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CLIMATE AND ENERGY INVESTMENTS IN THE HEATING INDUSTRY

2014–2030

EXECUTIVE SUMMARY

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Project in brief

The report contributes to the output of the O.IV project " **Climate investment capacity: climate finance dynamics & structure for financing the 2030 targets (CIC 2030**)". The main objective of the CIC 2030 project is to build capacity in the area of assessment of investment needs and plans for achieving the 2030 climate targets, together with identifying ways to meet these investment needs. The main outputs of the project are knowledge and procedures for (i) climate-energy investment maps to monitor public and private finance flows, (ii) analyses of investment needs and investment gaps to achieve climate and energy targets by 2030, (iii) capital raising plans to cover the gap between identified investment needs and current investment flows, and (iv) investment policy plans for meeting the 2030 heating targets. This report presents outputs focused on climate-energy investment and investment plans for the heating sector for 2030.

Report abstract

This report responds to the challenge of a low-carbon transformation of the heating sector in the area of realised climate-energy investments and their link to the expected investment needs for the low-carbon sector transformation by 2030. The report aims to map and evaluate the flows of climate and energy investment in the heating sector in 2014-2019 and highlight the investment need for the transition of heating from coal to low-carbon, sustainable sources. At the same time, we point to the possible trends and diversification of this sector's activities, using the example of two case studies.

Disclaimer

This project is part of the European Climate Initiative (EUKI – www.euki.de) of the German Federal Ministry of Environment, Nature Protection and Nuclear Safety (BMU). The main objective of the EUKI is to promote climate cooperation within the European Union (EU) to mitigate greenhouse gas emissions. The opinions presented in this report are the authors' sole responsibility, and they do not necessarily reflect the views of the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU).

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Executive summary

The report **aims to assist the low carbon transformation of the heating sector of the Czech Republic**, providing evidence-based information and advice. In 2015, ca. 40% of heat demand in the residential sector was addressed by the sector and thus, it plays a big role in the economic structure and the energy system of the country. The sector relies on domestic coal, which currently accounts for nearly 60% of its fuel mix and the transformation is a big challenge.

The report **presents the contribution of the sector to meeting 2030 country climate, energy, and renewable energy targets**. The Czech Republic has not set clear sector climate targets and it does not have yet a dedicated strategy for the sector's low carbon transformation. One of the main anchoring commitments is a recommendation of the Coal Commission on the phase out of coal mining and combustion in the Czech Republic. In December 2020, the Commission recommended to phase out coal by 2038, but this deadline has not been yet approved by the Czech Government. It is expected that the actual phase out of coal firing in the heating sector will occur earlier than this date due to the number of reasons. These include the overall economic and policy climate related to the EU long-term decarbonization targets, such as availability and cost of capital with a growing favour on low carbon technologies, as well as a decrease in the amount of free emission allocation for the heating sector, and a growing price of emission allowances due to the revision of legislation under the emission cap-and-trade regime of the European Union (Emission Trading Scheme – EU ETS).

The report discusses investment need, recent investment, and solutions to close the investment gap of the heating sector's energy transition. More specifically, it calculates the investment need of the sector over 2021-2030 to realize its greenhouse gas (GHG) emission reduction potential in line with the country's 2030 energy and climate targets and long-term decarbonization plans. It further tracks such investment occurred over the period 2014–2019, taking into account the recently adopted EU Taxonomy of Sustainable Activities. Finally, it offers two case studies representing typical Czech heating plants, for which it discusses decarbonization strategies. The experiences of these case studies offer useful food for thought and recommendations for the rest of the sector. The report represents the fourth study in a series prepared within the Climate Investment Capacity 2030 project supported by the European Climate Initiative, with the first report focusing on the assessment of investment need to meet the country's 2030 energy and climate targets in selected sectors, the second report tracking the recent investment in this process, and the third report articulating on the capital raising plan to close the investment gap between the investment need and the recent investment flows[1].

Investment needs for the low-carbon transformation of the heating sector

The transformation investment in the district heating sector must be aligned with the EU Taxonomy of Sustainable Activities. The taxonomy is a scientific-based classification system that allows identifying whether an investment is in line with long-term sustainable and climate plans and commitments of the European Union. It is a part of the European Commission's Action Plan on Financing Sustainable Growth. It aims to support the trend of sustainable investment and to reduce

[1] Please see the reports at the website of the Climate Investment Capacity (CIC2030) project at URL https://www.ikem.de/en/portfolio/cic2030/

the risk of greenwashing[2]. Non-compliance of investment with the taxonomy will likely cause a number of challenges for the operation of installations already in the near-term future. For instance, it may lead to a lower access or higher cost of capital from financial intermediaries, such as the EU funds, and thus also undermine these installations' competitiveness.

The low carbon transformation is not always straightforward, and the application of the EU Taxonomy of Sustainable Activities creates some uncertainty. Economic activities that are incompatible with net zero emissions and where technological alternatives exist do not comply with the taxonomy, such as coal firing for heat production. Where full low-carbon transition is not technologically and economically feasible in the short-term, the taxonomy temporarily allows some transition activities, which do not yet comply with climate neutrality. For the heating sector, this concerns above all the firing of natural gas. For these sectors, the taxonomy sets technical performance thresholds that determine whether such an activity can be regarded as sustainable. The thresholds for individual sectors are still being prepared at the time of writing of this report that creates some uncertainty in the investment decisions of heating companies.

In case of the Czech Republic, the re/construction of heating plants to allow natural gas firing is identified as a transition solution. As illustrated with the argumentation below for different categories of installations, the sector does not have many immediate alternatives, i.e., on the supply side of heat. It is important to emphasize that changes on the supply side (heat production) must be linked to changes in the heat demand, i.e., at final consumers. The transformation of the production base for heat supply must reflect the priority, which is to increase energy efficiency on the part of consumers (and thus the expected decline in heat consumption and a change in the profile of heat consumption during the year). At the same time, plans for the transformation of heat production must take into account the expected development in the use of RES (solar collectors, PV, heat pumps) together with heat accumulation, and design the entire development of heat supply systems to allow gradual integration of decentralized heat sources based on RES. These aspects were assessed and discussed in our previous reports in the series.

Scaling up of some of these solutions is not possible in the immediate timeframe and it is a long-term task. It is therefore the heating sector that shall search for immediate solutions giving the time for scaling up the right mix of low-carbon technologies at the demand and supply side.

Although natural gas firing brings an immediate reduction of GHG emissions as compared to coal, it cannot stay as a permanent solution in the current technological setting hindering the achievement of long-term EU decarbonization targets (in accordance with the meaning of the EU "taxonomy", EU Regulation 2020/852 and general transition to climate neutrality), **therefore such installations will have to be supplemented in the coming decades by either "greening of gas" or replaced by other technologies.** While "greening of gas" may be an important element of the future decarbonization trajectory, it is not currently clearly anchored technologically, economically, and politically.

In the category of heating plants above 300 MWt, it is practically possible to consider only their reconstruction to allow firing natural gas. At present, the experts do not see an alternative to reconstructing these plants so that they would emit less GHG emissions. While it is also theoretically possible to re/construct these installations for large-scale biomass firing and cofiring, practically it is hard due to the need to collect, transport, and store a large amount of sustainable biomass that will offset emission reductions gained. For these reasons, heating companies do not plan to build new

[2] Misuse of being referred to sustainable without being sustainable

installations in this size category. The same applies for using other fuels (such as energy recovery of municipal waste).

In the category of heating plants between 50 MWt and 300 MWt, it is technologically and economically feasible at present only to consider the re/construction of installations based on firing natural gas or hybrid solutions with (smaller) different boilers firing natural gas and biomass. To reconstruct or construct installations fully on biomass is not possible due the same reasons as discussed above. We also analysed a possibility to introduce installations in this size category based on energy recovery from municipal waste and alternative solid fuels. These installations will unlikely achieve higher output than 50 MWt due to the nature of the fuel, its limited availability, and its large collection distances and therefore, they cannot be an alternative in this category.

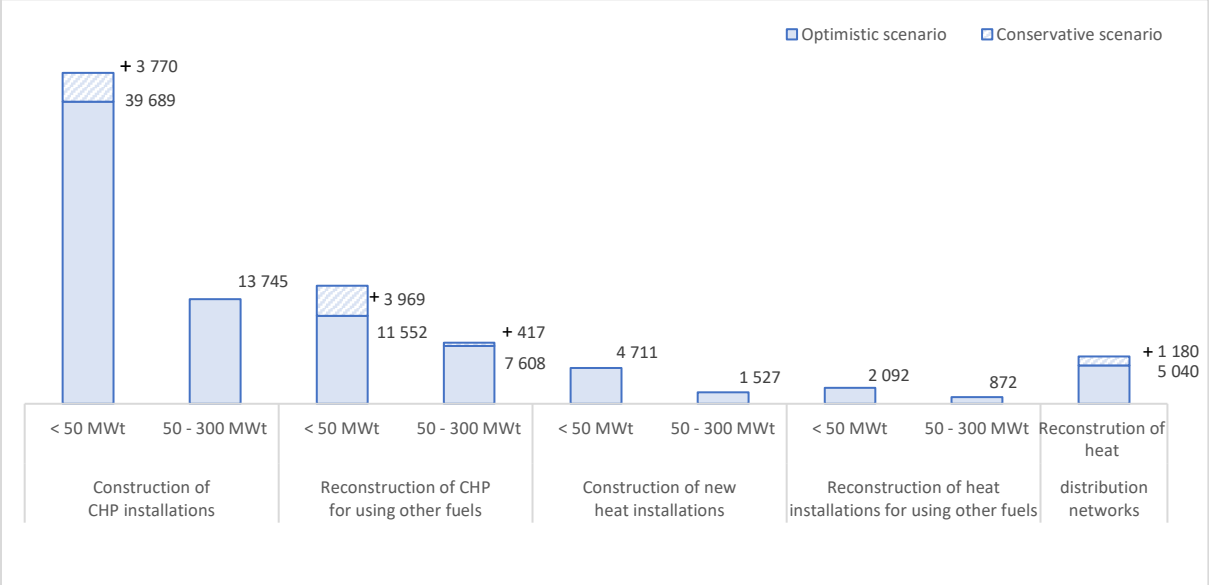
For the installations below 50 MWt, the choice of fuels is more flexible, but still somewhat constrained. The category includes at present mostly the installations under 20 MWt because many such existing units have downscaled to below 20 MWt, so not covered by the EU ETS, and thus they are out of our definition of the heating sector for investment needs purposes. They often had to undergo some reconstruction or modernization, realizing to some extent the decarbonization potential. For new installations in this category, next to natural gas and/or biomass, it is possible to consider those based on energy recovery from municipal waste and alternative solid fuels. The latter two installations are however not always possible, because they need a respective reliable supply of waste or alternative fuels that is site-specific. It is also not possible to reconstruct existing facilities to allow them utilizing these fuels, therefore these installations could only be new.

In summary, based on these limitations, **the sector transformation is likely to see a replacement of coal in the short- to medium- term mainly by natural gas and partly also by biomass and waste** (with the expected development of renewable energy sources). Relying on these conclusions, we developed two scenarios, optimistic and conservative, to estimate the investment costs by 2030 required to follow this trajectory. Only installations above 20 MWt were covered in this analysis. The optimistic scenario identifies the lowest cost estimate, whereas the conservative scenario calculates its highest range.

According to the optimistic scenario the total investment required over 2021-2030 is CZK 98.3 billion, and it totals to CZK 107.2 billion in the conservative scenario (in nominal prices of the given year). Figure 1 presents the breakdown of investment need according to capacity and type of the installations. It illustrates that most of these needs are installations up to 50 MWt. The largest investment is required for the construction of new combined heat and power (CHP) units, followed by the reconstruction of existing CHP units. Altogether, about two thirds of the current production of coal supply heat is expected to be secured by the reconstructions or new sources for natural gas, about a fifth of coal will be replaced by biomass, about 13% production of supply heat from coal will be replaced by new sources based on energy recovery from municipal waste and alternative solid fuels.

The investment identified will have to be implemented stage-wise. Until 2025, only projects that had been already prepared before 2020 are to be implemented. Between 2025 and 2030, a major part of required reconstruction covering ca. 70-80% of production and distribution capacity will take place. From 2030 to 2035, the last portion of ca. 10-15% capacity will be reconstructed, and the last coal-firing installations will be phased out.

Figure 1. Investment needs for the transition of the Czech heating sector in 2021-2030, million CZK



Recent investment in low-carbon transformation of the heating sector

In order to understand, how well Czechia is on track in meeting its investment needs in energy transition and specifically in the district heating sector, we tracked such recent investment. We found that **CZK 33.1 billion was invested over 2014–2019 in the measures, which led to a reduction of GHG emissions in the sector**. The highest volume was invested in 2014 as illustrated in Figure 2, being triggered by the National Investment Plan (NIP). In 2016–2018, the investment was ca. CZK 3 billion/yr.

Figure 2 breaks down the investment according to three groups: investment complying with the taxonomy, transition investment, and investment not complying with the taxonomy. The first category includes investment in heat production from renewable energy sources and investment in energy efficiency of heat distribution networks. The second category includes investment in natural gas firing. The third category includes investment reducing emissions of coal-firing installations.

The analysis of Figure 2 illustrates that **CZK 21.9 billion or two thirds of the investment occurred over 2014-2019 are those, which enable the reduction of emissions at coal firing installations without fuel switch and this is therefore the investment which cannot be counted as taxonomy-aligned**.

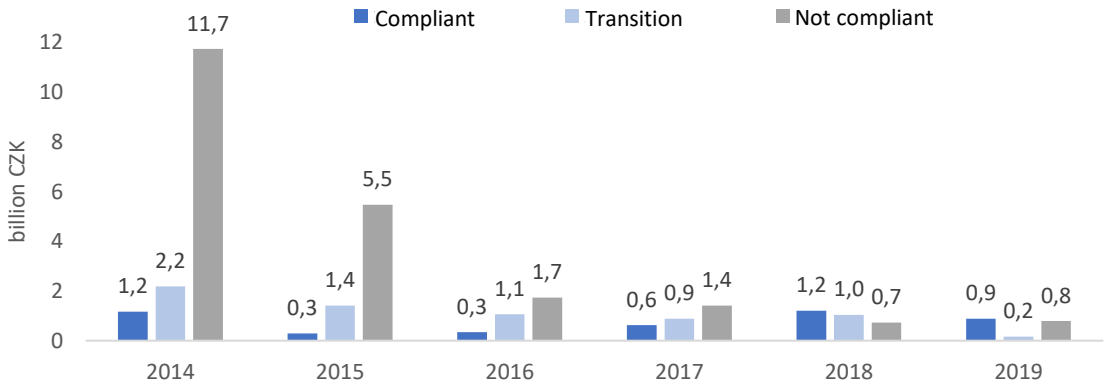
As this investment occurred relatively recently, it will have to be amortized before the end of its typical 20-year lifetime. This will require the adoption of measures on the part of the state in terms of accounting rules and enabling, for example, an accelerated write-off of the investment so that this problem does not prevent the transformation of such constructed resources.

The structure of the investment flows with a higher share of those not complying with the taxonomy is explained by the fact that subsidy programmes supporting them were set to reduce emissions but not eliminate them.

The figure however also illustrates that over time, this category of investment had declined. **In 2018 and 2019, investment aligned with the taxonomy including the transition investment was 75% and 66% of the total volume respectively.** Out of the taxonomy-compliant volume over 2014-2019, 40%

or CZK 4.48 billion was directed to the reduction of losses in heat distribution. The next flow of CZK 4.38 billion or 39% of the compliant volume represented the transition investment in new natural gas-based CHP installations. Finally, CZK 2.37 billion or 21% of the volume also was transition investment in the modernization and reconstruction of existing coal installations to allow them firing natural gas and/or biomass.

Figure 2. Investment in energy transition and decarbonization of the Czech heat sector broken down according to the compliance with the EU taxonomy of sustainable activities, in billion CZK



Note: The estimates present only primary investment flows, i.e., those that create new or additional physical assets. Therefore, they do not reflect expenditure, which was linked to intangible (soft) measures, such as energy audits, project preparation, documentation, and similar. The main sources of data were the reporting under the EU ETS, the project inventory of the NIP, the Operational Programme Enterprise and Innovation for Competitiveness (OPEIC), including its predecessor the Operational Programme Enterprise and Innovation (OPEI), and the Operational Programme Environment (OPE); as well as activities and data of COGEN Czech, an association for CHP generation bringing together small CHP producers, who are not covered by the EU ETS and are not eligible to the above subsidy programmes.

Private investment, consisting of own resources of companies and commercial loans, was the key flow covering over 80% of the total capital expenditure over the period analysed. This private investment was supported and/or triggered by policies and public finance. These were the NIP, as a part of the EU ETS, and then specific grant schemes offered by the Operational Programmes (OPs) of the European Regional Development Fund and the Cohesion Fund, including OP "Enterprise and Innovation for Competitiveness" (OPEIC) formerly OP "Enterprise and Innovation" (OPEI), and OP "Environment" (OPE) implementing the EU funds.

The role of public finance is proved by the dynamics of the investment over 2014-2019. Grants covered 17% of the compliant and transition investment volume, with a growing share over time, up to 35% of the investment volume supported recently by the OPs. Lower volumes of investment in 2016-2017 are due to the late start of the OPEIC financed from the EU funds within the EU budget period of 2014-2020. The NIP and the EU ETS are not explicitly reflected in investment flows: whenever heating plants implemented investment from their own resources, these were on the basis and in the value of freely provided emission allowances.

Over the next decade, it is expected that the largest role in supporting the investment will be played by the Modernization Fund, the Recovery and Resilience Facility, and operational support. The Modernization Fund will likely play the key role, setting aside ca. CZK 40 billion to support the Czech heating sector. The other source of funding is the Recovery and Resilience Facility, which is expected

to support the modernization of heat distribution networks. Finally, the operational support for the combined heat and power production is expected. The level of support for the investment will be very important so that the transformation of the district heating industry is reflected as low as possible up to the price of heat for final customer.

Investment plans for representative case studies

Many heating plants in the Czech Republic face a need to modernize or reconstruct their installations to decrease the CO_2 emissions. For our case studies, we have selected two of such, which have already started restructuring and/or modernization: the **heating plant in Písek and the heating plant C- Energy in Planá nad Lužnicí**. They represent different types of heating organizations, the first is a municipal heating plant and the second is a heating plant supplying heat to a portfolio of industrial customers next to buildings, commerce, and trade. Experiences of these heating plants **suggest useful recommendations for decarbonization strategies for similar organisations in the heating sector.**

Heating plant in Písek

The plant supplying heat to the town of Písek was built in 1987. The plant was initially equipped with two lignite boilers backed up with a fuel oil boiler used in case of failures and additionally on frosty days. **During the last 5 years, heat sales ranged from 350,000 to 380,000 GJ**, and the annual fuel consumption was respectively 40,000-50,000 tons of low-sulfur coal. The plant also produces 10 - 12 GWh/yr of electricity, which was dependent on heat supply, and which was used for own consumption or delivered to the distribution system. The heat is sold to 8,000 flats and over 400 other customers, including trade, services, and industry. Heat consumption is, therefore, affected by seasonality and average yearly temperatures. Heat was delivered to consumers via a steam distribution system.

The heating plant has been implementing a decarbonization strategy over 2016 – 2022. Implementing it scales to CZK 500 million over these years. About 30 % of the amount is being financed from grant programmes, mostly from the OP EIC, followed by long-term commercial loans, and own funds.

The largest share of investment need is for the reconstruction of heat distribution system from steam to hot water pipelines. The hot water system acts as heat accumulator and storage, which helps balancing peak loads. This will also allow reducing heat losses and thus downscaling heat production. This goes hand-in hand with the assessment of future heat needs of the town. Elimination of subsidies for heat consumption and gradual thermal efficiency improvement of buildings since the early 1990s resulted in the reduction of heat consumption of ca 1%/yr and some routes, therefore, are not cost-effective to operate. Simultaneously with the reconstruction of the pipelines and retrofitting the pipes, the reconstruction is underway for several dozen heat exchanger stations.

The next investment need is associated with a replacement of existing installations with those relying on low carbon fuels. The backup installation based on fuel oil was replaced by a natural gas boiler with installed capacity of 19 MW. The plant also introduced one additional natural gas boiler with installed capacity of 5 MW for the use in case of failures, accidents. One of two coal boilers was replaced with a boiler firing local biomass. One of the original coal boilers will remain for a few years more.

The plant has been developing further opportunities. The next stage is commissioning of a biogas installation in 2022. The opportunities considered include installing a smaller CHP unit in a place that

would be optimized with respect to the topology of the heating system. The other investment in consideration is heat storage, which would allow balancing the load with faster adjustments to outdoor temperature fluctuations. Furthermore, the plant considers construction of an installation allowing energy recovery from municipal waste. This will also address town priorities at a time when landfilling will be banned or at least significantly reduced. The preparation of this investment requires not only cooperation within nearby towns, but also with municipalities in the vicinity, to gather their waste for incineration. One of key challenges is to determine the annual amount of waste fired, that is expected to be ca 25 - 40 thousand tons.

C-Energy Planá s.r.o.

The plant producing heat for plastic and fiber factory, Silon Planá was constructed around 1960. At present, this is an **independent power and heat provider generating 350,000 GJ/yr of steam and producing 250,000 GJ/yr of hot water**. **Steam is mostly used for processes at industrial installations, whereas hot water is supplied for space heating** to the City of Sezimovo Ústí, the town of Planá nad Lužnicí, and to some localities in the town of Tábor. Space heating is mostly needed during cold periods, the demand for steam is more evenly distributed.

In 2012, the C-Energy started implementing a greening concept. The total investment required to realize it since then has been ca. CZK 1.5 billion. The investment was financed from own resources and commercial loans. Subsidies of approximately CZK 300 million were obtained from the OP E financed from the Cohesion Fund, Priority Axis 2 on emission reduction. The verification conducted in 2019 concluded on a reduction of SO_2 emissions by factor of 50, NO_2 emissions by factor of 3.65, and particle pollutants by factor of 83.3.

The largest share of investment was associated with a replacement of existing installations. The company replaced three old coal boilers with two 40 t/h coal fluid boilers equipped with exhaust gas cleaning system based on desulphurization, it also reconstructed the turbogenerator to increase its capacity. Later, these new installations started with 30% cofiring of wood chips was. The company further installed four CHP units with 10MW natural gas engines and exhaust-gas boilers generating steam and hot water. It also installed one backup natural gas steam boiler with installed capacity of 15 MWt. The company also launched a trial operation of a steam unit for energy recovery from non-recyclable plastics. The company further constructed additional pipelines to provide heat to residential sector, instead of locally used less efficient and more polluting heating sources.

Increasing its capacity and diversification allowed the company providing a wider range of power balance services and flexibility. To further improve the latter, it installed a battery storage with an output of 4 MW/2.5 MWh and photovoltaic power plant of 0.520 MWp (currently, the largest battery storage facility in Czechia).

Until 2025, the company plans to optimize available capacities and resources reducing less ecological operations in Tábor and replacing them with more ecological heat from Planá nad Lužnicí. The plans also include the reconstruction of steam into hot water pipelines to reduce heat losses and gain other benefits. In February 2021, CE Energy Planá adopted the Planá 2025 strategy. Its goal, while maintaining competitiveness and affordability of heat, is to completely abandon coal combustion and reduce CO_2 emissions from the current 120,000 to 11,000 tons per year by 2025.

In 2025-2030, the vision of the company is to phase out coal and operate in a CHP mode aiming towards carbon neutrality. This goal will be met by replacing coal with wood chip boilers. The company

also considers energy recovery from municipal waste with an annual utilization capacity of waste of ca. 40 thousand tons/yr. This will allow utilizing all municipal waste produced in the Tábor region. The company also plans to increase the capacity of the battery storage to allow for even larger flexibility.

Recommendations for other heating plants

The case studies suggest the following lessons learned for similar heat producing installations:

Fuel diversification and flexibility is a key to optimize heating plant operations and reduce its costs. The diversification also makes it possible to reduce the sensitivity of heating plants to external shocks such as fuel price fluctuations, prices of emission allowances, and changes in the regulatory environment. For these reasons, financial intermediaries also prefer financing low carbon technologies instead of fossil fuels, and especially coal.

Fuel switch to natural gas is a short-term technological alternative, which may allow reducing emissions in a relatively cost-efficient and time-wise affordable way. However, the emission reduction is only 40-50% and in the future the installations may either be further upgraded to allow „greening gas" or other energy carriers with lower carbon content. In the short term, it may help achieve greater flexibility and ability to provide power balancing.

Biomass can only fully replace coal in small installations, for large installations long-term supply of sustainable biomass must be secured, which is highly challenging. Addressing heat demand in large urban areas would require a large amount of biomass that is rarely possible to produce in a sustainable manner nearby or that is rarely possible to deliver in a low carbon manner. Other renewable sources, such as heat from biogas, have also limited potential.

Energy recovery from waste is a win-win small-scale installation which may deliver sustainable and reliable energy supply and simultaneously address the needs of sustainable waste management. The realization of this approach could only be, however, realized in an agreement and cooperation with the nearby municipalities, for whom this concept shall be an element of their waste management strategy. The latter is not always possible due to other, conflicting interests.

Gas turbines and battery energy storage systems can significantly improve the flexibility of energy systems. Technologies which allow regulating electric power supply in a short time significantly contribute to the reliability of production and supply of electricity and heat.

The other way to make the system flexible is to provide energy services to customers. Whenever a retrofit of a heating plant takes place, it is useful to consider the future development of heat demand and supply. It is further useful to work on the reduction of peak demands and thus energy management of customers to avoid the need to address it through additional supply and/or storage.

The reconstruction of heat distribution is an important measure requiring significant investment, especially for the repair and reconstruction of steam distribution systems. Switching to heat distribution at lower temperatures may significantly reduce heat losses, as well as switching to hot water supply instead of steam. Sometimes, it is also beneficial to install a steam generator next to a customer instead of transporting steam for long distances.

The case studies illustrate that investment to extensively reconstruct both heat production and heat networks is high while required within a too short timeframe. Our case studies articulated that **addressing it is hardly possible without one-off investment support from subsidy programmes**.