demand for each day of a month, all independent producers can bid a heating price (€/MWh$_{th}$) for the whole month and the daily amount of heat. The auction is cleared based on the lowest energy price and the amount of heat needed for each day of the month. Thereby, the auction follows the pay-as-bid logic, i.e. all third producers receive the heat price of their bid. If two bids have the same price, they are accepted based on the following priority-scoring:[40] (1) high-efficient CHP from renewable energy sources (RES) or waste, (2) CHP from RES or waste, (3) Heat generators using RES, (4) industrial waste heat, (5) high-efficient CHP, (6) general CHP, (7) fossil fuel boilers. Figure 4 and Figure 5 exemplarily illustrate the results of the auction from the 20th October and the 20th November 2020 in the DH network in the city Panevėžys.

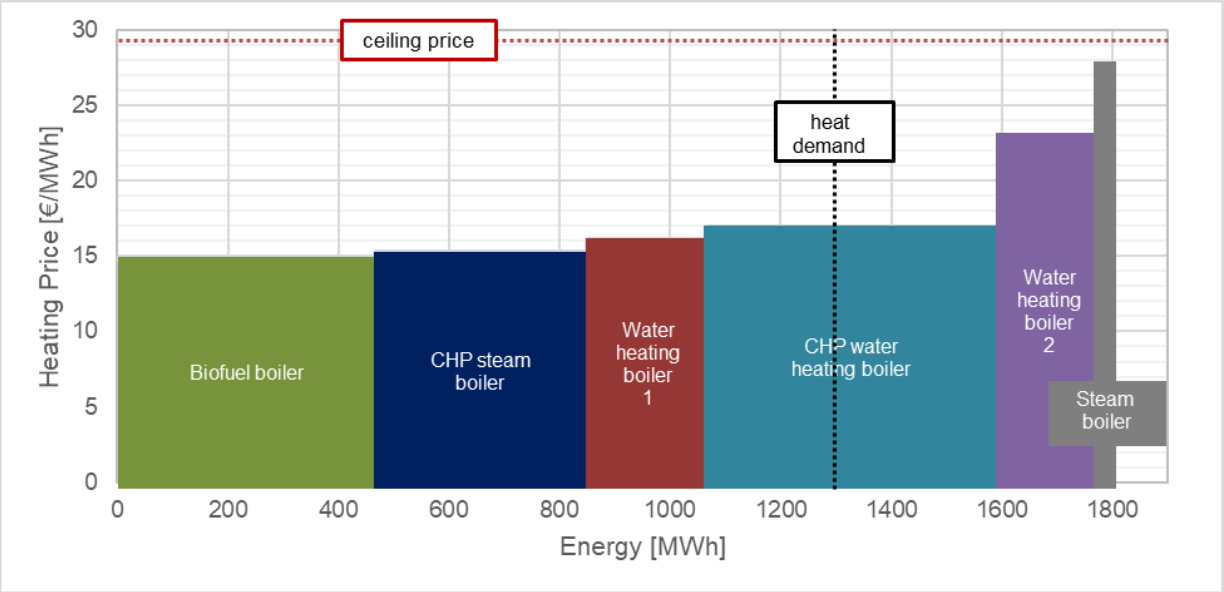

Figure 4: Results Heat Auction Panevėžys, 20th October 2020[41]

producers: https://www.regula.lt/siluma/Puslapiai/nepriklausomi%20silumos%20gamintojai/nepriklausomi-silumos-gamintojai.aspx

[35] http://www.baltpool.eu/en/

[36] See Art. 3, abstracts 13 and 14, https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/49e68d00103711e5b0d3e1beb7dd5516

[37] See Resolution O3-202/2019, https://www.e-tar.lt/portal/en/legalAct/TAR.A37C2263838C

[38] https://www.regula.lt/siluma/Puslapiai/nepriklausomi%20silumos%20gamintojai/nepriklausomi-silumos-gamintojai.aspx

[39] http://www.res-legal.eu/search-by-country/lithuania/single/s/res-hc/t/promotion/aid/price-based-mechanisms-purchase-of-heat-produced-from-res/lastp/159/

[40] See also IEA Report: https://iea.blob.core.windows.net/assets/4d014034-0f94-409d-bb8f-193e17a81d77/Lithuania_2021_Energy_Policy_Review.pdf, (p. 57)

[41] https://e.baltpool.eu/heat/?lang=en&ti=2895222&bp=h_auctions

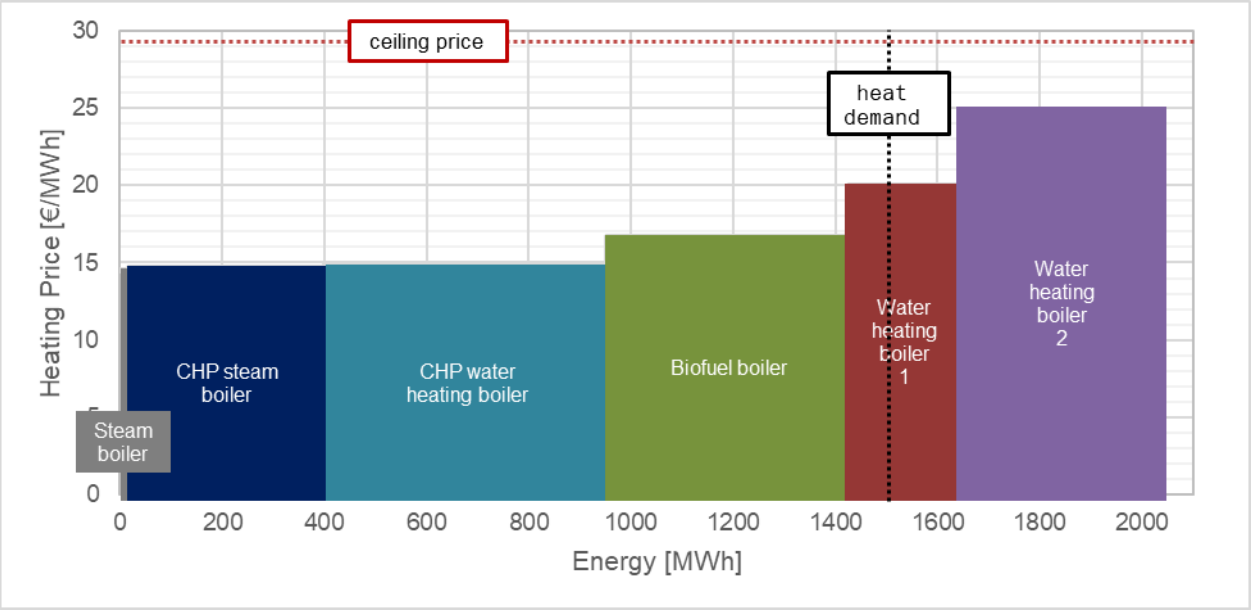

Figure 5: Results heat auction Panevėžys, 20th November 2020[42]

In both auctions, the same six bidders are active, however, the bids a very different. Most of the plants are owned and operated by the DH operator; only the biofuel boiler and the steam boiler are independent producers. In the October auction, four bidders got awarded to cover the forecasted demand for the 20th October. This highest awarded bid had a heat generation price of 16.9 €/MWh. The bid prices from the steam boiler and the second water heating boiler were higher and not awarded. In the November auction the order was different and five bidders were awarded to cover the demand on the 20th November. The increase in the heating demand can be explained by the colder temperatures in November. The highest awarded price also increased to 20 €/MWh. The comparison shows that the highest bid from October, the smoke utiliser, was the cheapest bid in November. The changed bidding behaviour might be caused by external influences, like fuel prices.

4.3 Netherlands: Emission reduction subsidy program

The Netherlands supports renewable heat provision within the SDE++ program since 2020. Several technologies can apply for a subsidy in the same auction that is cleared based on the lowest price for CO_2 reduction. The new SDE++ shares most elements with the former program SDE+.

The old SDE+ support scheme only included renewable technologies. It used an annual auction procedure, where all eligible technologies participated. The bids consisted of the power offered and an energy price (ct/kWh), with a conversion factor from chemical energy for the gas to electrical energy[43]. The auction was separated into three phases with increasing ceiling prices (from 70 €/MWh_{el} to 130 €/MWh_{el}) for the bids. In each round, the bids were selected based on the lowest energy price until the total budget was allocated or all bids were successful, and the next phase started. The subsidy was paid as a sliding premium for 12 or 15 years, depending on the applied technology.[44]

In contrast, the new SDE++ auctioning scheme also addresses heating technologies. Companies and other organisations can apply for the program if they plan a project from the categories and subcategories shown in Table 2. Eligible heating technologies fall in the categories “renewable heat and CHP” and “low-carbon

[42] https://e.baltpool.eu/heat/?lang=en&ti=2895222&bp=h_auctions

[43] $Conversion\ factor$: $\frac{price\_electricity}{price\_gas} = 0.706$

[44] https://english.rvo.nl/sites/default/files/2020/03/Brochure%20SDE%20Spring%202020.PDF

heating".

Table 2: Eligible technologies for SDE++[45]

Main category	Subcategory
Renewable electricity	Osmosis
	Hydropower
	Wind
	Solar
Renewable heat and CHP	Biomass (fermentation and combustion
	Composing mushroom compost
	Geothermal (deep and ultra-deep)
	Solar thermal energy
Renewable gas	Biomass (fermentation and gasification)
Low-carbon heat	Aquathermal energy (recovered from surface water and wastewater)
	Daylight greenhouse
	Electric boiler
	Geothermal (shallow)
	Waste heat
	Heat pump
Low-carbon production	Carbon Capture and Storage (CCS)
	Hydrogen by electrolysis

Every project that is connected to the electricity grid needs a feasibility study for the application and an indication of the electricity transmission capacity at the selected location. In the heating categories, this applies to CHP plants, electric boilers, and heat pumps.[46]

The auction of the scheme has a fixed annual budget. In 2020 this budget was 5 billion €, which is allocated to all technologies in four phases. The bidders bid a price per CO_2 reduction or per energy production, which they want to receive for their plant. From phase to phase the celling price increases (1st phase: 65 €/tCO_2, 2nd: 85 €/tCO_2; 3rd 180 €/tCO_2; 4th 300 €/tCO_2). To compare the given bids from different technologies, the bidding prices are converted into the so called subsidy intensity:

$$Subsidy\ intensity\ \left[\frac{€}{tCO2}\right] = \frac{Application\ amout\ \left[\frac{€}{kWh}\right] - long\ term\ price\ \left[\frac{€}{kWh}\right]}{emission\ factor\ \left[\frac{tCO2}{kWh}\right]}$$

In each phase of the auctions, all bids below the ceiling price are awarded, until the overall budget is reached. If there are more bids than budget, all bids submitted on the day are ranked based on the specific subsidy intensity (€/tCO_2), independent of the category, and the lowest bids are awarded. All awarded bids receive a payment for each unit of electrical, thermal, or chemical energy produced or CO_2-reduction for 8 to 15 years, depending on the technology. For the 2021 auction, minor adjustments have been made regarding the ceiling prices, but the overall mechanism stays the same. The SDE++ scheme is planned until 2025 and the Dutch government is expecting to phase out the subsidies for renewables afterwards.[47] The results of the auction in 2020 are presented in Figure 6.

[45] Netherlands Enterprise Agency (2021): https://english.rvo.nl/sites/default/files/2020/11/Brochure%20SDE%20plus%20plus%202020.pdf
[46] Netherlands Enterprise Agency (2021): https://www.rvo.nl/subsidie-en-financieringswijzer/sde/aanvragen/haalbaarheidsstudie
[47] Netherlands Enterprise Agency (2020): https://english.rvo.nl/subsidies-programmes/sde ; https://english.rvo.nl/sites/default/files/2020/11/Brochure%20SDE%20plus%20plus%202020.pdf

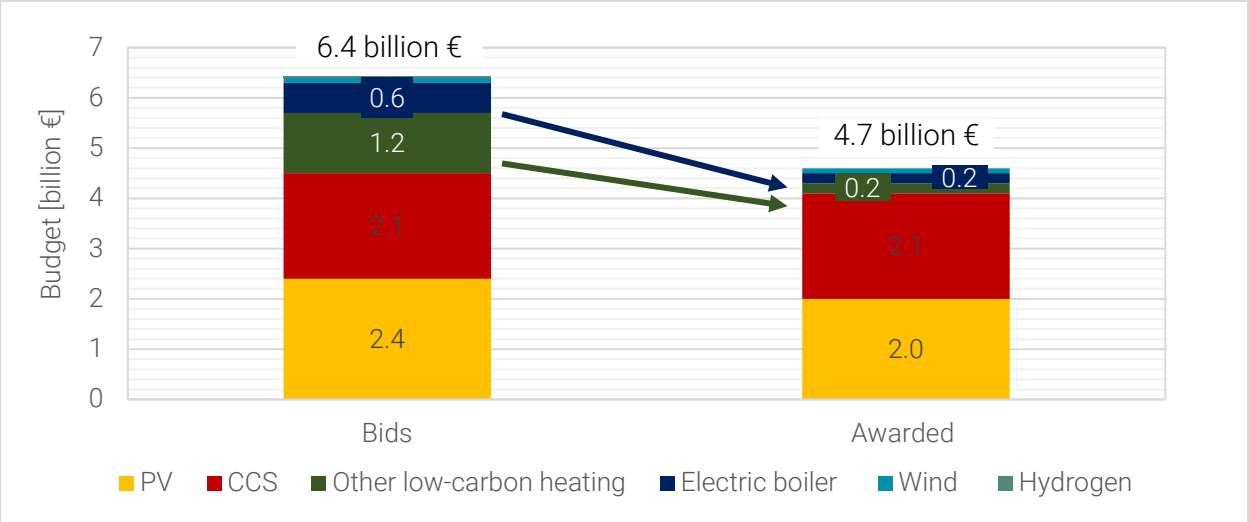

Figure 6: Technology Comparison Auction 2020, Bid vs Awarded[48]

All bids of the 2020 auction had a total subsidy value of 6.4 billion €. With a share of 37.5%, solar PV and 33% CCS, i.e. non-heating technologies, made up the biggest contribution. Electric boilers accounted for 9.4% and all other low carbon heating technologies for 18.8%. Out of the total awarded amount of 4.7 bil. €, 42.6% was allocated to PV and 44.7% to CCS. Electric boiler received 4.3%, Heat pumps 2.6%, and biomass (including gas) 1.7%. Geothermal did not receive any subsidy.[49]

4.4 Summary of the auctions for heat plants

This section shows that there are only very few auctions for heat only plants in Europe. The three examples presented are also very different and not comparable.

In Estonia, independent producers have the right to access DH networks (i.e. regulated TPA) and if there is a need for additional heat generation capacity, it must be auctioned in accordance with the national DH Act. The auction is organised by the DH provider after approval from the Estonian Competition Authority. The call for tenders includes, in general, the eligible fuel and heating technology and different qualification criteria. However, many auctions do not receive any expresses of interest and the network operators, therefore, often build the heating plants themselves.

Also in Lithuania TPA is regulated and there are several independent heat producers feeding into DH networks. To determine a dispatch order, i.e. which producer covers the forecasted heat demand to what extent, a monthly auction is held. The auction is held two months before the delivery month and is organised by the energy exchange operator Baltpool for each DH system with independent producers individually.

The last example in this section describes the SDE++ in the Netherlands, which is a support program that allocated subsidies to different technologies, including heating technologies, via an auction. Bidders bid a price per CO_2 reduction or per energy production. Awarded heat plants receive a payment for each unit of thermal energy produced or for each CO_2-reduction unit. In the 2020 auction, renewable heating plants got 8.6% of the total budget.

As the Estonian auctions have not received any applications and the SDE++ plants did not yet have to be built it is very difficult to assess the suitability of auctions for building new heat plants based on the described examples. Also with regard to dispatch auctions it is not yet clear whether these would be a useful tool for improving the framework conditions for renewables in district heating. At the same time, the diversity of auctions can be a first indication that there might be opportunities for using auctions for heat plants.

[48] Aurora Energy Research (2021): https://auroraer.com/insight/sde-subsidies-first-round-results/
[49] https://www.nsenergybusiness.com/projects/porthos-carbon-capture-and-storage-ccs-project/

5 Country examples for auctions for district heating and decentral heating systems

Another application of auctions in the heating sector are tenders for whole heating systems, which can be district heating systems or several decentral heating solutions (e.g. heat pumps). In this section auction for DH systems and decentral heating systems are presented with examples from Ireland and Germany. Two excursions on (1) auctions for concessions and public procurement and (2) tenders for public procurement under EU legislation provide basic knowledge for the examples described.

Auctions for concessions in the EU

Just like in the electricity and gas sector, companies in the DH sector must have a concession from the municipality. In the EU the granting of concessions is subject to regulation for public procurement.[50] This applies for the initial awarding of a concession and the awarding of expiring concessions. Typically, the awarding of DH projects is organised as a combination of a concession and a contract to design, build, operate and maintain a DH network including the heat generation. The duration of concession contracts is not directly given within the EU regulation. It should be oriented on the time required for the concessionaire to cover all investment costs including a return on the investment. The MS can specify the maximum time or duration of the concession.[51]

Tender for public procurement under EU legislation

The rules for public procurement procedures are specified in national laws of the MS. However, if the project value exceeds certain thresholds the national laws must be based on EU regulations for public procurement. Limits are 139.000 € for general services and 5.3 mil. € for construction contracts. The construction of new DH systems exceeds the threshold in most cases. The EU regulations also include the obligation to tender the project EU-wide.[52]

Depending on the size and complexity of a project the tender can be executed in different ways. For DH/decentral systems four procedures are possible (see Figure 7).

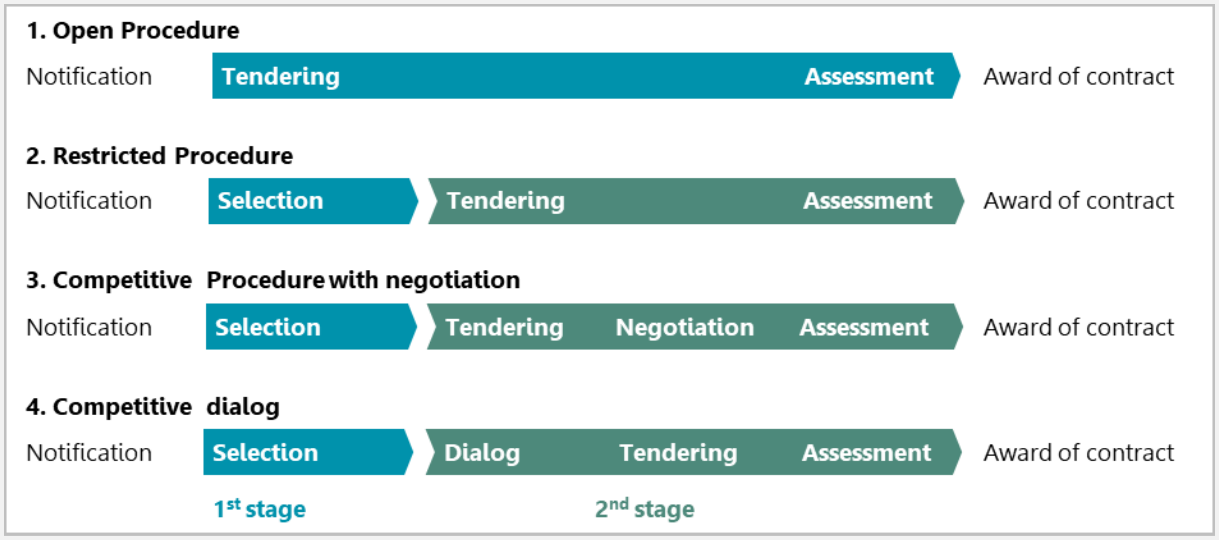

Figure 7: Selection procedures for Public Procurement[53]

[50] Directive 2014/23/EU Appendix 2: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32014L0023
[51] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32014L0023
[52] https://ec.europa.eu/growth/single-market/public-procurement/rules-implementation/thresholds_en
[53] Intereg North-West Europe Heat net NWE: Procurement guide (2019): https://www.nweurope.eu/media/7462/wpt3_d13_heatnet-procurement-guide_final.pdf (p. 6)

The simplest one is the "Open Procedure", where anyone can submit a bid for a call for tender and the contract is awarded in a one staged auction. One disadvantage of this procedure is that all the specifications of the project must be defined in the call for tender. For complex infrastructural projects this is very challenging, therefore, two-staged procedures are preferred. In their basic form of "Restricted Procedure", in the first selection round anyone can participate and is evaluated based on their capability, capacity, and experience to perform the contract. This leads to a shortlist of bidders, who are eligible to submit a bid for the actual tendering process (i.e., second selection round). The "Competitive Negotiated Procedure" follows the same principles, but negotiation, with all bidders, is allowed. Within the EU this procedure is only allowed in specific sectors including the energy sector. If the complexity of a project is high and the contracting authority needs to define the requirements and details of a contract during the tendering process, a "Competitive Dialog" can be used. The companies, that were successful in the first stage, enter a dialog phase with the authority and define all contract details. Afterwards all selected companies can give a bid for the actual contract, which is then awarded to the most advantageous bid.[54]

All companies, organisations, and institutes established in the EU have the right to compete in the tendering procedure, an exclusion is only possible, if the entity has not paid taxes or social securities in the past, is linked to corruption or any criminal organisation, or is bankrupt or is guilty of grave professional misconduct.

The authority calling for tenders must publish its call, including all relevant information and evaluation criteria, on the online platform Tenders Electronic Daily (TED). One part of the public call for tenders is the communication of the selection criterion and their weighting for the project, which can be determined by the authority. After the deadline, all bids are evaluated, and all participants must be informed. Unsuccessful bidders have the right to request a review of the procedure.[55]

5.1 Dublin: Auction for a district heating system

In southern Dublin, a new DH system is currently in the construction phase. It is supported by the "Government's Climate Action Fund"[56], the "Interreg North-West Europe HeatNet NWE project"[57] and the "Sustainable Energy Authority of Ireland"[58]. In 2018 a call for tenders for the design, construction, operation, and maintenance for the DH network has been published. The total contract has a duration of 14 years and is divided into the phase's construction and operation.[59] The tender was awarded using a competitive dialog.[60]

This project went through the following steps:

(1) Pre-qualification questionnaire
(2) Shortlisting of candidates to three
(3) Shortlisted candidates invited to complete an investment grade audit of applicable sites
(4) Invitation to participate in the Competitive Dialogue Process to shortlisted candidates
(5) Identification of economic operators with viable solutions
(6) Invitation to tender and issuing of the tender document to those identified
(7) Contract award decision and issuing of letters to successful and unsuccessful tenderers
(8) Standstill period

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[54] Intereg North-West Europe Heat net NWE: Procurement guide (2019): https://www.nweurope.eu/media/7462/wpt3_d13_heatnet-procurement-guide_final.pdf and Directive 2014/25/EU
[55] EU Tendering rules (2020): https://europa.eu/youreurope/business/selling-in-eu/public-contracts/public-tendering-rules/index_en.htm
[56] https://www.gov.ie/en/publication/de5d3-climate-action-fund/
[57] https://www.nweurope.eu/projects/project-search/heatnet-transition-strategies-for-delivering-low-carbon-district-heat/
[58] https://www.dublincity.ie/residential/environment/dublin-district-heating-system
[59] Call for tenders (2018): https://ted.europa.eu/udl?uri=TED:NOTICE:414813-2018:TEXT:EN:HTML&src=0&tabId=4 ; Euroheat (2020): https://www.euroheat.org/news/contract-awarded-irelands-first-large-scale-dh-scheme/
[60] https://irl.eu-supply.com/app/rfq/publicpurchase_docs.asp?PID=135534&LID=149580&AllowPrint=1

(9) Contract concluded
(10) Contract award notice published
(11) Contract commencement

The selection criteria is presented in Table 3 and shows a split into the quality of the system and its costs. These two categories are divided into subcategories. In the quality category, the building and operation phase is considered with the system design being the highest weighted subcategory. The cost category is dominated by the monthly payment. A more detailed description of the criteria including the exact metrics used to calculate the values has not been published. The current first phase of the project is planned to be finished by Q2 2022. After that the extension phase will begin.[61]

Table 3: Selection Criteria DH southern Dublin[62]

Criterion	Weighting
1. Quality of Proposed Equipment, Design, Service delivery and Resources	**60%**
1.1 Quality and comprehensiveness of proposed system design	20%
1.2 Quality and comprehensiveness of proposed equipment	10%
1.3 Quality and comprehensiveness of proposed service delivery including maintenance	10%
1.4 Project delivery plan (system build and ongoing service delivery)	10%
1.5 Resources proposed for project delivery (system build and ongoing service delivery)	10%
2. Costs - supply price, fixed monthly payments and discountable revenue	**40%**
2.1 Monthly Payment	35%
2.2 Discountable Revenue Threshold	2.5%
2.3 Discount	2.5%

A specific standard for the CO_2 emissions was not included, but the supply should primarily be covered by data centers and geothermal heating plants. The overall reduction is claimed to be approximately 1500 tCO_2 annually. The buildings connected to the network will include educational institutes and a hospital, as well as residential, commercial, and administrative buildings. An extension to more buildings is already planned and will be realised in multiple steps. The company, that has won the tender, is Fortum eNext Ireland Ltd, which started building the DH network in spring 2021.[63]

5.2 Hamburg: Technology open auction for a heating system

In Germany, a tender for the construction and operation of a new heating system (DH or decentral solutions) was held from 2007 until 2009 in the city Hamburg within the framework of the project HafenCity. The aim of the HafenCity project is to develop a sustainable urban district in a former port area. In the eastern part of HafenCity, the city of Hamburg is building residential and office buildings. Currently, some buildings are completed, others are still under construction or in the planning phase. For these new buildings, an external company is constructing a heating infrastructure to supply the buildings. The construction and operation of the heating infrastructure was tendered in 2007.

The call for tenders for the heating infrastructure was formulated as a technology open auction. However, an explanation that introduces three technical alternatives for the supply was published along the other tendering details. The first alternative was a supply via one DH system. The second alternative was a polycentric supply system with five separate DH systems with different energy carries (natural gas, biomass and hydrogen). The third alternative was designed as decentral supply, where all blocks are heated separately. For this

[61] https://www.codema.ie/images/uploads/docs/TDHS_Marketing_Brochure_for_Developers.pdf
[62] https://irl.eu-supply.com/app/rfq/publicpurchase_docs.asp?PID=135534&LID=149580&AllowPrint=1
[63] Publication of results (2020), https://irl.eu-supply.com/ctm/Supplier/PublicTenders/ViewNotice/238662

alternative natural gas, wood pellets, hydrogen and heat pumps were possible. Additionally, solar thermal plants could be included for all alternatives.[64]

The bidders had to develop a heat solution covering the forecasted annual heat demand of 59.2 GWh and the required heating capacity of 33 MW. The actual heat delivery for the first buildings should start in 2009 with more buildings being connected continuously. The specific CO_2 emission of the bid had to be below 170 g CO_2/kWh_{th} in 2009, with a dynamic reduction of to 120 g CO_2/kWh_{th} in 2020, which was oriented on the emission targets for Germany in the Kyoto protocol.[65]

The tender was held as a competitive procedure with negotiations. In the first step, a competition for participation was held in 2007 with seven companies being interested. These were evaluated based on their expertise, experience as well as technical and economic capabilities. Afterwards three companies have been selected for the second stage of the process, which included three rounds of bid submission and adjustments. The bids were analysed and a scoring based on the awarding criteria was determined (see Table 4).[66]

Table 4: Selection Criteria DH HafenCity Hamburg [67]

Criterion	Weighting
Heat price	40%
Low primary energy consumption and CO2-emission	25%
Sophisticated and reliable concept	10%
Security of supply	10%
Space requirement	5%
Flexibility concerning parameter changes within the development phase	5%
Openness and adjustability to new technologies	5%

All submitted bids planned to supply the area via a DH system (i.e. alternative 1). This includes the construction of the network and heat generation plants and the operation. The Dalkia GmbH (a subsidiary of the EDF group, the biggest utility in France) has won the tender in 2009 and started with the construction and supply. In 2013 Dalkia passed the project to the Enercity Contracting Nord GmbH, a subsidiary of the public utility of Hannover. Whereas the concept originally included a biogas CHP and a wood-based heating plant, the supply is now based on a combination of a waste heat plant from a nearby copper smeltery, a biomass CHP plant and a natural gas boiler for peak demand, achieving emissions below 70 g CO_2/kWh_{th}.[68]

5.3 Pinneberg: Auction for concession rights

An example of a tendering process of concession rights for a DH system can be found in Pinneberg, Germany. The prior concession with the public utility (Stadtwerke Pinneberg GmbH) ended in August 2020 and a call for tenders was published for the new concession to operate the local DH network. The annual heat production is approximately 60 GWh for around 465 households and 170 industrial customers. An extension of about 360 households was planned during the 20 years of the next concession contract.

Similar to the procedure in Hamburg, the applicants must prove their organisational and technical abilities to qualify for the second step of the competitive procedure with negotiation. However, the selection criteria are different (see Table 5). The city does not demand the successful bidder to pay a concession fee.

[64] Document from HafenCity Hamburg GmbH (2007), Technical explanation of the heat supply for the HafenCity
[65] Document from HafenCity Hamburg GmbH, Rahmenvertrag Wärmelieferung (engl. heat supply framework contract)
[66] Interview with project manager HafenCity Hamburg GmbH
[67] HafenCity Hamburg GmbH (2007), Call for submission of bids
[68] HafenCity Hamburg GmbH (2017), https://www.hamburg.de/contentblob/9430532/853953b3a7c5f367d23579455b5776a0/data/d-workshop-gebaeude-energie-hafencity-fk-klima.pdf

Table 5: Selection Criteria DH Pinneberg

Criterion	Weighting
Security of supply	25%
Price (grid fee)	15%
User-friendliness/customer service	12.5%
Efficiency (resources and heat losses)	10%
Environmental impact	12.5%
Concession contract (end-of-contract regulations, obligations of the city in events of incidents)	25%

The call for tenders ended unsuccessfully with the explanatory note: "No tenders or requests to participate were received or all were rejected."[69]

5.4 Summary of the auctions for district heating and decentral heating systems

Only few exemplary auctions for whole heating systems, i.e. district heating system or several decentral heating solutions (in new development areas) could be found.

In Dublin, an auction for the design, construction, operation, and maintenance for the DH network has been held. The auction was designed as a competitive dialog. The selection criteria was split into the quality of the system and its costs.

In Hamburg, an auction for the heating system of a new development area was held, whereby three technical alternatives for the supply were published along the other tendering details (1) supply via one DH system, (2) supply with five separate DH systems or (3) decentral supply, where all blocks are heated separately. Similarly to Dublin, the auction was held as a competitive procedure with negotiations. In contrast to the auction in Dublin, a specific standard for the CO_2 emissions was included.

The last example is an auction of concession rights for a DH system in Pinneberg, Germany. Similar to the procedure in Dublin and Hamburg, the auction was organised as a competitive procedure with negotiation.

The presented exemplary auctions are very individual processes. Similarities can be found in the procurement, i.e. in all cases a competitive dialog was used. Furthermore, the selection criteria is to some extend similar, i.e. prices as well as emissions and other criteria are considered. The cases do however present a first basis for analysing the effectiveness and efficiency of the auctions and potentially draw more general conclusions with regards to expanding such auctions to other countries and municipalities.

[69] Published tender document (2019), https://ted.europa.eu/udl?uri=TED:NOTICE:570344-2019:TEXT:EN:HTML&tabId=0

6 Conclusions

Due to the diversity of actors and technologies, diverse types of auctions could be used in the heating sector. Auctions in the heating sector could (in theory) be used to allocate support for (central) district heat supply, decentral heat in buildings or process heat for industrial processes.

Auctions for (central) district heat could focus on new generation plants, such as CHP plants feeding into electricity and DH grids or renewable heat (only) plants feeding into DH grids. Besides, auctions for DH could also address whole networks including pipes and the whole infrastructure, i.e. new DH systems or modernisation and/or expansion of existing DH systems.

Similarly, decentral heat auctions could be held to provide investments support for new heat installations in in new buildings or by serial renovation, i.e. several decentral solutions are installed at once. Auctions for single installations are also possible, but less likely and no exemplary auction could be found.

New decentral heating appliances in industrial companies could also be addressed with an auction, whereby investment support or operational support could be paid. In this context, also auctions for contracts for difference for carbon-free process heat technologies (CCfD) are under discussion.

So far, the use of auctions in the heating sector is not very widespread. Nevertheless, the report presents exemplary auctions in different countries. Thereby, auctions for CHP in Germany, Poland and Slovenia are described (see section 3). Furthermore, auctions for heat (only) generation plants are presented based on exemplary auctions in Estonia, Lithuania and the Netherlands (see section 4). Lastly, auctions for DH systems or decentral heating solutions (in development areas) as well as auctions for concessions for DH with examples from Ireland and Germany are discussed.

Auctions for CHP plants are used in a few MS. Usually they support renewable electricity generated and fed into the electricity grid, while the feed-in into the DH grid is not supported. The country examples show that the specific design differs in terms of prequalification, type of financial support (e.g. feed-in tariff or market premium) and the awarding process. As auctions have not been used for a long time, a full evaluation of the auction especially with respect to effectiveness and realisation rates is not yet possible. However, the auctions tend to be undersubscribed and have thus not resulted in very low award prices. The German auction for innovative CHP systems is an example for a very complex support which is addressing its objective very indirectly. The aim of introducing this auction was to increase the share of renewable heat generation in DH systems. Therefore, a certain minimum share of renewable heat in the DH grid is set as a prequalification requirement for the participation in the auction. The support is then still paid based on the electricity generation of the non-renewable CHP plant. This design should not be recommended but might be a way to promote renewables in DH if direct support for renewable heat is not possible for political reasons.

Auctions for renewable heat (only) plants are foreseen in Estonia whenever a new heating plant becomes necessary within an existing DH grid. However, the auction only takes place if more than one third party is interested in building such a plant. So far, to our knowledge no auction has been conducted here. New heat plants are also able to participate in the Dutch SDE++ auction and have been successful there. No full evaluation of these auctions is possible at this point in time due to the fact that realisation times are not yet reached. It is however possible to state that the multi-technology auction design of the SDE++ is not reliable for reaching specific renewable heat shares in DH as other technologies from other sectors can be more successful in the auction. Latvia uses auctions for heat dispatch in DH systems. This might be a way to enable third party participation in DH but further analysis is required for a full evaluation and policy recommendations.

Auctions for district heating systems on subnational or municipality level have been conducted in several MS. In the case of the city of Hamburg, also decentral heating was allowed to form part of the offered solution. The unsuccessful auction in the case of Pinneberg shows that there might be room for improving the auction design of such auctions but of course competition will also depend on the expected profitability of the auctioned system and other framework conditions. Again, further research is necessary to recommend certain auctions design elements.

To summarise, this policy brief shows that the decarbonisation of the heating sector could potentially profit

from using auctions. However, so far examples are scarce and diverse and sometimes have been quite unsuccessful. Thus, as in the case of electricity and other sectors, before introducing an auction a careful assessment of the market and framework conditions needs to be realised in order to design an auction in an effective and efficient way. Further research is necessary to explore suitable areas for using auctions as well as developing more in-depth lessons learned from the existing auction schemes.

AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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