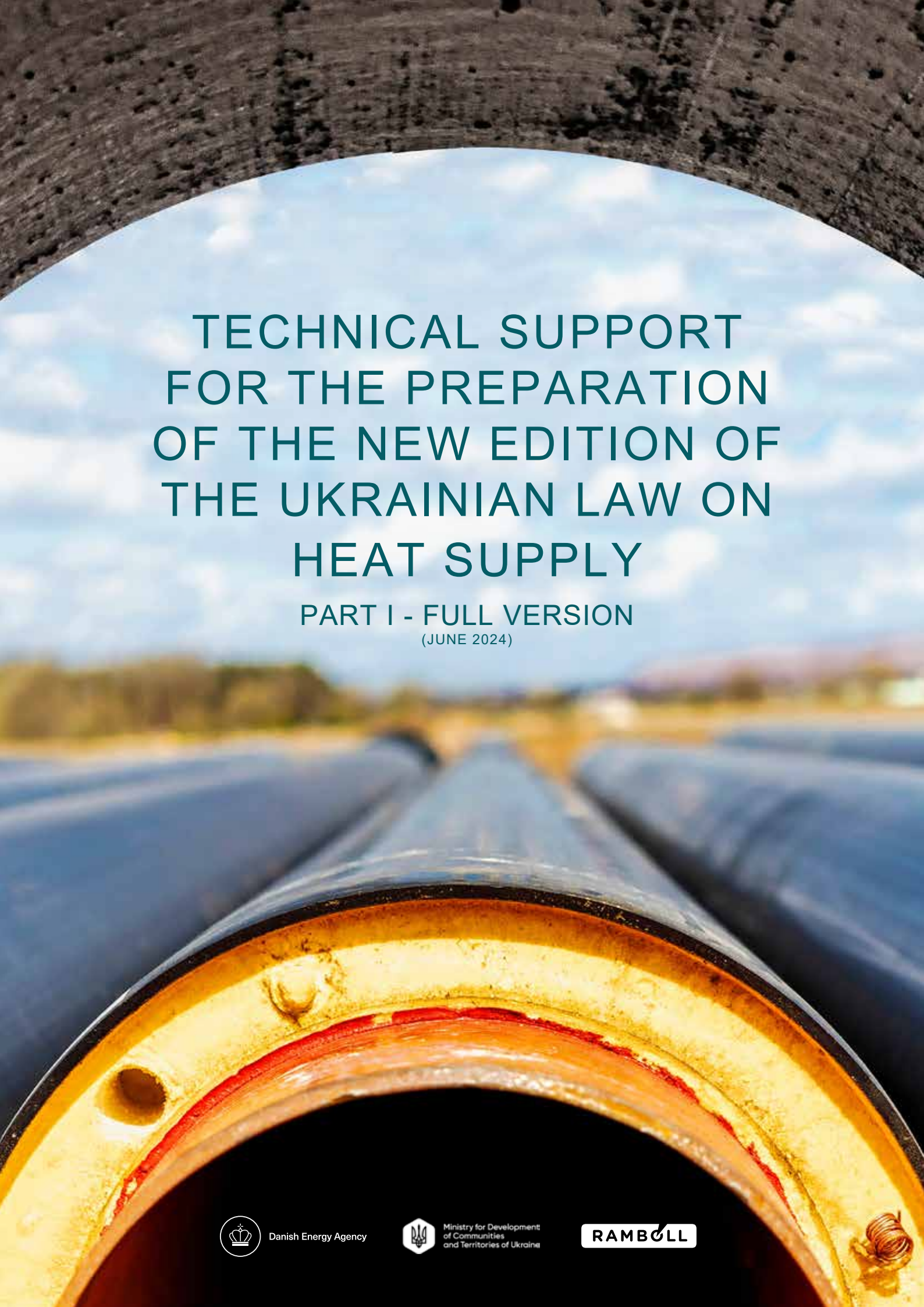

TECHNICAL SUPPORT FOR THE PREPARATION OF THE NEW EDITION OF THE UKRAINIAN LAW ON HEAT SUPPLY

PART I - FULL VERSION

(JUNE 2024)

Danish Energy Agency

Ministry for Development of Communities and Territories of Ukraine

RAMBØLL

Project name:

Technical support to align Ukraine's heat supply regulation with EU directives

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Report I provides an overview of the Ukrainian district heating sector, institutional roles, regulatory framework and main challenges and provides technical support for the preparation of the new version of the Ukrainian law "On Heat Supply" in compliance with the EU Energy Efficiency Directive.

Executive summary

Efficient heating and cooling are critical to Ukraine's energy sector, especially given the country's heavy reliance on imported natural gas and aging infrastructure. The challenges are significant, including energy security risks, inefficiencies, and financial constraints. However, there is significant scope for improvement through the integration of renewable energy, energy efficiency upgrades, supportive policies, and international aid. By tackling these challenges and taking advantage of these opportunities, Ukraine can significantly improve the efficiency of the heat supply and cooling sector, reduce emissions, and improve energy security.

District heating systems are widespread in Ukraine, especially in urban areas and serve a significant part of the population. The primary fuel for district heating is natural gas, but there is also some use of coal, biomass, and waste heat. Gas-fired cogeneration is a key component in major district heating systems.

The cooling sector in Ukraine is much less developed compared to the heating sector, with fewer buildings equipped with centralized cooling systems. Integrated systems of centralized district heating and district cooling systems do not exist, although there is a need for more centralized and efficient cooling solutions in urban areas together with existing district heating.

Upgrading the district heating network with modern, efficient technologies can reduce energy losses and improve system performance in accordance with the European Union Energy Efficiency Directive (EED). However, there is also a considerable economic and environmental potential in expanding the use of biomass and biogas in district heating and for cogeneration, which will also reduce dependence on natural gas. Centralized solar heating systems as well as solar PV and wind power combined with centralized heat pumps and electric boilers have also a huge potential as renewable energy source for district heating.

In principle, the Ukrainian green tariff on electricity generation promotes both renewable power-only generation and cogeneration, but most of the investments have been in power-only projects such as solar PV and wind and electricity-only biomass. The green tariff can just as well support combined heat and power (CHP) projects that use e.g., biomass and biogas, in line with Ukraine's goals for energy efficiency and expansion of renewable energy, but appears to face a barrier in developing such projects in cooperation with district heating companies that deal with huge technical and financial challenges.

When comparing with Poland, efficient district heating in accordance with the EED is also essential in Poland to reduce energy consumption, lower emissions and improve energy security. While the country faces significant challenges, particularly with its dependence on coal and aging infrastructure, there are also significant opportunities to improve efficiency and integrate renewable energy sources. Addressing these challenges requires significant investments, which is also a huge challenge. However, Polish district heating companies are generally in much better financial shape than their Ukrainian counterparts due to a combination of factors, including:

- More stable and supportive regulatory environment.
- Higher profitability and better managed tariff structures.
- Greater access to domestic and EU funding, despite also challenges in Poland.
- More modern and efficient infrastructure in Poland, supported by ongoing investments.

Compared to Denmark, efficient district heating in accordance with the EED is almost fully developed in Denmark and the modern approach of realizing the potential of sector coupling to increase energy efficiency, reduce energy consumption and lower emissions, is ongoing. While Ukrainian district heating companies struggle with profitability problems and limited access to financing, the Danish district heating companies are generally financially stable and have heat tariffs set to cover the necessary costs, including investments in infrastructure, especially in often investment-heavy renewable energy solutions, where access to favorable loan opportunities through municipal loan guarantees is supportive.

When comparing the transposition of the EED into national laws and regulations, it is not higher in Denmark than in Poland. In Poland, however, there is a gap between the transposition of the EED into national legislation and its practical administrative implementation into the heating and cooling supply sector. Where strong legislative support for district heating and cooling has been realized in Denmark - encouraging energy efficiency, integration of renewable energy and consumer protection - Poland faces different challenges, mainly due to the need for significant financial resources.

The transposition of the EED into the national legislative and regulatory framework is less implemented in Ukraine than in Poland and Denmark, largely in relation to the much severe economic challenges in the Ukrainian heat supply sector. Ukraine has already extensive legislation governing the heat supply sector - and the energy sector in general. The central act for the heat supply sector, the law of Ukraine on heat supply, defines the basic legal, economic, and organizational principles of activity at heat supply facilities. Moreover, it regulates subjects related to the production, transportation, supply, and use of heat energy to ensure the energy security of Ukraine, increase the energy efficiency of heat supply systems, create and improve the heat energy market, and protect the rights of consumers and workers in the heat supply sector.

However, it seems limited how the objectives of the heat supply act of "increase the energy efficiency" and "create and improve the heat energy market" are followed up legislatively and in practical administrative implementation.

In several areas, extensive adjustment of Ukrainian legislation is underway to comply with the EU directives, primarily the EED, but also the Energy Performance of Buildings Directive (EPBD) and the Renewable Energy Directive (RED). However, practical administrative implementation based on limited financial means is one of the main challenges. This includes the need for capacity building within central and local authorities and other relevant stakeholders, including updating technical guidelines and staff training.

With this introduction to challenges and opportunities, the main aim of this report is to provide an overview of the Ukrainian district heating sector, institutional roles, regulatory framework, and the main challenges to comply with the EED. In addition, the report aims to provide technical support for the preparation of the new edition of Ukraine's heat supply act in accordance with the EED.

By including legislation related to the EED in Denmark and Poland, in addition to matters relating to the Danish and Polish heat supply and cooling sectors, the supplementary aim of the report is to create inspiration and insight for the Ukrainian counterpart.

Lastly, six recommendations are provided for Ukraine's heating sector to comply with EU legislation, especially the Energy Efficiency Directive (EED):

- Regulatory Framework Enhancement
- Reform of Tariff Design and Structure
- Integration of Heat Planning with Urban Planning
- Promotion of Cost-Effective and Sustainable Heat Supply
- Strengthening the Investment Environment
- Enhancing Consumer Protection and Information

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1. Legal Framework in Ukraine

Ukrainian legislation in the field of heat supply is quite extensive. It regulates various aspects of heat supply in Ukraine: state regulation (licensing, tariff regulation) of district heating companies, contractual relations between district heating companies and consumers, energy efficiency requirements, commercial heat metering and billing, etc. It includes both legal acts directly related to heat supply (such as the Law on Heat Supply) and acts regulating broader/other areas that have an impact on the operation of DH companies (such as the Tax Code of Ukraine). In the heat supply sector, both laws adopted by the Verkhovna Rada of Ukraine and bylaws adopted by the Cabinet of Ministers of Ukraine, ministries and the National Energy and Utilities Regulatory Commission (NEURC) play an important role.

In the table below, we provide a list of legal acts that regulate the heat supply sector in Ukraine in one way or another. According to our assessment, we sorted them by level (laws first, then bylaws), by relevance (more relevant first) and by logical connection between the acts (interconnected acts one next to other).

Table 1: Selected primary and secondary legislation in the Ukrainian heating sector

Name of the Law	Number and Date	Subject/Impact
Law of Ukraine on Heat Supply	No. 2633-IV dated June 2, 2005	The Law defines the basic legal, economic, and organizational principles of activities at heat supply facilities and regulates relations associated with the production, transportation, supply, and use of heat energy. This is the basic/framework law in the field of heat supply.
Law of Ukraine on Housing and Public Utility Services	No. 2189-VIII dated September 9, 2017	The Law regulates relations arising in the process of providing consumers with services for the management of apartment building, supply of heat energy, supply of hot water, centralized water supply and sewerage, household waste management. Furthermore, it regulates relations arising in the process of providing services for the supply and distribution of electricity and natural gas to consumers in residential buildings.

Law of Ukraine on Commercial Metering of Heat Energy and Water Supply	No. 21119-VIII dated June 22, 2017	The law establishes principles for ensuring commercial metering of heat energy, hot water, and centralized water supply services, and it mandates that consumers receive relevant accounting information. It requires mandatory commercial metering of heat and water supply. Operators of external engineering networks that were either not equipped with metering units or had non-functional units at the time the law came into force must equip buildings with commercial metering units within 24 months after the termination or lifting of martial law in Ukraine.
Law of Ukraine On The Peculiarities Of Regulating Relations In The Natural Gas Market And In The Field Of Heat Supply During Martial Law And The Subsequent Restoration Of Their Functioning	No. 2479-IX dated July 29, 2022	The law prohibits raising tariffs for heat energy, heat energy supply services and hot water supply for the population (households) during martial law and six months after it.
Law of Ukraine on Local Self-Government in Ukraine	No. 280/97-BP dated May 21, 1997	The law is important for the heat supply sector, in particular, because it defines local self-governments' powers and responsibilities for public utilities provision, tariffs setting, constructing and operating urban infrastructure (including heat networks), managing municipally owned enterprises.
Law of Ukraine on Licensing of Types of Business Activities	No. 222-VIII dated March 2, 2015	The law is relevant for the heat supply sector because it stipulates that the production of heat energy, the transportation of heat energy through main and local (distributive) heating networks and the supply of heat energy are subject to licensing.

Law of Ukraine on State Regulation in Public Utilities Sector	No. 694/2014 dated August 27, 2014	The law defines the legal framework for state regulation in the field of public utilities. It is important for the heat supply sector, in particular, because it regulates the issues of tariff formation / tariff setting, applying tariffs, licensing, developing investment program.
Law of Ukraine on National Energy and Public Utilities Regulatory Commission	No. 1540-VIII dated September 22, 2016	This law defines the legal status of the National Energy and Public Utilities Regulatory Commission, its tasks, functions, powers and the procedures for their implementation. It is relevant for the heat supply sector, in particular, because it regulates some aspects of licensing, tariff setting and approving investment programs.
Law of Ukraine on Key Fundamentals of State Oversight (Control) in Business Activities	No. 877-V dated April 5, 2007	The law defines the legal and organizational framework, basic principles and procedures for state supervision (control) over business entities. It is relevant for the heat supply sector, in particular, because it regulates some aspects of licensing.
Law of Ukraine on Natural Monopolies	No. 1682-III dated April 20, 2000	The law sets out the principles of state regulation of natural monopolies, which include heat supply companies. Among the principles are the principle of self-sufficiency of natural monopolies and the principle of increasing the efficiency of business entities in related markets in the field of combined heat and power production using incentive regulation.
Law of Ukraine on Regulation of Urban Development	No. 3038-VI dated February 17, 2011	The law establishes the legal and organizational framework for urban development. It is important for the heat supply sector, in particular, because it regulates the zoning of urban development and the issuance of technical conditions for connection to engineering (including heating) networks.

Law of Ukraine on Energy Efficiency	No. 1818-IX dated October 21, 2021	The law defines the legal, economic, and organizational framework for energy efficiency in the production, transportation, transmission, distribution, supply and consumption of energy. The law is important for the heat supply sector, in particular, because it legally determines what effective heat supply is, obliges local self-governments to develop heat supply schemes on the most economically effective scenario, introduces energy service contracts, etc.
Law of Ukraine on Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential	No. 2509-IV dated April 5, 2005	The law defines the legal, economic, and organizational framework for the use of cogeneration plants, regulates relations related to the peculiarities of production, transmission, distribution and supply of electricity and heat from cogeneration plants. Inter alia, the law is aimed at creating conditions for the development of high-efficiency cogeneration in Ukraine in compliance with the EED. The implementation of the Law's provisions ensures: - reorganization of existing heat generating facilities into highly efficient cogeneration plants and economic incentives for the use of highly efficient cogeneration units at enterprises regardless of ownership and industry. - qualification of a cogeneration unit by introducing a condition that qualified cogeneration units must be high-efficiency cogeneration units, i.e., provide primary energy savings of at least 10% through combined heat and power production compared to separate production of electricity and heat.

		- issue of guarantees of origin of electricity produced based on the agreed benchmark efficiency of a high-efficiency cogeneration unit.
Law of Ukraine on Alternative Energy Sources	No. 555-IV dated February 20, 2003	The law defines the legal, economic, environmental, and organizational framework for the use of alternative energy sources and the promotion of their use in the fuel and energy complex. For the heat supply sector, this law is important, in particular, because it defines what constitutes alternative energy sources.
Law of Ukraine on Alternative Fuels	No. 1391-XIV dated January 14, 2000	The law defines the legal, social, economic, environmental and organizational principles of production (extraction) and use of alternative fuels. For the heat supply sector, this law is important, in particular, because it defines what constitutes alternative fuels.
Tax Code of Ukraine	No. 2755-VI dated December 2, 2010	The code defines the list of transactions that may be carried out regarding tangible and intangible assets used for the purpose of generating income.
Law of Ukraine on Public Procurement	No. 922-VIII dated December 25, 2015	The law defines the legal and economic principles of public procurement. For the heat supply sector, this law is important, in particular, because it makes public procurement procedures obligatory for the municipally- and state-owned companies who generate, transport or supply heat energy.
Law of Ukraine on Privatization of State and Communal Property	No. 2269-VIII dated January 18, 2018	The law prohibits the privatization of municipally- and state-owned engineering infrastructure of cities, including networks, structures and equipment related to the supply of water, gas, heat, wastewater disposal and treatment.

Law of Ukraine on Prices and Pricing	No. 5007-VI dated June 21, 2012	The law outlines the primary directions of the state pricing policy and defines the powers of the Cabinet of Ministers of Ukraine and local governments in pricing matters. It also addresses public administration in pricing, state pricing policy for natural monopolies and related markets, and provides social guarantees for the population in the event of price increases.
The Rules for Use of Heat Energy	Approved by the Resolution of the Cabinet of Ministers of Ukraine No. 1198 dated October 3, 2007	The rules define the relationship between heat supply organizations and heat consumers, including the issues of connection and disconnection from heat networks, certain issues of payments for heat energy, etc.
The Rules for Setting Tariffs for Heat Energy, Its Production, Transportation and Supply	Approved by NEURC* resolution No. 1174 dated June 25, 2019	The resolution outlines the mechanisms for calculating tariffs for heat energy, including its production, transportation, and supply, specifically for natural monopolies and business entities licensed by the NEURC. It does not apply to tariffs for heat energy production by combined heat and power stations, heat power plants, nuclear power plants, co-generation autonomous heating systems, or installations using alternative energy sources.
The Procedure for Setting Tariffs for Heat Energy, Its Production, Transportation and Supply	Approved by NEURC* resolution No. 528 dated March 31, 2016	The resolution outlines the procedures for calculating tariffs for heat energy, including its production, transportation, and supply, specifically for natural monopolies and business entities licensed by the NEURC. It does not apply to the formation of tariffs for heat energy production by combined heat and power stations, heat power plants, nuclear power plants, co-generation autonomous heating systems, or installations using alternative energy sources.

Procedure for Development, Coordination, Approval, and Implementation of the Investment Programs of Business Entities in the Heat Supply Sector	Approved by NEURC* resolution No. 1059 dated August 31, 2017	The procedure establishes a mechanism for developing, approving, coordinating, confirming, and implementing investment programs for business entities in the heat supply sector. This mechanism determines the validity of their planned investments and expenses in the investment component of heat tariffs, which are set on principles of economic feasibility, including incentive regulation and the targeted use of funds. This procedure does not apply to the approval of borrowings from international financial organizations for financing measures aimed at: - Renewing fixed assets - Improving production efficiency - Ensuring accounting of natural and energy resources - Increasing sales volumes of services - Optimizing technological costs and heat losses - Enhancing service quality and production organization These measures, which affect tariff components, are excluded from this procedure.
Procedure for Setting Tariffs for the Transportation of Heat Energy by Main and Local (Distribution) Heating Systems on the Principles of Incentive-Based Regulation	Approved by NEURC* resolution No. 964 dated July 27, 2017	The procedure establishes a mechanism for setting tariffs for the transportation of heat energy by main and local (distribution) heating networks. This mechanism is based on principles of incentive regulation for natural monopolies engaged in, or intending to engage in, economic activities related to heat energy transportation. These activities must be licensed by the NEURC. Translated with DeepL.com (free version)

NEURC* Resolution on Establishing the Regulatory Rate of Return on the Non-Regulatory Asset Base for Entities Carrying Out Economic Activities for the Transportation of Heat Energy by Main and Local (Distribution) Heating Systems	No. 965 dated July 27, 2017	Establishes the Regulatory Rate of Return on the Non-Regulatory Asset Base for Entities Carrying Out Economic Activities for the Transportation of Heat Energy by Main and Local (Distribution) Heating Systems at 12.50% (after taxation).
Procedure for Determining the Regulatory Base of Assets of Natural Monopolies Carrying Out Economic Activities for the Transportation of Heat Energy by Main (Distribution) Heat Systems	Approved by NEURC* resolution No. 966 dated July 27, 2017	The procedure establishes a mechanism for determining the regulatory asset base of NEURC licensees, groups of assets included in the regulatory asset base, their useful life, and depreciation methods for calculating the required income from the conduct of economic activities in the field of heat energy transmission on the principles of incentive regulation.
Procedure for Setting Tariffs for the Transportation of Heat Energy by Main and Local (Distribution) Heating Systems on the Principles of Incentive Regulation	Approved by NEURC* resolution No. 967 dated July 27, 2017	The procedure establishes a mechanism for setting tariffs for the transmission of heat energy by main and local (distribution) heating networks (hereinafter referred to as heat energy transmission) based on incentive regulation for natural monopolies that carry out (intend to carry out) economic activities in the field of heat energy transmission and whose activities are licensed by the NEURC.
Methodology for the Formation, Calculation and Setting of Tariffs for Electricity and (or) Heat Produced at Combined Heat and Power Stations and Co-Generation Plants	Approved by NEURC* resolution No. 991 dated August 1, 2017	The methodology outlines the mechanism for forming, calculating, and setting tariffs for electricity and/or heat. It applies to business entities engaged in producing electricity and/or heat at combined heat and power plants (CHP), thermal power plants, and cogeneration plants, including those using alternative energy sources. These entities must be licensed by the NEURC.

Rules for the provision of heat supply services	Approved by the Resolution of the Cabinet of Ministers of Ukraine No. 830 dated August 21, 2019	The rules regulate the relations between a business entity engaged in heat supply activities (contractor) and an individual and collective consumer (consumer) who receives or intends to receive heat supply services (service) and determine the quality requirements, units of measurement of the volume of heat consumed by the consumer, and the payment procedure.
Procedure for Setting Tariffs for Heat Energy, its Production, Transportation and Supply, Heat Energy and Hot Water Supply Services	Approved by the Resolution of the Cabinet of Ministers of Ukraine No. 869 dated June 1, 2011	The resolution outlines the mechanisms for calculating tariffs for heat energy, including its production, transportation, and supply by heat supply companies that are not licensed by the NEURC. This procedure applies to local governments establishing tariffs for heat energy, its production, transportation, and supply, as well as heat energy and hot water supply services for natural monopolies and business entities in related markets. It does not apply to tariffs for heat energy production by combined heat and power stations, heat power plants, nuclear power plants, or co-generation plants.
Methodology for the distribution among consumers of the volumes of utilities consumed in the building	Approved by the order of the Ministry of Regional Development No. 315 dated November 22, 2018	The methodology outlines the procedure for distributing the consumption of heat energy, hot water, and centralized water supply services among consumers in a building or house. It determines the volume of consumption using a commercial metering unit or calculates it in cases of absence, temporary failure, or loss. For centralized sewage services, the consumption volume is determined based on the consumption of other utilities.

* National Energy and Utilities Regulatory Commission

Based on monitoring results as of February 20, 2024, the number of buildings equipped with the necessary facilities is as follows:

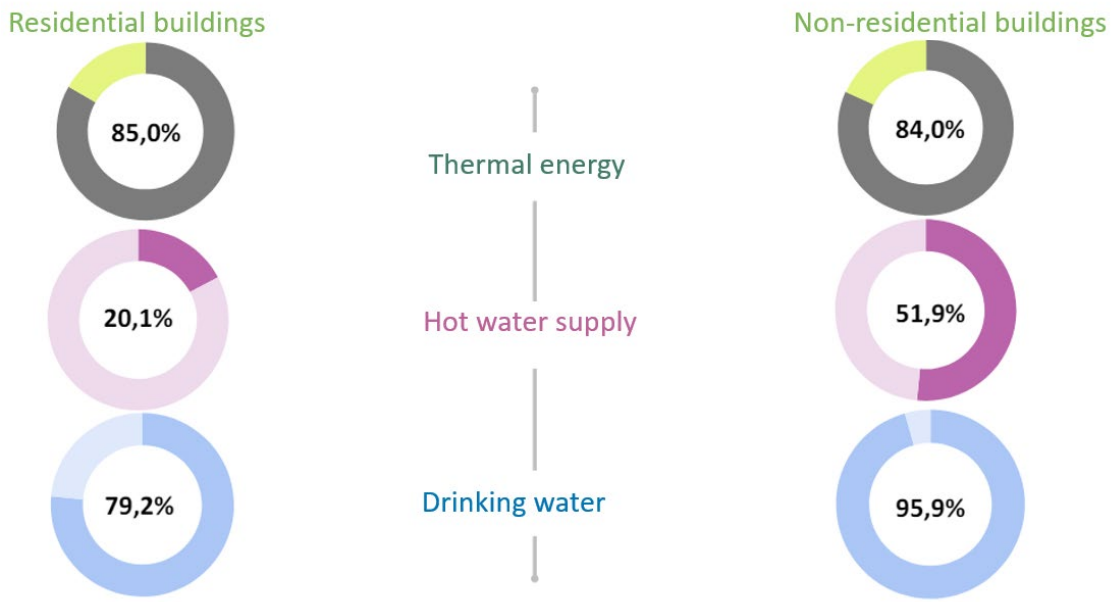

Figure 1: Equipment of buildings with commercial heat and water metering units[1]

The national legislative and regulatory framework for the heating sector in Ukraine supports the country's overall energy policy. In 2017, the Energy Strategy of Ukraine for the period up to 2035 "Security, Energy Efficiency, Competitiveness" was adopted. The strategy was focused on measures to improve energy efficiency in district heating systems.

On April 21, 2023, the Cabinet of Ministers of Ukraine approved the Energy Strategy of Ukraine until 2050 to replace this document. The Strategy was prepared by the Ministry of Energy together with energy companies, including NNEGC Energoatom, NPC Ukrenergo, NJSC Naftogaz of Ukraine, GTSOU, Ukrhydroenergo and others, with the support of the UK Government and the involvement of KPMG. During preparation, consultations were held with the International Energy Agency, the U.S. Department of Energy, the German Energy Agency, the Berlin School of Economics, and the Danish Energy Agency. Access to the text of the document is restricted.

In addition to the 2017 Energy Strategy, the Concept for the Implementation of the State Policy in the Heat Supply Sector was approved in the same year. For the first time, it was officially recognized that the financial standing of most thermal power companies is unsatisfactory, as their business activities are unprofitable and lead to the accumulation of debts.

The Concept proposed the following areas of modernization:

- Optimization of heat generation sources with a focus on cogeneration capacities and maximization of efficiency.
- Possible switch from the most inefficient sources of district heating to modular house boilers.

[1] Source: https://saee.gov.ua/uk/content/commercial-accounting

- Replacement of pipelines with pre-insulated ones and reduction of energy transportation costs.
- Modernization of heating units.
- Utilization of heat from technological processes of industrial enterprises.
- Creation of conditions for open access of third parties to heating systems.
- Use of variable frequency device for pumping equipment.
- Use of automatic heat energy regulators at heating unit stations depending on changes in atmospheric temperature.
- Switching to autonomous and/or individual heating in cities where the state of the district heating system leads to excessive losses and inefficient use of resources.
- Unleashing the energy saving potential in industry through the introduction of energy management and energy service systems, stimulating government economic policy, and gradual increase in energy efficiency requirements by revising energy consumption standards.
- Introduction of demand management mechanisms, in particular, the mechanism of "energy services" as an alternative to new energy production, which is in line with Ukraine's commitments under the Energy Community Treaty.

1.1. Overview of recent district heating sector reform developments

In recent years, there have been significant changes in the management of district heating because of the decentralization of public administration and the empowerment of local self-government bodies. The authority to regulate the activities of heat supply companies that produce heat in boiler houses has been transferred to local authorities.

Additionally, Law No. 2479-IX, which addresses the regulation of relations in the natural gas market and the heat supply sector during martial law and further restoration of their functioning, has been adopted by the Verkhovna Rada. This law prohibits raising tariffs for natural gas distribution services, heat energy (including its production, transportation, and supply), and heat energy and hot water supply services during martial law and for six months after its termination. At its meeting on August 22, 2023, the Cabinet of Ministers of Ukraine extended the operation of the Public Service Obligation (PSO) in the natural gas market, which will allow keeping heat tariffs for households unchanged.

Thus, Resolution No. 812 of the Cabinet of Ministers of Ukraine and the Regulation on PSO it was approved to extend it until August 31, 2024 (inclusive)[2].

GSC Naftogaz Trading LLC, state-owned gas company that has special responsibilities for the supply of natural gas, will sell gas at the following prices:

- 7,420 UAH/thousand cubic meters – for heat producers for households.

[2] https://zakon.rada.gov.ua/laws/show/812-2022-%D0%BF#Text

- 16,390 UAH/thousand cubic meters – for heat producers for public bodies.

For other consumers, the gas price will be reduced compared to the previous season and will be determined by a formula based on market prices in Ukraine.

A flexible mechanism for the use of fixed volumes of gas by heat producers during the heating season was also introduced. From now on, heat producers will be able to use the fixed volume of gas saved during the month in the following periods of the heating season.

The Government has also decided to suspend the contractual write-off of funds from the accounts of district heating companies (DHCs) for late payment for gas. Now they will retain 35% of the funds received from heat consumers for the services provided. This will enable the heating companies to allocate money for their priority needs.

Without this, the forced debiting of heat supply companies' accounts for their debts would effectively leave them without working capital. Indeed, Ukrainian DHCs are mostly in significant debt, accumulated over the years because of the lack of cost-reflective heat tariffs, residential customer nonpayment, and a range of other factors.[3]

The adopted rule will be effective from September 1, 2023, to August 31, 2024. This decision does not solve the immediate problems of enterprises but improves the situation during the heating season.

1.2. Housing subsidies to consumers

The social protection of low-income families in Ukraine in the context of rising prices and tariffs for housing and utility services is ensured by providing such families with state social assistance. There is two types of assistance;1) a monthly targeted non-cash subsidy to reimburse the costs of housing use or maintenance and utilities (water, heat, gas, sewage, electricity, household waste and liquid sewage disposal), and 2) cash subsidies once a year for the purchase of LPG, solid and liquid furnace fuel (subsidy).

The housing subsidy is a non-refundable targeted state social assistance to vulnerable consumers of housing and utility services who cannot pay for these services on their own. Approximately 2.3 million of households received such subsidies as of February 2023.[4]

The subsidy is provided to citizens in cash by:

- Transferring funds to an account in an authorized bank.
- Through a branch of the organization that pays and delivers pensions and financial assistance at the place of actual residence.

The procedure for granting subsidies to households is regulated by the Regulation on the Procedure for Appointing and Granting Subsidies to the Population to Reimburse Expenses for Housing and Utility

[3] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-29764.pdf
[4] https://www.epravda.com.ua/news/2023/02/17/697169/

Services, Purchase of LPG, Solid and Liquid Furnace Fuel, approved by Resolution of the Cabinet of Ministers of Ukraine No. 848 dated October 21, 1995.

Families are eligible for the subsidy if the amount of payment for housing and utility services within the consumption standards, including benefits, exceeds the mandatory payment percentage determined by the Cabinet of Ministers of Ukraine.

Currently, the mandatory percentage of payment for housing and utility subsidies is 10 or 15 percent of the average monthly total income of citizens registered in the apartment (house) and 10 or 15 percent of the annual total income for the purchase of LPG, solid and liquid furnace fuel.[5]

Other regulations that determine the procedure for granting subsidies:

- The Law of Ukraine on Housing and Utility Services.
- Resolution of the CMU No. 848 on Simplification of the Procedure for Providing Subsidies to the Population for Reimbursement of Payment for Housing and Utility Services, Purchase of LPG, Solid and Liquid Furnace Fuel dated October 21, 1995.
- Resolution of the CMU No. 1156 on the New Amount of Payment for Housing and Utility Services dated July 27, 1998.
- Resolution of the CMU No. 409 on Establishment of State Social Standards in the Sphere of Housing and Utility Services dated August 6, 2014.
- Resolution of the CMU No. 632 Some Issues of Payment of State Social Assistance dated July 22, 2020.
- Resolution of the CMU No. 214 Some Issues of Provision of State Social Assistance and Benefits for the Period of Martial Law dated March 7, 2022.
- Resolution of the CMU No. 215 on Peculiarities of Calculation and Payment of Cash Allowances, Benefits and Housing Subsidies for the Period of Martial Law dated March 7, 2023.
- Resolution of the CMU No. 356 on Establishing Minimum Standards for Provision of Solid and Liquid Furnace Fuel and LPG to the Population and Limits on Their Cost for Provision of Benefits and Housing Subsidies dated April 23, 2012.

1.3. Development of heat supply schemes

According to Article 26 of the Law of Ukraine on Heat Supply, the design, construction, and reconstruction of heat supply facilities are carried out based on heat supply schemes, state building codes and regulations for construction works.

[5] Resolution of the Cabinet of Ministers of Ukraine No. 1156 on the New Amount of Expenses for Housing and Utility Services, Purchase of Liquefied Gas, Solid and Liquid Stove Household Fuel in Case of Housing Subsidies dated July 27, 1998, as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 621 dated July 14, 2010.

A heat supply scheme for a settlement is a document that contains a technical and economic justification for the construction, reconstruction (expansion, technical re-equipment) and modernization of heat supply facilities. In addition, the prospects for the development of the settlement should be taken into account, as well as measures to ensure energy efficient, high quality, safe, environmentally friendly and reliable operation of the heat supply system of the settlement, which is approved by the central executive body that implements state policy in the housing and utilities sector.

The heat supply scheme shall comply with the requirements of the Methodology for the development of heat supply schemes for settlements of Ukraine, approved by the order of the Ministry of Communities and Territories Development of Ukraine No. 235 dated October 2, 2020, and registered with the Ministry of Justice of Ukraine No. 1144/35427 dated November 18, 2020.[6]

To make decisions on the heat supply of a particular locality, the following activities are carried out:

- Inspection of the city's boiler houses for their further efficient operation.
- Inspection of heating networks to identify emergency areas.
- Calculation of the heat balance to ensure that the installed heat generating capacities meet the heat loads of consumers.

As a result of summarizing and analyzing the existing heat supply system, development prospects, and local conditions, priority urgent measures are developed for the optimal operation of boiler houses, heating networks, and their possible modernization and reconstruction.

The heat supply scheme is approved by the local self-government after its preliminary approval by the central executive body that implements the state policy in the field of housing and communal services (which currently is Ministry of Development of Communities, Territories, and Infrastructure of Ukraine).

The period for which the heat supply scheme is approved is not regulated (it is up to the local self-government), but the scheme is subject to review every 5 years.

1.4. Description of the involvement of ongoing local initiatives or parallel initiatives of other donors in the adaptation of district heating legislation

1.5.1. General overview

The district heating sector in Ukraine has been and is the subject of attention of many international donors.

As of March 2024, it is worth noting:

- Projects implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ):

[6] https://zakon.rada.gov.ua/laws/show/z1144-20#Text

    - **Reform of the Ukrainian district heating sector (ReWarm)** on behalf of the Federal Ministry for Economic Affairs and Climate Action (BMWK) and funded by the International Climate Initiative (IKI).
    - **Promotion of Energy Efficiency and Implementation of the EU Energy Efficiency Directive in Ukraine** on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) and funded by the Swiss State Secretariat for Economic Affairs (SECO).
    - **Support of the national energy efficiency fund and of a climate-friendly reform agenda (S2I) in Ukraine** on behalf of the Federal Ministry for Economic Affairs and Climate Action (BMWK).
    - **Energy-efficient district of Lviv** on behalf of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)
- **Energy Security Project (ESP)**, implemented by Tetra Tech ES, Inc. with funding from the United States Agency for International Development (USAID).
- **Energy Sector Transparency Project**, implemented by the DIXI GROUP NGO with funding from USAID.

In addition to the above, USAID has long funded several other district heating projects. Among them is the Municipal Energy Reform Project (MERP), which was implemented in 2013-2019.

GIZ, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ), implemented the Energy Efficiency Reforms in Ukraine project in 2017-2020.

The implementation of several World Bank Group projects in previous years should be noted separately. Among other things, in 2019, the International Finance Corporation (IFC), in partnership with the EU, helped establish the State Energy Efficiency Fund. Also, the Energy Sector Management Assistance Program (ESMAP) prepared several analytical reports on district heating in Ukraine, such as "Setting the agenda for further district heating reform in Ukraine" (2019).

1.5.2. Reform of the Ukrainian district heating sector (ReWarm) project

The project has been implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) since 2020.

The project supports the Ministry of Communities, Territories, and Infrastructure Development of Ukraine in developing a national heat supply strategy. The project provides recommendations for the adaptation of the legal framework and supports the pilot implementation of adapted business models for district heating companies, including socially mitigated cost-covering tariffs.

As of March 2024, the Project is preparing the selection of pilot cities to implement new business models for district heating organizations and developing a stakeholder engagement plan.

1.5.3. Implementation of the EU Energy Efficiciency Directive in Ukraine

The project is being implemented by the German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ) since 2020. The project advises the Government of Ukraine on the practical implementation of EU Directives 2012/27/EU and 2010/31/EU.

The project supports the Ministry for Communities, Territories, and Infrastructure Development of Ukraine (Ministry of Infrastructure), the Ministry of Energy and Coal Industry (MECI) and the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) in three areas of activity: policy advice, advice on legislative and reform improvements, and information and dialogue activities.

The project supported the preparation of the Law of Ukraine on Energy Efficiency. The Ministry of Infrastructure, with the support of the Project, also developed the draft Law of Ukraine on Amendments to Certain Laws of Ukraine Regarding the Creation of Conditions for Comprehensive Thermal Modernization of Buildings.

The project helped develop by-laws and regulations on implementing energy management systems in public sector buildings and certifying energy auditors.

The project also:

- ensures the implementation of practical measures in communities, as well as the inclusion of energy efficiency in educational programs and training programs at enterprises.
- conducts energy management training courses for local government officials.
- supports the implementation of energy management and the development of municipal energy plans.
- advises destroyed or damaged enterprises in Sumy and Chernihiv regions on damage assessment, technical analysis, and modern energy efficient reconstruction.

1.5.4. Support of the national energy efficiency fund and of a climate-friendly reform agenda (S2I) in Ukraine

The project has been implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) since 2018.The project supports the Government of Ukraine in the strategic development of the Energy Efficiency Fund (EEF).

The project promotes the development of the EEF staff's competencies by training, participates in developing the EEF national office and other EEF structures. The project supports Ukrainian service providers in the construction market to develop their competencies in energy audits, design and estimate documentation, and other technical areas for cooperation with the EEF.

The project also facilitates the exchange of information within the framework of the International Climate Initiative (IKI), which allows Ukraine to develop its EE sector strategically.

1.5.5. Energy Efficient District of Lviv project

This is a demonstration project and has been implemented by the German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ) since 2018. The project provides support to the Government of Ukraine, Lviv City Council, Lvivteploenergo utility company, and Homeowners Association (HOA).

HOAs are supported to implement specific measures to reduce heat consumption in their buildings, in line with the requirements of the EEF's Energodim program.

A digital model of heat supply in the Sykhiv district of Lviv is being created in cooperation with Lvivteploenergo company. The model is used to analyze the district heating network and for strategic planning of modernization.

Heat pumps with a minimum total capacity of 1 MW will be integrated into Lviv's heating system.

1.5.6. The Energy Security Project (ESP)

Since 2018, Tetra Tech ES, Inc., funded by USAID, has been implementing a project to strengthen Ukraine's energy security by improving the regulatory environment and increasing energy supply resilience. The primary goal is to develop free market mechanisms.

Project Goals:

- Ensure affordable, reliable, sustainable, and secure energy for Ukrainian citizens.
- Aid Ukraine's integration into European energy markets, meeting EU Energy Acquis requirements, including the Third Energy Package.
- Increase energy security by creating competitive energy markets in electricity, natural gas, and district heating.
- Improve energy supply and efficiency in Ukraine.

Project Sectors:

- Gas, electricity, district heating, and renewable energy.
- Applying global environmental requirements and best practices.
- Acting as an independent procurement agent for the Energy Support Fund of Ukraine.

District Heating Sector Areas:

- Policy and Regulatory Reform:
    - Standardize and update legislation and regulations for a coherent district heating environment.
    - Engage stakeholders in policy coordination, tariff review, energy efficiency, renewable energy technologies, improved customer service, investment, and subsidy-to-assistance transition.
- Local Self-Government and Municipal Heating Companies:
    - Develop measures to improve technical and financial performance.
    - Create a financial model for Zaporizhzhia's district heating company with cost-plus tariffs for production, transportation, and supply.
    - Implement geospatial software for Kyivteploenergo to enhance maintenance, repair, and planning efficiency.
    - Collaborate with the EBRD to attract investment and transform Kyivteploenergo into an investor-friendly energy company.

The project also produced the report "White Paper on Transforming District Heating in Ukraine: Assessment and Recommendations" (August 2020).

1.5.7. The Energy Sector Transparency Project

Since 2019, the DIXI GROUP NGO with funding from USAID has implemented this project. The goal of the project is to increase data transparency in the energy sector, empower civil controlling authorities to monitor and prevent corruption in the energy sector, and enable consumers to express their opinions on how the energy sector is regulated and managed.

In 2020, the project updated the Ukrainian Energy website (https://ua-energy.org) to improve transparency and efficiency of energy sector governance by monitoring, collecting, and publishing key energy sector information.

1.5.8. Energy Efficiency Reforms in Ukraine

GIZ implemented the project in 2017-2020. The goal of the project was to increase the capacity of national institutions to implement the energy efficiency reform process effectively.

The areas of work included the provision of professional information, policy advice on specific energy efficiency reform processes, and the development of implementation plans and tools for specific sectors (e.g., advice on the creation of an energy efficiency monitoring system for public sector buildings).

With the support of the project, 10 position papers were developed at the request of the project partners, the Ministry for Development of Communities and Territories of Ukraine and the State Agency on Energy Efficiency and Energy Saving (SAEE).

Among other things, the project has prepared the following documents:

- White Paper on the implementation of Article 8 of the EU Energy Efficiency Directive 2012/27/EU (2018).
- White Paper on the implementation of Article 5 of the EU Energy Efficiency Directive 2012/27/EU (2019).

1.5.9. The USAID Municipal Energy Reform Project (MERP) project

The project was implemented during 2013-2019 and is now completed. The main goal of the project was to increase Ukraine's energy security by:

- improving energy policy
- developing energy efficiency
- increasing investment in the energy sector.

The project included four areas of activity:

- improving the regulatory and legal framework
- attracting investors to energy efficiency and clean energy
- development of professional potential and dissemination of achievements
- low-carbon development strategy for Ukraine.

Within the framework of the project, a report "Long-term development of district heating (including heating networks) in Ukraine: concept and roadmap" was prepared (January 2019).

1.5.10. Key associations

The Government in cooperation with relevant local stakeholders and key interest organizations elaborates the legal documents in Ukraine, in particular: The Association of Municipalities[7] and The District Heating Association in Ukraine.[8]

In the process of preparing legal documents, the proposals related to the heating sector are shared with the associations, which collect comments from members and respond to the ministries on behalf of all members. Once the legislation is in force, the associations are available to help members to understand and implement the regulation.

[7] Новини | Асоціація міст України https://www.auc.org.ua/
[8] Міжгалузева асоціація з розвитку систем теплопостачання «Укртеплокомуненерго» https://mautke.com.ua/

Table 2: Key analytical/position papers on district heating

Item no.	Title	Publisher	Year
1	Setting the agenda for further district heating reform in Ukraine[9]	World Bank / ESMAP	2019
2	Long-term development of district heating (including heating networks) in Ukraine: Concept and roadmap[10]	USAID / MERP	2019
3	White paper on the transformation of district heating in Ukraine: Assessment and recommendations[11]	USAID / ESP	2020

For more information on the status and challenges of district heating in Ukraine, we recommend reading the ESMAP report "Setting the agenda for further district heating reform in Ukraine". Its conclusions are generally still relevant today, subject to the clarifications and changes we have mentioned above.[12]

[9] https://documents1.worldbank.org/curated/en/477931583763702822/pdf/Setting-the-Agenda-for-Further-District-Heating-Reform-in-Ukraine.pdf
[10] Not available on the internet
[11] https://energysecurityua.org/wp-content/uploads/2021/04/050G-DH_White-Paper_for_DEC-2021-02-02-ENG.pdf
[12] ESMAP report link: https://elibrary.worldbank.org/doi/abs/10.1596/33473

2. Legal Framework in the European Union

The legal framework in the European Union with relation to the heating sector is a package of directives, which are coordinated and support each other. The most important for the heating sector is the Energy Efficiency Directive (EU-EED), in combination with the Energy Performance of Buildings Directive (EPBD) and the Renewable Energy Directive (RED).

The overall aim of all directives is to facilitate development of the energy sector meeting the EU energy policy objectives in the most cost-efficient way. Besides cost-efficiency, the policy has special attention to the following two energy policy objectives:

- Greenhouse gas reduction and thereby also reduction of the use of fossil fuel
- Security of supply and thereby also reduction of the use of imported fossil fuels

The overall criteria of cost-efficiency is logic, as the financial resources and the consumers ability to pay are limited and that cost-efficient solutions thereby give more value for money.

- Energy Efficiency Directive (EED): The EED is designed to promote energy efficiency within the European Union and to achieve specific energy savings targets by a certain deadline. This directive impacts district heating by encouraging the efficient generation and use of heat, optimizing heat distribution, and minimizing losses. It may lead to the adoption of more efficient technologies and practices in district heating. Additionally, district heating can contribute to the overall energy efficiency goals set by the directive, as it can utilize waste heat and renewable energy sources, reducing the need for primary energy sources. The EED focuses on how to plan and operate energy efficient and cost-efficient solutions for district heating and cooling.
- Energy Performance of Buildings Directive (EPBD): The main purpose of the EPBD is to promote the improvement of the energy performance of buildings within the EU through design and construction choices. The directive intends to reduce energy consumption and CO2 emissions in the building sector, which is a major contributor to total energy consumption in Europe. The directive addresses aspects like the establishment of common standards and methodologies for calculating energy performance, building certification, regular inspection of heating and cooling systems, and the requirement to make energy performance indicators a part of property sale and rental processes. As most buildings are situated in urban areas, it is important to remember, that the directive requests that buildings shall be carbon neutral considering that renewable energy and efficient heating from e.g., cogeneration can be transferred to the buildings via district heating and cooling.
- Renewable Energy Directive (RED): The RED aims to increase the use of renewable energy sources within the EU's energy mix. This is important for heat planning as it encourages the integration of renewable energy into district heating systems, promoting the transition from fossil fuels to renewables such as biomass, geothermal energy, or solar thermal energy. The revised directive (RED III) includes specific targets or incentives for the increased use of

renewable heat sources in district heating and cooling, further influencing heat planning policies and infrastructure development. Thus, Member States shall endeavour to increase the share of energy from renewable sources and from waste heat and cold in district heating and cooling by an indicative 2.2 % points per year as average for the period 2021 to 2030. Thereby RED paves the way for renewable energy sources which can be utilized in district heating and cooling and anticipates that Member States will plan for cost-efficient district heating and cooling.

The EU-EED is the most important directive for the district heating sector for several reasons:

- It outlines obligations for member states to work with heat supply planning to develop the most cost-effective heat supply in urban areas, which can implement the EU energy policies.
- It recognizes that district heating is necessary to utilize most of the energy efficiency measures in the heating sector, in particular heat that else would be wasted in thermal power generation, in heavy industries, and in waste incinerators.
- It also recognizes that district heating is necessary to integrate almost all renewable energy resources and low temperature heat resources in the energy system due to economy of scale.
- It outlines the obligations for the district heating companies to engage with the consumers.

The EU requests the Member States to implement these directives in the national legislation.

Below is a list with links to legislation relevant to the EU directives:

Table 3: Links to relevant EU directives

Legislations	Source
Directive (EU) 2023/1791 on energy efficiency (EED)	https://eur-lex.europa.eu/eli/dir/2023/1791/oj
Directive (EU) 2023/2413 on the promotion of energy from renewable sources (RED III)	https://eur-lex.europa.eu/eli/dir/2023/2413/oj
Directive (EU) 2024/1275/EU on the energy performance of buildings (EPBD)	https://eur-lex.europa.eu/eli/dir/2024/1275/oj

In the following subsections is given a summary of the EU-EED directive adjusted to the conditions in Ukraine and the relevant national legislation in Denmark and Poland.

2.1. Overview of the EU-EED with focus on the articles connected to district heating

2.1.1. Article 2 – Definitions

This article includes 56 definitions, of which some of them are important for implementing the directive for heating, cooling, and hot water, e.g.

(27) **Retail energy sales company** means a natural or legal person who sells energy to final customers. This is e.g., the district heating company, who sells heat to building owners at the point of delivery, where the district heating company installs a same type of heat meter to all district heating final customers, typically all building owners.

(28) **Final customer** means a natural or legal person who purchases energy for own end use. This is e.g., the building owner, which is supplied by the district heating company at the point of delivery. Apartment buildings, which are supplied at the point of delivery will normally have their internal distribution systems for production and distribution of hot tap water to apartments and for distribution of heat via vertical pipes to radiators in the apartments.

The final customers could principally also be owners of sections of a building, e.g., apartments in buildings with horizontal distribution of heat. In that case, the district heating can be sold to each owner of a section at a point of delivery and the owner of the section will use the heat from the district heating to produce hot tap water and distribute heat horizontally in his own section without interconnection with other sections.

In case of privatized apartments, it is vital for the operation of the building that the owners of apartments (the final users) share the ownership of the building (a homeowners association or condominium) and share all costs related to a sustainable operation of the building, e.g.

- to repair the roof,
- to maintain front doors and staircases,
- to maintain the heating and hot water distribution,
- to pay for the heat which is delivered to the building at the point of sale,
- to distribute the total costs for heating among the apartments, and
- to collect payments to the budget of the home-owners association and pay for the district heating.

(53) **Final user** means a natural or legal person occupying a building or unit supplied with heating, cooling, or domestic hot water from a centralized source. This is e.g., an owner of an apartment, which has no direct contract with the energy supplier.

As regards definition 27 and 28, the **point of delivery** is defined as the point at which the retail energy sales company (district heating company) can sell heat to the consumer. At this point, it shall be possible

to install a heat meter, which can measure all the energy, which is supplied and stop valves as well that allows both parties to disrupt the supply. This point is important for the transformation of the heat sector in Ukraine from the centrally planned economy to the market economy. That is in particular important in multi-apartment buildings, as the point of delivery in typical multi-apartment buildings is between the building and the district heating company.

A fundamental issue in Ukraine and other former centrally planned economies is that the privatization of apartments was not fully implemented from the beginning through the formation of homeowners associations. It is crucial for the privatization process to include a homeowners association (condominium) as a legal entity representing all privatized apartments, ensuring this entity is operational.

While the Energy Efficiency Directive (EED) does not explicitly require a homeowners association for purchasing district heating, it assumes, through definitions 27 and 28, that there will be a mechanism for collective decision-making and building management, such as a homeowners association. This mechanism is important for purchasing district heating delivered to the building at the point of sale.

2.1.2. Article 3 – The Principle of Energy Efficiency First

The revised EED 2023 Article 3 establishes 'Energy Efficiency First' (EEF) as a fundamental principle of EU energy policy, giving it legal standing for the first time, thus significantly raises the EU's ambition on energy efficiency in all sectors, inclusive in the heat supply sector.

The term ' Energy Efficiency first' is defined in Regulation (EU) 2018/1999 Article 2, point (18):

'Energy Efficiency first' means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission, and distribution of energy, whilst still achieving the objectives of those decisions.

In practical terms, EEF means that Member States must consider energy efficiency in all relevant policy and major investment decisions taken in the energy and non-energy sectors, thus constituting a fundamental objective of national legislation involving energy. Article 3 implies:

- A mandatory assessment of energy efficiency solutions.
  With Art. 3.1, Member States must ensure that energy efficiency solutions (including demand-side resources and system flexibility) are assessed in any planning, policy and major investment decisions related to energy (as well as non-energy sectors) that have an impact on energy

consumption. Major investment decisions are defined as the decisions that have a total value of over 100 million EUR or 175 million EUR for transport infrastructure projects.

- A responsible entity to monitor the application of the Energy Efficiency First principle.
  Art. 3.b requests Member States to clearly assign responsibilities to ensure that the EEF principle is applied. Member States are required to identify an entity, or several entities, that will be tasked with monitoring the application of the principle. The responsible entity shall check whether the EEF principle has been applied in policy, planning, and major investment decisions, as well as monitoring the effects of these decisions on energy consumption.
- Cost-benefit methodologies that include wider benefits of energy efficiency.
  By Art. 3.3.a, Member States must develop and apply cost-benefit methodologies that include the wider benefits of energy efficiency measures from a societal perspective, including the reduction of greenhouse gas (GHG) emissions, the improvement of human health, and the greater energy independence they provide. In addition, Member States must make these cost-benefit methods publicly available to allow public scrutiny and promote their use by all relevant actors.
- Use of uniform recommendations and guidelines of the EU Commission.
  Cf. Art. 3.1b, Member States are encouraged to consider the recommendations and guidelines of the Commission to follow the EEF principle when implementing EED Article 3. These guidelines provide advice to policy makers and other stakeholders on how to integrate the EEF principle into their energy-related decisions in the heat supply sector and in other sectors and policy areas.

The EEF principle opens considerations such as the following regarding the important sector integration/sector coupling, especially between buildings, district heating and electricity generation:

- When designing the district heating network to supply old uninsulated buildings, it must be considered that the most cost-effective heat-saving measures will reduce the heat demand and the return temperature to the district heating and thus reduce the required pipe dimensions.
- In the planning of heat production for district heating, it must be considered that district heating can use surplus heat, which would otherwise be wasted in electricity production (in combined heat and power which reduces fuel consumption for heating by a factor of 2 compared to electricity only), as well as from industries and waste incineration.
- When planning the optimal insulation of buildings, account must be taken of the fact that district heating can utilize efficient heat sources. To reduce CO2 emissions in a cost-effective way, it may e.g., be better to use the effective thermal heat from a fossil-fueled CHP plant than from a biomass boiler.
- In the planning of district heating production facilities as well as in the planning of energy saving measures and local production of heat in buildings, the market price of electricity and thus the type of electricity at the margin must be considered hour by hour (and not annual average). If fossil fuels condensation is on the margin, heat from the combined production is

much more efficient than electric heat pumps and electric heating in particular. If solar PV, hydropower, wind, or nuclear power is at the margin, combined production of heat and power should stop and be replaced by heat from heat pumps and even electric boilers.

Proper implementation of the Energy Efficiency First (EEF) principle should guide Ukrainian district heating systems to develop differentiated heat production with load dispatch. This approach, similar to Danish district heating systems, adjusts heat production based on market prices of electricity or similar price signals, thanks to sector integration.

2.1.3. Article 14 – Metering for heating, cooling, and domestic hot water

Article 14 of the EED is fundamental for the relationship between district heating company and the consumer. It states that there shall be installed a heat meter at the heat point of delivery to measure the energy consumption. Meters shall be competitively priced and able to accurately reflect the actual energy consumption. Thus, it is anticipated:

- That the cost of the meters shall be reasonable (low) compared to the importance of the accuracy and
- That the consumer shall be able to adjust the consumption responding on the measurements.

The point of delivery will normally be at the heat exchanger in case of indirect connection or at shunt pump for reducing temperature, in case of direct connection.

Figure 2 below provides an overview of a district heating network system, with flow and temperature measurement system (energy meters), as demonstrated.

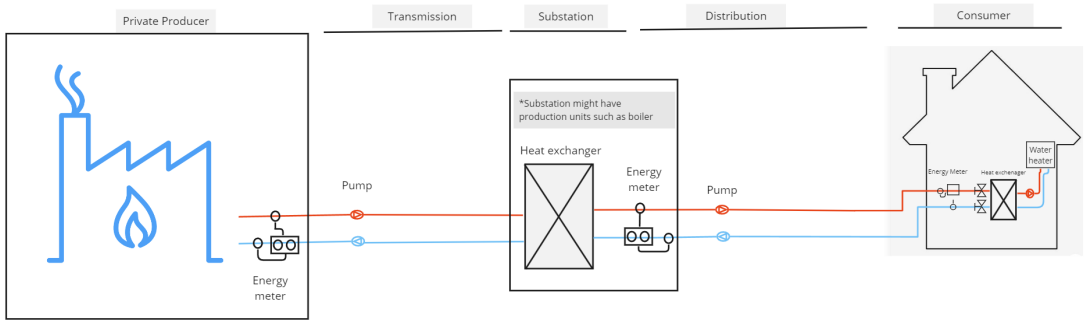

Figure 1: Overview of a district heating system with energy meters

It is as illustrated in figure 2 best practice that the point of delivery (the two stop valves and the heat meter) to a building is located inside the building typically in the boiler room. Some district heating companies prefer to establish the point of delivery in a box on the outside wall of the building.

To summarize: The final customer is a legal entity, which is connected to the supplier at a point of delivery at which there can be installed a heat meter, stop valves and a regulation valve for commercial supply of heat to the building:

- The consumer, which is the building owner, e.g., homeowners' association, can adjust the consumption of heat to the demand.
- The district heating company can sell heat to all consumers using a 2-tier tariff based on heat meters and on the subscribed building heat capacity (e.g., the maximal building heat load or the connected heated floor area).
- The district heating company can disconnect the consumer in case of non-payment.

Therefore,

- In case of apartment buildings or multi-purpose buildings with vertical integration (in which the several vertical pipes supply the radiators in an apartment), it is not possible to establish a point of delivery to each apartment, and the building owner (represented by the homeowner's association, where relevant) will be the final district heating customer.
- In case of group substations with central production of hot tap water, the owner of the group substation and the internal distribution system for heating and hot tap water to the group of buildings are the final district heating customers.
- In case the group substation only distributes heat to several buildings, it is possible to move the point of delivery from the group substation to each building substation.

The key problems in Ukraine for sale of district heating to consumers are that a delivery point is not defined in many cases, and that the total costs of the district heating are distributed on the total heated floor area due to the common vertical design of the inhouse pipe system. After the distribution, the heat is converted to a calculated heat consumption in Gcal, which is the same for all consumers of the same category, e.g., one price for commercial and one for housing.

2.1.4. Article 15 – Sub-metering and cost allocation

The district heating company delivers heat to a point of delivery, where stop valves and a heat meter can be installed to measure the consumption of heat.

Article 15 describes how to allocate costs of the supplied district heating at the point of delivery among the buildings' end-users who receive heat and hot tap water in apartment buildings, multi-user buildings, and group substations.

Meters shall be installed to each building unit if it is technically feasible and cost effective in relation to the potential energy savings. It is understood that the potential energy savings is close to zero in case the end-users are not able to adjust their consumption and be encouraged to save energy. In typical old

buildings and group substations in Ukraine it is not possible for the end users to adjust their heat consumption and therefore sub-metering of the heating will not be feasible.

In case individual heat meters are not technically feasible, or cost-efficient (e.g., in case of vertical integrated heating system) there shall be installed heat cost allocators at radiators to distribute the variable costs among the apartments, if it is cost-efficient. In some old buildings, it is not possible to adjust the consumption and therefore heat cost allocators are not feasible. In old buildings with vertical distribution and valves at each radiator, it is possible to adjust the consumption, and therefore a heat cost allocator at each radiator could give incentives for end-users in apartments to use the valves to adjust the consumption and save the variable cost of heat to the building. However, for Ukraine it is likely that the costs of the installation of heat cost allocators would not be cost effective in terms of being proportionate in relation to the potential energy savings.

The Member States shall according to the directive consider to which extend heat cost allocation is cost-efficient and consider alternative methods of heat consumption measurements and publish general criteria, methodologies, and procedures to determine which solutions are feasible and cost effective.

It could e.g., be stated that costs of domestic hot water in any case shall be distributed according to measured hot water consumption in m3 in case simple mechanical hot water flow meters can be installed to each apartment, whereas heating shall be distributed according to heated floor area in buildings with vertical distribution.

It could e.g., also be stated that the building owner shall focus on energy management and investments in cost effective savings which will be to the benefit of all building units, e.g., thermostatic valves, improvement of windows or other parts of the building envelope etc. In case the measured heat consumption for the building per m2 of heated floor is normal, it is not likely that the heat cost allocators will be cost effective.

In new apartment buildings, there shall be installed meters that can measure hot tap water to each apartment to distribute the costs of hot tap water. To meet this obligation considering that it shall be cost-efficient; a simple mechanical flow meter will be sufficient.

Member States shall have in place transparent publicly available rules for allocating costs in apartment buildings and multi-purpose buildings. The costs shall be divided into fixed and variable costs and divided on the following three categories of demand:

- Costs for hot tap water
- Costs for heating common areas
- Costs for heating apartments

There could e.g., be the following three cases:

1. No meters are technically feasible and cost-efficient:
    i. All costs are divided according to heated floor area.
2. Only domestic hot water meters are feasible and cost-efficient:
    i. Variable cost of hot water is divided on measured m^3 hot water.
    ii. All other costs of heating and hot tap water are divided on m^2 heated floor area.
3. Domestic hot water and heat cost allocators are feasible and cost-efficient.
    i. Variable cost of hot water is divided on measured m^3 hot water.
    ii. Variable cost of heat is divided according to heat cost indicators for each apartment.
    iii. All other costs of heating and hot tap water are divided on m^2 heated floor area.

In new buildings, which can have installed horizontal distribution of heat to deliver heat and hot tap water to each apartment, simple flow meters could be a cost-effective way to distribute the variable costs, in case costs of advanced electronic heat meters are relatively large compared to the total costs heat.

Ukrainian law requires a commercial meter to be installed at the heat / hot water supply inlets to each building. It is also required that, where technically feasible, apartment/unit meters are installed at the heat supply inlets to the apartment/unit. Where it is technically impossible to install meters, allocators must be installed, unless economically unfeasible. The total amount of heat / hot water consumed, as determined at the building entrance, is subject to proportional distribution according to the readings of apartment/unit meters or allocators. Then the actual price (tariff) is applied to the amount of heat / water determined during the allocation process. There are separate rules for exceptional situations, such as broken or missing meters, etc., as well as for apartments that have been disconnected from district heating. Temporarily, until meters and allocators are installed, proportional distribution of heat consumption and payments in proportion to the apartment/unit area is allowed.

Once all district heating is delivered to heat consumers (building owners) at points of delivery and sold according to a 2-tier tariff, which reflects the heat consumption and the heat capacity, the next step is to consider how costs shall be allocated to each end-user (apartments).

In most cases in the EU, the total costs for heating the apartment building are distributed among end-users according to:

- heated floor area for fixed heat capacity cost,
- heat cost allocators for the heat consumption costs,
- consumed m^3 hot water or hot water indicators for the costs of hot tap water.

As a new EU Member State, Ukraine can likely demonstrate that heat cost allocators are not cost-effective in typical apartment buildings. Consequently, distributing total heat costs based on heated floor area should be acceptable. The main difference from the previous system is that costs will be divided building by building, rather than pooling all buildings together. Additionally, this cost will not depend on the number of residents in the building, leading to an individual tariff per square meter of floor area for each building. This approach will encourage energy management and savings at the building level, especially if the district heating company, in line with the EED, informs consumers about their heat consumption and return temperature compared to similar consumers.

2.1.5. Article 16 – Requirement of remote reading

Article 16 specifies that newly installed meters and cost allocators shall be remotely readable, however following the principles from article 14 and 15 only if it is technically feasible and cost-efficient considering the potential savings. This became obligatory already in October 2020.

Moreover, article 16 specifies that old meters and cost allocators, which are not remotely readable, shall be replaced by remotely readable devices by 1st of January 2027, unless the Member State demonstrates that this is not cost-efficient.

This statement summarizes the basic rule of all the articles 14-17 (including article 17 for gas) regarding metering, namely that the Member State in the national regulation can consider that metering and cost allocation devices shall only be installed if it is cost-efficient.

Modern heat meters for district heating are remotely readable. In accordance with Article 16, district heating companies should be required to collect meter readings, for example, on a monthly basis for monthly billing. They should also inform consumers (or the energy manager of the buildings) about their heat consumption and return temperature (or cooling of the circulating water) when applicable. This practice can help increase the overall system's energy efficiency.

In accordance with EED Article 16, it is mandatory in Ukraine to provide consumers with monthly information on their heat consumption if their homes are equipped with remotely readable meters. According to the Law of Ukraine "On Commercial Metering of Heat Energy and Water Supply," providers must give consumers access to information on the dynamics of communal services consumption. This can be done through electronic systems of consumer accounts or via the interface of the metering units. The information provided includes monthly consumption data for the last three years.

2.1.6. Article 18 – Billing and consumption information

Article 18 and Annex IX set rules for sharing information on the meter readings.

Billing based on meter readings or cost allocation based on actual consumption shall take place at least once a year. Billing based on remote readings of meters or cost allocation shall be on monthly basis, but not necessarily outside the heating season.

The Member State can allow that a system of self-reading by the final customer or final user is possible. This can be an efficient way of reading, and in case the utility (DHC) finds that the readings are not realistic, it can inspect the meter and correct the billing. Billing shall only be based on estimated consumption in case the final customer has not provided the meter reading, or the meter has stopped. This problem is almost eliminated due to the modern electronic heat meters, with remote readings, which are installed at most district heating companies in the EU.

The Member States shall:

- Require that if historical information on meter readings is available, it can be made available for the final user.
- Ensure that final customers are offered the option of electronic billing information and bills.
- Ensure that clear and comprehensive information is provided with the bill, such as:
    - Price and consumption
    - Fuel mix, greenhouse gasses, taxes levies etc.
    - Compare consumption with consumption previous year.
    - Contact information on final customers organisations, energy agencies etc. Including web address from which information on energy efficiency improvement measures etc. is available.
    - Information on complain procedures.
    - Comparison of consumption with average consumption for similar consumer category.

The Law of Ukraine on Housing and Public Utility Services provides for a detailed procedure for a consumer to file a claim against a service provider. In case of failure to resolve the issue, the consumer may apply to the court.

2.1.7. Article 20 – Cost of access to metering and billing and consumption information

The Member States shall ensure that the consumers receive their bills and information for energy consumption and have access to their data free of charge.

The Law of Ukraine on Commercial Metering of Heat and Water Supply stipulates that utility bills are provided to consumers in hard copy. At the request or with the consent of the consumer, bills may be

provided to the consumer in electronic form, including through access to electronic systems for accounting for consumer payments. The bills are provided to the consumer free of charge.

It is stated in the law that the provider shall give access to the consumers to information on dynamics of communal services consumption (by giving access to the consumers to the electronic systems of consumer accounts or through interface of the metering units):

1. Information on the monthly volume of utility consumption for the last three years (or from the date of entry into force of the utility service agreement, if less than three years have passed since such date).
2. Information on the daily, weekly, monthly, and annual volumes of utility consumption for the last two years (or from the date of entry into force of the utility service agreement, if less than two years have passed since that date) if the meter allow receiving such information.

This information on consumption dynamics is a mandatory addition to the regular, obligatory paper or electronic bills. These bills include the following 10 items, with items 6-10 optionally provided as an annex to the bill:

1. **Provider Details:** Name and payment details of the utility service provider.
2. **Consumer Information:** Address, name, or subscriber number, as defined in the utility service agreement, which allows the provider to identify the consumer.
3. **Billing Period:** The period for which the charge is made.
4. **Total Amount:** The total amount to be paid.
5. **Meter Readings:** A field for the consumer to enter readings of distribution metering units/heat distributors (if required by law or contract).
6. **Consumption Details:** Amount of heat and water consumed for the current period, determined according to Articles 9-11 of the law, including meter readings or estimated/average consumption.
7. **Prices and Tariffs:** Current prices and tariffs for utilities.
8. **Payment Status:** Status of payments, including any arrears, periods in which they arose, calculation details, and benefits/subsidies (if any).
9. **Average Consumption:** Average consumption and payment for the utility service by other consumers of the same category (including by building class), determined according to the official methodology.
10. **Energy Efficiency:** Recommendations on improving the energy efficiency of buildings, information on state-targeted and other energy efficiency programs, and contact information for additional support.

Member States may stimulate competition in the service sector providing billing services, such as systems for heat cost allocators and billing, for sharing costs of heating, cooling, and hot tap water among apartments in apartment buildings or group substations. Ukraine is actively working to stimulate competition, including in the billing services sector, through regulatory reforms, market liberalization, and the introduction of competitive practices, all aimed at improving service quality for its citizens.

2.1.8. Article 21 – Basic contractual rights

The Member States shall ensure that final customers and end users are granted legal and contractual rights:

- The consumers have a right to a fair and transparent contract.
- Change in contractual conditions shall be given with an adequate notice.
- Suppliers shall offer customers a wide range of payment methods.
- Prepayment shall not be a disadvantage.
- Final customers shall be offered fair and transparent terms and conditions.
- Suppliers shall handle complaints in a fair and prompt manner.

Competent authorities, which are independent of market interests, shall ensure that consumer protection measures are enforced.

In case the supplier plan to disconnect the customer, the concerned customer shall be provided with adequate information on alternative measures in advance.

The Law of Ukraine on Housing and Public Utility Services details the procedure for concluding contracts between consumers and service providers. It includes a model contract, approved by the Cabinet of Ministers of Ukraine, that is binding and protects consumers. In this way, Ukraine complies with Article 21.

2.1.9. Article 25 – Heating and cooling assessment and planning

Each Member State shall submit to the Commission a comprehensive assessment of the heating and cooling as specified in Annex X of the Directive. The aim is to present the base line and the potential for further improvements in line with the broader goal of promoting energy efficiency.

Member States should carry out cost-benefit analysis (CBA) of identified cost-efficient solutions for heating and cooling, considering the Energy Efficiency First principles. Based on Danish experience, where CBA analyses have been extensively used since 1980, the following points are recommended for consideration at the societal level, addressing both supply and demand measures:

- Insulating uninsulated buildings and reducing the return temperature from their heating systems to save on heat production and distribution costs.
- Transferring cost-effective waste heat from industries and waste incinerators to buildings via district heating.
- Utilizing heat from efficient co-generation plants for district heating to reduce thermal losses from power generation. Highly efficient cogeneration can save up to 30% of total fuel for heat and power, with up to 60% saved related to heat production.
- Employing large heat pumps to utilize surplus low-temperature heat and surplus heat from cooling in buildings and district cooling systems.
- Implementing thermal storage tanks for heating and cooling to optimize the interaction between the power system and district heating and cooling.
- Using electric boilers in district heating to utilize surplus electricity from wind and nuclear energy, offering balancing services to the power grid.

Member States are required to designate competent authorities to carry out cost-benefit analyses and provide publicly available methodologies and assumptions. This implies that Member States must:

- Take adequate measures to develop efficient district heating and cooling systems to utilize cost-efficient heating and cooling sources.
- Adopt policies and measures to ensure the potential identified in comprehensive assessments are realized.
- Ensure that local authorities prepare local heating and cooling plans, at least in municipalities with populations over 45,000 inhabitants. Municipalities with smaller populations are also encouraged to prepare such plans.

According to Danish experience, the planning for heating and cooling in urban areas includes the following main steps for the planning authority in co-operation with main stakeholders:

- Identify a preliminary zoning of the district heating divided on suitable districts, e.g., apartment buildings and office buildings and other buildings, which have a substantial heat demand.
- Identify a preliminary zoning and district cooling in suitable districts in which there is a demand for comfort cooling and process cooling, e.g., data centers.
- Identify efficient heat sources and suitable sites for existing and new efficient heat production e.g., waste incinerators and Combined heat and Power plants and heat storage,
- Identify efficient cooling sources suitable sites for existing and new cold production and thermal storage, including heat pumps for cogeneration of heat and cold and cold storage.
- Define the baseline for end-users including end-use demand at points of delivery and costs of heating and cooling.

- Estimate realistic energy savings in buildings (e.g., lower heat demand and lower return temperature and necessary supply temperature) and final end-use demand considering the cost of production.
- Optimize networks for district heating and district cooling interconnecting sources and final end-use demand.
- Optimize the generation of district heating and district cooling.
- Cost benefit analysis of the district heating and cooling compared to the baseline.
- Optimize the preliminary zoning to ensure that it is cost effective to supply all the selected districts.
- Final cost-benefit analysis and identification of feasible investment projects

Member States are required to develop recommendations and guidelines to help local authorities identify and plan cost-efficient solutions. Local heating and cooling plans, in line with these recommendations, should be carried out by local authorities or jointly by groups of neighboring local authorities. Public and private stakeholders should have the opportunity to participate in these plans.

A competent authority will assess the local heating and cooling plans and, if necessary, follow up with appropriate implementation measures. Member States are expected to support regional and local authorities to the fullest extent, including providing financial and technical support schemes.

In Ukraine, heat supply schemes are prepared according to the Methodology for the Development of Heat Supply Schemes for Settlements of Ukraine, as specified in chapter 2.4. Currently, these schemes are very comprehensive and detailed, but also time-consuming. If periodic heat supply schemes, following this comprehensive methodology, become mandatory in Ukraine, many municipalities with limited funds will face challenges with 100% local financing.

Therefore, it is recommended to reduce the level of technical details in the schemes, making them simpler and more operative, in line with the Energy Efficiency First principle and Cost-Benefit Analysis (CBA) for new bankable investment projects. The technical details can be moved to the concrete project maturation process. In this regard, elements from Danish heat planning practice are recommended.

2.1.10. Article 26 – Heating and cooling supply

The article sets a timeline for criteria, which shall be met for being defined as 'efficient district heating and cooling systems'.

A characteristic of the criteria is that they will be gradually tightened over time to meet the climate neutrality target by 2050. This will be achieved either by: 1) Gradually tightening the requirements for the

production composition or 2) gradually tightening the requirements for permitted specific GHG emissions per unit of heat or cold delivered to customers, aiming for a target of zero emissions by 2050.

Thus, at present until 31 December 2027 'efficient district heating' is a system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat according to §1. Or the Member States may choose - and notify the Commission - the alternative criterion in §2: until 31 December 2025 the maximum amount of GHG emissions per unit of heat or cold delivered to the customers is 200 grams/kWh. (A natural gas boiler emits just over 200 grams per produced kWh of heat, but this must be corrected to a higher value due to the heat distribution loss to the customer).

Member States shall ensure that district heating and cooling systems, which are built or refurbished, shall meet the criteria, and shall ensure that district heating and cooling systems with a capacity above 5 MW shall prepare a plan for more efficient heat supply every 5 years.

Member States must ensure that cost-benefit analyses are carried out for the following installations:

- Combined heat and power installations with an average annual total energy input exceeding 10 MW.
- Industrial installations with an average annual total energy input exceeding 8 MW to assess waste heat utilization.
- Large heat pumps with an average annual total energy input exceeding 7 MW, using heat from wastewater treatment facilities and LNG facilities, etc.
- Data centers with a total rated energy input exceeding 1 MW.

However, the following installations may be exempt from the analyses:

- Peak load and backup power plants.
- Installations close to geological storage.
- Data centers whose waste heat is or will be used in district heating or directly for a group of buildings where they are located.

The cost benefit analysis shall consider cooling systems that allow removing or capturing waste heat at useful temperature level with minimal ancillary energy inputs.

Member States shall require cost-benefit analysis to be carried out in cooperation with companies responsible for the facility. To ensure that any decisions made are based on robust and systematic evaluations, Member States shall adopt authorization criteria for outcome of the comprehensive cost-benefit analysis.

Member States shall collect information on cost-benefit analysis carried out and publish them with respect to their potential sensitivity.

Member States may exempt individual installations in case the benefits according to cost-benefit analysis exceed their costs. This provision is intended to ensure that energy efficiency measures are implemented in a way that is economically rational and practical.

Member States shall remove barriers for utilization of waste heat and provide uptake of waste heat where the installations are newly planned or refurbished, and the Member States shall ensure that data centers shall utilize waste heat or waste heat recovery applications unless they can show that it is not feasible.

Fitting equipment to capture carbon dioxide by a combustion installation for storing CO_2 (referred to as Carbon Capture and Storage or CCS) shall not be considered a refurbishment. This distinction ensures that energy efficiency improvements focus on reducing energy consumption, while CCS is recognized as a complementary but separate environmental measure aimed at reducing GHG emissions.

Member States shall ensure that origin of electricity from high-efficiency cogeneration can be guaranteed according to objective and transparent non-discriminatory criteria. This is to promote the use of high-efficiency cogeneration and provide confidence to consumers and stakeholders about the source and efficiency of the electricity they are using.

Furthermore, Member States shall ensure that available support for cogeneration is subject to electricity produced originating from high-efficiency cogeneration and the waste heat being effectively used to achieve primary energy savings. Public support to cogeneration and district heating generation and networks shall be subject to State aid rules where applicable.

It is crucial to correctly include high-efficiency co-generation in the cost-benefit analysis:

- The criteria for high-efficiency co-generation are that the saved fuel used for co-generation of heat and power is at least 10% lower than the fuel consumption of separate production, if there is power-only production on the margin in the power system. For example, electricity from a gas-fueled co-generation plant replaces electricity from a gas-fueled power-only plant.
- The fuel used for co-generation of heat and power is approximately 30% lower than the fuel consumption of separate production of heat and power from a typical co-generation plant (see Table 4).
- The amount of fuel saved for co-generation of heat and power for supplying heat is 60% of the fuel used to generate the same heat by a heat-only boiler. This can also be expressed as an efficiency, defined as the additional fuel consumption to generate heat compared to power-only production divided by the fuel consumption by a heat-only boiler. In this case, it is around 250% (see Table 4). This reduces heat waste in cooling towers and seawater cooling in the power system.
- The benefit of co-generation is negative, corresponding to an efficiency of around 50% in hours when there is a surplus of electricity from wind, solar PV, and nuclear sources that cannot be downregulated.

- The energy efficiency term (saved MWh fuel) does not reflect the benefit if the co-generation plant uses a different fuel than the power-only plant on the margin.

Therefore, in the generic case, it is important that the cost-benefit analysis of cogeneration is based on a simple simulation of the electricity system. The fuel costs for heat from the cogeneration plant should be defined as the costs of fuel for the total production minus the income from delivered electricity from the plant, as illustrated in the table below.

Table 4: Examples illustrating fuel consumption with power-only production on the margin.

Production and fuel consumption	Production MWh	Efficiency	Fuel (PE) MWh
Cogen* mode - heat production part	100	60%	167
Cogen mode - power production part	57	34%	
Replaced marginal power-only production	-57	45%	-127
Heat production in cogen mode	100	250%	40
Heat-only boiler (to compare)	100	90%	111
Direct electric heating (to compare)	100	45%	222

*Cogen = co-generation

Primary Energy Key Figures	Fuel (PE) MWh	
Primary energy by separate production	111+127= 238	
Primary energy by cogen	167	
Primary energy savings cf. EED	71	71/238=30%

There is no current estimate of the extent of effective district heating in Ukraine, but the following points can be noted:

- Ukraine has a significant number of gas-fired cogeneration plants, many of which were established during the Soviet era. These plants are primarily used in district heating systems that supply both heat to urban areas and electricity.
- Recent efforts have focused on upgrading and modernizing these plants to improve their efficiency and meet the criteria for high-efficiency cogeneration.
- However, in many Ukrainian district heating systems, gas boilers are predominant, requiring significant investments to meet the efficiency criteria for district heating.

3. Legal Framework in Denmark

A significant part of Danish legislation concerning the heating sector has been in force since 1976 for combined heat and power and since 1979 for heat supply. This legislation reflects Denmark's commitment to promoting energy efficiency and resiliency, reducing greenhouse gas emissions, and increasing the share of renewable energy sources, in line with relevant EU legislation. Therefore, Denmark has implemented several legislative measures to promote energy efficiency and the use of renewable energy sources in the heating sector, with a particular focus on district heating.

Danish legislation has been a benchmark for EU directives, particularly concerning heat supply planning and the implementation of energy-efficient CHP projects. The latest amendments largely stem from EU legislation, notably the EU Energy Efficiency Directive (EED), the Energy Performance of Buildings Directive (EPBD), and the Renewable Energy Directive (RED), as they are closely related within a common legal framework.

The underlying political framework is the Paris Agreement, adopted at UNFCCC COP21 in 2015. In line with the European Climate Act, the goal in the Danish legislation is to reduce Denmark's total emissions of greenhouse gases by 70% in 2030 compared to the 1990 reference level and to achieve climate neutrality (net zero) by 2050 at the latest. Denmark is thus aiming to meet the EU's goal of reducing net greenhouse gas emissions by at least 55% by 2030 at the latest (the "Fit for 55" legislative package of EU) in the most cost-efficient manner for the society. Furthermore, in 2022, the Danish government announced the promotion of the net zero goal by 2045, which will tighten the requirements in future climate and energy legislation in relation to the heating sector legislation.

Below is a list with links to institutions and selected legislation relevant to the Danish heating sector that is further described in this chapter. As is applicable for all Member States, EU directives do not apply directly and immediately, but must first be implemented in national legislation based on a national interpretation.

Table 5: Selected key governmental bodies and legislation relevant to the Danish heating sector

Governmental bodies and legislation	Source
Danish Ministry of Climate, Energy, and Utilities	https://www.en.kefm.dk/
Danish Energy Agency	https://ens.dk/en
Danish Utility Regulator	https://forsyningstilsynet.dk/about-us
Danish Energy Appeals Board	https://naevneneshus.dk/om-os/
Heat Supply Act	https://www.retsinformation.dk/eli/lta/2024/124
Executive order for approval of projects	https://www.retsinformation.dk/eli/lta/2023/697
Executive order for mandatory connection	https://www.retsinformation.dk/eli/lta/2022/705
Executive order on guarantees of origin	https://www.retsinformation.dk/eli/lta/2023/913

Executive order on energy companies and building owners information obligations	https://www.retsinformation.dk/eli/lta/2025/29
The District Cooling Act	https://www.retsinformation.dk/eli/lta/2023/221
The Municipal Planning Act	https://www.retsinformation.dk/eli/lta/2024/572
The Electricity Supply Act	https://www.retsinformation.dk/eli/lta/2023/1248
The Building Act	https://www.retsinformation.dk/eli/lta/2016/1178
The Building Code	https://www.retsinformation.dk/eli/lta/2019/1399
The Act on the promotion of efficient energy use and greenhouse gas reduction	https://www.retsinformation.dk/eli/lta/2024/1036
Executive order on implementation subsidy	https://www.retsinformation.dk/eli/lta/2022/937
Executive order on the municipalities' borrowing and provision of guarantees etc.	https://www.retsinformation.dk/eli/lta/2024/1484
Executive order on building energy labelling	https://www.retsinformation.dk/eli/lta/2023/549

3.1. Institutions

The Danish heating sector is supported by a range of institutions, each with unique roles and areas of responsibilities. Table 6 provides a detailed overview of these institutions, outlining their specific roles and the scope of their responsibilities. The table serves as a guide to understanding how various entities contribute to the regulation, oversight, and facilitation of heating services in Denmark.

To show the relationships of the institutions, figure 3 is provided.

Table 6: Institutions in relation to the Danish heating sector

Institutions	Role	Responsibilities
Danish Ministry of Climate, Energy, and Utilities	Shaping and implementing Denmark's policies on climate change.	Developing and implementing Denmark's energy and climate policies to meet national and international climate goals. Regulating utilities within district heating and cooling, electricity, and gas to ensure efficient and reliable service delivery.
Danish Energy Agency	Governmental agency under the Ministry of Climate, Energy and Utilities.	Formulating national energy policies. Promoting renewable energy implementation and energy efficiency initiatives. Supporting the energy sector through research, data, and analysis.
Danish Utility Regulator	Administrating and supervising utility sectors according to national and EU regulations.	Enforcing Danish energy legislation. Regulating energy markets to protect consumer rights and promote fair competition. Collecting information about heat tariffs and conditions to process complaints and objections. Ensuring fair and impartial access to heating services.
Danish Energy Appeals Board	Independent institution addressing complaints and appeals related to regulatory decisions.	Handling consumer complaints regarding the purchase and delivery of energy services. Resolving complaints concerning authority decisions in individual cases and addressing potential legal misinterpretations.
Municipalities	Local authorities in heat planning, authorization, and regulation of heating infrastructure.	Conducting municipal heat planning and strategies. Approving or rejecting proposals for heat supply projects. Ensuring heat supply projects comply with Danish legislation.
National association of municipalities (KL - Local Government Denmark)	Representing Danish municipalities and providing coordination and information within municipal heat planning.	Supporting and guiding municipalities in local policy development and implementation of municipal heat plans. Facilitating cooperation and knowledge sharing between municipalities and other actors.

District Heating Companies	Utility entities contributing to efficient, sustainable, and reliable heat supply.	Producing, distributing, storing, and supplying heat through a network to residential, commercial, and industrial buildings. Buying heat from competitive third parties. Generating heat and selling electricity from CHP plants. Managing and operating district heating networks. Submitting investment project proposals to the local municipality. Adopting heat tariffs within the framework of the Heat Supply Act. Reporting tariffs and operational data to the Danish Utility Regulator.
District Heating Association	Representing district heating companies	Offering support and assistance to members. Facilitating exchange of knowledge and information. Developing technical guidance and standards for district heating systems. Promoting district heating networks and their advantages. Facilitating collaboration among member companies.
Energinet (TSO)	Managing and operating Denmark's national electricity and gas transmission grids	Managing Denmark's electricity market. Indirectly affecting heating systems through actions that impact energy markets and price fluctuations for electricity and gas.
Electricity Distribution System Operators	Managing the electricity distribution network	Maintaining a reliable and safe electrical distribution network. Delivering grid capacity for electric boilers, large heat pumps, and CHP plants.

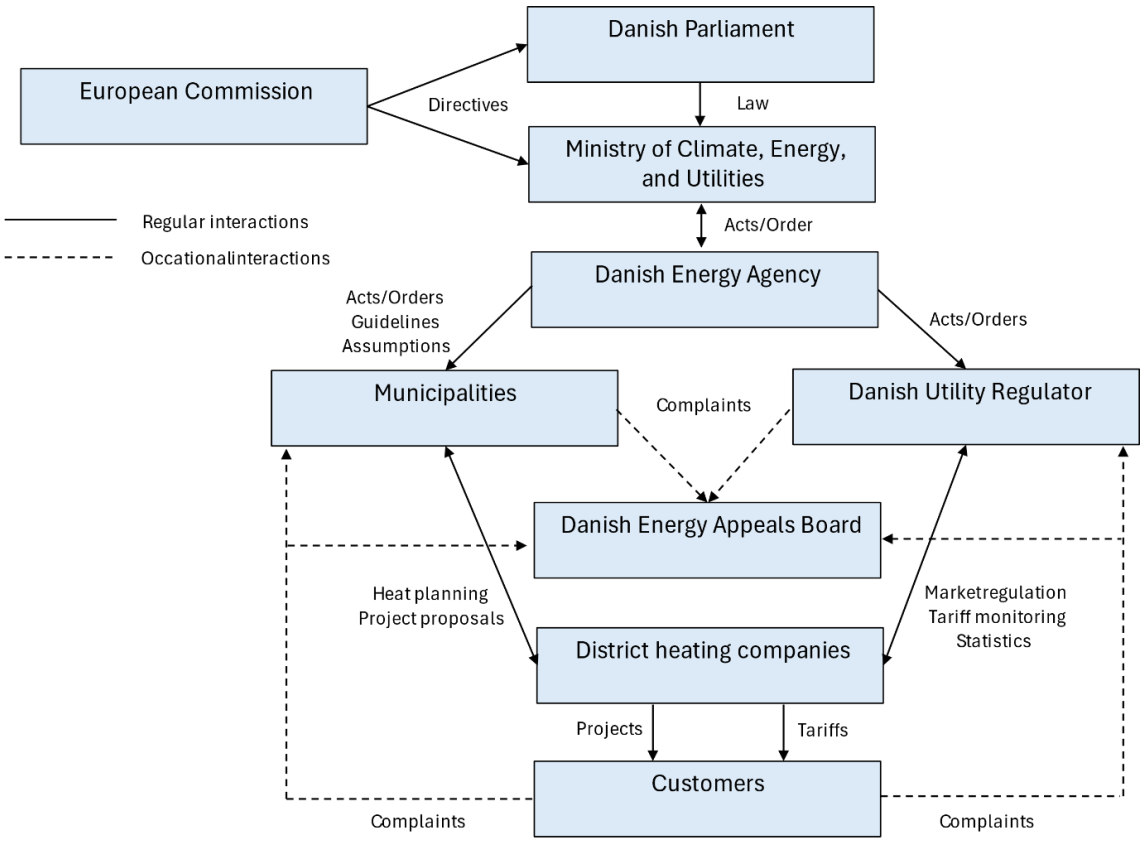

Figure 3: The relationship between actors in the Danish heating sector

As shown in Table 6 and Figure 3, a multitude of institutions play various roles within the Danish heating sector, each bearing distinct levels of responsibility. For instance, the municipalities are pivotal institutions, especially in terms of local heat supply planning, and they also play a substantial role in the authorization and regulation of heat supply projects. Additionally, other institutions, while not central, still exert an indirect influence and hold certain responsibilities within the sector.

As empowered body, the Danish Energy Agency (DEA) transposes the requirements and standards set out in, e.g., the EED into national legislation. This includes assessment of the scope of articles, working documents, instructions and guides from the commission, participation in EU network groups, informal discussion with other member states, and involvement of other national authorities and stakeholders. Main challenges include clarifying who is responsible for implementing a provision when a regulation cuts across ministries and supply areas, as well as possible administrative and financial burdens for industry and for central and local authorities.

3.2. The Danish heat supply act

The heat supply act is the central law on planning, development, and regulation of the heating sector in Denmark. The heat supply act, which was adopted in 1979 and subsequently revised several times, aims to promote cost-effective supply of heat and hot tap water for the society, considering costs of environment, and - within this framework - to reduce the dependency on fossil fuels, and in particular oil.

Thus, the act plays a decisive role in Denmark's efforts to promote cost-effective and resilient heat supply solutions, reducing greenhouse gas emissions and ensuring a reliable and affordable heat supply to heat consumers. Since the act has been in force long before the EU legislation on energy and climate, it can be considered a precursor and has inspired some elements of the EU legislation, including the EED. The act is an overall "framework" act in which several articles delegate the power to the minister to elaborate Executive orders in co-operation with major stakeholders in the sector, including the national association of municipalities (KL). Key aspects of the Danish heat supply act include:

- Chapter 2 in the act regulates the heat supply planning at an overall level and defines that the municipalities are heat planning authorities and have the obligation to work with heat planning in co-operation with local stakeholders to identify cost-effective projects and assess and approve/reject project proposals for heat supply. This is further elaborated in the executive order of projects. Article 5 delegates the power to the minister to elaborate an Executive order for planning and approval of projects. Article 14 delegates the power to the minister to elaborate an Executive order for obligatory connection.
- The act creates the framework for project proposals, which are typically used to propose specific projects for heat supply for space heating and hot tap water in buildings. The project proposals are submitted to the municipality for approval by typically district heating companies and previously by gas companies too, according to article 4, chapter 2.
- Projects for collective heat supply of buildings with a heat capacity of at least 250 kW and CHP plants with an electrical capacity of up to 25 MW are subject to municipal approval, according to article 2, chapter 1.
- Chapter 4 in the act regulates prices for production, transmission, and distribution of heat to district heating consumers and specifies that tariffs shall be reasonable and can only include the necessary costs, including a reasonable interest on invested capital. In other words, district heating companies shall operate on non-profit business basis to maximize profit to the consumers and give the consumers the profit by reducing the heat tariffs.
- Chapter 4, article 20, 21, 22 and chapter 4a, article 23 in the act determine the role of the Danish Utility Regulator in the heating sector and in other energy sectors.
- Chapter 4b in the act regulates to some extent the ownership of district heating utilities and consumer influence. In case a district heating utility is for sale, the consumers or the municipality shall have the first right to purchase the company at the market price, (which will take onto account that an owner only can include a reasonable (low) interest of invested capital in the heat price).
- Chapter 5 in the act empowers the minister to oversee the implementation of heat supply plans, monitor compliance with regulatory requirements.
- Chapter 6 in the act defines the role of the Danish Energy Appeal Board

The act, in combination with the electricity supply act, has been a central driving force in the development of an efficient and resilient heat supply sector:

- The act has since 1980 enforced all municipalities to prepare heat supply plans for the most cost-effective zoning of district heating areas against natural gas networks and individual heat supply and for supply of heat to the district heating.
- The act has enforced district heating utilities to propose and implement projects in accordance with guidelines for cost-effective heat supply.
- Due to these projects, the district heating market share has today reached more than half of residential construction, corresponding to 2/3 of all Danish households.75 % of the district heating now comes from green renewable energy sources, which include biomass, waste-to-energy processes, solar thermal and increasingly excess heat from various sources by using heat pumps.
- Recently the energy policy objectives have stimulated projects that eliminate gas for heating and promoted projects based on electricity from wind and solar energy, e.g.:
    - Completion of the conversion from old steam systems to hot water district heating.
    - A further extension of the district heating market share to replace individual gas boilers for heating in most urban areas.
    - Large heat pumps for district heating, which can interrupt at high electricity prices and use low temperature heat sources and ambient heat.
    - Electric boilers for district heating, which use surplus low-price electricity and balance the electricity system.
    - Large heat storage facilities for district heating.

The planning methodologies and technologies stimulated by the Heat Supply Act are generally in accordance with the EED. They also serve as a benchmark for other EU countries to implement the EED.

3.3. Executive order for approval of projects

This executive order to the heat supply act implements the heat supply planning provisions of the heat supply act. It has two main parts:

a) The procedure for approving project proposals including rights and obligations.
b) The criteria for assessment of project proposals.

3.3.1. The procedure for approving project proposal

Heat supply utilities normally develop project proposals on their own initiative, but the municipality, which is the heat planning authority, can also request heat supply utilities to elaborate project proposals.

All investment projects in district heating distribution and production as well as heat production at large heat consumers with a heat capacity above 250 kW are covered by the act.

The procedure for assessment and approval of a project proposal is as follows:

- A district heating company submits a project proposal to the authority.
- The authority shall assess the proposal and send it for hearing in four weeks to relevant stakeholders (potential new consumers in case of extension of the market, landowners who may be forced to cede land and major stakeholders).
- The authority shall assess the proposal considering the hearing responses.
- An approved proposal shall be announced to the stakeholders who have four weeks to complain.
- Any complain shall be submitted to the Energy Complain Board, which will assess the approval.

The procedure for assessment and approval is illustrated below.

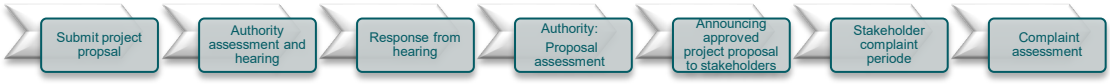

Figure 4: The procedure for assessment and approval of project proposals

3.3.2. The criteria for assessment of project proposals

The executive order goes into detail with the criteria for approval. The most important is that the proposal shall prove that the proposed investment is cost-effective for the society based on the methodology guidelines issued by the Ministry of Finance and the Danish Energy Agency, including a forecast of energy prices and costs of emissions compared to a realistic baseline. It is stressed that the cost of CO2 is included in the total costs and therefore CO2 neutrality is not a criterion.

Besides, it is requested that the proposal shall include all necessary data and information, which indicate that the project can be implemented successfully, e.g.

- The company, that is to invest, shall be presented and well known by the authority.
- The project shall be cost-effective for the consumers and the company.
- The project shall comply with other legislation, especially in the environmental field.
- Stakeholder comments from the hearing shall be taken into consideration.

An approved project has the following consequences:

- It is a binding agreement between the authority and the utility that obligates the utility to complete the project within 5 years and gives it a monopoly on the heat supply to the district approved for district heating.
- An approved project, which is sent for normally 4 weeks mandatory hearing to landowners, also gives the utility the right of way through private land, if necessary, following the same rules as for infrastructure in public roads.
- It can be used to justify mandatory connection within 9 years (no longer in force)
- It can open for financing with favorable loans and municipal guarantees.

- A consumer with a capacity larger than 250 kW must remain connected and use all heat from the district heating system, unless the planning authority approves a proposal from the consumer for an alternative heat supply.
- The main idea of the executive order is that any potential supplier of heat, including a large consumer, can propose a new project, which can be approved if it is more cost-effective for the society than the existing approved project. To give three examples:
    - The district heating company submits a proposal for replacing individual gas boilers and the gas grid with district heating e.g., large CHP plants and waste incineration plants.
    - The district heating company submits a proposal for a gas fueled CHP plant to be base load and replace less cost-effective heat production from large gas boilers.
    - The district heating company submits (20 years later following the energy policy) a proposal for an electric boiler and a large heat pump to replace most of the production from the gas-fired CHP plant, whereas the CHP plant and the gas boilers will be back-up for unreliable wind and solar energy.

3.4. The executive order on mandatory connection

The executive order on mandatory connection to projects for collective heat supply gives the municipalities the right to approve project proposals for mandatory connection to the approved district heating network, if it is cost-effective for the society and the consumers, including those to be connected. That includes:

- Mandatory connection for new buildings.
- Obligation to remain connected for existing consumers.
- Obligation to connect within 9 years for consumers below 250 kW.
- Ban on electric heating.

The obligation to be connected is an obligation to pay the annual fixed payment. It is not an obligation to use all heat from the district heating, as it is for consumers above 250 kW.

However, in 2019, this option to enforce mandatory connection in new projects has been cancelled, as the Parliament seems to think that district heating is competitive and that small consumers below 250 kW will connect anyway if district heating is the best solution.

The executive order on building regulations has enforced calculation factors that provide low-energy houses the opportunity to get individual heating. Examples include:

- The Municipality of Copenhagen has used mandatory connection to district heating when enforceable through project proposals, resulting in 99% of all existing buildings being connected.

- The Municipality of Frederiksberg, in the center of Copenhagen, also has 99% connection of all existing buildings to district heating, but without mandatory connection.
- Many district heating companies do not submit project proposals for supplying new urban development areas, although it is cost-effective, due to the risk of low connection rates.

3.5. The planning in accordance with the Municipal Planning Law

The act sets the legal framework for the spatial planning and land use in the municipalities, including planning of space for energy facilities including networks. In new urban development areas, the municipal plan could specify obligatory connection for new buildings to new district heating networks, which was approved in accordance with the heat supply act including obligatory connection. Thereby the local planning authorities could plan the most cost-effective heat supply (gas, district heating or individual heating) to new buildings in line with planning of other infrastructure such as sewage pipes. This option has now been cancelled.

3.6. The electricity supply act

This act came into force for the first time in 1976 and has been revised several times, not least for implementing the electricity market. The most important article with relation to the heat supply act and the EED was that the act in 1976 gave the minister the authority to approve all new power capacity with a capacity above 25 MW. This was in line with an announcement from the European Community (EC) (the precursor to the European Union (EU)) which requested Member States to consider how to plan new power capacity with the ability to deliver efficient combined heat and power (CHP) to district heating systems.

Since 1976, all new power capacity in Denmark has been cost-effective CHP plants located in the most optimal way for the society. Up to 1990, all new capacity was large plants located at the largest urban areas and based on coal. After 1990, the main fuel has been straw and natural gas for large plants and gas for small CHP plants. After 2010, several coal-fueled plants were reconstructed to wood pellets and new CHP plants were fueled with straw.

The first CHP plant to be approved was *Studstrupværket* unit 3 and 4 to supply the city of Aarhus, which at the same time submitted the first heat supply plan to the minister for approval in 1981, for supplying the whole city of Aarhus with heat from the CHP plant.

The first CHP plant to be approved at a new location with respect to the heat market was *Avedøreværket*. The new site is close to the large heat markets in Greater Copenhagen.

Thus, the electricity supply act has been and is important for the Danish heat supply sector, primarily by supporting increased sector integration of electricity and heat supply. The act originally supported the expansion of cogeneration, which today is significant part Danish district heating, and by promoting renewable electricity generation (such as wind and solar power) it supports today also the use of electric heat pumps and electric boilers in the district heating sector.

3.7. The district cooling act

The purpose of the district cooling act is to promote efficient district cooling based on renewable energy, to regulate district cooling and to regulate the municipal owned companies. In general, district cooling is considered a commercial activity that cannot benefit from municipal guarantees if it is financed by municipal district cooling.

3.8. The act on promotion of efficient energy use and greenhouse gas reduction

The implementation of the EU directives stimulates new Danish legislation. The implementation of the latest version of the Energy Efficiency Directive (EED) has so far primarily taken place by the latest revised act. This aims at promoting energy savings and energy efficiency as well as greenhouse gas reduction in accordance with climate and environmental considerations and considerations for security of supply and social economy.

The act includes:

1. The prioritization of energy savings activities, thus promoting energy savings and energy efficiency as well as greenhouse gas reduction in accordance with climate and environmental considerations and considerations for security of supply and social economic criteria.
2. Cooperation and coordination on the execution of the activities to ensure that efforts to promote energy savings are coherent and effective.
3. Efficient use of energy through campaigns, market introduction and information.
4. Energy savings and energy efficiency improvements as well as greenhouse gas reductions through state support, i.e., by allocating funds from the annual state budgets.
5. Energy savings by getting energy supply companies to allocate costs between fixed and variable tariffs.
6. Energy savings in public institutions, which include buildings, facilities, equipment, and the like.

Together with other climate and energy legislation, this act, which refers directly to the EED, is an important basis for the acts, executive orders, guidelines, and procedures related to all parts of the energy sector, including the heating sector.

3.9. Executive order on the municipalities' borrowing and provision of guarantees etc.

This executive order regulates the municipalities' access to take out loans or provide a municipal loan guarantee for use in construction projects or expenses. The financial unit KommuneKredit can grant the loans on favorable terms.

KommuneKredit is an association whose members consist of all municipalities and regions in Denmark. KommuneKredit aims to provide loans to municipalities, regions, and other entities, e.g., district heating companies, which solve a public task and can thus obtain a full guarantee from a municipality. KommuneKredit is regulated by law and does not profit from lending. All loans and credits provided by KommuneKredit are financed by KommuneKredit issuing bonds on the national and international capital markets.

Municipalities can thus provide a guarantee for the district heating companies' loans with KommuneKredit, as the companies are solving a public task that the municipalities could alternatively legally handle. Since the companies (as a kind of substitute) solve a public task, it is also a condition that the companies are regulated according to the Danish heat supply act as a non-profit company.

For the district heating company, a municipal guarantee involves a support element when obtaining favorable loan terms from KommuneKredit. For the municipality (i.e., the taxpayers in the municipality), the guarantee is a financial risk, in case the district heating company cannot pay the loan to KommuneKredit, and KommuneKredit therefore will charge the guaranteed amount to the municipality.

Therefore, the city council decides on a fixed loan guarantee commission as a percentage of the remaining debt on the loan. The commission percentage is based on the EU Commission's minimum premiums and based on a credit assessment of the borrower (i.e., financial due diligence of the district heating company), which is carried out by an audit firm. The municipality thus ensures that there is no (or limited) distortion of competition in relation to loans taken out on market terms. At least in principle, as the ordinary loan market can generally be difficult and expensive to operate on for a district heating company.

The commission percentage for Danish district heating companies is typically in the range 0.4-0.8%, depending on the assessed credit quality. For very risky projects, the municipality can raise the commission percentage to 2-3%. The municipality can provide a guarantee for loans with up to 5 years grace period and with a term of up to 30 years.

3.10. Executive order on implementation subsidy

The executive order on subsidies for implementing electrically driven heat pumps and solar heating systems for district heating production is based on a financial disposition framework from the Finance Act. With this order, the Danish Energy Agency can provide subsidies to district heating companies for investments in electrically powered heat pumps and solar heating systems, aiming to displace existing heat production primarily based on coal, oil, or natural gas.

For electrically driven heat pumps, a condition for receiving a subsidy is that the total district heating system, either before or after installation, constitutes "efficient district heating," as defined in EED Article 26. Generally, Danish state subsidy schemes for district heating and cooling are conditional on efficient

district heating. The criteria for efficient district heating and cooling are defined in Danish legislation in line with the EED.

Figure 5 shows that almost all district heating systems in Denmark meet the criteria for efficient district heating. Only a few systems do not yet meet these criteria, mostly because they still rely too heavily on gas boiler production. However, they have ongoing investment projects to transition away from fossil fuels.

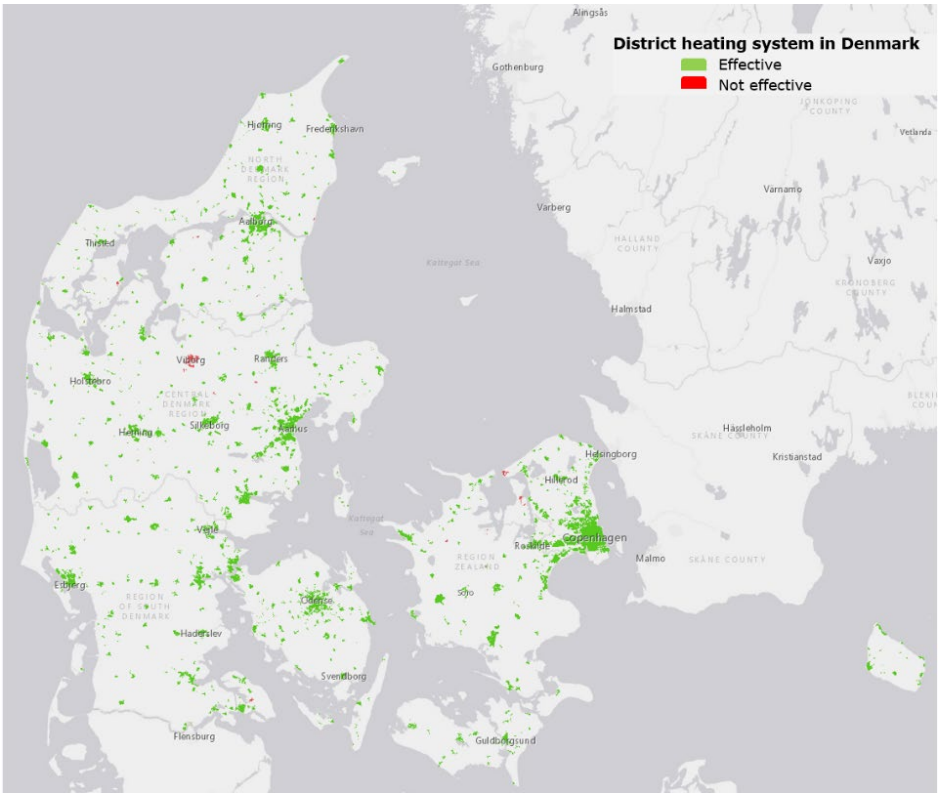

Figure 5: Effective district heating systems in Denmark[13]

Note that until 31 December 2027, the criteria for an efficient district heating or cooling system are that it uses at least 50% renewable energy, 50% waste heat, 75% high-efficiency cogenerated heat or 50% of a combination of such thermal energy going into the network. The criteria are gradually tightening in the EED until 2050 where the criteria will be a system using only renewable energy, only waste heat, or only a combination of renewable energy and waste heat.

Also, note the term 'high-efficiency cogeneration' defined in the EED. It means cogeneration production resulting in primary energy savings of at least 10% compared to the production of electricity and heat separately using the same type and amount of fuel. All Danish CHP plants (including the waste CHP plants) meet this criterion.

[13] Source (and zoom options): https://energidata.maps.arcgis.com/apps/dashboards/4168f1efa64c4c37a9ddee58dd5db83c

3.11. Future legislation on promoting the phasing out of individual oil and gas boilers

The green conversion signifies a shift in usable forms of heat supply and technologies. In the Climate Program 2023, the Danish government expressed its intention to present "models for stopping the new installation of oil and gas boilers," which is under development.

3.11.1. Individual Oil Boilers

Since 2013, it has been illegal to install oil boilers in new houses.

As of July 2016, it is also prohibited to replace an old oil boiler with a new one if district heating or natural gas is available in the area.

Municipal heat planning divides urban areas into zones for either district heating or individual natural gas.

The government's aim is to phase out oil boilers as a form of heating by 2030.

3.11.2. Individual Gas Boilers

The national climate plan aims to phase out natural gas boilers for building heating due to their fossil origin.

There are currently no plans to ban natural gas in the heating sector in Denmark. Instead, biogas is intended to gradually replace natural gas in the national gas network.

The national gas network is expected to consist of 100% upgraded biogas (biomethane) by 2029 (with biomethane making up nearly 40% in 2023).

As biogas production in Denmark cannot meet current gas demand, it is desired to phase out individual gas boilers for heating buildings, reserving biomethane for industries, power peak generation in CHP plants, and spare capacity in district heating.

3.11.3. National Ambitions and Challenges:

By 2035, the national political ambition is to eliminate buildings heated by individual gas boilers. However, legislation to enforce this phasing out remains unclear due to other EU legislation preventing a ban on purchasing gas boilers.

3.11.4. Existing Boiler Prevalence:

In 2024, around 60,000 residential buildings are heated with oil boilers, and about 290,000 with gas boilers.

In the coming years, these boilers are expected to be replaced by more climate-friendly options, such as district heating and individual heat pumps.

Rural buildings will continue using wood-burning stoves for economic reasons despite their local pollution impact. Solar heating panels can also cover part of individual heating needs.

3.11.5. Future Heating Options

District Heating: Based on an increasing share of renewable energy and excess heat via heat pumps, predominantly in urban areas.

Individual Heat Pumps: Efficient with low supply temperatures, best for well-insulated houses with underfloor heating, typically where heat density is lower. The high price often deters choosing this option.

3.11.6. State Aid Programs

The national Climate Agreement 2020 allocated funds for phasing out individual oil and gas boilers and converting to heat pumps or district heating. Specific executive orders translated this into funding pools:

- **District Heating Pool (2021-2023):** For conversion to efficient district heating, approved via municipality project proposals.
- **Gas Disconnection Scheme (until 2026):** Funds for free disconnection from the gas network.
- **Building Improvement Pool (until 2026):** For energy improvements, e.g., insulation, heat pumps, and window replacements. In 2023, divided into the Heat Pump Pool and the Energy Renovation Pool.
- **Scrapping Scheme:** Subsidies to replace old oil, wood pellet, or gas boilers with heat pumps by subscription.

3.11.7. Latest Projections

The 2024 projection shows the effect of promoting district heating and heat pumps, reducing gas and oil boilers in the Danish housing stock. (Refer to Figure 6.)

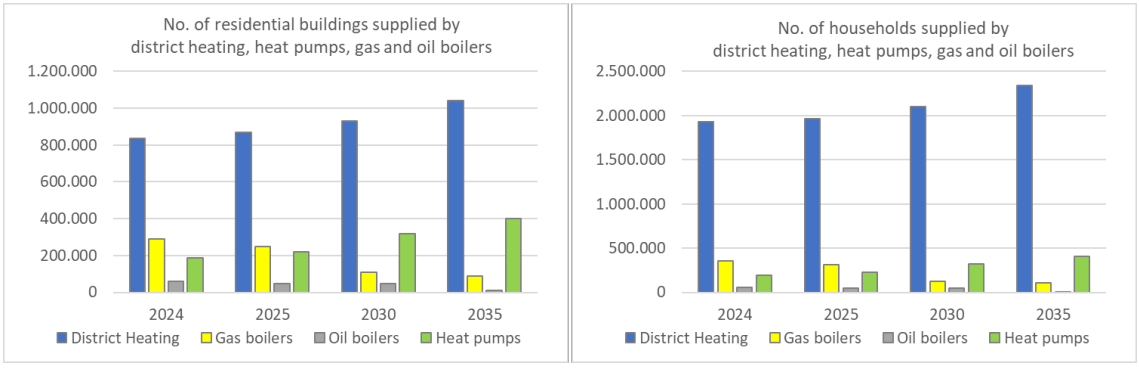

Figure 6: Forecast of heat supply from different energy technologies[14]

[14] Source: Climate status and projection 2024 of the Danish Ministry of Climate, Energy and Utilities, and Statistics Denmark

3.12. The executive order on guarantees of origin

The aim of executive order on guarantees of origin for electricity, gas, district heating, and district cooling from renewable energy sources is primarily to issue a declaration to end users of energy. Guarantees of origin are also issued to promote the sale of energy from renewable energy sources, as consumers receive more transparent and verified information about the origin of the energy from renewable energy sources offered on the market. Thereby, guarantees of origin will have an indirect effect via increased income for renewable energy (RE) production, which can lead to an expansion of existing or new RE production facilities.

The Renewable Energy Directive (RED) contains rules on guarantees of origin for energy from renewable energy sources. The latest version RED III from 2023 has not yet been implemented in Danish legislation, where associated Executive orders on guarantees of origin include:

- District heating, district cooling, electricity, and gas from renewable energy sources
- Electricity from high-efficiency cogeneration as defined in the EED, i.e., production from a cogeneration unit that results in primary energy savings of at least 10% compared to separate production of electricity and heat.

Guarantees of origin in Denmark can only be issued for production at facilities that are registered, and are issued as an electronic document, the function of which is to prove to an end customer that a given share or amount of energy is produced from renewable energy sources such as: wind power, solar PV, biogas, biomass, landfill gas, etc.

Ensuring renewable energy sources is important, as the RED prescribes for the Member States an annual increase in the RE share in heating and cooling of 0.8 percentage points from 2021-2025 and 1.1 percentage points from 2026-2030, or a RE share of over 60% in 2030. The total RE share in Denmark is estimated to increase to approx. 74 % in 2030.

Sustainable biomass has received particular attention, as it is confirmed in the latest version of RED from 2023 that so-called primary wood biomass – i.e., wood directly from the forest for use in energy supply - can still be categorized as renewable energy (and thus CO2-neutral), when certain sustainability requirements are met, which they already do by law in Denmark. This has a major influence on the continued use of wood chips in Danish district heating.

The scheme of guarantee is according to the common European standard "EECS" (European Energy Certificate System). The standard prescribes how guarantees of origin are issued, traded, and used. The rules for the EECS standard have been drawn up under the cooperation organization 'Association of Issuing Bodies' (AIB).

3.13. The executive order on information obligations

The Danish executive order on energy companies and building owners' information obligations towards end customers and end users on energy consumption and invoicing applies to energy companies and owners of buildings with distribution meters and deals with their obligation to inform end customers and end users about their energy consumption, invoicing accordingly and other invoicing information. The energy companies are electricity trading companies, natural gas distribution companies, and heat distribution companies (i.e., the district heating companies). Customer information, which can be found on the energy companies' website, include:

- Current operational disruptions if any.
- The development in the customer's energy consumption in the past years.
- Bills issued and explanation of the structure of the bill.
- Heat tariffs and connection fees.

The executive order specifically applies the district heating companies' duty to publish information about their ranking category and plans for green conversion. In addition, district heating companies must publish information on energy consumption, greenhouse gas emissions etc. named as a district heating declaration.

Note that a separate chapter below presents the tariff structure and how complaints from customers are handled, etc. in Denmark.

3.13.1. Renewable energy ranking category

District heating companies are obliged to prepare the company's ranking category using the Danish Energy Agency's ranking model. The ranking category must be made publicly available via the energy company's website or equivalent online platform and updated at least once a year. The purpose is to make district heating consumers aware of how green their district heating is. The ranking must be presented as a traffic light color (red, yellow, or green) corresponding to three possible categories as shown in Figure 7.

As shown in Figure 7, the natural gas boiler has been chosen as the lower reference threshold value due to its widespread use for individual building heating in Denmark. The air-to-water heat pump has been chosen as the upper reference threshold value because it is the most widespread type of heat pump for individual heating in Denmark.

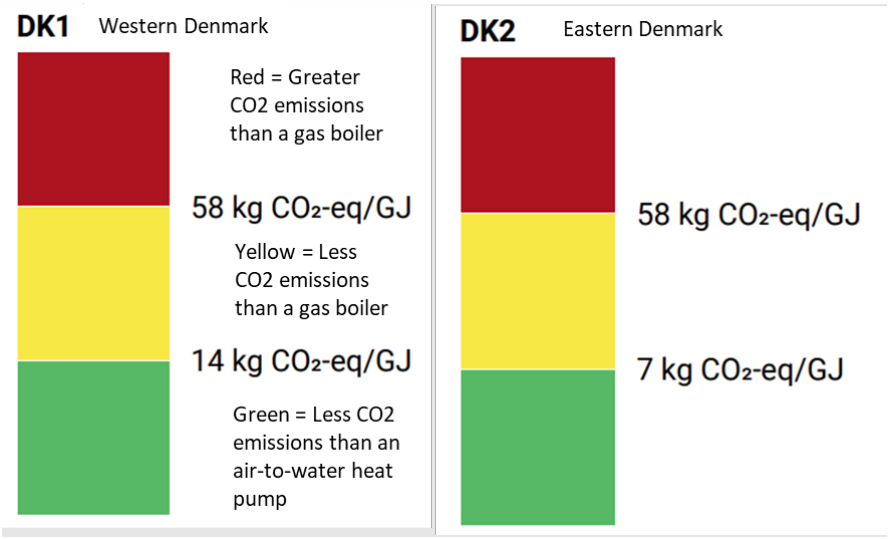

Figure 7: Traffic light ranking model with CO_2e emission threshold values (valid for year 2022)[15]

Note that the Danish electricity system is divided into two bidding zones for electricity producers with different GHG emission levels: DK1 and DK2. DK1 represents Western Denmark (west of the Great Belt). DK2 represents Eastern Denmark (east of the Great Belt). DK1 is connected to the Central European electricity grid with a greater use of coal and gas than DK2, which is connected to the Nordic electricity grid, where hydro, nuclear and wind power are the main sources.

3.13.2. Green conversion plans

District heating companies are obliged to prepare and publish a plan for green conversion in line with recommendations issued by the Danish Energy Agency.

The purpose of the green conversion plans is to get the district heating companies to think ahead towards a green transition, as well as create transparency for consumers in relation to their heat supply. The intention of plans is to help the district heating companies to show commitment to becoming fossil-free and contribute to Denmark's goal of a fossil-free district heating sector in 2030. A plan includes an estimate of derived investment costs.

The publication of green conversion plans is a requirement, but they are not binding. There will be no supervision of whether the company implement new production units because of the plans. The green transition plans must instead be seen as a guide for the district heating companies in thinking green, as well as giving their consumers insight into the company's plans.

[15] Source: Danish Energy Agency

3.13.3. District heating declarations

District heating declarations are a part of the regulatory requirement that drive the development of green conversion plans. In addition, district heating declarations ensure the district heating companies' compliance with the mandatory information obligations towards their customers. Key data from a website of a district heating company's district heating declaration is shown in Figure 8. The traffic light ranking described above is a mandatory addition to the district heating declaration since 2023.

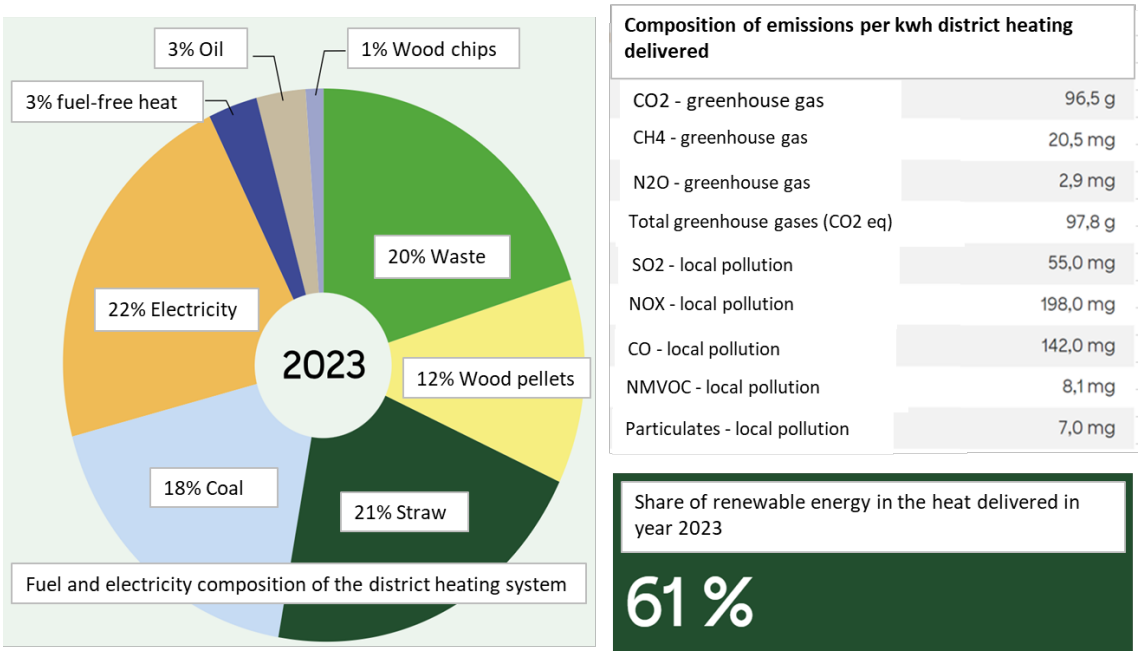

Figure 8: Example of district heating declaration key figures[16]

3.14. The building regulation and the executive order on building regulations

Together with the Energy Efficiency Directive (EED), the Energy Performance of Buildings Directive (EPBD) is central legislation within the EU's climate and energy policy. The EPBD aims to ensure more energy-efficient buildings throughout the EU and contribute to the green conversion of the building stock. (The Danish building stock accounts for almost 40% of the total national energy consumption).

The Danish building regulation contains provisions that implement parts of the EPBD. Among others, the regulation is basis for the executive order on building regulations, which specify the requirements of the building regulation.

The executive order on building regulations, also named the building code, specifies that new or renovated buildings must be designed so that the energy supplied does not exceed the calculated energy framework, which includes the building's total annual energy demand for space heating, ventilation,

[16] Source: Kredsløb - www.kredslob.dk

cooling, hot tap water, and lighting. Based on the type of energy supplied to the building, it is calculated whether the new or renovated building meet the calculated energy framework, or the building envelope should be improved further, or other improvements should be made, which costs extra.

3.14.1. Regarding the formulas to calculate the energy framework

The energy framework, that the new or renovated buildings shall meet, is defined in the executive order. Figure 9 below show the criteria for residential and non-residential buildings. The energy consumption is listed in kWh/m2 refers to the energy consumption as defined in the executive order with factors on district heating and electricity, and the floor area A is the gross floor area (including outside walls). New or renovated buildings shall meet energy label A2015 or may voluntarily comply with A2020.

For residences, dormitories, hotels, and similar buildings		For other buildings, non-residential	
Label	Energy framework in	Label	Energy framework in
A2020	27,0	A2020	33,0
A2015	< 30,0 + 1000/A	A2015	< 41 + 1000/A
A2010	< 52,5 + 1650/A	A2010	< 71,3 + 1650/A
B	< 70,0 + 2200/A	B	< 95,0 + 2200/A
C	< 110 + 3200/A	C	< 135 + 3200/A
D	< 150 + 4200/A	D	< 175 + 4200/A
E	< 190 + 5200/A	E	< 215 + 5200/A
F	< 240 + 6500/A	F	< 265 + 6500/A
G	> 240 + 6500/A	G	> 265 + 6500/A

Figure 9: Criteria for energy labelling[17]

/A = gross floor area (including outside walls)

3.14.2. Regarding weighting the type of energy supplied

The different kinds of energy supplied to the buildings must be weighted when calculating the supply of energy that is required to meet the energy framework. Energy factors are used for this weighting. The determination of the energy factors is based on the Danish Energy Agency's energy statistics and associated projections of the energy system. It is thus intended that factual quantities determine the energy factor to describe the relationship between the final energy consumption of district heating and

[17] Source: Danish Energy Agency - https://www.hbemo.dk/vaerktoejer-og-tabeller/energimaerkeskala/skala-for-boliger

electricity at the consumer per meter, respectively, and the gross energy consumption that goes to produce the district heating or electricity.

The following energy factors are at present required to use in the energy framework calculation:

- 1.9 for electricity from the electricity grid
- 1.0 for other forms of heat produced from, e.g., an individual oil and natural gas boiler located at the specific building,
- 0.85 for district heating as a general factor at national level, independent of the individual district heating systems
- 0 (zero) for renewable energy (e.g., solar energy, sustainable biomass, ambient heat, or surplus heat) produced to the specific building, if the renewable energy plant is located at the building or near the building but not necessarily on the parcel.

In addition, the relevant efficiency of the heat or cooling production device or plant is used, e.g., heat from a heat pump with COP = 3.0 results in the adjusted factor: 1.9/3.0 = 0.63. The efficiency of the heat substation for a building supplied by district heating is set to 1.0, so the adjusted factor: 0.85/1.0 = 0.85. This is significantly higher than the factor 0.63 for a heat pump, even though the local district heating in general is more cost-effective for the society and could be produced on a large heat pump with the same or better COP or is based on a large share of renewable energy.

The consequence of the difference in the adjusted factor (0.63 vs 0.85 in the example above) is that many builders of new buildings are forced to use individual heat pumps instead of district heating, because individual heat pumps make it easier (cheaper) to meet the required energy framework.

The EPBD allows a great deal of freedom to the Member States to determine their own energy factors. However, the requirement is that it must be done on a non-discriminatory basis. This means that the individual Member States are free to determine the primary energy factors as weighting factors that create equality between the inclusion of renewable energy on a non-discriminatory basis. As shown above, the Consultant (*Rambøll*) finds that this is not the case in Denmark today, with these factors are in contradiction with the heat supply act and the article in the EPBD, which states that it shall be considered that renewable energy can be transferred to the buildings via district heating and cooling.

3.15. Executive order on building energy labelling

The Danish energy labelling scheme has been developed by the Danish Energy Agency according to common guidelines defined in the EPBD. The purpose of the statutory energy label is to provide information about the building's energy consumption and propose potential energy-saving measures.

Since its introduction in 1998, the scheme has been used to classify buildings on a scale from A to G (See Figure 10). The criteria for labelling can be found in Figure 9. Due to stricter requirements and ambitions

in the executive order on building regulations, the 'A' category now includes classes A2010, A2015 and A2020.

The energy label is assigned in an energy labelling report, which also contains a building description and calculation assumptions as well as an estimate of the most cost-effective measures that can reduce the building's energy demand.

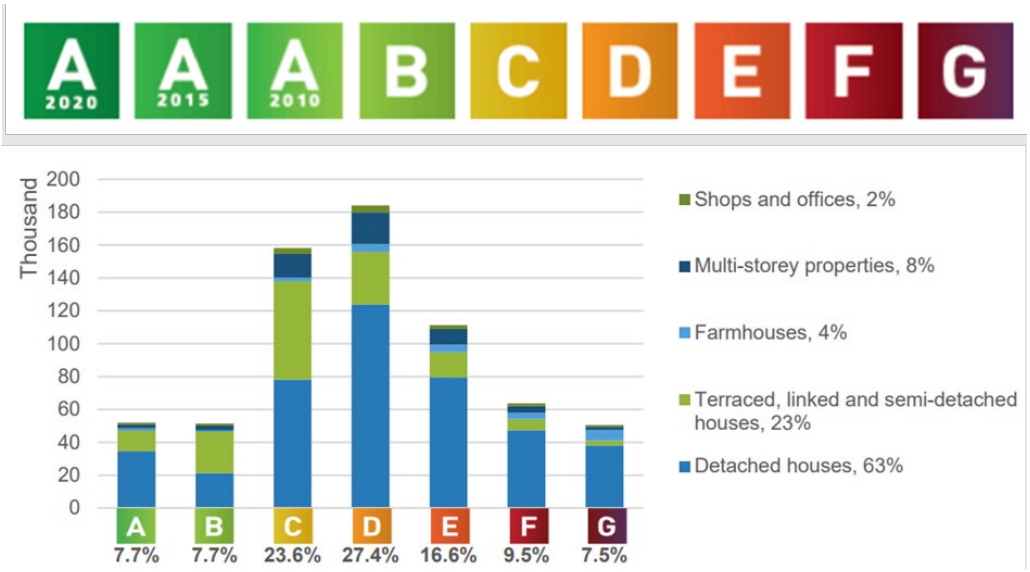

Figure 10: The Danish energy labelling scale and breakdown by use (2019)[18]

The energy label is based on a theoretical calculation of the energy consumption under the standard as assumptions regarding user behavior and weather conditions. The label therefore indicates the building's energy standard, but not its actual consumption. This method provides a better basis for comparing the condition and quality of different buildings. The calculation considers the current heat source and contribution from renewable energy sources. Specifying the heat source makes it possible to determine the building's primary energy demand using national energy factors for electricity and heat respectively. Thus, the energy label reflects the total primary energy consumption that must be produced to operate the building, however based on the factors in the executive order on building regulations.

An energy label must be assigned when new buildings are constructed and when existing buildings are sold or rented out. Thereafter, the label is valid for 10 years, so that the same label can be used in connection with repeated sales within its validity period. For public buildings, the label must be renewed before it expires.

Energy labelling is carried out by a certified energy consultant, who is registered and monitored by the Danish Energy Agency.

[18] Source: Danish Energy Agency

The concept of the energy labelling is very good to stimulate consumer behaviour, also in the real estate market, however the Danish labelling is based on the key figures from the executive order on building regulations and not on the approved heat supply. Therefore, in case district heating is approved to be the most cost-effective heat supply form, the labelling is in contradiction with the heat supply act.

3.16. Tariff setting of district heating in Denmark

District heating tariffs play an important role for the overall efficiency of the heating sector, as it is an efficient way of communicating between owners of production plants, district heating companies, and consumers, who are supplied by heat at a point of delivery.

The overall regulation of district heating tariffs from district heating companies to all consumers is laid down in Chapter 4 of the heat supply act, as described above.

3.16.1. District heating distribution tariffs

It is the obligation of the district heating distribution company to establish its own statutes and conditions for heat supply as well as design their own tariff structure that is in accordance with the heat supply act. Most of these conditions are generic of general interest, while some are specific for each company. Therefore, the Danish District Heating Association, which represents around 350 district heating companies, most of which are consumer cooperatives, prepares standard documents and guidelines and discusses general principles with the Danish Utility Regulator.

The basic principles for sale of heat from the distribution company to consumers are:

- The district heating company sells heat to consumers at points of delivery where stop valves and a heat meter can be established, typically at the boundary between the two legal entities, the utility, and the consumer, who is typically the building owner.
- In general, the consumers own the heat substation for production of heat and hot tap water in a boiler room of the building; however, a new option, which has been very successful for replacing gas boilers, is that the district heating company owns the heat substations. This possibility can offer numerous benefits, including the opportunity for the district heating company as the owner to optimize the operation of the substation (se also Chapter 4.4).
- The district heating company will always be the owner of the heat meter and installs the same type of heat meter to all consumers; however, consumers can complain and ask for a check of the heat meter.
- The tariffs and conditions must be based on the same principles for all consumers; however, they may differ if it can be justified based on objective cost-based criteria, e.g., lower fixed tariff for large consumers.
- The district heating company determines the tariff principles and communicates the principles to the Danish Utility Regulator, which notifies the principles or declares them illegal if they violate the heat supply act.

- The tariff principles determined by the company include a set of documents:
    - The statutes of the company - rarely changed.
    - The general legal conditions for the sale of district heating and tariff principles.
    - The technical conditions for the sale of heat, e.g., design criteria of substations.
    - The annual tariff announcement based on the annual budget, in which the expected revenues cover all necessary costs, updated once a year or in case of unforeseen changes in costs or revenues.
- The annual tariff is submitted to the Danish Utility Regulator, which notifies it and includes it in the price statistics for all Danish district heating companies (submitted twice a year).
- The Utility Regulator can request a justification of the tariff and can declare it illegal if it includes costs that are not necessary for the supply of heat. For example:
    - If a multi-utility company transfers costs from the district heating budget to finance a deficit in the budget of the water or traffic section.
    - If a private owner purchases goods for district heating from their private company at a price that exceeds the market price (conflict of interest transactions).
    - If the company's management allows the company to pay for a car that is not necessary for the district heating business.
- The decision of the Utility Regulator can be appealed to the Energy Appeal Board.
- Consumers can also complain to the Energy Appeal Board, which deals with problems of general interest, while minor problems will be taken care of by the Energy Supplies Complaint Board
- The annual announced district heating tariff at the point of delivery includes:
    - A one-time payment for connection
    - An annual tariff
    - Charges for various services
- The one-time tariff for connection may typically include:
    - A fixed payment per point of delivery.
    - A fixed payment for connected heated floor area in m2 gross area in accordance with the national building register or per subscribed capacity in kW (often discount to large consumers).
    - A payment for costs of the branch pipeline exceeding a certain length.
- The annual tariff may typically include:
    - A fixed payment per point of delivery.
    - A fixed payment per heated floor area in m2 gross area in accordance with the national building register or per subscribed capacity in kW (often discount to large consumers).
    - A variable payment per MWh metered heat (same tariff for all consumers).
    - An incentive to reduce the return temperature:

        - If modern electronic heat meters are installed, e.g., 2% discount of the variable price for each degree the average return temperature is lower than a reference value, e.g., 50oC.
        - If old heat meters are installed, e.g., 2% discount of the variable price for each degree the annual cooling of the circulating district heating water is larger than the reference value.
        - If old heat meters are installed a part of the variable tariff could also be based on metered circulated flow in m3.
- The share of fixed payment should in principle cover all the company's fixed costs, and variable tariff should reflect the actual variable costs of production; however, the fixed payment is often lower than the fixed cost, typically from 20% to 40% of total income.

3.16.2. The incentive to reduce the return temperature

This incentive is important for improving the energy efficiency of the buildings as well as the district heating system for several reasons:

- Lower return temperature increases the capacity of the district heating pipes or reduces the cost of new pipes.
- Lower return temperature opens for a similar reduction of the supply temperature and lower temperatures in general is important of efficient use of heat from CHP plants and from Heat pumps.
- Lower temperatures also reduce heat losses.

In the district heating system, at least the following four methods have been used for this incentive:

- **Flow tariff:** Until recently, several Danish district heating companies used the circulated water flow in m³ for sharing the variable costs. This provided maximum incentive to save flow and thereby cool the district heating water as much as possible.
- **Flow and heat tariff:** Some companies have used both heat energy in MWh and flow in m³ for distributing the variable costs. Typically, all costs of the network were distributed according to the used flow, as the network basically distributes flow and not heat.
- **Average cooling tariff:** In 1990, long before modern electronic heat meters were on the market, district heating companies started using the annual average cooling of the district heating water to provide an incentive. The district heating system registers the accumulated consumption of heat in MWh and flow in m³ at the end of the period and calculates the consumed heat and flow for the period. This allows the calculation of the average cooling in °C for each consumer. It is also possible to define a reference cooling, e.g., the weighted average cooling for all consumers. For each consumer, the difference between the average cooling and the reference cooling can be multiplied by a factor and the energy consumption. An alternative is to multiply by the flow consumption, which gives a more progressive incentive to avoid low cooling. This approach is

only fair if the supply temperature to all consumers is at the same level or if there is compensation for large deviations in supply temperature.

- **Average return temperature:** Modern electronic heat meters can measure not only the accumulated flow and energy but also the accumulated enthalpy in the supply and return pipes. The difference between the accumulated enthalpy in the supply pipe and the return pipe equals the accumulated heat. The district heating system registers the accumulated consumption of heat in MWh, enthalpy in the return pipe in MWh x °C, and flow in m³ at the end of the period. It then calculates the consumed heat, enthalpy, and flow for the period. This makes it possible to calculate the average return temperature in °C for each consumer during the period. It is also possible to define a reference return temperature, e.g., slightly higher than the average, to give most consumers a bonus instead of an extra charge. This method is more reasonable for consumers than an average cooling tariff because the supply temperature, which may differ across the network, often has only a minor influence on the calculated bonus. In cases where the supply temperature is close to (e.g., around 5°C higher than) the temperature in the consumers' internal distribution network, some companies increase the reference return temperature. In low-temperature district heating systems, this could be an issue, necessitating the calculation of the average supply temperature and increasing the reference return temperature for consumers receiving supply water at a lower temperature.

3.16.3. Case: Cost of heating for district heating and individual heating (heat pump)

In the tables below (all considered table 7) is a generic case for cost of heating a building, which is supplied with district heating or an individual heat pump for two typical consumers:

- A small consumer with one end-user, e.g., a one family house
- A large consumer with many end-users, e.g., in an apartment building in which the end-users have to share the total heating costs, which is the payment to district heating plus the costs of the building installations.

Consumer data at point of delivery	Units	One family house	Apartment building
Number of end-users	Pcs.	1	100
Heated floor area building	m^2	130	10.000
Annual heat demand	Gcal	15,5	1.000
Maximal capacity	Mcal/h	9,1	5.000
Specific heat demand	Kcal/m^2	119	100
Reference return temperature	ºC	45	45
Measured average return temperature	ºC	35	35
Temperature for bonus	ºC	10	10

Cost of district heating	EUR for One Family House	EUR for Apartment Building
Capital costs		
Substation (lifetime 25 years)	270	10.000
Connection (one time)	200	5.000
Operations and maintenance costs		
Substation	110	5.000
Systems in building	50	10.000
Consumer Equipment costs	**580**	**30.000**
District heating bill		
Annual fixed payment (134)	134	134
Annual subscription fee		
- Up to 1.000 m2 (EUR/m2=6,7)	871	6.702
- Above 1.000 m2 (EUR/m2=5,0)	0	45.000
Variable fee (EUR/Gcal=77,9)	1.206	77.935
Minus bonus for lower return temperature (DKK/Gcal/°C=0,5)	-72	-4.676
Annual cost for district heating	**2.139**	**125.095**
Total annual cost of district heating (incl. equipment)	**2.719**	**155.095**
Cost of district heating per m^2	16	13
Cost of district heating per Gcal	138	125
Total costs per m^2	21	16
Total costs per Gcal	176	155

Cost of individual heat pump (incl. 25% VAT)	EUR for One Family House	EUR for Apartment Building
Capital costs		
Heat pump (lifetime 17 years)	2.010	150.000
Operation and maintenance costs		
Heat pump	400	30.000
Systems in the building	50	10.000
Total fixed costs of heat pump	**2.460**	**190.000**
Efficiency of heat pump (COP= 3)		
Variable cost of electricity, small (EUR/MWh=160)	**826**	
Variable cost of electricity, large (EUR/MWh= 120)		**40.000**
Total annual cost of individual heating	**3.286**	**230.000**
Total costs per m^2	25	23
Total costs per Gcal	212	230

Table 7: Generic case for cost of heating for district heating and individual heating (heat pump)

In the section below about cost allocation is described how the total bill of the apartment building in principle is distributed among the apartments.

3.16.4. Tariffs of heat from CHP plants

Denmark has a more than 100-year-old tradition of using surplus heat from the thermal power generation and thereby reducing thermal losses from the thermal power generation. For many years, tariffs for heat from large CHP plants have been based on a guideline from 1976, which defines that the district heating pays for all additional costs compared to power-only production, and that the district heating after a period of e.g., 12 years pays a compensation equal to half of the saved fuel. This cost-based tariff incentive to use heat is cost-effective for society.

For smaller CHP plants, which typically are owned by the district heating company, the cost of heat from the plant will be the total cost minus the income from sold electricity and capacity services to the grid. This cost of heat could also be the basis for a tariff from a privately owned CHP plant.

3.16.5. Taxes on fossil fuels and subsidies

The tax on fossil fuels has played an important role in improving energy efficiency in the building and district heating sector. 5 years after the oil crisis in 1979, OPEC lowered the oil price to pre-crisis levels, but The Danish Government introduced a tax on oil, coal, and electricity (three times the coal tax) to fill the gap. This stimulated the development of district heating projects, the new natural gas projects, and energy savings in buildings.

The tax on heat from the large CHP plants was thus based on the actual fuel consumption corresponding to a marginal efficiency of around 200%, which further stimulated heat from the combined production. However, later the aim of taxation changed. Tax-saving fuels reduced the incentive for efficient CHP and use of surplus heat.

In 1990, an additional tax on fossil fuels was introduced, and the revenue was used to give subsidies to various energy efficiency projects, including completion and renovation of district heating networks and the installation of central heating in old buildings connected to the district heating system.

3.16.6. Cost allocations

The heat cost allocation in multi-user buildings in Denmark is the responsibility of the building owner, who normally engages a housing administration company, except the social housing companies, which have their own staff for this.

All these companies usually engage a company that provides heat cost allocators and systems for heat cost distribution or even billing directly to each apartment on behalf of the building owner.

The total annual cost to be divided between the apartments are:

- Fixed cost of district heating

- Variable cost of district heating
- Fixed cost of the internal heating and hot tap water system in the building.

These costs are divided into the following components:

- Fixed cost, which will be distributed according to floor area.
- Variable cost for hot tap water divided on measured indicators for hot tap water or number of hot-water taps in case metering is not feasible and not cost-effective.
- Variable heating costs divided on measured units at the heat cost indicators.

3.16.7. Case: Cost allocation

In the table below is a generic case for cost allocation of heat energy in an apartment building with district heating, based on the numbers from the case for district heating tariffs above.

Cost allocation one end-user with district heating	**Share**	**EUR**
Total cost	**100%**	**155.095**
Fixed cost per m^2 floor area (10.000 units)	30%	46.529
Variable cost of m^3 hot domestic water (20.000 units)	20%	31.019
Variable cost of heating (20.000 units)	50%	77.548
Total cost to be shared	100%	155.095
Bill to each apartment		
M^2 floor area of apartment (100 units)	1,00%	465
M^3 hot domestic water, flow meter (220 units)	1,10%	341
Heating, heat cost allocators (180 units)	0,90%	698
Total heating costs		**1.504**
Total costs per m^2/EUR		15

Table 8: Case of cost allocation

In this case, there are installed flow meters for hot domestic water costs and heat cost allocators on radiators for sharing the variable heating costs.

If cost allocators or flow meters for hot domestic water is not installed, the water costs e.g., can be divided according to number of hot domestic water taps (and not number or residents).

If heat cost allocators are not installed, e.g., because the costs of installation and administration are significant compared to the potential heat savings, which are possible to obtain in a multi-user building, the costs will be allocated according to heated floor area.

In this case, the end-user consumes 10% more hot domestic water than the average and 10% less heat than the average.

3.17. Key associations

Draft legislation is sent for hearings with a wide range of stakeholders and interest organizations. This is part of the transparent and democratic legislative process. Incorporating feedback from them can lead to more effective and efficient policy outcomes. By leveraging their expertise, the final legislation is more likely to achieve its intended goals.

As regards regulation of the heat supply sector, the two most important interest organizations are:

- KL – Local Government Denmark (association of municipalities)
- The Danish District Heating Association

Sending draft legislation for hearing at these two key associations not only helps create well-informed, practical, and effective legislation, but it is also more likely to be successfully implemented and accepted by the members the associations represent and who will be affected by the new legislation.

KL represents all municipalities in the dialog with the central administration in all relations, including heat supply planning. The association is directly listed as a stakeholder in the legislation.

The Danish District Heating Association is in principle a private interest organization representing all their members, which with a few exemptions include all district heating companies. The consumers own most of these companies directly or indirectly via municipal ownership (on a non-profit basis). The association also represents the consumers' interests as a whole and thereby 66% of the population in Denmark. Therefore, the association has an important role:

- The association guides the central administration to implement legislation, which are profitable for the heat consumers and for Denmark as a whole.
- The association inform member companies to comply with the legal requirement.
- The association issues standard documents for statutes and tariff conditions, which are accepted by the authorities.

4. Legal Framework in Poland

The electricity and heat markets in Poland began in December 1997 when the Energy Act was implemented, replacing the Energy Economy Act of 1984, which was issued during the centrally planned economy era. From 1997, the body responsible for the energy market, granting concessions, accepting tariffs, and promoting competition in the market has been the Energy Regulatory Office (URE). URE is a central government administration body, separate from the Ministry of Climate and Environment, municipalities, and other state/governmental entities, created to execute these specified tasks. The Prime Minister grants its statute that regulates its organization.

The Energy Act has been amended numerous times. In May 2004, Poland became a member of the European Union, which imposed many additional EU-policy requirements on heating companies.

As of the end of 2022, 392 companies in Poland held licenses to operate in the field of heat supply to consumers. These licenses included heat generation (355), heat transmission and distribution (352), and heat trading (109). Since 2005, the number of license holders has stabilized. The obligation to obtain a license has been imposed on entrepreneurs with a heat generation capacity of more than 5 MW. Previously, the limit value was 1 MW.

The obligation to obtain a concession applies to all economic activities related to heat supply to consumers, except for the following:

- Heat generation from sources with a total installed heat capacity not exceeding 5 MW.
- Generation of heat obtained in industrial technological processes.
- Generation, transmission, distribution, and trade in heat if the heat capacity ordered by customers does not exceed 5 MW.

After 2005, changes in the heating market were minor and resulted in organizational and ownership transformations: takeover of heating assets by other licensed enterprises, consolidation of enterprises, and limitation of the scope of activities, resulting in the lack of obligation to hold a license.

Licensed district heating companies have diversified and fragmented technical infrastructure described by two basic characteristics: installed thermal capacity and the length of the heating network. The total amount of installed thermal capacity of licensed heat producers decreased from 70,952.8 MW in 2002 to 53,188.4 MW in 2022. This decrease resulted from the increased capacity requiring a license and decreased individual customer consumption due to modernizations, prices, habits, and climate changes. The enterprises generate heat in sources of various sizes, with a predominance of small sources up to 50 MW (220 entities in 2022). Only eight licensed companies had an achievable capacity of their sources exceeding 1,000 MW each, accounting for about one-third of the achievable capacity of all licensed sources. These entities were also active in electricity generation.

In 2022, licensed district heating companies had networks totaling 22,578.4 km in length. This includes district heating networks connecting heat sources with heat substations and low-parameter networks – external receiving installations. Forty-six licensed companies did not have networks, 268 had networks over 10 km in length, and 88 had networks over 50 km. From 2002 to 2022, the total network length increased from 17,312.5 km to 22,578.4 km. The length of the network per company increased from 23.81 km to 62.89 km.

In response to market demand, local heat markets (heating plants and combined heat and power plants) have developed mainly in cities. In small towns and rural areas, individual heat sources remain the norm.

District heating companies are increasingly interested in expanding their scope of operations. Above all, they are looking for opportunities to enter new, even small local markets. Some heating companies' activities go far beyond their original area of operation and are directed towards other provinces, not just neighboring ones. Entry into new heat markets usually occurs through the acquisition of other district heating companies.

Due to the reduction in heat consumption by individual customers because of thermal modernization of buildings, global warming, and a reduction in heat consumption by consumers due to rising prices, heating companies are forced to optimize their operations, seek new customers, and explore new forms of heat sales (e.g., supplying cold).

Below is an overview of institutions relevant to the Polish heating sector referred to in this chapter:

Table 9: Institutions relevant to the Polish heating sector

Institutions	Role/responsibilities
Ministry of Climate and Environment	The Ministry plays a crucial role in shaping and implementing Poland's policies on energy, environment, and climate change.
Energy Regulatory Office (URE)	The central government body responsible for the energy market, granting concessions, accepting tariffs, and promoting market competition.
The District Heating Team	Established by the President of URE to ensure smoother implementation of changes in legal regulations.
District Heating companies	Responsible for heat production and distribution, contributing to efficiency, sustainability, and reliability of heat supply. Mainly municipal-owned, but some are private companies.
The National Fund for Environmental Protection and Water Management (NFOŚiGW)	The main part of the Polish financing system for environmental protection. Offers loans, grants, and other financing forms for various projects. Also, the largest partner of international financial institutions in Poland.
Polish Development Bank (BGK)	State-owned bank supporting government socio-economic programs and local self-government and regional development programs. Finances infrastructure projects, exports, municipal companies, and local governments. Also involved in the distribution of EU funds.

4.1. Changes in legal framework to implement EED

The district heating industry must cope with huge challenges posed by a dynamic regulatory environment, including the implementation of EU directives. Challenges for the heating industry resulting from the EU climate and energy policy were included in the "National Plan for Energy and Climate for 2021-2030" and in the "Polish Energy Policy until 2040" (PEP 2040), and before:

- **National energy efficiency action plan for Poland 2017 (Fourth)** – a document adopted by the Council of Ministers on 23 January 2018. It included a description of energy efficiency improvement measures divided into energy end-use sectors and calculations of final energy savings achieved in 2008-2015 and planned to be obtained in 2020. This was the last National Action Plan on energy efficiency for Poland, the next one was already part of the National Plan for Energy and Climate developed within the governance of the Energy Union
- **National energy efficiency action plan for Poland 2014 (Third)** – a document adopted by the Council of Ministers on 20 October 2014. It included a description of planned energy efficiency improvement measures specifying actions aimed at improving energy efficiency in individual sectors of the economy, necessary to achieve the national target in energy efficiency for 2016, as well as measures to achieve the overall energy efficiency target understood as achieving 20% savings in primary energy consumption in the European Union by 2020.
- **Second national action plan on energy efficiency** – a document adopted by the Council of Ministers on 17 April 2012. It included a description of planned energy efficiency improvement measures aimed at the end use of energy in individual sectors of the economy, as well as information on progress in achieving the national goal in the field of energy savings, energy management, and actions taken to remove obstacles to achieving this goal. This goal was to achieve final energy savings by 2016, in an amount not less than 9% of the average national energy consumption per year (i.e. 53,452 GWh of energy savings by 2016).
- **National action plan on energy efficiency** – a document adopted by the European Committee of the Council of Ministers on 31 July 2007. It included calculations of the intermediate target for energy efficiency for 2009 and the indicative target for energy efficiency for 2016, as well as a list of energy efficiency improvement programs, energy services, and other energy efficiency measures by the energy end-use sector to help achieve these goals.
- **"Poland's Energy Policy until 2030"** – a document adopted by the Council of Ministers on 10 November 2009 with the aim to replace heating plants supplying the centralized heating systems of Polish cities with cogeneration sources by 2030. One of the specific goals indicated in this document was to double the production of electricity generated using high-efficiency cogeneration technology by 2020. Compared to production in 2006, the target was not achieved.

4.1.1. National Plan for Energy and Climate for 2021-2030

The Council of Ministers adopted the document on 18 December 2019.

It included the following climate and energy goals for 2030:

- 21-23% share of renewable energy sources in gross final energy consumption (total consumption in the power industry, heating, cooling, and transport.

The 23% goal to be achievable if additional EU funds are granted to Poland, including those for 'just transition'), considering the annual increase in the share of renewable energy in heating and cooling by 1.1 percentage points on average annually, i.e. to the level of approximately 28.4%.

- Energy efficiency increased by 23% compared to PRIMES2007 forecasts. This goal translates into a reduction in primary energy consumption in 2030 by approximately 27.3 MTOE (Million Tonnes of Oil Equivalent) compared to the PRIMES 2007 forecasts.

Regarding heating, it is expected that by 2030, at least 85% of heating systems with ordered power exceeding 5 MW will meet the criteria of an energy-efficient heating system.

The above purpose is served by the following activities:

- Development of cogeneration.
- Adding heating to the operation of existing power plants.
- Increasing the use of renewable energy and natural gas in district heating.
- Increasing the use of waste for heating purposes.
- Modernization and expansion of the heating and cooling distribution system.
- Popularization of heat storage and smart grids.
- Ensuring conditions for increasing the use of system heating, especially by:
    - Simplifying procedures for investment in heating network infrastructure.
    - Changing the heat market model and tariff policy.

Thermal needs should be met primarily using district heating. This ensures high efficiency of raw material use, improves the quality of life of citizens, and reduces the problem of low emissions. If connection to the heating network is not possible, efforts should be made to use individual sources with the lowest possible emissions. In 2018, 58% of households in urban areas were connected to the heating network. The goal is to gradually increase this indicator to 70% by 2030. The goal for 2040 is for the heating needs of all households to be covered by district heating and zero- or low-emission heat sources.

Poland prepared a preliminary version of the plan's update, which was submitted to the European Commission on March 1, 2024. Broad consultations on the project will begin soon. The document presents the first of the two required analytical scenarios: the baseline scenario (WEM, with existing measures).

This scenario reflects the current assessment of Poland's possible contribution to the implementation of the EU's climate and energy goals for 2030.

The trajectory enabling Poland to achieve the GHG emission reduction target at a level similar to the EU level (i.e., 55%) will be presented in a more ambitious transformation scenario (WAM, with additional measures). Advanced work on this is underway at the Ministry of Climate and Environment.

The target document containing both scenarios—base (WEM) and ambitious (WAM)—will be presented for full public consultations and sector arrangements, and then finalized at the turn of the second and third quarters of 2024.

The main goals for the heating sector specified above are also included in Chapter 7 of the Polish Energy Policy by 2040, published on March 10, 2021. Furthermore, by the end of 2024, the Strategy for the Heating Sector until 2030, with a perspective until 2040, will be published. This strategy will be consistent with the National Plan for Energy and Climate for 2021-2030 and the Polish Energy Policy until 2040.

Generally, in the Polish heating sector, EU directives are implemented pointwise (e.g., cogeneration) or follow implementations in the electricity and gas markets (e.g., EU ETS, RES, IED, energy efficiency). The implementation of the 2030 energy efficiency target is supported by an amendment to the Energy Efficiency Act of 2021, which, among other things:

- Extends the number of obligated entities under the energy efficiency certificate system to include the liquid fuels sector.
- Simplifies the regulation of the development of market mechanisms for the implementation of energy efficiency improvement projects (e.g., EPC contracts).EED, art. 8 was transposed to the applicable national law through Chapter 5 of the national Energy Efficiency Act.

The currently applicable Energy Efficiency Act of 20 May 2016 introduces a national target of final energy savings to be achieved by the end of 2030 for PLN 5,580,000 TOE (Tonnes of Oil Equivalent), which is implemented from 1 January 2021 to 31 December 2030. The target set for 2030 is implemented through a system of energy efficiency certificates and the so-called alternative means.

The system of energy efficiency certificates, commonly known as white certificates, imposes an annual obligation to save energy on obligated entities. The obligated entities are enterprises selling electricity, district heating and gas fuels to end users and, from mid-2021, fuel entities introducing liquid fuels to the market, as well as end users connected to the network in Poland and brokerage companies.

The obligation may be fulfilled by:

- implementing a project aimed at improving energy efficiency at the end user, or
- implementing a non-repayable subsidy program to co-finance projects aimed at improving energy efficiency, or

- obtaining/purchasing white certificates that the obligated entities will submit for redemption at the President of the Energy Regulatory Office.

An alternative way of fulfilling the statutory obligation is for the obligated entity to pay a substitute fee to the National Fund for Environmental Protection and Water Management.

Alternative measures were introduced as a complementary method of achieving the national final energy savings target for 2030 in relation to the system of energy efficiency certificates. They were defined in the act as programs and instruments aimed at improving energy efficiency, financed from:

- the state budget,
- the budgets of local government units,
- the EU budget,
- funds from aid provided by Member States of the European Free Trade Association,
- funds from the National Fund for Environmental Protection and Water Management (but other than those resulting from the substitute fee) and
- funds from the 16 provincial funds for environmental protection and water management.

The list of alternative measures was published in the announcement of the Minister of Climate and Environment of 17 December 2021 on the list of programs and financial instruments regarding projects aimed at improving energy efficiency at the end user (M.P. 2021, item 1190).

For the purposes of counting energy savings resulting from alternative measures, the Energy Efficiency Act established, from 1 January 2022, the Central Register of Final Energy Savings (CROEF).

The aim of the regulation is for everyone who meets certain requirements (energy efficiency audit for a specific investment) to receive a benefit in the form of property rights resulting from energy efficiency certificates (commonly called white certificates). To obtain property rights resulting from white certificates, energy must be saved at least 10 toe/year.

White certificates can be obtained by representatives of:

- housing communities
- cooperatives
- housing estates who:
    - collect audit-confirmed data on the thermal modernization of a house or a medium-sized building or replacement of household appliances (e.g., refrigerators, dishwashers, and ovens), lighting or heating devices,
    - prepare and submit appropriate applications to the President Energy Regulatory Office.

The procedure for applying for an energy efficiency certificate is described in detail in the Energy Efficiency Act.

After the certificate is granted and the investment is completed, the applicants receive property rights that can be sold (e.g., on the energy commodity exchange) to obtain specific financial benefits.

Another benefit resulting from the act is support for entrepreneurs operating in the so-called ESCO (Energy Saving Company) formula, who offers energy services consisting in reducing energy consumption in exchange for remuneration from the savings obtained. An entrepreneur operating in the ESCO formula can, among other things, perform an energy efficiency audit, implement an investment, and then manage and supervise it. In such a case, they apply for a white certificate as an entity authorized by the person with whom the investment will be carried out. The list of companies operating in the ESCO formula in Poland can be found on the Climate and Environment Ministry website[19].

Moreover, the act obliges public finance sector entities to use at least one of the energy efficiency improvement measures when performing their statutory tasks. Offices are obliged to take actions such as thermal modernization of the building, purchase of office equipment and household appliances, and vehicles with low energy consumption and low operating costs. The financial resources generated in this way can be spent on other purposes related to the tasks currently being carried out.

This act implemented the EU Directive 2012/27/EU on energy efficiency into the Polish legal system and continued (with some modifications) the obligation to save energy introduced in Poland in 2013, for which energy efficiency certificates can be obtained.

From May 22, 2021, the provisions of the act of April 20, 2021, amending the Energy Efficiency Act and certain other acts, which implement the provisions of Directive (EU) 2018/2002, entered into force. The purpose of the act was to adapt Polish law to the solutions provided for in the directive amended in 2018. This directive imposes higher obligations on Poland in terms of final energy savings, setting a target of PLN 5,580,000 toe by the end of 2030.The most important changes are summarized below:

- **Modification of the legal framework of the energy efficiency certificate system:** This includes expanding the list of obligated entities to include those placing liquid fuels on the market for transport purposes, in order to maintain consistency with Directive 2018/2002.
- **Subsidy Programs for Energy Efficiency:** Obligated entities under the energy efficiency certificate system can implement the obligation to save energy through non-repayable subsidy programs for end-user projects. These projects mainly involve the modernization or replacement of heating devices or installations with more energy-efficient ones. The programs aim to accelerate the modernization of individual heat sources, a major cause of harmful air pollution in Poland, and to unlock pro-efficiency investments among small end users, such as households.
- **Introduction of Alternative Measures:** These measures complement the energy efficiency certificate system. Investments are included in the implementation of energy efficiency targets and are financed by the state budget, local government budgets, European funds, the National

[19] https://www.gov.pl/web/klimat/lista-dostepnych-dostawcow-uslug-energetycznych

Fund for Environmental Protection and Water Management, and provincial funds for environmental protection and water management.

- **Establishment of the Central Register of Final Energy Savings:** This tightens the system for monitoring and reporting energy savings, aggregating energy savings realized by alternative measures in the register.
- **Strengthening Regulations on Energy Efficiency Improvement Contracts (EPC contracts):** The act specifies situations where EPC contracts do not result in increased public debt, implementing Eurostat's guidelines and removing a major barrier to the use of EPC contracts in Poland.
- **Clarification of Requirements for Energy Efficiency Audits:** This aims to improve the quality of energy efficiency audits prepared by specifying requirements for auditors.

In addition, the act also changed:

- The Energy Act: Strengthening existing regulations regarding the measurement and individual settlement of heat by end users
- The Act on Personal Income Tax
- The Act on Public-Private Partnership
- The Environmental Protection Law: Adjustments were made in response to changes introduced by the act.

Poland is consistently carrying out activities that help it move towards energy transition and climate protection. This requires many costly modernizations and investments. The transition of the Polish energy sector takes place under difficult conditions. In addition to the historical burdens, recent years have seen problems related to the excessive speculative influence on the EUA, fuels, and electricity markets, especially after Russia’s attack on Ukraine.

Without further deep reforms of the energy market, it may be difficult to effect the energy transition, and the funds allocated for it may be directed elsewhere. Since 2020, the dynamic development of low-carbon and zero-emission energy sources has exceeded the pace assumed in strategies. Additionally, challenges related to the limited availability of raw materials and dynamic price changes make it necessary to accelerate the reduction of fossil fuel use in the Polish energy sector while maintaining energy sovereignty.

4.2. Other measures

Due to the scope and amount of the necessary investments, it is crucial for the heat supply sector to ensure **financing for the investments**. The heat companies in tariff applications submitted to URE include, together with costs of current activity, also investment costs and receive investment bonuses. It should be stressed that not all costs related to district heating transformation can be included in tariffs. Therefore, the huge investment challenges faced by the heating sector in Poland require external sources of financing. It is crucial for the district heating companies to use financing from the existing funds, including the European Modernisation Fund.

Considering the above, in 2022 the President of URE started cooperation with the Polish Development Bank (BGK) which offered heating companies loans with BGK guarantees for maintaining liquidity and for investments (loan interest rates: variable, WIBOR 1M[20] + individual margin depending on financing period and credit scoring). URE has also taken steps to disseminate information among heating companies about the possibility of receiving such loans. Importantly, the costs of servicing such a loan were included in the heat tariffs.

In May 2020, the President of URE has appointed the District Heating Team. For the changes in legal regulations to be smoothly implemented, the **District Heating Team** developed uniform rules of conduct each time for eight local branches and the Electricity and Heat Markets Department. The efficient and comprehensive operation of the District Heating Team enabled smooth, uniform, and quick implementation of the numerous changes in the law introduced by the legislator. The Team's meetings are also a forum for internal communication – the exchange of experience and knowledge on the current heating situation throughout Poland and in individual heating companies.

In a dynamically changing environment, the President of the Energy Regulatory Office plays a key role in the heating market, **approving heat tariffs** after **granting licenses** to energy companies. The regulator's comprehensive approach to changes taking place on the heat market allows for maintaining a balance between the interests of energy enterprises and the legitimate interests of heat consumers, providing heat tariffs with part of the financial resources for the implementation of investment tasks related to the energy transformation, while protecting consumers against unjustified prices and fee rates.

4.2.1. Heat tariffing in Poland

Heat tariffs are subject to approval by the Energy Regulatory Office (URE). Heating companies submit tariff applications to URE, which accepts an application, rejects it, or requests supplements or additional information.

[20] WIBOR 1M – Warsaw Inter-Bank Offer Rate for 1 month, determined every working day at 11 AM based on large commercial bank offers.

The requirements for the heat tariffs are described in the Regulation of the Minister of Climate of 7 April 2020 on detailed rules for shaping and calculating tariffs and settlements for heat supply[21].

The energy company prepares its tariff in such a way as to ensure:

- coverage of justified costs – understood as costs necessary to fulfil obligations arising in connection with the heating company activity and adopted by the company for the calculation of prices and fee rates in an economically justified manner, with exercising due diligence to protect the interests of recipients,
- eliminating cross-subsidization.

The heat generator's tariff includes:

- prices for ordered thermal power – expressed in PLN for MW,
- heat prices – expressed in PLN for GJ,
- heat carrier prices.

Tariffs for cogeneration heat sources can be built based on one of two methods: reference price or justified costs method. The sources that do not generate heat in high efficiency cogeneration can only use the second method. The two methods are described in more detail below.

A. Reference price

Heat sources in which heat is generated in cogeneration units can use a simplified method of calculating prices and rates in the tariff for heat from these sources on a basis of justified planned revenues from the sale of heat. Then the price of heat may not be higher than the ratio using the reference price being average heat sale price, generated in non-cogeneration units, which use the same type of fuel as given cogeneration unit [PLN/GJ]. The price is announced by URE every year.

For cogeneration sources in which heat is generated with use of several types of fuels simultaneously, reference price is determined as the average of the reference prices weighted by planned shares of chemical energy of particular types of fuels consumed for the production of electricity and heat in these sources. If the price of heat from a given source is below the reference price, the maximum tariff increase level [%] is determined according to a specific formula.

B. Justified costs

Prices and rates for the first year of using the tariff are determined based on planned for this year:

1. Justified annual operating costs of the heat supply activity;
2. Justified annual modernization and development costs as well as costs of investments in the area of environmental protection;
3. Justified return on capital employed in the economic activity;

[21] Journal of Laws of 23 April 2020, item 718.

4. Justified costs of fulfilling the obligation of relevant energy efficiency investments or energy efficiency ('white') certificates redemption.

The sum of justified annual costs and justified return on capital constitutes the justified planned revenue of the energy company from heat sale being the basis for calculating prices and rates set in the tariff.

The planned justified revenue from heat sale constituting the basis for calculating prices and rates in tariffs of the energy companies generating heat in cogeneration units, which do not use the simplified method of calculating prices, and rates is calculated according to the following formula:

Pc = Pec – (Es × Ce) – PMC – PMZ

Pc – planned revenues from heat sale for the first year of using the tariff [PLN]

Pec – planned total justified revenues from the sale of heat and electricity for the first year of using the tariff, being the sum of the planned total costs of heat and electricity production and the return on capital employed in the economic activity related to the production of heat and electricity [PLN]

Es – planned volume of electricity sales for the first year of using the tariff [MWh]

Ce – price of electricity set in the tariff for the given source or the planned price in competitive conditions or the price being the result of the appropriate auction, in accordance with the relevant provisions [PLN/MWh]

PMC – planned revenues from sale of property rights from certificates of origin from cogeneration

PMZ – planned revenues from sale of property rights from certificates of origin from renewable

Heat tariffs, which are subject to approval by the Energy Regulatory Office, should ensure that heat production costs are covered and allow for a justified profit.

Generally, it is often a problem that some costs may not be accepted by URE, or costs accepted by one branch in one procedure may not be accepted in another procedure by another branch. In relation to financial costs, only those specified by URE are accepted (related to specific programs).

It is generally expected that production costs, if well-grounded, will be accepted. However, there is a risk that the profit accepted might be lower than the profit expected by the investor. This results in significant uncertainty and dependence of the heating companies' financial situation on the individual decisions by URE.

4.2.2. Municipal heat planning

Planning and organizing heat supply belong to the tasks of municipalities. Pursuant to the Energy Act, the mayor/city president prepares draft assumptions for the heat, electricity, and gas fuel supply plan for the area of the municipality for a period of at least 15 years and updates it at least every 3 years.

The draft assumptions should specify:

- An assessment of the current state and expected changes in demand for heat, electricity, and gas fuels.
- Projects to rationalize their use and the possibilities of using existing surpluses and local fuel and energy resources.
- The possibility of applying measures to improve energy efficiency.

Unlike energy companies dealing with transmission or distribution of gaseous fuels or energy, heating companies are not obliged to prepare development plans to meet the current and future demand for gaseous fuels or energy, agree them with URE and make them available to the mayor.

Heating companies independently decide on the development of their heating networks. Significant parts of them are municipal companies.

In 2020, the Construction Law introduced the obligation to connect new buildings to a heating network in areas where there is a heating network (if there are technical and economic conditions for connecting to the heating network and supplying heat to the facility from the heating network). However, there are exclusions from the obligation – i.e., if heat is planned to be supplied from an individual heat source characterized by a non-renewable primary energy input coefficient of no more than 0.8 or from a heat pump or electric heating. It is only possible for individual premises (e.g., flat) in a multi-premises building to disconnect from the central heating system and install their own individual heating system if the community of owners consents to this in the form of a resolution. In such a case, however, the owner of the premises still participates in the costs of providing heat to the common property.

National strategies and plans are implemented through laws and regulations affecting the operating conditions of heating companies and the profitability of investments. Municipal heat planning itself is not part of legislation.

As indicated in Poland's Energy Policy until 2040, in 2018 only 22% of municipalities had a planning document regarding the supply of heat, electricity and gas fuels. Heating needs are met close to the place of residence, and heat markets are local. The involvement of local authorities and local energy planning plays an important role in the implementation of state policy in the field of heating. Therefore, as indicated in the strategy, greater activity of municipalities, counties and voivodeships (local governments) is necessary in local energy planning.

4.2.3. Resolving complaints from customers

The heating company is responsible for maintaining the quality standards specified in the contract and is obliged to supply heat to the customer in accordance with these standards. If it fails to meet the quality standards, the recipient is entitled to discounts in the amount specified in the tariff or contract.

Pursuant to the above-specified regulation, the recipient is entitled to discounts if the heating company fails to comply with the terms of the contract regarding:

1. Dates of starting and ending the supply of heat for heating purposes.
2. Planned interruptions in heat supply during the summer period.

The discount amount, unless the contract provides otherwise, is determined according to the formula specified in the above-specified regulation.

Complaints regarding the supply of heat by heating companies can be submitted in writing, via an online form, email, or by phone directly to the heating company. Residents of multi-family buildings may submit complaints to the building administrator. If the resolution of the complaint is not satisfactory to the reporting entity, it may request a reconsideration of the complaint. The complaints procedure may include negotiations. If there is no satisfactory resolution, both parties may submit the dispute to the court.

4.3. Main challenges

On the one hand, EU regulations create opportunities to increase links between the heating sector and the electricity sector; on the other hand, they impose important requirements that the district heating sector in Poland will have difficulty meeting.

The current requirements for efficient heating systems according to the Energy Efficiency Directive assume that 75% of heat will come from cogeneration or 50% from RES, or waste heat, or a combination of these sources with cogeneration. However, these requirements are not met in many heating systems in Poland, in particular in small systems, most of which are based on solid fuel boilers – mainly hard coal. This means that there is a need to replace many sources along with the change of fuel used. In Poland, only about 20% of heating systems meet the condition of an energy efficient heating system, which is shown in the figure below.

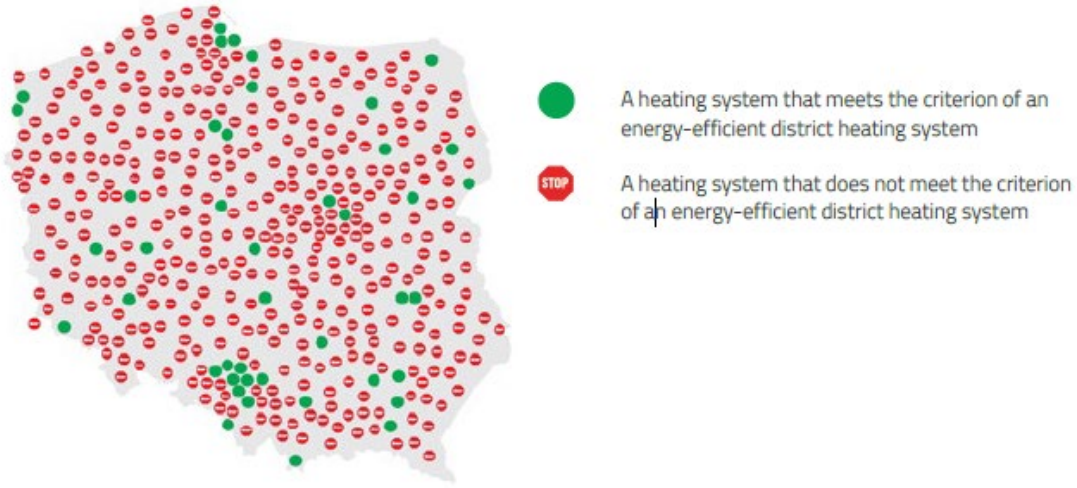

Figure 11: Layout of efficient district heating systems (IGCP, Report on heating 2020)

The changes in the "Fit for 55" package further tighten the requirements of recognizing a given heating system as energy efficient.

Other main challenges in Poland include the lack of a list of all entities covered by the energy audit obligation and the fact that market developments are difficult to track and be considered in assessing the fulfillment of the obligation (some enterprises fall within the definition only in certain years). Keeping track of all affected businesses is difficult and resource intensive. Furthermore, there is scope for improving the quality of energy audits, which should better reflect the cost-effectiveness of the measures to increase the implementation rate of the identified measures. Finally, the Energy Regulatory Office and the Ministry of Climate and Environment have limited resources to introduce changes and expand the scope of monitoring and verification.

The particularly important challenges include:

- **Limited Resources for Transposition:** Effective transposition of the EED with limited resources is a challenge. The Managing Authority (URE) has limited resources to implement, enforce, monitor, and verify the obligation (in terms of both staff and financial resources). A similar situation also applies to the Ministry of Climate and Environment. Moreover, current practices in the enforcement, monitoring, and verification of the obligation have been found by the Supreme Audit Office (NIK) to be unsatisfactory and require changes.
- **Identification of Obligated Companies:** In the first period of the obligation, self-declaration was used by obligated companies. This was the basis for creating a list of companies liable for the following years. This list was not published, but the report on the implementation of the obligation provided the total number of companies that carried out audits. This is considered insufficient to properly monitor the implementation of the obligation.

- **Audit Quality:** The quality of energy audits is considered unsatisfactory in some cases, but it is also not extensively verified. An energy audit is often seen as a burden rather than a useful source of information and advice. Poland has established criteria for auditors, but only for energy efficiency audits performed for the purposes of the White Certificates system (tradeable documents certifying that a certain reduction of energy consumption has been attained). In other cases, there are no requirements for auditors performing energy audits, and the market itself is supposed to ensure the quality of the audits.
- **Increasing the Implementation of Measures:** The implementation of the actions recommended during the controls in Poland is not directly monitored. It is tracked through participation in support programs such as the White Certificate system. However, when comparing the total potential energy savings with the results of support programs, there is still significant potential to be exploited. Low awareness among companies about the benefits of audits affects the level of implementation.
- **Creation of Support Mechanisms:** The core of the support system in Poland is grants and loans at the regional level offered by provincial environmental protection funds and European funds. There may be different financial instruments in individual voivodeships. In some, there is no support at all. There is no national mechanism, so local organizations offering support or advice inform in each region separately. Many programs have additional financial criteria that are difficult to meet for small and medium enterprises (SME) – loan guarantees, minimum investment value, etc. For this reason, many support programs produce unsatisfactory results among SMEs. Coordination of activities is a challenge to better inform and target support for SMEs.
- **Raising Awareness of Opportunities:** Small and medium-sized enterprises have little awareness of the opportunities and benefits of energy efficiency measures and energy audits.

Undoubtedly, the Polish heating industry faces huge challenges related to the EU's climate policy, and the adaptation of heating in Poland to the EU's climate and energy policy should be carried out while maintaining the basic objectives of the Energy Act, i.e., environmental protection and balancing the interests of consumers and energy enterprises.

Huge changes are already visible in the Polish heating market, with heating companies investing in cogeneration units (mainly gas) and increasing the use of renewable energy sources. However, meeting the challenges of the EU's energy and climate policy will require significant investment in energy transformation projects in the coming years. Therefore, the transformation of heating in Poland should be carried out using national and EU funds, such as:

- The Cohesion Policy
- The Recovery and Resilience Instrument
- The Just Transition Fund
- ReactEU

- Priority programs of the National Fund for Environmental Protection and Water Management and Common Agricultural Policy funds
- The Modernisation Fund and the Energy Transformation Fund – the national special-purpose fund supplied with funds from the sale of CO2 emission allowances.

The President of URE points out that the heating systems in Poland should be changed and made independent of fossil fuels, but this transformation should also consider the local specificity, which is very characteristic of the Polish market. Moreover, the modernization of the heating sector should be treated as an element of security, as clearly demonstrated by the situation related to the war in Ukraine and concerns about the lack of coal supplies for Polish heating and power plants. Therefore, according to the URE President, a model of central financing for the modernization of heating should be created. However, it is only an idea with no materialized actions taken so far.

The implementation of transformation goals by enterprises should be done in a diversified way. Each heating system is different; therefore, it must prepare its own local strategy using the strategy of the Ministry of Climate and Environment. In the current situation, it is worth opening heating to renewable energy sources as much as possible, but also ensuring the security of heat supplies at a socially acceptable price. This requires detailed planning at the level of each local heat market. It should be noted that it must be a mix of solutions based on coal and gas (optimally cogeneration) and alternatives to them, prepared based on plans for the next 15-20 years.

Further work to improve energy efficiency will focus on reducing energy demand through the intensification of activities in process efficiency in industry as well as thermal modernization and renovation of buildings, which will help protect households from energy poverty.

4.4. Comparison with the Ukrainian district heating sector

The district heating sectors in Poland and Ukraine have some similarities. Poland's district heating sector dates back to the mid-20th century, driven by urbanization and industrialization during the communist era. Similarly, Ukraine's district heating systems were developed during the Soviet era with extensive networks in urban areas.

A significant difference, however, is that coal remains a major fuel source in Poland, although there is a growing shift towards natural gas and renewable energy sources. In contrast, Ukraine is predominantly dependent on natural gas, with some use of coal and biomass.

Poland:

- Faces high environmental impacts from coal.
- Incurs significant economic costs associated with the transition to renewable energy.
- Deals with political issues due to coal's economic importance.

- Has made significant technical progress in modernizing its infrastructure but faces big challenges.
- Only about 20% of district heating systems meet the EED condition for efficient district heating.
- Lacks financial and administrative capacity to achieve EU targets.

Ukraine:

- Has relatively minor environmental impact from natural gas.
- Faces significant energy security risks and economic risks related to gas price volatility.
- Requires huge investments to modernize its infrastructure.
- Faces greater technical challenges due to aging infrastructure, heavy debt burdens, and lack of favorable investment sources.
- Legislative framework is evolving, including efforts to attract investments.

5. Recommendations to the proposed reforms in the district heating sector in Ukraine

This chapter presents recommendations on key areas regarding the heating sector in Ukraine to be addressed in an ongoing reform process to comply with EU legislation, with a focus on the EED, as parts of the EED have already been implemented. Based on the topics presented in previous chapters, the recommendations are organized into six groups:

1. **Regulatory Framework Enhancement:** Setting up the Energy Efficiency First principle as the overall qualitative principle and cost-benefit calculation methodology for quantitative assessment of the optimal least-cost path.
2. **Reform of Tariff Design and Structure:** Establishing a new heat tariff system that covers all justified costs and provides incentives to invest in improvements, including energy efficiency and heat savings.
3. **Integration of Heat Planning with Urban Planning:** Ensuring sustainable and efficient heat supply in urban areas, as well as more livable, robust, and sustainable urban environments.
4. **Promotion of Cost-Effective and Sustainable Heat Supply:** Describing an optimal structure of the district heating system to be promoted through legislation.
5. **Strengthening the Investment Environment:** Essential for realizing the objectives.
6. **Enhancing Consumer Protection and Information:** Ensuring that rights, obligations, and information for end users are maintained throughout the conversion process.

Ukraine already has extensive legislation governing the heating sector—and the energy sector as a whole—but it is lagging in implementing the legislation in practice. Ukraine may find itself in a similar situation to Poland in 2004, where membership in the European Union subjected the sector to significant additional EU requirements and implementation goals, as described further in Chapter 4 about the legal framework in Poland.

It must be emphasized that the ongoing war has created an extraordinary situation in Ukraine, affecting the legislation with restrictions. Moreover, the implementation and functioning of the existing legislation face extraordinary obstacles.

5.1. Recommendation 1: Regulatory framework enhancement

The Heat Supply Act of Ukraine defines the basic legal, economic, and organizational principles of activity at heat supply facilities. It regulates subjects related to the production, transportation, supply, and use of heat energy to ensure the energy security of Ukraine and increase the energy efficiency of heat supply systems. It also aims to create and improve the heat energy market and protect the rights of consumers and workers in the heat supply sector.

However, it seems limited how the objectives to "increase the energy efficiency" and "create and improve the heat energy market" is followed up legislatively and in practical administrative implementation. In

addition, in 2005, when the Heat Supply Act of Ukraine was adopted, there was no interaction with the EED or other EU directives.

In line with the application for EU membership, extensive adjustment of Ukrainian legislation is underway to comply with the EU directives, primarily the EU Energy Efficiency Directive (EED), but also the Energy Performance of Buildings Directive (EPBD) and the Renewable Energy Directive (RED). In this context, the following is recommended.

5.1.1. Definition of the new Heat Supply Act objectives

As described in Chapter 2.1.2, EED, art. 3 establishes "Energy Efficiency First" (EEF) as a fundamental principle of EU energy policy and gives EEF a legal status for the first time, increasing the EU's ambition for energy efficiency in all sectors, including the heat supply sector. This new article requires Member States to ensure that energy efficiency solutions are assessed in planning, policy, and major investment decisions. In the district heating sector, implementing EEF requires:

- Systematically assessing energy efficiency among the possible investment options when planning investments in district heating projects according to EED preamble point (16).
- Ensuring that energy efficiency is assessed on a holistic approach by balancing demand-side and supply-side improvements, according to EED preamble point (18).
- Creating energy efficiency through sector coupling between buildings, district heating, electricity production, industrial processes, etc., according to EED, art 1, para. 1.

Proper implementation of EEF in district heating systems focuses on coordinated planning between heat production, distribution, and the heat demand in buildings. Reduced and more flexible heat demand makes it cheaper and easier to increase the share of renewable energy (RE) production in the district heating system. Additionally, investing in lower heat demand in already connected buildings can result in reduced dimensions and thus lower pipe costs when pipes are replaced, or provide the opportunity to connect more buildings. However, in Ukraine, the connection level is normally very high, despite increasing disconnections in recent years. These benefits can help overcome the initial barrier that a lower heat demand means less revenue for the district heating company. The EEF principle also opens opportunities for sector coupling, i.e., energy-efficient interconnection (integration) of other energy-consuming sectors such as power generation and industry with the district heating sector.

It is recommended that the new Heat Supply Act implement Energy Efficiency First (EEF) from the EED as a fundamental objective or overarching principle, recognizing that there are no EEF-specific policies. Implementing EEF requires a broad systemic approach to policymaking, integrated planning, and investment decisions so that supply-side and demand-side resources are jointly considered and coordinated among the involved stakeholders. Adjustments to decision-making, governance structures, and investment frameworks must be introduced across all sectors, including building policies, the heating and electricity sector, climate action, management systems, policy objectives, etc. Implementing EEF is

not necessarily about adopting new policies but ensuring that existing policies and regulations align with this principle.

Focusing on national legislation, the EEF can be considered the main link between the EED and the Energy Performance of Buildings Directive (EPBD), which promotes energy improvements in buildings, and the Renewable Energy Directive (RED), which promotes the transition from fossil fuels to renewable energy.

5.1.2. National least-cost assessment methodology

According to EED Preamble, point (17) and art. 25 para. 3 (chapter 2) least-cost modelling using a nationally recognized assessment methodology defined through the heat supply act is recommended. In Denmark, the executive order for approval of projects states that the least-cost assessment calculations are made in accordance with the Danish Energy Agency's guidance on socio-economic analyses in the energy sector. The calculations are based on the most recently updated assumptions about energy price and emission cost projections for the next 20 years, and a national discount rate for net present value calculations.

The methodology includes to compare demand-side and supply-side options, thereby assessing the level of energy efficiency that benefits society, at least considering the benefits of reduced energy system costs and possibly other benefits (including reduced greenhouse gas emissions, improved health due to lower local pollution). Energy efficiency investments thus bring many additional benefits to society and should be prioritized by public policies in line with the national energy and environmental goals.

This approach may not always be the most cost-effective option for individual investors: some of the benefits may arise at the societal level (e.g., reduced greenhouse gas emissions), whereas all costs would be at the investor level in the absence of public policies. Designing policies in accordance with EEF also means reducing the possible gaps between the individual investor's and society's perspectives. These policies can include taxes on greenhouse gas emissions and on local air pollution emissions, just as targeted programs based on state aid can promote specific national energy and environmental goals.

It must be emphasized that least-cost modelling of energy systems on a uniform and nationally recognized basis is the key to both political decision-makers and private actors being able to make informed decisions within the framework of EEF.

Ukraine has also developed a method, which is described in the Methodology for the Development of Heat Supply Schemes for Settlements of Ukraine[22], where cost-benefit analysis of proposed heat supply schemes using the present value method is described. Nevertheless, the method seems to be used in a complex framework, and streamlining and simplification could create a better overview for potential stakeholders. Comparison with the Danish method can therefore be recommended.

[22] https://zakon.rada.gov.ua/laws/show/z1144-20#Text

Furthermore, the Ukrainian method of developing heat supply schemes with the new edition in 2023 of the EED should be assessed, how it can be anchored to the Energy Efficiency First principle.

5.2. Recommendation 2: Reform of tariff design and structure

When drafting legislation, it is crucial to consider all aspects necessary for successful and effective implementation and assess how it complies with the EED. This means that not only the heat supply act must be adjusted, but also several other acts and secondary legislation must fit together and be able to function in practice through orders, instructions, and guidelines realized by responsible and knowledgeable entities.

The comprehensive implementation package described below aims to significantly strengthen the heat tariff structure. The heating tariff system should be reformed to cover all necessary costs and provide incentives to invest in improvements to the district heating system:

- **Regulatory Approach:** Several pieces of EU legislation collectively establish rules and guidelines for tariff setting to promote both consumer protection and efficient competition in a market-based system. Within the same framework, the EEF encourages the design of tariffs that promote energy efficiency and demand-side management. Translating this into the Ukrainian regulatory framework will contribute to strengthening the tariff structure for district heating to reflect the actual fixed and variable costs of heat production, distribution, maintenance, and modernization, while also strengthening incentive-based regulation and considering affordability for consumers, especially vulnerable households.
- **Operational Approach:** In the previous Ukrainian system, all tariffs were based on a 1-tier fixed tariff structure based on m² of heated floor area, expressed as a price per calculated Gcal. In the transition to metering, the tariff often changed to a 1-tier 100% variable tariff according to the heat meters. To promote both energy efficiency and fairness in billing, the EED assumes cost-reflective pricing, meaning that energy prices should reflect the true costs of supply, including fixed and variable costs. Thus, it is important that a new commercial tariff has at least a 2-tier tariff structure: a fixed part per m² floor and a variable part per measured Gcal (or MWh thermal). For end-users in multi-user buildings with vertical distribution, see Chapter 5.2.
- **Organizational Approach:** In line with EED art. 14, para. 2, the definition of the point of delivery at which district heating can be sold to consumers (building owners) is an important part of the transition from the previous system to a market-based system. The point of delivery/sale at the entrance to the building - not the apartment - is already foreseen by the commercial metering law in Ukraine. Most buildings (but not all yet) are equipped with a heat meter at the point of delivery at the building entrance. Thus, the bill for each apartment shall be based on the building-level heat meter, divided among all apartments according to heated floor area. Several companies in Ukraine has already implemented this principle, and it may even be more efficient than engaging separate billing companies. It may improve the relationship between the district heating company and the end users, which aligns with the intention of the EED.

- **Technical-Economic Approach:** In typical existing buildings in Ukraine, it is important in the first stage to balance the in-house radiator system to avoid uneven distribution of heat and, in the second stage, to invest in thermostatic valves at the radiators to improve thermal comfort and ensure a balanced heat distribution. After installing these valves, it is relatively expensive to establish heat cost allocators compared to theoretical additional heat savings, considering the situation in Ukraine. Therefore, it will be fully in line with the EED if the national authorities do not enforce the installation of these devices but focus on cost-effective investments in heating installations in buildings and building energy management.

5.3. Recommendation 3: Integration of heat planning with urban planning

It is recommended to integrate district heating planning with urban planning and develop strategies to ensure sustainable and efficient heat supply in urban areas. By aligning district heating infrastructure with urban development plans, cities can reduce local pollution and greenhouse gas emissions, and create more livable, resilient, and sustainable urban environments.

This aligns with EED Article 25, para. 6, which states that Member States shall ensure heating and cooling plans are aligned with other local climate, energy, and environment planning requirements to avoid administrative burdens for local and regional authorities and encourage effective implementation of the plans. The following recommendations can be made:

1. **Mandatory Connection of New Buildings:**
    - The central government could allow local governments to ensure mandatory connection of new buildings to the district heating system if the local government approves the district heating.
    - City zones by type of heat supply should be introduced.
    - The Act of Ukraine on Regulation of Urban Development (supported by the new Heat Supply Act) should supplement urban planning conditions and restrictions with heat supply zones and obligations or restrictions on connecting to district heating.
    - Clarify (restrict) the right of the customer to use individual or autonomous heat supply systems when district heating systems are available.
    - Experience from Denmark shows that district heating can provide very cost-effective solutions. Mandatory connection will help strengthen district heating companies' bottom lines and drive investments in modernization. However, significant investments are needed to modernize outdated and inefficient systems in Ukraine.
2. **Design Criteria for Heating Installations:**
    - The building code could include design criteria for heating installations to facilitate low-temperature in-house heating systems in buildings.
    - Low-temperature heating systems should be integrated from the design phase in new buildings or when renovating existing buildings, adhering to norms and standards such as EN 15316 for energy performance.

3. **Horizontal In-House Distribution:**
    - Implement in the Building Code that new or renovated buildings be supplied from heating systems with horizontal in-house distribution, creating an internal heating network with a branch line to each apartment for establishing a point of delivery.
    - Note that Ukrainian legislation states that all new buildings must have per-unit heat meters and regulation, but practical realization is unclear.

Regarding heat planning, EED Art. 25, para. 6 states that "Member States shall ensure that regional and local authorities prepare local heating and cooling plans at least in municipalities having a total population higher than 45,000." This can also apply to smaller municipalities.

- The Ukrainian Heat Supply Scheme is non-obligatory for cities with more than 20,000 inhabitants, which aligns well with EED guidelines when comparing cities to municipalities.
- If the Heat Supply Scheme were obligatory only for settlements with more than 50,000 inhabitants, it would not align with EED.
- The period for which the Heat Supply Scheme is approved is unregulated (left to local self-government) but subject to review every five years.

In Denmark, municipalities are obliged to carry out heat planning, but not issue periodic heating plans. Municipal heat plans were replaced in the 1990s by a project proposal system in the Heating Supply Act. This system improves efficiency and flexibility in heating planning, allowing specific project proposals to form the basis for developing local heat supply.

5.4. Recommendation 4: Promotion of cost-effective and sustainable heat supply

The EED promotes a cost-effective and sustainable heat supply through several mechanisms aimed at enhancing energy efficiency and integrating energy planning with broader sustainability goals.

The EED emphasizes the "Energy Efficiency First" principle, which prioritizes energy efficiency measures in planning, policy, and investment decisions across both energy and non-energy sectors. This principle ensures that energy-saving measures are considered before investing in new energy production, thereby reducing overall energy demand and avoiding stranded assets.

In the EED preamble, point (17), it is stated that the energy efficiency first principle is at the core of the EU Strategy for Energy System Integration. While the principle is based on cost-effectiveness, its application has wider implications from a societal perspective. Those implications can vary depending on the circumstances and should be carefully evaluated through robust cost-benefit analysis methodologies that consider the multiple benefits of energy efficiency.

In Ukrainian cities, there is a large variety of heat supply systems with different technical and economic challenges. In general, the following structure is recommended for the development of district heating,

and it is recommended to be promoted through legislation, especially with a view to modernizing Ukraine's new Heat Supply Act:

1. **Promoting Right Sizing of District Heating Areas:**
    - Only cover economically reasonable urban areas by incorporating district heating considerations into heat zoning requirements, permits for land use, environmental regulations, and building regulations.
2. **Promoting Interconnection of Smaller District Heating Systems:**
    - Integrate smaller systems into larger ones to benefit from economies of scale, i.e., cost advantages by increasing the scale of production and operation. Achieving these advantages in the long term requires initial investment in costly modernization of the district heating system.
3. **Promoting Diversification of District Heating Production:**
    - Introduce load dispatch operation, creating the basis for the cheapest heat production by competition between heat production plants, including biomass-based combined heat and power (CHP) plants, large heat pumps, electric boilers, and gas boilers in the same system.
4. **Promoting Integration of Renewable Energy Sources:**
    - Enhance energy security by integrating local renewable energy sources into district heating systems, as international energy will no longer be an instrument of political or military influence.
5. **Supporting Coordination between Building Owners and District Heating Companies:**
    - Promote lower supply temperature to buildings from the district heating system and better cooling of the circulating district heating water. Such targeted improvements will result in lower heat distribution losses and higher efficiency of district heating plants, benefiting building owners with cheaper district heating.
6. **Moving the Point of Delivery and Ownership to the Secondary Side of the Heat Substation:**
    - Allow the district heating company as the new owner to optimize the operation of the substation, positively influencing the rest of the district heating system. The district heating company will be responsible for financing the heat substation, often with access to more favorable loans than individuals, lightening the financial burden for customers in the long run. Customers will pay continuously (monthly) for a subscription scheme. This approach has been present in Denmark for over a decade, following the decision by the Danish Utility Regulator.

Achieving these benefits requires large investments, which is why the focus needs to be on financial instruments, including favorable loans with low interest rates and long repayment periods, reflecting the long technical lifespan of modern district heating systems.

5.5. Recommendation 5: Strengthening the investment environment

A strong investment environment based on clear and supportive policy framework is crucial to being able to meet the requirements of the EU legislation and policy. This is closely related, as investment projects must adhere to EU legislation to access to funding opportunities, which includes alignment with EU directives and policy objectives related to improved efficiency, energy savings, greenhouse gas reductions, etc. The following can be recommended:

5.5.1. Strengthening the financial resilience of the district heating companies

It is recommended that the district heating companies' financial resilience is strengthened through the new Heat Supply Act and/or derivative laws and political initiatives. This aims to attract investments with reduced risk coverage, such as favorable loans with low interest rates and long maturities. Measures recommended to strengthen financial resilience include:

1. **Statutory 2-Tier Tariff Structure:** Implementing a tariff structure with both fixed and variable components to ensure cost recovery and incentivize efficiency.
2. **Supportive Rules for Depreciation of Investments:** Establishing rules that allow for favorable depreciation rates on investments to encourage modernization and efficiency improvements.
3. **Statutory Tariff Adequacy:** Ensuring that tariffs are adequate to cover the full costs of heat production, distribution, maintenance, and modernization, while considering consumer affordability.
4. **National Debt Restructuring Program:** Creating a program to assist district heating companies in restructuring existing debt to improve financial stability and attract new investments.

Statutory 2-tier tariff structure

The 1-tier tariff structure, i.e., use of a fully variable tariff is recommended to be banned, as it can create a large liquidity risk for the district heating company, if the heat sale fails, because it leads to an under coverage of all the fixed costs that the district heating company has. When dealing with high old debts the Ukrainian district heating companies are very vulnerable to a fully variable district heating tariff. The use of 1-tier tariffs also results in a lack of incentives for DH companies to improve system efficiency (i.e., reduce thermal energy production), even it gives the maximum signal to heating customers to save heat, if they have the possibility at all to do that technically.

The EED assumes cost-reflective pricing, which means that energy prices should reflect the true costs of supply, including fixed costs and variable costs. Thus, the EED does not prescribe 2-tier tariffs (variable and fixed tariff elements) directly, but the principle of cost-reflective pricing leads to the adoption of various tariff structures, including tiered tariffs, with 2-tier tariffs being the most comprehensive to promote both energy efficiency and fairness in billing.

A relatively high fixed district heating tariff share provides a stable income and thus creates greater certainty that the budgets can be kept. In Denmark, the national regulator has announced that a minimum of 20% of the total costs must be covered by a fixed payment to ensure stable financial conditions. In

practice, the fixed share is on average 31% of the total district heating price in Denmark. However, this average covers a very large variation. In other countries, the fixed tariff share can be considerably smaller.

Supportive rules for depreciation of investments

Supportive depreciation rules are recommended to give the district heating companies the opportunity to depreciate investments over the technical lifetime of the new assets, however a maximum of years is recommended to ensure correspondence with the maturity of the loans that can be raised for investments and avoid risky depreciations.

Denmark has thus a depreciation maximum of 30 years, which corresponds the district heating company's option to raise a municipally guaranteed loan with a central municipal credit institution with a term of up to 30 years. (However, there is a proposal from the expert committee to extend the depreciation and thereby also the loan term of up to 45 years for investments in facilities with a very long technical lifetime, such as district heating pipelines).

In addition, supportive rules of provisions for investments are recommended, which imply that allocations for new investments can be made several years before the year of commissioning of new assets. In Denmark provisions for investments can be made up to 5 years before the year of commissioning of new assets. The Danish rules mean that up to 75% of the construction cost can be financed as advance depreciation (savings) in heating prices. Such method aims to stabilize the heating prices, especially when planning comprehensive investments.

Statutory tariff adequacy

According to the Law of Ukraine "On Local Governance of Ukraine," municipal authorities set tariffs for heat production, transport, and supply (except for enterprises - licensees of the NEURC, for which tariffs are set by the NEURC in accordance with the Law on State Regulation in the Field of Public Utilities). Furthermore, Article 13 of the Heat Supply Act and the Utilities Act assigns local authorities the responsibility for approving development and investment programs. Given the rather wide approval powers of local authorities, it could be argued that they do not have a similar level of responsibility for their decisions, even if the same local authority that approves the tariff owns the specific district heating company.

In the worst-case scenario, the municipal/local regulator may set unreasonably low tariffs that do not allow the district heating company to collect enough tariff revenue to maintain financial stability. This can happen due to a lack of specific knowledge and expertise, or for socio-political reasons. If it is a deliberate policy to keep the tariff level lower than what is financially justifiable, it can legally conflict with the general principles of local governance and in principle justify demands for financial compensation to the district heating company.

To minimize the risk of periods of insufficient tariffs due to changing fuel costs, it is recommended that the regulator can allow the district heating company to change tariffs quickly in connection with sudden changes in fuel costs (currently the fuel is almost only gas) or electricity costs. This approach can be solved in several ways, such as considering the energy price as a separate part of the tariff, a one-off recalculation for consumers at the end of the heating period or automatically adjusting the tariffs according to a set of rules to reflect changing energy prices. Alternatively, more subsidies need to be in place for vulnerable household.

National debt restructuring program

Concerning the assessment of restrictions on measures for the recovery of utility debts during the war and afterwards. A well-functioning payment discipline is not only a business necessity, but also a legal obligation under several pieces of EU legislation with the aim of promoting fair and efficient trading practices, protecting businesses, and strengthening the EU single market.

It is estimated that Ukraine has already implemented all necessary legal instruments, including simplified legal procedures and an "automatic" court order to obtain debt to utility companies. However, the large old debt from previous years (due to low heating tariffs, etc.) still burdens the entire district heating sector and must be resolved, so new rates not only has to cover past losses, but also proper operation and improvements.

Therefore, it is recommended to adopt a comprehensive national debt restructuring program where Ukraine can address the old debt problems plaguing the district heating companies and thus lay the foundations for a more sustainable and efficient heating sector. This may include:

- **Centralized Debt Management:** Consolidate district heating companies' old debts into a centralized fund. This allows for more effective negotiation with creditors and better management of the debt portfolio.
- **Debt Restructuring Negotiations:** Participate in negotiations with national and international creditors to restructure existing debts. This may include extending maturities, reducing interest rates, or even partially forgiving debt.
- **International Assistance:** Seek support from international financial institutions for technical assistance and potential financial support.

Since the debt is mainly to the Ukrainian state company Naftogaz, a better cooperation between Naftogaz and the district heating companies is recommended to enable a proper management of the debt and its reduction in the near future. Furthermore, the potential for the district heating companies to develop fuel diversity options such as local and sustainable biomass to replace gas in periods, when gas is too expensive, is strongly recommended. Nevertheless, implementation of biomass as a fuel in the Ukrainian district heating sector depends largely on the success of managing sustainable biomass growth in line with the EU RED as well as developing logistics for sale of biomass.

5.5.2. Strengthening the investment environment around the district heating sector

Strengthening the investment environment around the district heating sector includes the following proposed measures:

1. **Strengthening the Applicability of Heat Supply Schemes:** Ensure that heat supply schemes are robust, widely applicable, and effectively implemented.
2. **Enhancing Legal, Regulatory, and Policy Conditions and Procedures:** Improve the legal, regulatory, and policy framework to facilitate investments in the district heating sector.
3. **Creation of a National Investment Pool:** Establish a national pool for investments in the district heating sector to centralize funding and attract investments.
4. **Promoting Financial Incentives and Regulatory Support:** Introduce financial incentives, subsidies, and regulatory support to encourage investments in the district heating sector.
5. **Eliminating Subsidized Tariffs:** Remove all subsidies on energy and strengthen the social subsidy scheme to ensure targeted support for vulnerable households.

Strengthening the applicability of heat supply schemes

The heat supply schemes for district heating systems should be strengthening in terms of attracting investors and increase competition.

Project proposals should thus be able to be extracted directly from heat supply schemes to make cost-benefit analyses with a view to investments/loans. This will ensure coordinated investments, thereby considering system-integrated assessments and the Energy Efficiency First principle. The analyses are either based on a national assessment methodology (see chapter 5.1.2) or meet an investor's requirements, e.g., the requirements of an international financial institution.

Enhancing legal, regulatory, and policy conditions and procedures

Streamlined permitting processes to reduce bureaucratic hurdles, and transparent regulations: clear guidelines and predictable outcomes are essential to minimize uncertainty, attract investment, and facilitate public-private partnerships. This includes:

- Adherence to international standards and adoption of best practices in regulatory and policy frameworks to align with EU standards, recommendations, and guidelines to follow the Energy Efficiency First principle and other EED definitions, including high-efficiency cogeneration and efficient district heating.
- Creating a conducive environment for procedures and permits, including the environmental impact assessment (IEA) procedures based on Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, and Medium Combustion Plant Directive (MCPD) 2015/2193 which sets out rules to control flue gas emissions, both transposed into national Ukrainian law.

Creation of a national investment pool

Based on a cooperation agreement with international financial institutions, it is proposed to create a national pool for investments in the district heating sector, projects that are presented and analyzed in project proposals for municipal approval and local consultation.

The advantages of coordinating all funds and loans offered by donor countries and international financial institutions are to avoid overlapping of studies and investments and to ensure that the projects that are most profitable for the society of Ukraine that meet the energy and environmental policy goal, is promoted.

Promoting Financial Incentives and Regulatory Support

That may include grants and subsidies for investment projects, low-interest loans for investment projects, tax on fossil fuels or tax credits on renewables but should also be compatible with EU state aid rules.

Eliminating Subsidized Tariffs

It is recommended to remove requirements to differentiate tariffs according to category of consumers to simplify tariff setting and avoid cross-subsidization. If subsidies through tariffs are still maintained for some reason, it is recommended to only provide subsidies on the fixed tariff part, assuming a 2-tier tariff structure. This ensures coverage of the fixed costs for maintaining the district heating system, while at the same time the customer can save on the variable part, i.e., save on the consumption of heat.

In combination with cost recovery tariffs, it is recommended to maintain the existing system, where social subsidies cover heating costs for the most vulnerable customers. However, Ukraine should depoliticize the tariff-setting process. All heat tariffs should cover all economically justified costs, and policy decisions should not be used to change these tariffs.

5.6. Recommendation 6: Enhancing consumer protection and information

The EED preamble, point (114), aims to strengthen consumer protection by introducing basic contractual rights for district heating, cooling, and domestic hot water, consistent with the level of rights, protection, and empowerment provided to final customers in the electricity sector. Plain and unambiguous information concerning their rights should be made available to consumers.

According to EED preamble, point (122), it is necessary to ensure that people affected by energy poverty, vulnerable customers, people in low-income households, and, where applicable, people living in social housing are protected and empowered to actively participate in energy efficiency improvement interventions, measures, and related consumer protection or information measures implemented by Member States. Targeted awareness-raising campaigns should be developed to illustrate the benefits of energy efficiency and provide information on the financial support available.

Furthermore, EED, Article 21, (section 2.1.8) specifies the basic contractual rights for heating, cooling, and domestic hot water, which final customers shall have the right to through a contract with their supplier.

The elements above are largely stipulated in detail in Article 8 of the Act of Ukraine on commercial accounting for heat and water. This serves as an extension to the Ukrainian Heat Supply Act, Article 24: Rights and Basic Obligations of the Heat Energy Consumer. However, in a new Heat Supply Act, it is recommended to strengthen the rights and obligations written directly into the Act.

Additionally, it is recommended to strengthen and refine customer relationships and information through organized exchanges of experiences between district heating companies via the Ukrainian District Heating Association and/or other district heating companies in the EU, such as companies in Denmark, where information obligations are also laid down by law and implemented in practice.

Focus on best practices in the following areas is recommended:

1. **Keeping Customers Informed:** Properly inform customers of important updates, notices, tariffs, and service changes through standard digital communication channels.
2. **Tailoring Communications:** Tailor communications to individual customers, including personalized billing statements, targeted promotional offers, or reminders of upcoming system maintenance tasks.
3. **Providing Educational Resources:** Provide educational resources and materials to help customers understand how district heating works, its benefits, and tips to maximize energy savings and efficiency.

As described in Chapter 4.2, best practices include district heating companies handling invoicing in multi-user buildings. Contracting directly with each end user can further strengthen consumer information and relationships. For example, the district heating company can inform consumers about the building's monthly consumption and return temperature and benchmark it against similar consumers.

6. Specific comments to the Ukrainian Law on Heat Supply

The aim of this chapter is to assess the extent to which the Law of Ukraine on Heat Supply No. 2633-IV, dated June 2, 2005, complies with each article in the EU directives.

In general, the Ukrainian law includes articles that are fully in line with the intention of the EU directives. However, it is not possible from the text alone to assess how the articles will be implemented. Articles alone are not sufficient; there is a need for executive orders and guidelines that specify the division of responsibility among legal entities, the procedures, and the practical implementation.

It should also be noted that the Ukrainian law on heat supply does not cover all areas related to district heating. A significant volume of relations is regulated by laws on housing and communal services, commercial metering of heat and water supply, and other laws mentioned above.

The Danish case describes a set of documents and an institutional setup that has transformed the heating sector since 1979. Similarly, the Polish case describes how the Polish sector has started this transformation since 1990, particularly since Poland became a member of the EU.

6.1. Article 14: Metering for heating, cooling, and domestic hot water

The present law on heat supply is not in accordance with Article 14. It does not enforce a clear definition of the point of delivery at which district heating can be commercially sold to consumers. These issues are regulated by the laws on utility services and on commercial metering of heat and water supply.

The point of delivery, which is the interface between the district heating company and the consumer, should include:

- A branch line connection with stop valves to deliver the subscribed maximal capacity and to disconnect the consumer if necessary, e.g., in case of non-payment.
- A heat meter installed by the district heating company for distributing the variable cost (which depends on the amount of heat) to all consumers.
- Regulation valves at the consumers' installations to enable them to adjust consumption according to their needs.

The heat meter should be used for billing the variable tariff.

The district heating contract between the company and the building owner must include information on the agreed and subscribed capacity. This capacity can be expressed as the heated floor area used previously or converted to maximal capacity in kW based on estimated kW/m² or registered maximal capacity at the time of connection. It is important that the same principles for defining capacity are used for all consumers, as they share the fixed costs according to their subscribed capacity.

Heat meters and the rules for calculating subscribed capacity should be based on the same criteria and principles for all connected consumers.

Many heat meters are correctly installed at the point of delivery for many consumers, but in some companies, they are still only used for metering heat in the district heating distribution, not for tariffing. The tariff is effectively a calculated fixed tariff in UAH/m², including all costs and converted to a price in UAH/Gcal based on Gcal, which is not measured but calculated.

It takes time to install heat meters for all consumers and ensure that the building owner can adjust consumption based on the heat meter. District heating companies need guidelines on how to implement metering and apply tariffs.

To comply with Article 14, the tariff should be divided into at least two parts:

- A variable tariff in UAH/Gcal based on total variable costs divided by the total heat sales to all consumers.
- A fixed tariff in UAH/m² of heated floor area based on total fixed costs (including the estimated cost of heat losses) divided by the total subscribed floor area.

According to international best practices, a third tariff element that provides incentives to reduce the return temperature should be included. This is not required by the EED, but aiming for low-temperature heating systems in buildings is vital for the cost-effectiveness of the total heat supply system by lowering heat losses and increasing energy efficiency.

The total heat sales can either be the registered consumption from the previous month or a forecast adjusted according to the measured heat. In Ukraine, the post-payment system is used.

6.2. Article 15: Sub-metering and cost allocation

Submetering for the allocation of costs among end-users in multi-user buildings is possible in cases where heat is not sold at a point of delivery.

Today, the general calculated fixed price expressed in UAH/Gcal is the same for all end-users in all buildings.

To comply with Article 15, the Law will need to set rules for sharing the total bill for heating and hot tap water among end-users in the building.

The total costs to be divided are:

- Fixed costs of district heating based on the subscribed heat capacity or connected heated floor area.
- Variable costs of district heating based on the building-level heat meter at the point of delivery.

- Plus/minus incentive to lower return temperature.
- Cost of maintaining the heating and hot tap water installations.
- Capital costs of investments in the heating and hot tap water system.
- Costs of administrating the cost allocation.
- Costs of heat and hot tap water cost allocators, if any.

There are, in principle, 5 methods:

1. The most pragmatic method, which is very similar to the present method, is to divide the total costs according to the heated floor area. The only difference is that there will be an individual price for each district heating consumer (building), as the heat consumption in kWh/m² for the whole building will differ based on the building's performance and the end-user's ability to adjust their demand.
2. If hot tap water is supplied by one pipe to each apartment, it is possible to install a flow meter at each pipe and distribute the costs of hot tap water according to these meter readings.
3. In the case of horizontal distribution of heat and hot tap water, it is possible to distribute the variable costs of heating according to the measured heat or flow to each apartment.
4. If heat cost allocators are installed at each radiator in a building with vertical distribution, it is possible to allocate the variable cost of heating according to the indicators for heat consumption.
5. The most advanced and costly method, which is common in most EU countries today, involves installing cost allocators for both heating and hot tap water. In this case, the bill to each apartment will include three main components:
    - A fixed payment per m²
    - A variable payment according to hot tap water allocators
    - A variable payment according to heat cost allocators

In terms of compliance with the EED, it is important for Ukraine to focus on cost-efficiency.

The authorities can assess the profitability of heat cost allocators considering the expected result given the local conditions. The outcome could be:

- That the pragmatic method (Method 1) can be used in all old apartment buildings with vertical distribution.
- That Method 3 should be used in all buildings with horizontal distribution.
- That Method 3 or Method 5 should be used in all new buildings.

6.3. Article 16: Requirement of remote reading

Modern heat meters ready for remote reading are important for the district heating company:

- To monitor the performance of the delivery.
- To communicate with the building energy managers.

- To administrate the monthly billing in a cost-effective way.

Therefore, to comply with the article, the law should set a deadline for the installation of remotely readable meters, e.g., within 5 years, giving companies an opportunity to replace old meters. Thus, the current heat supply act does not comply with this EED article.

6.4. Article 18: Billing and consumption information

Once the point of delivery and remote reading requirement is installed, it is possible to establish good communication between the district heating company and consumers.

This is regulated in detail in the current law on commercial metering, although not all companies have implemented it properly so far.

Companies will need support to implement web-based data systems to distribute the information to consumers.

The challenge will not be the communication from the district heating company to the building owner, but rather using the information for better energy management within the building organization.

Therefore, the law should address this problem and set rules for building energy management and for distributing information among end-users.

One option could be to allow the district heating company to offer consumers (building owners) the service of administering cost allocation and billing of heat, as well as providing information to end-users.

In case of non-payment from an apartment, there will be a problem to solve, but it will be the same problem faced by any housing administrator.

6.5. Article 20: Cost of access to metering and billing and consumption information

This is provided for in Article 8 of the law on commercial metering of heat and water and is implemented in practice.

6.6. Article 21: Basic contractual rights

This is regulated in detail by the law on utility services and model contracts approved by the CMU.

The contracting procedures and the content of the contracts comply with the requirements of Article 21 of the Directive.

It also considers the legal regime of ownership of apartment buildings in Ukraine.

The challenge will be to implement local democratic ownership and building energy management within homeowners' associations.

6.7. Article 25: Heating and cooling assessment and planning

Ukraine has a great opportunity to be supported by the International Financial Institutions (IFIs).

These institutions use the same overall principles for economic and financial assessment of investment projects, which will benefit Ukrainian society. Therefore, the law should adopt these principles. Ukraine has already developed a methodology described in the Methodology for the Development of Heat Supply Schemes for Settlements of Ukraine, where cost-benefit analysis of proposed heat supply schemes using the net present value methodology is described. However, the methodology seems to be used in a complex regulatory framework, and streamlining in line with IFI methodologies could be recommended.

Moreover, the Government of Ukraine should ensure that legislation in other sectors complies with the interest of society for a cost-effective transition of the heating sector, considering sector couplings. This includes the building sector, the power sector, the gas sector, and social security.

Key Recommendations:

1. **Building Sector:**
    - The building code and related legal acts should ensure that new apartment buildings and other large buildings suitable for district heating are planned and designed with district heating in mind.
2. **Power Supply Legislation:**
    - Legislation should consider sector integration, such as using highly efficient co-generation of heat and power to reduce the emission of waste heat from power generation (e.g., 50 GCal of additional fuel and 50 GCal less waste equals roughly 100 GCal useful district heating).
    - Ensure that district heating only pays the actual additional cost of generating this heat.
3. **Market Prices for Power and Regulation Services:**
    - Consider opportunities in district heating, such as:
        - Gas-fueled small-scale CHP owned by the district heating company to improve resilient power supply and generate power that replaces power-only production.
        - Electric boilers using surplus nuclear capacity and shutting down in case of capacity problems.

6.8. Article 26: Heating and cooling supply

The deadlines and performance metrics for district heating stated in Article 26 are recommended to be used as a landmark. These should be incorporated into the new heat supply act to guide the overall planning of the energy sector in Ukraine.