Deutsche Umwelthilfe

Promoting Renewable District Heating

Seven Policy Recommendations

Seven political recommendations to promote renewable district heating:

1. Subsidies for renewable heat should be provided directly, without the detour via CHP subsidies. The level of support must vary according to the technology.
2. Generation of electricity and heat should be separated. Coupled generation in CHP plants keeps the fossil heat share unnecessarily high and prevents the use of renewable heat.
3. The technology of cogeneration should no longer be classified as "highly efficient" and promoted with this label. Renewable heat systems deliver greater efficiency.
4. The primary energy factor for district heating should be calculated using the so-called Carnot method. Current methods make fossil district heating appear climate-friendly only in mathematical terms and slow down investments into green heat and building insulation.
5. All subsidies for fossil heat, particularly for fossil CHP plants, must be abolished in order to end the economic disadvantage of green heat.
6. Municipalities should be required to plan heating systems in line with climate targets in order to initiate the conversion to green (district) heating where it makes sense to do so.
7. Governments should assess how best to provide third-party renewable heat providers access to heating grids. Heat generation and heat network operation should be unbundled.

Introduction

Green heat has so far played only a minor role in heat supply. This is also reflected in district heating. Only about 15 percent of district heating is renewable, and this share has been stagnating for years. Only about 1 percent - from geothermal and solar thermal energy or environmental heat - does not require fuels. Currently, 220 terawatt hours (TWh) of the German annual heating demand of about 1,330 TWh are provided via heating networks. 120 TWh of this flow into public heating networks.

An expansion of heating grids may well make sense under the right circumstances, such as sufficiently dense development or favourable renewable heat sources. In the long term, in any case, climate neutrality can only be achieved if district heating grids switch to renewable heat, replacing fossil heating systems.

District heating can offer advantages for the integration of sustainable heat. It allows different heat sources including industrial waste heat to be combined. Large seasonal storage facilities can also be integrated. This could make seasonal renewable heat such as solar thermal or ambient heat available all year round. This is often not possible close to buildings in densely populated urban areas, however. Whether district heating or individual heating systems are more appropriate for a given situation must always be decided on a case-by-case basis.

Clear targets have been formulated at the European level for climate-friendly district heating: According to the EU's RED II directive, countries should "aim" to increase the share of renewable energies in district heating by one percentage point each year from 2020 to 2030. The directive also includes waste heat. Germany has taken up this directive in the NECP, announcing its intention to achieve a 30% share of renewables in heating networks by 2030. This means that the current share of renewable district heating (14.5% in 2019) would have to be doubled. However, Germany is a long way from achieving this target with current measures. On the contrary, a survey conducted by DUH among hard-coal CHP operators in January 2021 revealed that natural gas is by far the predominant replacement fuel operators are planning to use after the coal phase-out. Renewable concepts for the conversion of district heating supply are the exception. The lack of economic viability of green heat is cited particularly frequently as the reason for this. The same problem exists in many EU countries, particularly in the CEE region where coal-based district heating is still common. The Nováky combined heat and power (CHP) plant in Slovakia, for instance, will close by 2023. It is currently planned to replace the coal-based heat generation it provides with fossil gas.

Without a doubt, renewable heating must become more economically competitive. However, there are a number of regulatory measures that can promote green district heating. Environmental Action Germany (DUH) makes seven recommendations to government that can make district heating a pioneer in decarbonizing building heat.

Direct subsidies for renewable district heating

District heating today comes mainly from combined heat and power (CHP) plants. In Germany, it is indirectly subsidized via the Combined Heat and Power Act (KWKG). Operating subsidies are paid for each kilowatt hour (kWh) of CHP electricity generated. Since CHP plants under the German CHP Act are usually operated with fossil fuels, fossil district heating also benefits from this. In addition, a bonus for the use of innovative renewable heat (iKWK) has recently been introduced (see Figure 1). If renewable heat is fed into the same heating network as the heat from a CHP plant, the CHP plant receives an extra bonus paid per kilowatt hour of electricity produced (!). This applies to new or modernized CHP plants. In order to receive subsidies for renewable heat, (fossil) CHP electricity and heat must always be produced as well.

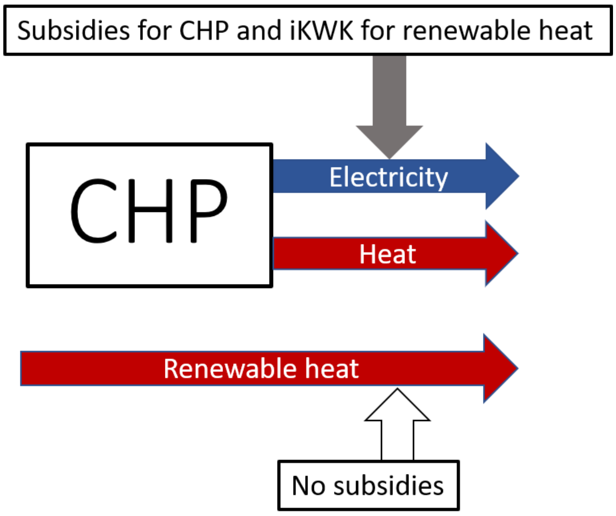

Figure 1: Current support system for cogeneration in Germany

This policy runs counter to climate targets. In order to achieve a complete decarbonization of district heating, renewable heat must be promoted directly, rather than as a byproduct of fossil electricity and heat production. This support must be technology-specific, rather than technology-neutral, in order to scale up the market for renewable heat generation technologies, as has been achieved for wind energy and photovoltaic systems. There should be no public subsidies for the use of waste heat, although it may be a sensible and economic solution under certain circumstances.

When promoting renewable heat, however, it must always be taken into account that promoting heat generation lowers incentives to reduce energy consumption through efficiency measures such as insulation. This is of great importance in the building sector, where investment cycles are particularly long. Misaligned incentives remain in place for decades. Buildings that are constructed or renovated today to a lower efficiency standard are highly unlikely to change by 2050. Promotion of renewable heat must not lead to a reduction in efficiency standards or obligations to renovate.

As an alternative to subsidizing renewable heat, fossil heat can be reduced by increasing financial burdens (e.g. CO_2 taxes or concession fees) and administrative hurdles (limits, regulatory requirements or bans). A strategy to make fossil heat less attractive would be a significant departure for the current German approach of providing financial support under the KWKG and the Electricity Grid Access Ordinance and administrative favouritism under the GEG, the Emissions Trading Act and municipal bylaws.

» **Subsidies for renewable heat should be provided directly, without the detour via CHP subsidies. The level of support must vary according to the technology.**

Separating generation of heat and electricity

72 percent of district heating is provided by CHP plants, which are primarily financed by electricity production. Public subsidies in Germany and elsewhere are paid per kWh of electricity produced. Throttling electricity and thus heat production when the supply of renewables is high is not in the interest of the power plant operator and must be incentivized at great expense.

In order not to compete with renewable electricity during a heating day, CHP plants are combined with heat storage units, for which there is also a subsidy in Germany. In these units, the CHP electricity is converted into heat and stored. However, this is fossil heat which competes with renewable heat in the market. The subsidy for CHP storage is thus a subsidy for fossil heat.

Conventional fossil CHP plants in Germany usually are designed for high full load hours because producing electricity 24 hours every day technically speaking is the most efficient operation mode for transforming primary energy input into electricity and heat. Operating CHP plants flexibly means that, at times, they do not run under optimal operating conditions. Storage additionally increases energy losses, leading to an even higher CO_2-footprint of CHP plants with storage facilities.[1] Together with the energy losses due to storage, this leads to reduced efficiency and higher CO_2 emissions from CHP-generated heat. The very basis of CHP support - efficiency - is lost as a result. As such, combined generation of electricity and heat from fossil fuels leads to inefficiencies and an increase in CO_2 emissions in an energy system that should increasingly integrate renewable electricity and renewable heat.

With separate generation can better provide the residual load and it is not a detriment to efficiency in this regard. The following example highlights that separate generation in combination with renewable heat technologies can achieve an overall higher efficiency than a single CHP plant. Simple gas turbines combined with electric heat pumps can generate more heat, and with a lower climate impact, than "high-efficiency" CHP (Figure 2).

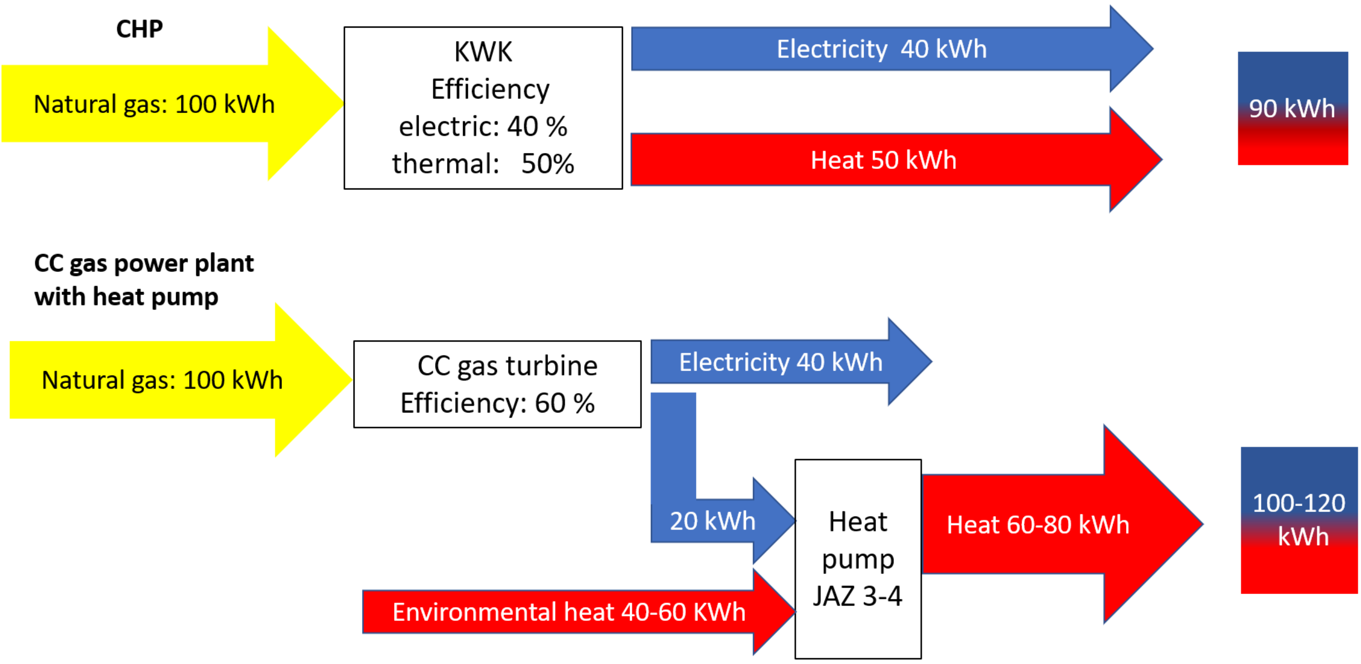

Figure 2: Efficiency comparison between CHP and CCGT (own illustration, after Luther[2]

The efficiency of a small CHP plant can reach 90 percent under optimal operating conditions. Practical values are sometimes well below this; often as low as 60 percent. An uncoupled gas turbine (gas and steam, CCGT) has an efficiency of about 60 percent, but generates more electricity from the same amount of primary energy than the CHP plant (60 kWh instead of 40 kWh). If this electricity is used in a heat pump, the energy production of the CCGT can be increased by the contribution of environmental heat. 100 kWh from natural gas delivers a maximum of 90 kWh electricity/heat in a CHP plant, while 100-120 kWh electricity/heat can be achieved with a CCGT plus a heat pump. This works even in periods without wind or sun, where solar and wind energy production are constrained. Thus, with separate generation and a

[1] This is no argument against storage per se – a renewables-based heating system will need to rely on large-scale heat storage and some efficiency losses will necessarily go along with that. Contrary to fossil-based heat storage, these losses do not lead to additional CO_2 emissions, however.

[2] Luther, Gerhard; Bruhns, Hardo (2020): Wärmepumpe versus Kraft-Wärme-Kopplung, In: Deutsche Physikalische Gesellschaft, Physik konkret Nr. 49

downstream heat pump, more district heat can be generated, some of which is already renewable, and the system is more efficient overall.

In addition, CCGT-produced electricity can easily be replaced by renewable power in a competitive electricity market. As the share of renewable electricity increases, the CO_2 emissions of the system will then decrease even further. CO_2 emissions of electricity-based heat thus fall along with CO_2 emissions from power production. In the case of heat generation by CHP, CO_2 emissions remain at the same level or are even increased by heat storage.

The separate generation of electricity and heat makes room for renewable energy - both in the electricity and heat sectors. In this way, CO_2 emissions from district heating can be reduced continually.

» **Generation of electricity and heat should be separated. Coupled generation in CHP plants keeps the fossil heat share unnecessarily high and prevents the use of renewable heat.**

Eliminating the "high-efficiency cogeneration" eligibility criterion in EU Energy Efficiency Directive and State Aid Guidelines

In the EU's Energy Efficiency Directive (EED), support for CHP is justified on the grounds of better energy efficiency compared with the separate generation of electricity and heat. According to the directive, a large CHP plant must have 10 percent better fuel efficiency than comparable separate generation to be considered "highly efficient." For smaller CHP plants, the requirement is even lower. Based on this definition, massive subsidies for CHP plants are approved under the EU's State Aid Guidelines, even though the heat network into which they feed heat has losses averaging over 10 percent, negating the 10 percent efficiency improvement classified as "highly efficient". EED and EU state aid rules make possible billions of euros in national subsidy programs that reward municipal utilities and industry for maintaining fossil fuel-based district heating systems.

In the heating market, this results in a preferential treatment of CHP district heating. Renewable district heating as well as building-specific heating must compete with highly subsidized fossil CHP. This puts individual heating systems at a price disadvantage, even if they are just as efficient due to the lack of transmission losses. The fact that individual heating systems in Germany can also receive a small investment subsidy does not change this.

The slight increase in the energy efficiency of the CHP system is not an appropriate condition for subsidies because it is completely negated by grid losses. The EED approach to determine efficiency improvements by only comparing fuels within the same category (e.g. gas CHP with gas turbines or coal CHP with coal boilers) also falls short. Systems with a renewable energy share are significantly more efficient in terms of primary energy and climate impact and must be included in such comparisons (see Fig. 2).

The term "highly efficient" should therefore be abolished with regard to CHP and the subsidies schemes based on it by member States should be discontinued. Instead, renewable heat must be promoted directly, without the detour via CHP, if such support is not made superfluous by a comprehensive abolition of subsidies for fossil electricity and heat generation.

» **The technology of cogeneration should no longer be classified as "highly efficient" and promoted with this label. Renewable heat systems deliver greater efficiency.**

The primary energy factor as a disincentive for district heating

The primary energy factor (PEF) was created to take into account energy losses between the (fossil) energy put into the system and the final energy it puts out. The PEF set for different fuels play an important role in energy balances of buildings according to the Energy Performance of Buildings Directive (EPBD). Comprehensive regulations exist for this purpose, e.g. in Annex 4 of the German Building Energy Law (GEG). For example, energy from coal has a PEF of 1.1, which means that about 10 percent of the energy used is lost. These losses must be taken into account in the overall energy balance. For electricity, the factor is currently 1.8, since electricity generation is associated with greater energy losses. However, this factor has already been lowered several times to account for the increasing share of renewable electricity. Heat from geothermal energy, solar thermal energy or environmental heat is attributed a PEF of 0.

Surprisingly, the PEF of (fossil) district heating is quite low, set at a minimum of 0.3. This is already a small improvement, as even negative PEFs were used for fossil district heat in the past. In this accounting, district heating seems to use almost no fossil fuels whatsoever. How is this possible, when the majority of CHP plants use such fuels?

The reason is a calculation trick employed in German regulation. The energy losses between primary and final energy are almost completely added to the electricity produced in CHP plants, so that almost no fossil energy is used for the heat, and the PEF for fossil district heating is almost zero. This calculation method is referred to as the "electricity credit method" (*Stromgutschriftmethode*). It makes district heating appear more environmentally friendly than it currently is. While the PEF for fossil district heating is exceptionally low in Germany, the PEF applied in different EU Member States for fossil CHP is usually below 1.

A low primary energy factor is a competitive advantage for district heating operators in the heating market. It also lowers incentives of district heating systems operators to integrate renewable heat. PEF calculation methods such as the one used in Germany thus present an obstacle to green district heating.

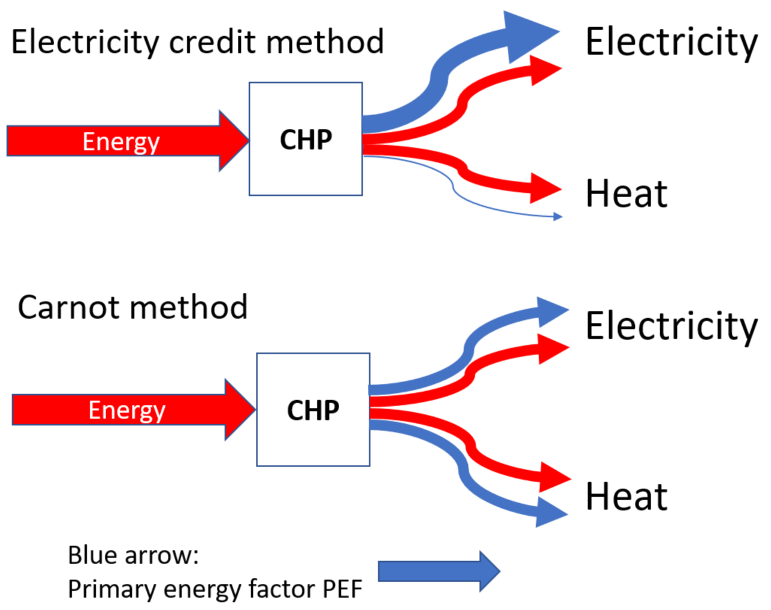

Figure 3: Allocation of primary energy factors to electricity and heat under different methods

The low PEF for fossil district heating also leads to another problem: If a homeowner decides to connect to district heating in a new building, they can achieve the “nearly zero-energy” standard required by the EPBD even with lower insulation values. For these buildings, this triggers decades of avoidable additional energy demand, as wrong investment decisions in the construction of new buildings are locked in for decades under “grandfathering” provisions.

The so-called Carnot method should thus be applied to calculate PEF. In the Carnot method, the energy losses between primary and final energy are attributed to heat and electricity according to where they arise. District heating from CHP plants would thus receive a higher PEF, which would stimulate the development of green heat in the district heating sector.

Under the current system, Member States are free to set PEF that give an advantage to CHP, and they will likely continue to do so for the foreseeable future unless EU regulation specifies otherwise. It is unclear whether the Commission will change its approach to allow national governments to set PEFs flexibly in the upcoming EPBD and EED revisions. In Germany, for instance, the GEG only foresees a revision of PEF calculation methods in 2025, with an implementation deadline of 2030.

This is too late and wastes valuable time, particularly since significant additional funds will flow into the building and heating sectors in the context of post-Corona stimulus programs. PEF calculation methods must be revised as early as possible so as not to hold back the development of renewable district heating.

» **The primary energy factor for district heating should be calculated using the so-called Carnot method. Current methods make fossil district heating appear climate-friendly only in mathematical terms and slow down investments into green heat and building insulation.**

Ending fuel fossil subsidies

One of the most promising measures to accelerate the growth of renewable district heating is to end fossil fuel subsidies, creating a level playing field for renewable heat. This includes CHP subsidies in particular, since CHP plants mainly rely on fossil fuels. Many EU countries have put in place subsidy schemes for CHP district heating building on the eligibility criterion in the EED. Germany, for instance, provides the following subsidies (Table 1):

Table 1: Subsidies from the KWKG 2020 and the Electricity Grid Charges Ordinance, own calculations

A **basic bonus** is paid for each electrical kWh generated, depending on plant size, up to a maximum of 30,000 operating hours. This amounts to 8 cents/kWh for plants below 50 kW and 3.1 cents for plants larger than 2 MW. The fuel used is irrelevant.	**930 to 2,400 €/kW**
An additional 0.3 cents/kWh are paid to compensate for the purchase of **CO_2 emission allowances** (required for plants larger than 2 MW).	**90 €/kW**
A one-off bonus of €5 to 390/kW is paid for **switching from coal to other fuels**, depending on the date of commissioning.	**5 to 390 €/kW**
In each year of operation, a CHP plant can receive a **payment for avoided grid charges** according to the regulation of power grid charges (*Stromnetzentgeltverordnung*). The subsidy was calculated here for 10 years, which applies to new plants connected to the grid until 31.12.2022.	**400 to 1,000 €/kW**
Total subsidies:	**1,425 to 3,880 €/kW**

These payments are far higher than the investment costs of CHP plants and they also cover part of the fuel costs. Additional subsidies are available for the construction of heat storage facilities and district heating networks.

It should be noted that these subsidies, which are paid for what is essentially fossil-fuel electricity and heat provision, are far higher than the subsidies e.g. for wind turbines. Small plants covered by the Effort Sharing Regulation (ESR) do not receive compensation.

CHP and fossil district heating are neither efficient nor climate-friendly enough to warrant such massive subsidies. In terms of both efficiency and CO_2 avoidance costs, clearly superior systems with renewable components are available. The current approach of setting climate targets while subsidizing fossil plants that torpedo exactly these targets is nonsensical and lacks any coherent vision. Renewable heat is not yet economically competitive because fossil heating receives massive subsidies while CO_2 pricing for heat provision is too low, as in Germany, or nonexistent, as in many other EU countries. As a result, new district heating plants that are currently being planned still rely predominantly on fossil fuels.

» **All subsidies for fossil heat, particularly for fossil CHP plants, must be abolished in order to end the economic disadvantage of green heat.**

Introducing obligatory heat systems planning at the municipal level.

Municipalities have to take far-reaching decisions to convert today's predominantly fossil-based municipal district heating to renewable heat. The decisions are complex and require forward-looking planning. For example, municipalities must determine in which areas a heating network makes sense and where building-specific heating is a better solution. Waste heat sources need to be identified and land for renewable heat secured. Renewable heat needs space; however, municipal land use plans so far do not include such a category.

Heat planning on the municipal level is necessary in order to assess all these requirements fully and find the best solutions for specific local circumstances. Long-term heat planning is essential to avoid lock-in effects and bad investment decisions. However, only a few municipalities have dedicated planning processes for heating in place. Municipal heat systems planning that is geared to climate targets should be made a legal requirement for municipalities. It is needed to unlock potentials for renewable district heating and chart a path towards decarbonization.

It must also be ensured that municipalities have no economic interest in the expansion of fossil heating supply. Part of the high subsidies for CHP and district heating currently end up in municipal budgets, where they finance projects like swimming pools and cultural facilities. This results in problematic incentives for municipal decision-makers, which can influence them to decide in favour of fossil energies in urban land use planning, municipal heating statutes and many other administrative decisions.

» **Municipalities should be required to plan heating systems in line with climate targets in order to initiate the conversion to renewable (district) heating where it makes sense to do so.**

Examining feed-in rights for heating networks

Unlike in electricity and gas markets, there is no unbundling of heat generation and grids for heating networks. District heating networks are regularly operated by the companies that also provide the heat. This concerns mainly CHP plants that produce electricity and heat and use the network as a heat sink. Heating customers who have opted for district heating once have no influence on the heat source and cannot change the heat provider.

Technically, it is possible to integrate other heat generators into the network, and in some cases this is done. However, the heat network operator decides whether to allow this. In Germany, the innovative renewable heat (iKWK) bonus also benefits the CHP plant operator and cements its dominant role in the heating grid. Legislators have attempted to incentivize the integration of renewable heat into CHP district heating networks via the CHP Act. So far, with little success.

To encourage priority use of sustainable district heating, heating networks would have to be opened up to other heat providers where this is technically feasible. The non-discriminatory access in the unbundled electricity and gas networks could be used as a model here. Competition law could also be used to introduce such a requirement. A feed-in priority for green heat is another policy option.

The Renewable Energy Directive (EU Directive 2018/2001, RED II: Article 24(4)(b)) also opens up the possibility: "... that operators of district heating or cooling systems are obliged to connect suppliers of energy from renewable sources and from waste heat and cold."

We call for consideration of non-discriminatory market access for renewable heat providers. In many cases, this would help achieve sustainable district heating more quickly. Heat generation and heat network operation should be unbundled to allow easier access for sustainable alternatives to fossil heat.

» **Governments should assess how best to provide third-party renewable heat providers access to heating grids. Heat generation and heat network operation should be unbundled.**

Conclusion

The heating transition is an indispensable building block to achieve climate neutrality. The long investment cycles in this area, coupled with the high risk of carbon lock-in, make it particularly important to act quickly. This also applies to district heating. Germany and the EU must urgently abandon the complex system of subsidies in favour of fossil heat that is currently in place. The revision of the EU Energy Efficiency Directive is a key legislative opportunity in this regard. In parallel, Germany and other EU Member State should address misaligned incentives skewing decisions in favour of fossil heat and adopt policies to promote a complete transition to renewable heat.

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