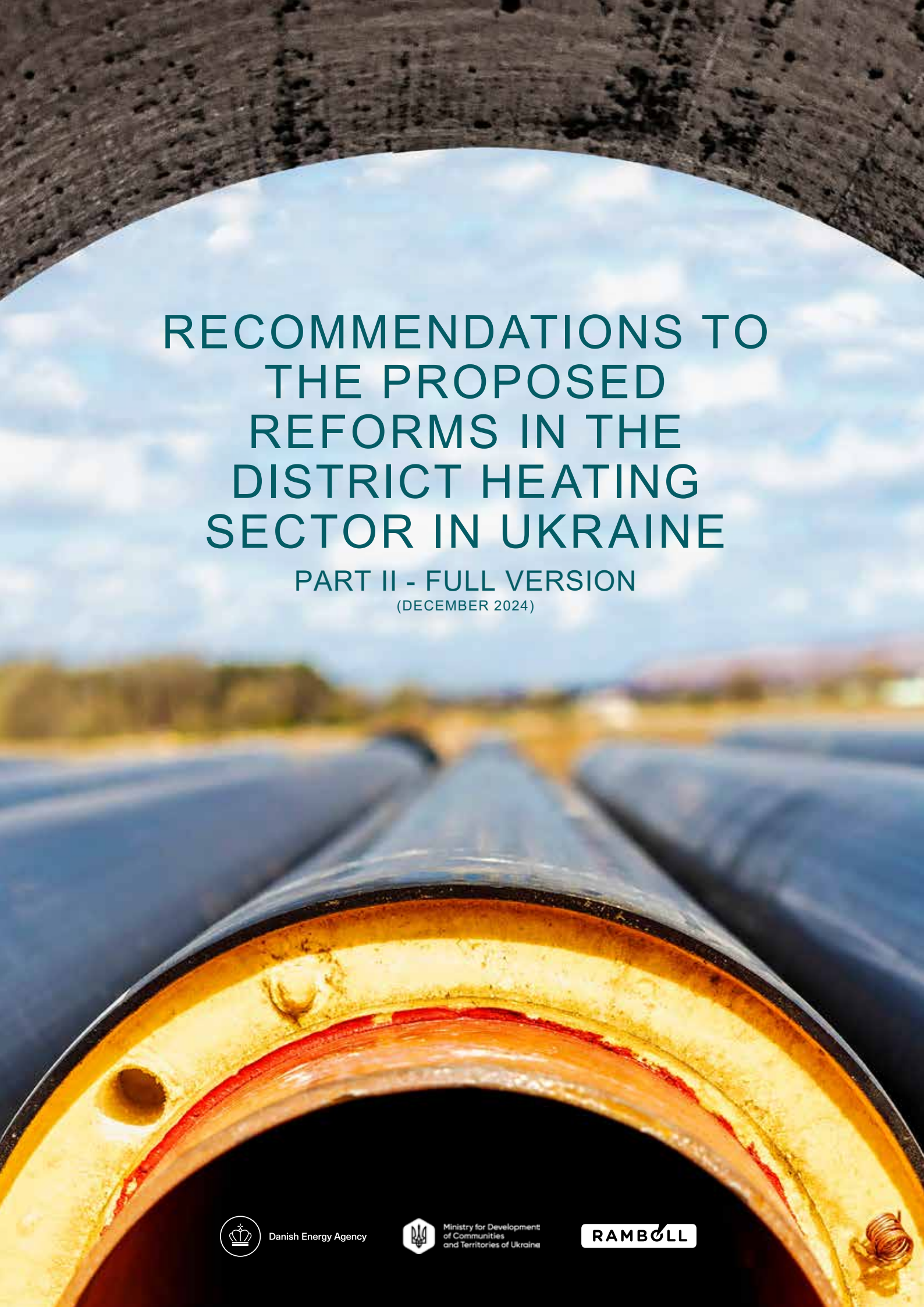

RECOMMENDATIONS TO THE PROPOSED REFORMS IN THE DISTRICT HEATING SECTOR IN UKRAINE

PART II - FULL VERSION

(DECEMBER 2024)

Danish Energy Agency

Ministry for Development of Communities and Territories of Ukraine

RAMBØLL

Project name:

Technical support for the harmonization of the Ukrainian regulatory framework in the field of district heating

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Danish Energy Agency and the Ministry for Development of Communities and Territories of Ukraine

Report II is a further operationalization of the six recommendations related to the implementation of the EU EED, which were identified in report 1: "Technical Support for the Preparation of the New Edition of the Ukrainian Law on Heat Supply".

Executive summary

This report is one of two reports that together form part of the Danish technical support to align Ukraine's heat supply rules with the EU EED and related legislation, led by the Danish Energy Agency (DEA) in cooperation with the Ministry for Development of Communities and Territories of Ukraine (MinInfra).

- Report 1 provides an overview of the Ukrainian DH sector, institutional roles, regulatory framework, main challenges, and recommendations for strengthening the Ukrainian Law "On Heat Supply" in line with the EED.
- Report 2 (this report) builds on 6 recommendations from Report 1 and further analyses the key challenges facing the Ukrainian district heating (DH) sector and proposes concrete reform improvements inspired by Danish and Eastern German experiences.

The overall objective is to create a roadmap for transforming the sector into a modern, efficient, and sustainable system aligned with EU standards and climate goals. However, challenges and barriers have been identified in the Ukrainian DH sector. They include:

- Much of Ukraine's DH infrastructure is outdated, energy inefficient and cost ineffective. This leads to significant energy losses during heat production, transmission, and distribution. Lack of opportunities to modernize and develop technical capabilities unnecessarily degrades district heating services.
- Although Ukraine has adopted reforms to improve energy efficiency and align with EU standards, enforcement at local level is often inconsistent and discretionary. The lack of realised cost-reflective tariffs means that DH companies (DHCs) cannot generate sufficient revenue to invest in modernization or even cover operating and maintenance costs. Without transparent and cost reflective tariff policies, lenders and investors are reluctant to engage.
- Overall poor financial condition of DHCs and financial instability, as heat tariffs do not reflect real costs. In addition, DHCs have in practice lost control over their financial flows, making it difficult to identify opportunities for reform, and heavy debt burdens prevent DHCs from investing in upgrades or improving efficiency. This creates a vicious cycle where poor financial health leads to further technical degradation of the DH system, and even greater financial instability.
- Ukraine's DH sector lacks clear frameworks for investments, and there is insufficient coordination between stakeholders, including municipalities, national authorities, and national, private, or international investors. The absence of a stable regulatory environment and clear investment guidelines discourages much-needed financing from international and private sector actors. With limited public financing available, Ukraine cannot modernize its DH systems without leveraging international loans, grants, and private investments.
- Urban planning and DH planning are not well aligned in many Ukrainian cities. For example, existing buildings are disconnecting from the DH system in favor of autonomous or individual heat supply solutions, and new urban developments are sometimes built without considering their

integration into existing DH networks. This fragmented approach makes DH systems less viable technically and economically.

To address these challenges and barriers, the recommendations outlined in Report 1 have been refined and expanded in this report (Report 2). In general terms, these include:

1. Regulatory Framework Enhancement
    a. Adoption of the EU's Energy Efficiency First principle to modernize legislation, reduce energy losses, and integrate renewables.
    b. Improvement of the technical-economic assessment method, drawing from Danish best practices.
2. Reform of Tariff Design and Structure
    a. Implementation of cost-reflective tariffs, and provision of targeted social subsidies instead of general "social tariffs" for households.
    b. Returning the control of financial flows to the DHCs and resolving accumulated debts.
    c. Establishment of transparent, consumer-friendly billing and info systems to rebuild trust.
3. Integration of Heat Planning with Urban Planning
    a. Updating the urban planning laws to include DH zoning and guidelines, harmonized with EU standards, to ensure sustainable city development.
    b. Establishing mechanisms for handling disconnections from DH.
4. Promotion of Cost-Effective and Sustainable Heat Supply
    a. Promotion of modern DH system operation, sector coupling to utilize renewable sources and excess heat, cogeneration and innovative technologies like heat pumps and storage.
    b. Incentivizing energy efficiency upgrades and decarbonization of DH systems.
5. Strengthening the Investment Environment
    a. Creation of a centralized agency to oversee municipal DH reforms, coordinate public-private partnerships, and facilitate access to international funding (e.g., via the Ukraine Investment Framework).
6. Enhancing Consumer Protection and Information
    a. Mandating transparent, itemized billing and strengthen regulatory oversight to ensure service quality and fairness.
    b. Educating the consumers on their rights and encourage energy-saving behaviors.

Experiences and best practices from Denmark and Eastern German are used to explain some aspects of these recommendations, considering Ukraine's unique context.

- From Denmark, this includes the benefits of the Danish project approval mechanism, cost-effective and transparent heat tariffs, incentives, and requirements for energy efficiency improvements in the DH sector, mechanisms for the transition of DH production to higher

efficiency and greener energy sources, and comprehensive and integrated planning, which promotes stakeholder adaptation and sustainable investments.

- From Eastern Germany, the following can be highlighted: the state-led coordination and organization of the comprehensive and rapid modernization of the DH sector after the reunification, with significant also international investments aimed at upgrading the outdated and polluting district heating systems inherited from the former GDR.

Considering the proposed recommendations and by learning from Danish and German experiences and best practice, Ukraine can develop a robust, efficient, and sustainable DH sector that is in line with European standards, while addressing Ukraine's unique challenges.

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Abbreviations

CBA	Cost-Benefit Analysis
CCGT	Combined cycle plants
CHP	Combined Heat and Power (Cogeneration)
DCE	Danish Centre for Environment and Energy
DEA	Danish Energy Agency
DH	District heating
DHC	District heating company
EED	EU Energy Efficiency Directive
EEF	Energy Efficiency First (principle from the EED)
EEOS	Energy Efficiency Obligation Schemes
ESP	USAID Energy Security Project
HSS	Heat Supply Scheme
IFI	International Financial Institution
KPI	Key Performance Indicators
LCSA	Least-Cost Scenario Analysis
MinInfra	Ministry for Development of Communities and Territories of Ukraine
MS	Member States of the EU
NEURC	National Energy and Utilities Regulatory Commission of Ukraine
NPP	Nuclear power plant
NPV	Net Present Value
PES	Primary Energy Saving
PIP	Priority Investment Plan
PPP	Public Private Partnership
RED	Renewable Energy Directive
SCADA	Supervisory Control and Data Acquisition
TPP	Thermal power plant
TWC	Tradable white certificate ("white" stands for efficient energy use)
UDEPP	Ukraine-Denmark Energy Partnership Programme
UIF	Ukraine Investment Framework

Introduction

Ukraine's heat supply sector is a vital component of the country's energy infrastructure. The sector is predominantly dependent on district heating (DH) systems, many of which were built during the Soviet era and suffer from inefficiency, high energy losses and outdated technologies.

However, in recent years, Ukraine has taken significant steps to modernize its heat supply infrastructure, aligning it with EU directives and standards as part of the country's wider efforts to integrate into the European energy market.

Ukraine's heat supply sector operates within the framework of Law of Ukraine on Heat Supply, but recent reforms include the adoption of laws aligned with the EU's Energy Efficiency Directive (EED).

At local level, municipal heating supply schemes are statutory, with the aim of optimizing heat supply systems and promoting sustainable energy use.

Despite these advances, the heat supply sector faces challenges such as insufficient funding, outdated infrastructure, and inconsistent and often discretionary enforcement of legislation. Strengthening the legislative framework and ensuring the effective implementation of new policies is crucial to achieving an efficient and sustainable DH sector.

Based on Report 1, which provides a comparative analysis of the Ukrainian, Polish and Danish DH sectors, institutions, and regulatory frameworks, this report analyses selected Ukrainian challenges in more detail and makes recommendations to strengthen regulatory and strategic areas within the Ukrainian DH sector. The analysis and recommendations are grouped into the following 6 main topics:

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

To support some of the recommendations, comparative analyzes and information from Denmark and the eastern part of Germany (Eastern Germany) have been added. Eastern Germany has been selected as inspiration for Ukraine, as the Eastern German DH systems have undergone a significant transition since German reunification in 1990, evolving in their technical, institutional, and financial dimensions.

1. Recommendation: Regulatory Framework Enhancement

Recommendations to regulatory framework enhancement in Ukraine includes in this chapter: incorporating the Energy Efficiency First (EEF) as the overall qualitative principle as well as enhancement of the present methodology for technical-economic assessment of DH solutions.

1.1. Incorporation of the Energy Efficiency First Principle

Incorporating the Energy Efficiency First (EEF) principle from the EU EED into Ukrainian legislation could be a significant step in improving energy use, particularly in regulation of the Ukraine's DH sector, ensuring that energy efficiency is prioritized at all levels from heat production, distribution, and consumption. The EEF principle implies that energy efficiency measures should be considered as the first option in energy planning, policy, and investment decisions.

For Ukraine, it is assessed very beneficial to integrate this principle, considering the huge task of modernizing and rebuilding the DH infrastructure. Recommended approaches are described below, which include adding legislative amendments on the EEF principle, but also how the principle should be implemented in practice through essential system changes, targeted investments, and national schemes:

1.1.1. Amendments to energy efficiency legislation

The Law of Ukraine on Energy Efficiency, adopted in 2021, defines efficient heat supply as the provision of heat in a way that optimizes energy consumption, minimizes energy losses, and ensures cost-effectiveness and reliability. The law is important for the heat supply sector, especially because it legally determines what efficient heat supply is, obliges local governments to develop Heat Supply Schemes in the most economically efficient scenario, introduces energy service contracts, etc.

Although the law generally proclaims the EEF principle, it can be further developed to prioritize energy efficiency in all planning and investment decisions. This would mean revising it to ensure that energy-efficiency/energy-savings measures are prioritized over, e.g., additional energy production. It could require that any public or private investment in the energy sector, including the DH sector, must demonstrate that all cost-effective energy efficiency measures have been exhausted before new supply-side infrastructure is implemented. Therefore, the following legislative changes are recommended:

- A clause mandating energy efficiency measures in the planning phase of all energy infrastructure projects, including all DH projects.
- Energy efficiency audits are made mandatory for DH companies seeking public funds for DH modernization.

However, to balance the EEF principle with practical concerns and trivial limits, certain exceptions may be necessary to allow for flexibility while ensuring that the EEF principle is generally maintained. Thus, small projects below a defined investment threshold or emergency investments essential to maintain system stability and security can be exempted from the EEF requirement.

The EEF principle can be incorporated in the Law of Ukraine on Heat Supply as a core principle. Thus, adding a specific clause stating that the EEF principle shall be prioritized in all decision-making processes, ensuring that energy savings and efficiency improvements are systematically considered and implemented wherever technically and economically feasible.

1.1.2. Promotion of energy-efficient heat production

The main purpose of energy efficiency regulations includes the development of a DH market, which promotes the most favorable heat production, including CHP production, utilization of industrial surplus heat, and integration of renewable energy sources. By aligning its national policies with EU standards and leveraging international funding, Ukraine can modernize its DH sector while maximizing efficiency, reducing energy waste, and improving system resilience.

Ukraine is recommended to adopt regulations requiring heat producers connected to DH networks to meet minimum energy efficiency standards, such as the use of highly efficient cogeneration plants, heat recovery technologies or renewable energy sources. This will ensure that heat is generated as efficiently as possible, reducing the need for primary energy. Introducing energy efficiency audits for heat producers (see the box below) could be a requirement to ensure compliance with these standards, helping to identify potential areas for improvement and modernization further.

Elements of an energy efficiency audit for district heating producers

The purpose of an energy efficiency audit is to identify and implement measures to improve energy efficiency, reduce emissions, and increase economic sustainability. The energy efficiency audit is usually followed by an implementation roadmap for prioritized measures. For DH heat producers, the following steps are recommended:

1. Baseline energy assessment

Performing energy flow analysis of the production facility to assess inefficiency and thermal losses.

Inventory of the technical condition of boilers, pumps, pipes, turbines, heat exchangers, etc.

2. Performance benchmarking

Comparison of a DH heat producer's performance against best practices and standards. It requires defining Key Performance Indicators (KPIs) for efficiency, harmful flue gas emissions, etc., which can be assessed through benchmarking with other heat producers of the same design and size.

3. Technical-economic feasibility study

Potential upgrades and modernizations (replacement of boilers, pipes, pumps, exchangers, etc.) are evaluated and prioritized. Through economic analysis of payback times, cost-effectiveness, and ease of implementation, a division is made into short-term, medium-term, and long-term measures. The short-term measures are detailed in a Priority Investment Plan (PIP). Emergency investments also belong to short-term measures.

4. Implementation roadmap

An action plan or roadmap for the implementation of the PIP is drawn up. As it will often require significant financial resources, an energy efficiency audit implementation roadmap in Ukraine can be carried out in cooperation with International Financial Institutions (IFIs), e.g., EBRD, EIB, or NEFCO, or in connection with other bilateral or international support programs, e.g. from the EU and the USA. However, it should be noted that concessional loans or grants from IFIs, etc. will usually require a much broader approach that may involve the entire business of the DH heat producer or the DH company including environmental and social safety measures, and institutional and management reforms that go beyond technical-economic energy efficiency audits for the individual DH heat production plant.

An energy efficiency audit for DH producers can be considered a sub-element of the mandatory Heat Supply Schemes for Ukrainian DH systems, but there are some differences. While an energy efficiency audit is a valuable tool for identifying short-term improvements and investment priorities for the heat production plants, the Heat Supply Scheme provides a comprehensive, legally binding, and approval-required strategic plan for managing and developing the entire DH system over a fixed period. Both can be regarded as complementary, and their integration can strengthen the strategic and operational effectiveness of a DH company.

Regulation and institutional strengthening should also remove any institutional barrier against potential heat producers' access to the DH networks and combined heat and power (CHP) plants' access to both the DH networks and the electricity grid.

These barriers include:

- **Monopolistic Control:** Municipal DH companies have in many cases monopolistic control over the DH heat production as well as the DH network. This control may result in discriminatory practices or delays in granting access to potential, independent heat producers, even though they may be able to produce heat cheaper and more efficiently.
- **Complex Legislative Framework:** The legislative framework for independent heat and CHP producers is often unclear or overly complex. The result is that discretionary powers can dominate instead of fixed rules and criteria. Although a certain level of discretion can be necessary for effective governance and adaptation to specific circumstances, excessive or ill-defined discretionary powers can lead to inconsistent application of the rules and make it both time-consuming and expensive for heat producers to obtain the necessary licenses and permits from the authorities.
- **Non-Transparent Tariffs:** Tariffs for heat supplied to the DH system by independent heat producers are often not transparently regulated. The absence of standardized contracts and clear legal frameworks between independent heat producers and DH companies creates uncertainty.

Thus, clear, transparent, and rules-based procedures for granting access are strongly recommended to eliminate monopolistic practices and minimize discretionary powers. It is therefore recommended to implement regulations that create equal opportunities for all potential DH heat producers, and issue model contracts for heat and power sales agreements to reduce legal risks. It should be followed up by educating municipal officials and DH business managers on the benefits of integrating independent heat producers.

1.1.3. Prioritizing energy efficiency in district heating distribution

Legal requirements for DH network modernization are recommended to include the adoption of variable flow regime together with smart control, metering, and data acquisition (SCADA) systems to allow load dispatch of different heat producers as well as high-efficiency components such as pre-insulated pipes and pressure control pumps to optimize the heat distribution and reduce heat losses.

Thus, it is recommended that the regulatory framework KTM 204 Ukraine 244-94 “Norms and guidelines for rationing fuel and heat energy consumption for heating residential and public buildings, as well as for household needs in Ukraine” (KTM 204) is enhanced to include specific guidelines, mandates or even incentives:

- Standards for achieving efficient DH according to the EED definition.

- Standards for efficient operation: Introduction of variable flow regime, SCADA systems for smart control and monitoring, and load dispatch strategies to integrate and optimize the operation of several heat producers.
- Efficiency standards for components: Requirements for the use of pre-insulated pipes, proper water treatment to improve system life and efficiency, and high-efficiency pumps to reduce energy consumption.

These updates will enable the KTM 204 to adapt to Ukraine's energy efficiency goals and meet EU EED and other directives and standards and international obligations.

Along with a national building modernization program, regulation could impose minimum energy efficiency standards for buildings connected to DH networks. These standards would require building owners to implement measures that reduce the indoor operating temperatures. Such measures include upgrading radiator systems with hydronic balancing and thermostatic controls, as well as installing improved insulation, new windows, and other energy-saving features. For new buildings, the building code should mandate designs that incorporate low-temperature operation for the inhouse heat distribution systems.

However, the fragmented building ownership structure in Ukraine with condominiums often creates complications and barriers against initiatives to improve the energy efficiency of buildings connected to a DH system:

Achieving consensus among most apartment owners can thus be time-consuming and contentious. It is therefore recommended to introduce clear rules that define apartment owners' as well as condominiums' responsibilities for energy efficiency upgrades, based on guidelines for cost sharing, decision-making processes, and mechanisms for resolving disputes between owners.

In addition, many apartment owners have limited financial resources, which makes it difficult to contribute to financing energy efficiency measures. Even when government programs or international financial institutions (IFIs) offer concessional loans and grants, residents are often hesitant to participate due to concerns about affordability. It can therefore be recommended to expand access to favorable loans and grants for energy efficiency improvements, including creating funds with revolving or other financial mechanisms that reduce upfront costs for owners, as well as targeted aid (grants) for vulnerable households.

1.1.4. The Principle of EEF in planning and investment decisions

An energy efficiency screening as part of the approval process for new DH projects must be made mandatory by law. Every major project - whether it concerns the expansion of the DH area, new heat production or network modernization - should go through an assessment to determine whether energy efficiency measures have been prioritized. If more energy efficient alternatives are available, these should be implemented first.

For investments in DH modernization projects. Ukraine can incorporate energy efficiency into legal and regulatory frameworks. This will ensure that public funds – and investments in general – are primarily used for projects that comply with the EEF principle. This includes that public procurement laws can be updated to require that energy efficiency is a key criterion in the selection and financing of DH modernization projects. This involves mandating that all public investments in DH infrastructure must demonstrate compliance with the EEF principle. Specifically, tender legislation may require preference for tenders that demonstrate the highest energy savings based on public procurement guidelines that emphasize energy-efficient solutions in the selection of contractors and technologies for DH modernization projects.

Adoption of EU energy performance standards for DH systems through KTM 204 as well as building energy efficiency and energy labelling will increase regulatory coherence, and help position Ukraine to benefit from international investment, including EU funding for energy efficiency.

1.1.5. Energy Efficiency Obligation Schemes (EEOS)

The government could introduce EEOS for energy companies, including those that operate DH systems. EEOS are also known as energy saving obligations, supplier obligations, distributor obligations or utility obligations and, in the US context, energy efficiency resource standards.

Several EU Member States (MS) have implemented or are considering implementing EEOS. These schemes consist of energy saving obligations imposed on energy distributors and/or retail energy sales companies and may be linked to a trading system, where different trading options are considered, e.g.:

- Trade in energy efficiency measures resulting in certified energy savings (tradable white certificates, TWCs).
- Trade in eligible measures without formal certification or trading in commitments.

One of the main drivers for the implementation of these schemes in the EU is currently Article 7 of the EED. This article is a key pillar of the EED, which requires MS to introduce EEOS. Under EEOS, energy companies must save 1.5% annually of their energy sales with additional energy efficiency projects. Article 7 also allows MS to introduce alternative policy measures to EEOSs if these measures provide equivalent energy savings.

Denmark introduced EEOS for energy companies, including DH companies, in 2006. The scheme was part of Denmark's wider effort to improve energy efficiency across different energy sectors, including electricity, gas, oil, and district heating. The scheme worked until 2020, after which it was replaced by other measures when Denmark revised its energy efficiency policy. The Danish EEOS traded in eligible energy savings measures and did not use formal certifications like TWCs. Obligated parties, such as DH companies, achieved their savings by implementing various energy-saving measures, either directly or through third parties, and could "trade" or transfer these documented savings among themselves if one company exceeded its targets while another fell short. For the DH sector in general, the expected annual savings targets were in some years up to around 3% of the total heat sales.

After Denmark phased out EEOS in 2020, new more sector-specific support measures were introduced to promote energy efficiency. Regarding district heating, the focus shifted towards a mix of government incentives, including:

- Support for the promotion of electric heat pumps and electric boilers to integrate renewable electricity in the DH sector.
- Creation of a scheme, called the District Heating Pool, which grants subsidies to DH companies to extend networks to areas previously dependent on fossil fuels, especially gas boilers.

With inspiration from, e.g., the Danish EEOS, Ukraine could implement EEOS to improve the efficiency of the Ukrainian energy sectors. For the Ukrainian DH sector, EEOS could include:

- The scheme should focus on both improved efficiency of the DH systems and efficiency at consumer level, including insulation of the building envelope, efficient heat distribution control in the buildings, lowering the heat supply and return temperatures, etc.
- Ukraine could set specific annual energy savings targets for DH companies as obligated parties based on achievable benchmarks. Goals can be phased in, starting with modest savings requirements, and increasing as the program gains traction.
- Part of the cost of meeting the EEOS targets could be recovered through heat tariffs with regulatory oversight to ensure fairness and affordability. Given Ukraine's current fiscal challenges, international concessional loans and grants could support the rollout of the scheme.

To establish EEOS, Ukraine will need a clear legislative framework that mandates the energy conservation targets, with a central regulatory authority overseeing compliance and monitoring.

1.2. Least-cost assessment methodology

Based on the project evaluation method in Denmark, the recommendations below aim to strengthen the Ukrainian project evaluation method through legislation and accompanying guidelines.

In Ukraine, Cost-Benefit Analysis (CBA) based on the Net Present Value (NPV) valuation method is used to evaluate proposed elements of a Heat Supply Scheme. The CBA method is described in the guide: Methodology for the Development of Heat Supply Schemes for Settlements of Ukraine.

Similarly, the Ministry of Finance in Denmark publishes a guideline for the assessment of projects for national infrastructure investment projects, including district heating projects. In continuation of this, the Danish Energy Agency (DEA) has published a corresponding publication with a focus on the energy sector. Mandatory assessment and municipal approval of DH projects under the Danish Heat Supply Act must, as in Ukraine, be based on the NPV method for a planning period of 20 years.

1.2.1. Analysis method with a focus on scenarios

When a project is planned to improve or expand the DH supply, a Net Present Value (NPV) assessment of the project's financial advantages and disadvantages is carried out. This assessment can be set up in two ways:

1. **Cost-Benefit Analysis (CBA)** method, which assesses whether the project yields a positive NPV, which means the benefits (or cost savings) outweigh the costs over the project planning horizon. Thus, this method has focus on the value added by the project in relation to a baseline.
2. **Least-Cost Scenario Analysis (LCSA)** method, where the NPV of several scenarios (including a baseline) is calculated separately to determine which option has the lowest total NPV of costs over the project planning horizon. This method focuses on identifying the scenario with the lowest cost and thereby the most cost-effective solutions rather than comparing benefits to costs. (However, benefits may still appear in scenario analyses, as electricity produced from a proposed CHP plant).

In Ukraine, when developing Heat Supply Schemes for DH systems, CBA is described in the methodology as the standard method used to assess and select the most economically sustainable options. LCSA can presumably also be used. However, it is recommended that the regulation and guidance explicitly recommend using the LCSA, because by analyzing total costs, decision-makers can see the full cost profile of each option. This allows for a comprehensive long-term comparison of relevant alternatives.

2.2.2. Inclusion of the socioeconomic perspective

Overall, the LCSA method (or CBA) is a quantitative assessment of the economic efficiency of various options to select the one that provides the greatest net benefit. Qualitative elements that are difficult to quantify can be discussed for inclusion (environmental impacts, social effects, security of supply, quality of life benefits), especially when comparing DH with individual alternatives.

In Denmark, several standardized key figures including such elements are determined through national publications, which the Danish Energy Agency (DEA) publishes and maintains assisted by other national research institutions such as the Danish Centre for Environment and Energy (DCE).

This standardization of prerequisites and quantified data ensures consistency, transparency, and comparability in Danish project proposals across different projects and facilitates the authority approval process. Socioeconomic calculations are used in Denmark for the approval of project proposals in accordance with the Danish Heat Supply Act, which aims to promote the most efficient socioeconomic energy use for building heating and domestic hot water supply.

The Danish socioeconomic LCSA method is thus designed to assess the costs of different project scenarios from the broad perspective of society, rather than from the point of view of an individual company or investor.

Appendix A shows an Excel demo model that illustrates the structure of the Danish socioeconomic method. In addition, Appendix B shows an example of a project proposal drawn up in accordance with the Danish Heat Supply Act. As in the Danish socioeconomic method, it is recommended in Ukraine to incorporate such a broader socioeconomic assessment into the Ukrainian method. In this connection, the following can be highlighted:

Energy price forecasts

Energy price forecasts form the basis for socioeconomic LCSA. In Denmark, the DEA continuously (typically every two years) develops and updates long-term energy price forecasts of 20-30 years in real terms (i.e. adjusted for inflation) for various energy sources, including natural gas, biomass, oil, coal, and electricity.

The DEA uses energy modelling tools (such as the Balmorel model) to develop scenarios that explore different paths for energy prices under different assumptions about market developments and policy interventions. The energy price forecasts are linked to forecasts from the IEA and European market trends, while price forecasts of certain local fuels such as straw and wood chips are based on national assumptions. National and EU policies, such as carbon pricing, are considered in the forecasts. (For example, expected increases in the EU carbon price affect the cost of fossil fuels and encourage shifts towards low-carbon alternatives.)

Handling of excise taxes

In a socioeconomic LCSA, excise taxes on energy consumption are excluded or adjusted to reflect a societal perspective rather than the perspective of individual investors or companies.

Taxes (and subsidies viewed as negative taxes) can be excluded if they are considered transfer payments rather than real economic costs to society, as they simply transfer funds within the economy (from consumers or businesses to the government)

An alternative approach is to include taxes with an adjustment called "deadweight loss of taxation", which represents the economic welfare loss or market distortion due to taxes. This approach was used in the Danish method but has recently been cancelled.

Certain taxes, like carbon taxes and other environmental taxes, may be included in socioeconomic analyses as a proxy for external costs (e.g. the societal cost of air pollution from combustion). This inclusion is recommended only if these taxes closely represent the true marginal societal costs of pollution. However, a more common approach is to directly quantify environmental externalities as separate cost items, rather than including the taxes themselves.

Environmental externalities can include costs for emissions of greenhouse gases (e.g., CO_2 and CO_2-equivalent gases like N_2O and CH_4) and local air pollutants (e.g., SOx, NOx, and particulate $PM_{2.5}$). Cost of local air pollution from heat production facilities can also be considered as social costs due to an impact on public health.

Note that in Ukraine electricity and energy to produce district heating are currently not subject to excise taxes (except for CO2 tax on fossil fuels), although such taxes may be introduced in the future, especially as Ukraine will adapt its energy and environmental policies to EU standards. Quantifying environmental externalities as separate socioeconomic cost items is recommended.

2.2.3. Inclusion of the socioeconomic perspective

In socioeconomic analyses, energy consumption for DH production should not be allocated based on contractual agreements. Instead, a uniform or recognized method is recommended to assess the energy needed to produce one unit of heat from a DH production plant. Four different types of technologies can produce this heat (as simple direct heat production from, for example, a solar heating plant is not relevant to assess further):

- Boiler
- Heat pump
- CHP plant in back-pressure mode
- CHP plant in heat extraction mode

For these four cases, formulas can be drawn up for calculating the energy required to produce a unit of heat. Thus, the heat price can also be estimated when the social-economic price of the energy is known, just as air emissions related to heat production due to energy consumption can be determined. These formulas are detailed in the Excel model in Appendix A, sheet “Basis”:

- The formula is simple for a boiler, where the heat price is determined based on the boiler efficiency and the social economic fuel price, or electricity price for an electric boiler.
- The same applies to a heat pump, where the COP reflects how efficiently the heat pump converts electricity into heat (or/and cooling).
- For CHP plants, the formulas are more complex and based on the Primary Energy Savings (PES) method derived from the EED. This method compares the plant’s fuel use to the fuel that would have been consumed for separate heat and electricity production. This is also known as marginal allocation, ensuring proper recognition of cogeneration benefits by attributing fuel use based on savings achieved.

The DEA issues Technology Catalogues with technical and economic key data for various technologies, including those used to produce heat. These catalogues provide standard values that can be used in the formulas mentioned above if data that is more precise is not available for a specific project.

This approach ensures that energy use, socioeconomic prices, and emissions are allocated fairly and reflect actual efficiency gains, which is especially important for CHP plants. By using the Marginal Allocation Method, the socioeconomic analysis will align with recognized international standards.

2.2.4. Adjustment for scrap values of assets

Adjusting for the scrap value of assets at the end of the project horizon (normally 20 years) is considered a best practice in LCSA. This adjustment enhances the accuracy of scenario comparisons, particularly in DH projects where upfront investment costs often are substantial.

A scrap value occurs both if the technical lifetime of an asset is longer than the project horizon, and if the technical lifetime of an asset is shorter than the project horizon, because a cyclical reinvestment in the asset is assumed. Therefore, scrap value adjustment could also be labelled with the term "life cycle adjustment".

The scrap value depends on the technical life but also on the chosen depreciation method for the asset. There are two common types of depreciation: Straight-line depreciation, and Annuity method of depreciation.

However, as illustrated in Figure 1, this can result in markedly different scrap values after 20 years. In addition, if the investment costs are significant in relation to the other costs in a scenario, it is important to make clear which depreciation method the DH company will or shall use, as the scrap value and thus the project's NPV can change significantly.

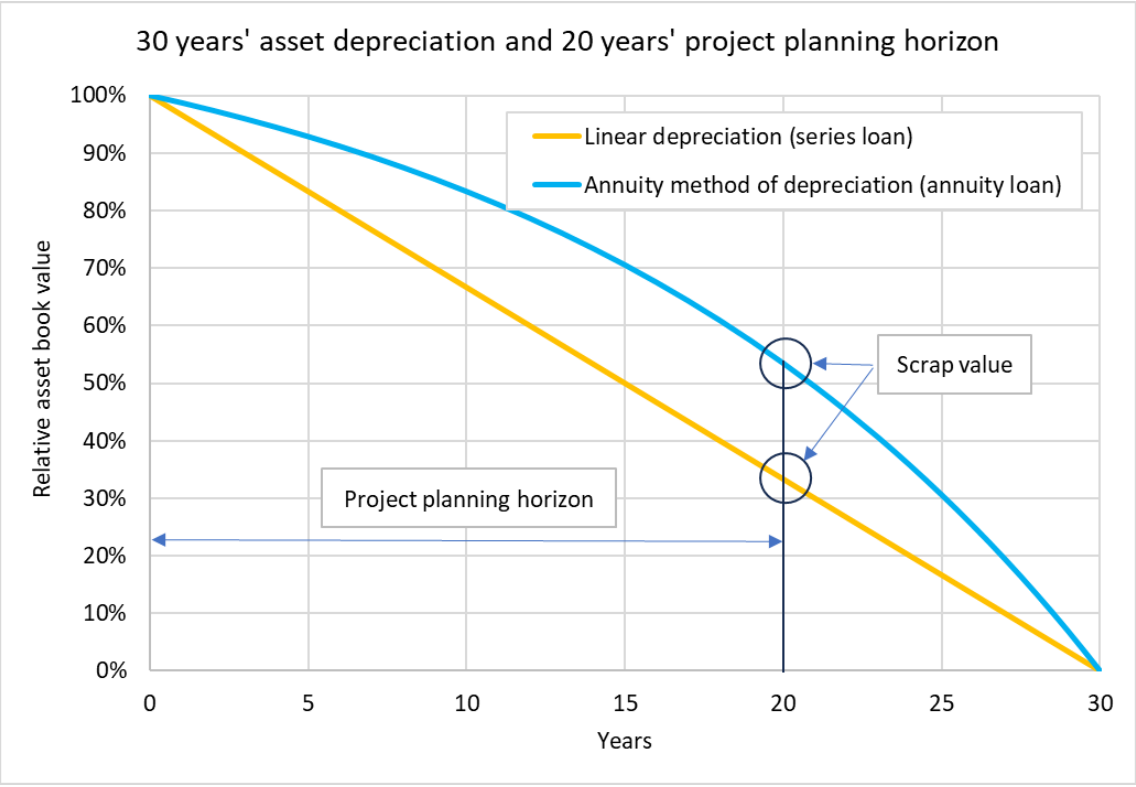

Figure 1: Impact of the depreciation method on the scrap value

Therefore, it is recommended in national guidelines to clarify the depreciation method to use, or require a justification of the chosen depreciation method, as it directly influences the NPV of the scenarios. Furthermore, it is crucial to for the liquidity of the DH company that the chosen depreciation method corresponds the company's loan repayment strategy.

2.2.5. Socioeconomic discount rate

For a socioeconomic LCSA, it is recommended that the central government determine the real discount rate for project assessments rather than allowing each project developer to determine a rate based on government bond yields (i.e., the accounting rate of the National Bank adjusted for inflation, as stated in the Ukrainian methodology guideline).

The yield on government bonds may fluctuate with various market conditions, which could lead to inappropriate discount rates. A government-set real discount rate can be more stable and purposefully aligned with political or societal objectives rather than market volatility. Such objective could include:

- High discount rate tends to promote modernization by replacing outdated systems with efficient alternatives, as the cost savings in fuel, energy, and operational expenses can quickly offset the investment.
- Low discount rates favor maintenance strategies, as maintaining current infrastructure is seen as cost-effective when future expenses are heavily weighted in the net present value.

In Denmark the Ministry of Finance issues assumptions for real discount rate (currently 3,5%).

2.2.6. Sensitivity analyses

The LCSA assessment should include sensitivity analyses to account for uncertainties such as changes in energy prices, heating demand, capital costs, and technical lifetime. The Danish method includes mandatory sensitivity analysis to assess how various variables such as capital costs and fuel prices can affect the outcome of a project. This allows for better risk management and decision-making, something that could be extremely beneficial for Ukraine's DH sector, where uncertainty is a major challenge.

Note that unforeseen expenses are usually considered risk elements that are not included in the basic socioeconomic calculations but are addressed in the sensitivity analysis.

Appendix B shows a project proposal drawn up in accordance with the Danish Heat Supply Act, which includes a sensitivity analysis.

2.2.7. Compliance with the principle of EEF

LCSA methods have cost effectiveness as the primary criterion and not energy efficiency, although they are usually closely related. To promote high prioritization of energy efficiency, Ukraine is recommended to implement a socio-economic LCSA method as described in the previous sections. In this context, the following is recommended:

- Energy efficiency improvements often lead to reduced emissions and less environmental impact. By including the social-economic costs of CO2 emissions and local air pollution in the LCSA, energy-efficient projects will appear more favorable and thus be prioritized.

- Energy efficiency should be considered as a quantifiable factor in the assessment process with a clear measure such as energy savings per unit of investment and establishing specific thresholds for this factor that any project must meet to qualify for public funding or approval.

By including all costs from production to consumption, it is further ensured that the LCSA method avoids sub-optimization but includes the entire system and thereby becomes a tool for prioritizing cost efficiencies collectively and thereby also usually prioritizing energy efficiency. This broader approach promotes the involvement of all stakeholders (those who will share the costs and benefits of the project) in the LCSA process, including input from local communities and private sector participants.

Highlights of this chapter

This section has assessed and made recommendations on how the principle of Energy Efficiency First from the EU Energy Efficiency Directive (EED) can strengthen national legislation and encourage the implementation of energy efficiency measures targeted at the Ukrainian district heating sector. For Ukraine, applying this principle could drive reforms to modernize district heating systems, reduce energy losses, and cut reliance on fossil fuels, aligning with EU energy policies.

Furthermore, this section has assessed the Ukrainian method for technically and economically assessing district heating projects, and recommendations have been drawn up to improve this method based on experiences from the corresponding Danish method.

2. Recommendation: Reform of Tariff Design and Structure

International best practices for district heating (DH) tariffs aim to ensure cost-reflective tariffs with the following characteristics:

- Cost structure reflective tariffs: Tariffs with focus on separating and clearly presenting fixed and variable components of costs in the tariff design.
- Non-discriminatory pricing: Tariff structures should be fair and independent of customer type, ensuring that no customer group (such as households or businesses) cross-subsidizes another.
- Differentiated tariffs: Fixed tariffs should vary between large and small customers, accounting for economies of scale in a fair way.
- Incentives for energy efficiency: Tariff structures should encourage cost-effectiveness and energy efficiency, e.g., through return temperature tariffs.
- Profit/surplus allocation: Profit or surplus generated by the DH system should in a transparent way be used for the benefit of the customers, such as lower future tariffs or system upgrades that improve system efficiency or service quality.
- Transparent tariff structures: Pricing should be simple, transparent, and easy for customers to understand.

Thus, **cost-reflective tariffs** are not cost-true tariffs, which refer more to an ideal, but are cost-covering and designed to balance practical considerations and energy efficiency goals.

In line with international best practices, the Law of Ukraine on Heat Supply stipulates that DH tariffs should cover economically justified costs and ensure energy efficiency, and it emphasizes transparent and non-discriminatory pricing. However, the legislation on tariffs can be further improved, which the below sections will elaborate on.

2.1. Separation of social policy from heat tariff regulation

Separating heat tariff structures from social protection measures in line with international best practices is highly recommended. This approach will ensure that the DH companies can establish cost-reflective tariffs, which is the basis for maintaining the DH infrastructure, and investing in DH system improvements.

To protect low-income households from the full impact of higher cost-covering tariffs, targeted social support schemes must be used. These may include heat assistance to the heat bill, and more general social assistance tailored for the low-income households through existing welfare systems.

The approach of combining cost-reflective pricing with social protection measures is also in line with the EU guidelines on energy poverty and vulnerable consumers, which emphasize that energy services should remain accessible to all, while ensuring long-term sustainability for energy providers. As an example of the same approach, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has through the ReWarm project proposed Ukraine to implement socially mitigated cost-covering tariffs.

Ukraine has long-standing social support programs for vulnerable households but faces a significant challenge in the transition to cost-reflective tariffs for DH. The primary barrier is political because of reluctance to separate social policy from heat tariff regulation. To overcome this impasse, a regulatory reform is proposed to focus on the following:

- Clear and transparent separation of tariff setting for DH and social support schemes in line with national legislation.
- A gradual increase in heat supply tariffs to the cost-reflective level, while targeting the social support schemes for the most vulnerable households. In parallel with this, the DH companies are required to improve their energy efficiency through the legislation, which is adapted to meet the EED and thereby reduce the total cost burden that is passed on to consumers.
- These measures shall be done simultaneously with the tariffs for natural gas and electricity for households being also increased to the cost-reflective level, and the difference between the tariffs for households and the tariffs for other customers being eliminated.
- The moratorium on raising heating tariffs for households, introduced by law in 2022, should be lifted. It only worsens the current situation of DH Companies, while the government's return of the “tariff difference” is untimely and has unclear prospects.

2.2.Pricing of district heating production

When pricing heat production in district heating, it is important to balance cost recovery, fairness, and incentives for efficiency, while ensuring a competitive heat production market.

A challenge for the Ukrainian DH company in a liberalized energy market is to balance the contradiction between fluctuating heat production costs or variable heat purchase prices, which can vary hour by hour and seasonally, and stable customer tariffs according to the tariff sheet, which is adopted annually. This applies to both fluctuating gas prices when using gas boilers and gas-fired cogeneration plants and fluctuating electricity prices when using cogeneration plants, electric heat pumps and electric boilers.

To avoid passing on these fluctuations directly to consumers, the DH company must absorb short-term fluctuations and adjust the heating bill based on an annual review. If the DH company does not have liquidity to wait until the end of the financial year, the adjustment of the customers' tariffs must follow pre-established rules and procedures that can be activated quickly. Clear communication must ensure that consumers understand their tariff structure, including that they may risk an annual adjustment of their heat bill or an extraordinary tariff adjustment.

The costs of energy input for CHP should be regulated for a fair distribution between the electricity and heating side by using the marginal distribution method as specified in the EU EED. The method is based on comparing the cogeneration plant's fuel consumption with what would have been used for the separate production of heat and electricity, thereby allocating the share of fuel that heating customers must pay for

in a fair way. In Appendix A is listed the formulas that follow the method from the EED (see also Chapter 2.2.3).

Installation of thermal storage solutions is also a cost-efficient way to help to protect the DH company and thereby the customers against short-term fluctuations of energy prices.

2.3. Addressing debts of district heating companies

Table 1 shows the debts in Ukrainian DH companies (DHCs) nationwide as estimated at 1 Sept. 2024.

District heating companies' debt summary, per sept. 2024 (in millions)	Total UAH	Total EUR	Per HH EUR
State compensation for the difference in tariffs	48 790	1 084	167
Customer debts	29 680	660	101
Old debts before June 1, 2021	28 880	642	99
Total debt	**107 350**	**2 386**	**367**

Exchange rate UAH/EUR = 45

Households (HH) connected to district heating = 6,5 million

As the table shows, the debt falls into three categories:

1. **State compensation for the difference in tariffs:** The largest burden for district heating companies (DHCs) today is the debt item related to state compensation due to inadequate tariffs. This indicates that the current system for handling debts generated by inadequate tariffs is inefficient. A recommended approach is to strengthen the staff of accountants and lawyers in the DHCs and implement adequate and cost-reflective tariffs.
2. **Customer debt:** The debt statement shows that customers are paying off their debt, with a present payment level of 115%. Currently, only two regions, Donetsk and Kherson, have low customer payments, which is clearly due to their status as frontline regions. These two regions now account for approximately 10% of total debt, and this proportion may increase in the future. The payment level for other municipal services (water, wastewater, and waste) is not as high nationally as for district heating and is below 100%.
2. **Old debt before June 1, 2021:** According to the law "On measures aimed at settling debts of heat supply and heat generating organizations and enterprises of centralized water supply and drainage" (Law No. 1730-19), the government and Naftogaz have agreed to settle DHCs' old debt before June 1, 2021, to Naftogaz. This means that the government agrees to cover a portion of the total debt that they recognize as their responsibility due to the "difference in tariffs" (i.e., tariffs below economically justified levels). The state aid goes directly to gas suppliers, as DHCs do not receive state aid to cover the debt.

Overall, current legislation has not proven sufficiently effective. While DHCs appreciate the government's initiatives, they fail to address fundamental challenges, particularly inadequate tariffs.

As a condition for the supply of natural gas to DHCs at a special (preferential) price, DHCs are required to open special accounts with the State Treasury, according to the Cabinet of Ministers' Resolution No. 812 of July 19, 2022. DHCs have no choice (as there is a moratorium on raising tariffs for households), and thus effectively lose control over their financial flows, which worsens the financial burden. According to the basic rule, 65% of the heat payments is automatically transferred to gas suppliers, while 35% is credited to DHCs. In addition, this 35% are not quickly available to DHCs in practice due to the way the State Treasury works.

The persistent high debt levels, accumulated over many years, severely burden Ukraine's DH companies. This debt constrains their ability to secure financing for modernization projects, as investors are hesitant to provide funds without clear repayment strategies and supportive tariff structures. Additionally, underfunding has resulted in poor service quality and system inefficiencies, eroding consumer trust, and making it increasingly difficult to justify necessary tariff adjustments.

Moreover, raising tariffs to economically justifiable levels is insufficient to promote technical improvements, because a significant portion of the revenue would anyway be consumed by debt repayment, leaving little room for the necessary investments. Comprehensive initiatives are therefore essential to enable recovery of Ukraine's DH companies. Recommended initiatives are listed below and are divided into two groups: initiatives to stop further debt accumulation and initiatives to handle old debt, combining elements that overlap with themes in other parts of this report:

Initiatives to stop debt accumulation

Establishing cost-reflective tariffs, and separating tariffs from social subsidies.

Aligning tariffs for gas, electricity, and heat across consumer groups.

Restoring financial flows directly to the DH companies.

Initiatives to handle old debts

Establishing debt restructuring with concessional loans. i.e. loans provided with terms more generous and flexible than those normally available on the financial market.

Implementing a scheme linking performance benchmarks to debt restructuring and state subsidies.

Attracting IFIs, international donors, and PPPs to implement modernization projects with concessional financing or grant.

These recommendations are further explained in Chapter 5 - Strengthening the Investment Environment.

2.4. Strengthening law implementation and sound governance

Efforts should not only focus on improving the quality of legislation, but also on ensuring that it is implemented in a coordinated, efficient, and productive manner. This requires alignment among stakeholders and support from DH customers, including private, public, and commercial entities. Strengthening legislative implementation and sound governance and administration includes the following measures:

2.4.1. Institutional reforms

Although a formal framework for an independent tariff regulation exists, ensuring its practical autonomy is essential to achieve effective oversight and prevent political interference. The role of independent regulators includes:

- Regulators must be empowered to set or ensure fair and cost-reflective tariffs based on transparent methodologies.
- Regular audits and performance reviews should ensure that DH companies (DHCs) meet regulatory and service standards, promoting accountability and public trust.

2.4.2. Capacity building and responsible management of DH companies

Strengthening the institutional capacity of DHCs is essential for their sustainability and effectiveness. This includes:

- Training DHCs in modern financial practices to manage budgets, optimize expenses, and manage debt responsibly.
- Support for the introduction of energy-efficient technologies and innovative heating solutions to prolong technical lifetime, lower maintenance costs and operating costs and emissions.
- Encouraging initiatives such as heat loss reduction and better energy consumption management to improve overall DH system performance.
- Developing clear, measurable benchmarks for service quality and operational efficiency and linking these to financial support mechanisms.

Capacity building should extend beyond DHCs to include all municipal housing services, promote a collaborative platform for sharing best practice and implementing good corporate governance.

2.4.3. Public engagement

Public understanding and acceptance of reforms is critical to their success. Educating consumers about the benefits of a well-functioning DH system can promote trust and cooperation. This includes to:

- Highlight the importance of tariffs that reflect the real costs while protecting vulnerable populations through targeted social subsidies.
- Demonstrate how reforms lead to reliable, high-quality heating services.

- Ensure clear communication about how funds are used, which can counter skepticism and promote public support for the local DH company.

The intent of these measures is to create a holistic approach to addressing systemic issues in Ukraine's DH sector, strengthening regulatory oversight, and public trust.

In Denmark, good governance remains also relevant in the DH sector, especially for smaller DH companies. While Danish DHCs are largely considered to be run efficiently, smaller companies often face challenges due to limited resources and may find it particularly difficult to comply with increasingly complex legislative requirements. Initiatives have therefore been developed that include:

- The Danish District Heating Association and other knowhow entities continuously offers workshops etc. tailored to (in particular) small DHCs to improve management practices and the skills of board members.
- Shared services models, where several companies collaborate on administrative and technical functions, and standardized governance frameworks have been promoted, as have mergers or collaborative agreements.

Highlights of this chapter

This section provides recommendations to improve the heat tariff structures in Ukraine based on international best practices. Key recommendations include:

1. **Establishing cost-reflective tariffs**: Ensuring tariffs accurately reflect the cost of providing district heating services.
2. **Separating tariffs from social subsidies**: Tariffs should be distinct from social subsidies to promote financial transparency and efficiency.
3. **Handling debts**: Addressing the existing debts of Ukrainian district heating (DH) companies to enable their technical and financial viability.
4. **Strengthening regulatory oversight**: Enhancing the regulatory framework to ensure effective supervision and governance of DH companies.
5. **Building public trust**: Increasing the institutional capacity of DH companies and fostering public trust in the sector.

These measures aim to create a more sustainable and efficient district heating sector in Ukraine.

3. Recommendation: Integration of Heat Planning with Urban Planning

In Ukraine, the integration of district heating (DH) planning into municipal urban planning is still a developing concept. Thus, there is no comprehensive law that explicitly mandates the integration of DH planning into municipal urban planning, but several laws affect the coordination between urban development and DH infrastructure.

The integration of DH planning into urban planning is recommended as essential to create more sustainable, efficient, and resilient urban environments in Ukraine. By amending urban planning laws, developing national guidelines, optimizing zoning, and harmonizing with EU standards, Ukraine can ensure that its cities are improving the quality of life for residents. These reforms will also support Ukraine's broader policy goals, including energy independence and decarbonization.

3.1. Proposal to amend the urban planning legislation

To strengthen the role of DH in urban development, Ukraine should amend its urban planning legislation to explicitly recognize DH as a critical component of urban infrastructure. This amendment will ensure that DH systems are incorporated into the early stages of urban design, covering both new construction and renovation of existing urban areas.

Key provisions should include:

- Mandatory consideration of DH systems in the planning phase of all new residential, commercial, and public infrastructure projects.
- Requirements for local authorities to assess the feasibility of connecting new or refurbished buildings to existing DH networks.
- Restriction (prohibition) of disconnection of existing buildings and apartments from the DH network in the urban zones of DH.

The integration of DH into urban planning shall support the optimization of energy consumption, reduce the cities' CO2 footprint, reduce local air pollution, and ensure an affordable and reliable heat supply for residents.

However, challenges can arise when autonomous and individual heating options, such as gas or electric heating, appear cheaper for building and even apartment owners than district heating. If this is the trend over a longer period, it raises the question of whether building owners should remain connected to district heating despite potential higher heat bills. This gives rise to the following considerations:

- Municipal heating planning is based on long-term analysis: individual heating may seem cheaper in the short term, but district heating often has lower costs over time, especially when it is modernized and made more efficient. The local community will suffer economic losses in the long term by maintaining parallel and fragmented energy supply systems and not regarding district heating distribution systems as natural monopolies. For that reason, there

could imposed disconnection fees to discourage switching to individual heating in places where district heating based on well-defined criteria is judged to be more sustainable.

- DH systems are often better at limiting local air pollution and can undermine political goals such as increased national energy independence, which citizens must consider a benefit that justifies a (periodically) higher district heating bill.

Urban planners and policy makers must thus balance the immediate economic interests of building owners with long-term political goals and ensure that DH systems are modernized and competitive, while providing flexibility to accommodate different conditions.

A particular challenge is urban planning in areas with multi-storey residential buildings, where sometimes there is both district heating and individual heat supply in the same multi-storey residential buildings. In addition, there might be a local disagreement about whether district heating should be fully re-established or whether it should be converted to full individual heat supply. This limbo, which is present in many places today, is unsustainable both legally, technically, and economically. It is recommended to address this uncertain situation with a comprehensive policy intervention at the national level that includes:

- Clear national policy must ensure that either all apartments in a building where both DH and individual heating is present are switched back to DH, or all switch to individual installations. This involves clearly defining roles and responsibilities for municipalities to support and manage the chosen heat supply system, ensuring accountability. For this, the municipalities must have clear guidelines for assessing the economic and technical feasibility of maintaining or phasing out DH systems.
- Continuing to focus on addressing the core issue of underperformance by many DH companies by implementing performance benchmarks and investing in efficiency improvements and modernizations. In this process, it can also be recommended to improve management transparency of the municipal DH companies and involve condominium board of apartment owners, building owners and municipal authorities to resolve conflicts about DH versus individual heating.
- Promotion of reconnection to district heating through financial incentives, such as grants or loans on favorable terms, targeting disconnected apartment owners.
- During the transition period, the present legal obligations to participate in the payment for DH imposed on apartment owners who have switched from DH to individual heating should be preserved as an additional economic incentive.

3.2. Spatial planning and zoning for efficient heating networks

Effective spatial planning and zoning are essential to ensure a sustainable expansion of the DH networks. Urban planning authorities should reserve optimal locations for new heat production plants and ensure an efficient layout of heat distribution networks to minimize heat loss and reduce costs and environmental impact.

Zoning regulations should prioritize the development of DH systems in areas with high building density and thereby significant heat demand, making it easier to achieve economies of scale. Specific zoning policies should include:

- Designation of priority areas for DH infrastructure, especially in new urban developments, commercial zones, and areas under modernization.
- Identifying strategic locations for heat production facilities, ensuring proximity to both existing and future heat demand centers, such as residential areas, public institutions, and commercial complexes.
- Planning the layout of heat distribution pipelines in coordination with other infrastructure, such as roads and utilities, to minimize disruption and reduce infrastructure costs.

Incorporating DH into physical plans can help align urban growth with sustainable energy use and ensure cities are more resilient to energy shocks or disruptions.

3.3.National guidelines for district heating and urban planning

To support effective integration of DH with urban planning, Ukraine should develop comprehensive national guidelines that provide local authorities with a road map template. These guidelines will offer technical, regulatory, and operational frameworks to ensure that DH is embedded in urban planning processes across the country.

Key elements of the guidelines should include:

- Best practices for incorporating DH into zoning and land use decisions, ensuring that DH networks are planned in coordination with urban growth strategies.
- Guidance on how to support a gradual decarbonization of DH systems by integrating renewable energy sources and waste heat recovery.
- Technical standards for DH network efficiency, i.e. improvement of the standards, including design requirements for pipes, heat substations, and metering, to ensure new developments are built to maximize energy efficiency.
- Training programs for local urban planners, architects, and engineers on how to design urban environments that support sustainable DH systems. This training must also provide the municipalities with the necessary resources to plan, implement, and manage the DH infrastructure.
- Tools to assess the long-term feasibility of DH systems in different urban contexts, considering population growth, economic development, and trends in energy consumption.

National guidelines will provide consistency in DH planning across Ukraine, while allowing for flexibility in local implementation, ensuring that each city can tailor its DH system to its specific needs and challenges.

3.4. Harmonization with EU standards and best practices

To ensure that Ukraine's DH sector aligns with international best practices and is consistent with its ambitions for EU integration, it is vital to harmonize the regulatory framework with relevant EU standards and directives. This will not only help modernize Ukraine's urban infrastructure, but also unlock potential access to EU funding and technical assistance.

Key areas of harmonization should include:

- Ensuring that DH systems meet or exceed the standards outlined in the EU EED, including provisions for the EEF principle in urban planning decisions.
- Aligning DH policies with the Renewable Energy Directive (latest RED III from Nov. 2023) to increase the share of renewable energy in heat production, such as biomass, geothermal, and solar thermal energy.
- Incorporating sustainability standards from the EU's Urban Agenda to ensure that DH contributes to creating compact, connected, and climate-resilient cities.
- Ensuring that DH networks contribute to meeting CO2 emissions reduction targets as per the EU's 2030 Climate and Energy Framework and EU Green Deal.

By aligning with EU standards, Ukraine can improve the efficiency, environmental performance, and resilience of its DH systems, while demonstrating its commitment to sustainable urban development and low-carbon energy transition.

Highlights of this chapter

This section outlines recommendations for integrating district heating (DH) planning into urban planning to foster more sustainable, efficient, and resilient urban environments in Ukraine.

Key actions include amending urban planning laws, developing national guidelines, optimizing zoning practices, and aligning with EU standards.

These measures will enhance the quality of life for residents and support Ukraine's broader policy objectives of energy independence and decarbonization.

4. Recommendation: Promotion of Cost-Effective and Sustainable Heat Supply

While the Ukrainian district heating (DH) systems are capital intensive to modernize, their long technical life gives them the potential to deliver long-term value by realizing their role in sector coupling and balancing of renewable electricity generation. The focus is thus not only to cover the customers' heat demand in a satisfactory way, but also to adapt the Ukrainian DH systems to beneficial modernizations and technological developments in other sectors.

4.1. Valuable technical characteristics of modern district heating systems

The long-term value for the DH sector is delivered through four technical objectives: robustness, efficiency, sustainability (green transition) and flexibility. To realize these objectives, basic modernizations of the technical concept for a DH system must be carried out at national level, which includes the establishment of the variable flow operation allowing several production units operating in load dispatch regime.

As in the electricity system, the key word in DH systems is load dispatch. It refers to the process of distributing heat demand between different heat producers to ensure that the heat demand is met in the most cost-effective way. This means that the system has access to several energy producers, with the cheapest energy producers being prioritized first at any given time. In addition to the robustness of having multiple energy producers available, this creates cost-effective flexibility.

To optimize load dispatch, DH systems have a unique flexibility due to the possibility of storing heat cheaply in hot water accumulators. (This is an advantage that the electric system does not have to the same extent, as electric batteries are still too expensive). Therefore, cost-effective flexibility can be achieved through sector coupling between the electricity system and DH systems via heat pumps and electric boilers, where excess and thus cheap electricity that cannot be used flexibly in the electricity system is stored in hot water accumulators in the DH system or used directly. The DH systems become large flexible electricity customers. This has economic potential, if large solar PV plants are established, because they create strong fluctuations in the electricity system and create a need for flexible electricity consumers. Conversely, the DH systems that have CHP plants are also flexible electricity producers, and the simultaneously produced heat is utilized in the DH system or can be stored in hot water accumulators.

In addition, DH has the potential to utilize excess heat from energy-intensive industries and from future data centers by storing the waste heat in hot water accumulators or using it directly, which will overall improve energy efficiency and reduce emissions. However, utilization of excess industrial heat in Ukraine can have several technical, economic, and legal challenges:

- It can be a challenge to ensure fair and stable pricing for excess heat, as e.g. clear regulatory and contractual frameworks are lacking.
- There can be legal uncertainties in contracts, investments and ownership, as clear guidelines and pricing models are missing.

- Ownership differences between private industrial companies and municipal district heating units can create significant barriers, e.g. because industrial companies may be reluctant to share excess heat if it requires investment or operational changes without guaranteed benefits.
- Industrial companies can rearrange their primary processes and reduce the amount of excess heat for district heating before the investments in excess heat access are written off.
- Many Ukrainian DH systems need investments in infrastructure and control equipment to be able to use excess industrial heat efficiently.

Using excess heat from nuclear power plants (NPP) in Ukraine for district heating could be possible, as NPP has a significant potential excess heat from thermal loss. As NPP are not normally designed for waste heat recovery for district heating, conversion can be expensive and must meet strict nuclear safety standards. Furthermore, expensive transmission lines will be needed to transport heat over long distances, as the Ukrainian NPPs are generally located far from major urban centers. Countries such as Sweden and Finland are successfully using waste heat from NPPs for district heating in nearby cities, showing that such initiatives are feasible under the right conditions.

Of great importance for the development of the Ukrainian DH sector is that natural gas-fired CHP plants can effectively operate as cogeneration plants in Ukraine by leveraging a combination of heat storage, flexible mode switching, supplementary heating, and digital controls. These measures allow the plants to meet varying heat demand in DH systems, while also serving as a highly flexible and rapid-response source of electricity. Integration with renewable energy sources like solar PV and wind will require careful planning and coordination, but with the right strategies and support, the CHP plants can play a pivotal role in the energy transition.

Especially natural gas-fired combined cycle plants (CCGT), where the gas turbine is combined with a steam turbine, are highly efficiency and flexible and can be highly valuable for the regulation of the electricity system, and at the same time provide cheap heat to the DH systems due to the high efficiency. Figure 2 shows the efficiencies of various power generation technologies and shows that combined cycle significantly improves the electrical efficiency of the gas turbine.

The future of Ukraine's electricity market, especially with increasing wind and solar energy, is expected to impact the Ukrainian DH sector significantly. As seen in Denmark, fluctuating electricity prices enable gas-fired CHP plants to work in the DH system with heat pumps, electric boilers, and thermal heat storage. This setup adapts dynamically: when electricity is abundant and cheap, DH companies use heat pumps and electric boilers to store heat. When prices are high, CHP plants produce electricity and heat, replacing less efficient power-only generation operating as the marginal power source.

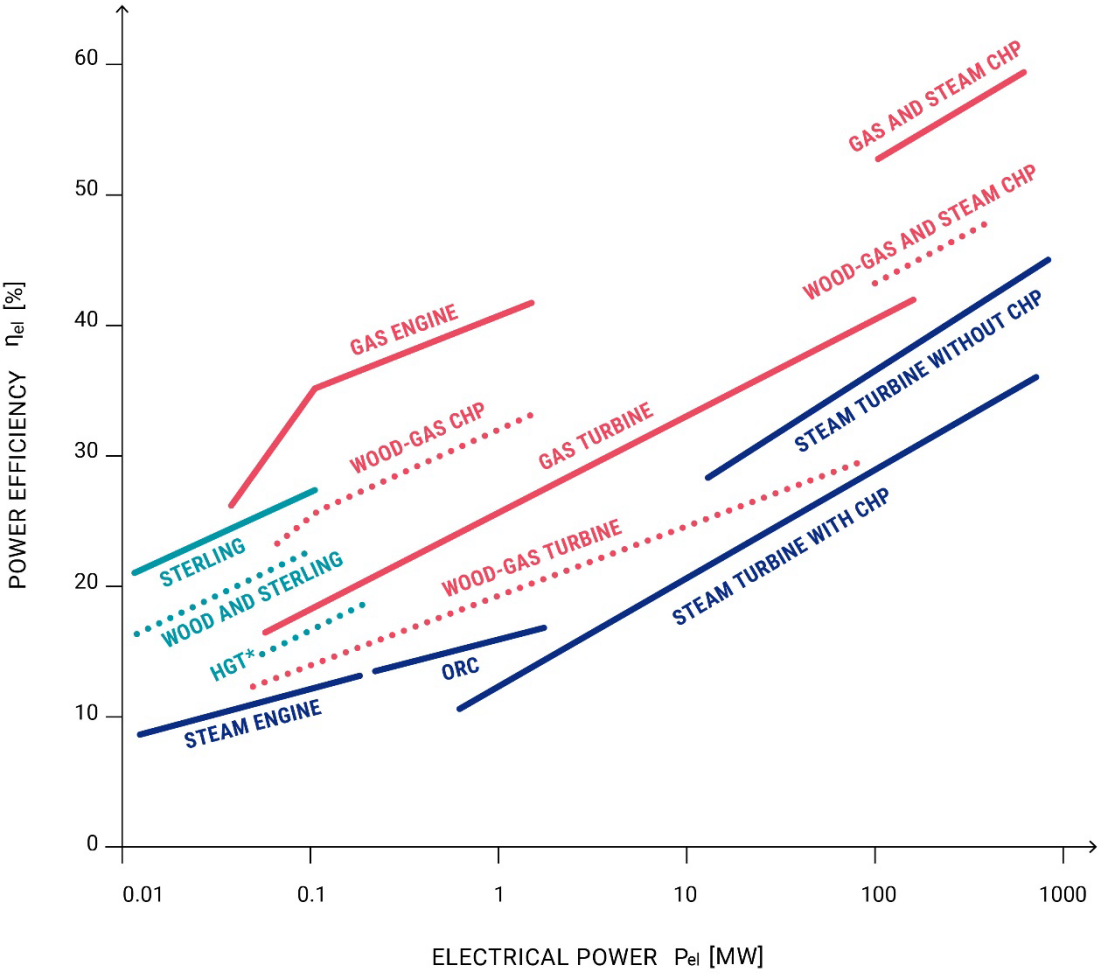

Figure 2: Efficiency of various power generation technologies in functionality of the electric power.

**HGT = Hot Gas Turbine (with wood combustion).*

Reference: Handbook on Planning of District Heating Networks (2020), www.qmfernwaerme.ch

The risk of fossil fuel lock-in by investing heavily in natural gas-fired CHP plant in Ukraine's DH sector is a concern and can be mitigated by:

- Greening (decarbonizing) the gas by transitioning to renewable methane (biomethane) and blending green hydrogen (H_2), while maintaining the gas network infrastructure.
- Gradually moving away from gas or minimize gas use by incorporating renewable energy sources, such as biomass, geothermal, solar thermal, and electrification, alongside improving energy efficiency.

Greening piped gas in Eastern Europe, including Ukraine, by replacing natural gas with biomethane and blending H_2 is a realistic, but challenging strategy that require significant upfront investments:

- Ukraine and other Eastern European countries have significant agricultural and forestry resources, offering strong potential for large-scale biomethane production. Ukraine has extensive agricultural land and organic waste that could be converted into renewable gas. In addition, the infrastructure of the gas network system is well developed in Ukraine, where natural gas has historically been the primary fuel for DH in Ukraine.
- Blending hydrogen with natural gas is technically feasible up to certain limits, typically around 10-20% by volume, without requiring major modifications to existing infrastructure. Ukraine and Eastern Europe have growing potential for renewable electricity generation from solar, wind, and hydro, which could support green hydrogen production. However, green hydrogen is still expensive, and scaling production to replace a substantial portion of natural gas would require significant investment in renewable energy infrastructure.

The described approach allows Ukraine to use natural gas-fired CHP in the short to medium term while setting the stage for a transition to a decarbonized energy system.

4.2. Proposals for legislative measures

Targeted legislative measures can unlock the full potential of district heating (DH) as a flexible and sustainable energy solution, ensuring it remains an essential part of future energy systems rather than a barrier to progress:

- **Flexible Market Design with Renewable Integration:** Regulations should support market mechanisms that enable DH systems to act as flexible electricity consumers and producers, such as through combined heat and power (CHP) plants. Legislation should promote integrated energy planning between the electricity and district heating sectors, prioritizing the use of excess renewable electricity in DH systems. This could include feed-in tariffs to encourage the use of cheap electricity from solar and wind energy for heat production and storage. Additionally, compensating DH systems for contributing to electricity grid stability will enhance their role in balancing the energy system. Coordinated infrastructure planning is also crucial to maximize waste heat recovery and renewable energy absorption.
- **Incentives for Technical Sector Coupling:** Industries may lack incentives to recover and transfer waste heat, especially if the economic benefits are unclear or require capital investment. Introducing financial incentives, such as subsidies or tax credits for investments in heat pumps, electric boilers, and hot water storage systems, can encourage utilities to integrate electricity and DH systems and promote flexible energy consumption and storage. Proposals for cooperation between selected energy-intensive industrial plants and DH suppliers are also recommended.
- **Incentives for Organizational Sector Coupling:** A clear legislative framework is needed to facilitate cooperation between industries and DH suppliers. While DH is a public service, industries often operate under private ownership, requiring clear incentives or legal requirements for industries to make their waste heat available to the public DH system. DH

companies must also be ready to purchase industrial waste heat based on mutual benefits from such projects.

- **Simplified Approval Procedures, Guidelines, and Pricing Models:** Complex permit processes, regulatory barriers, and ownership barriers (private business versus municipal-owned DH services) complicate agreements on waste heat recovery projects. Establishing guidelines for public-private partnerships (PPPs) can be useful in bridging the gap by sharing risks and benefits between private industry and municipal DH companies.
- **Strengthening Awareness and Expertise:** There is limited awareness and knowledge of the potential for waste heat recovery among industry players and DH suppliers, coupled with a lack of technical expertise in waste heat recovery technologies and their integration into DH systems. Providing guidelines and showcasing successful examples are recommended.

Highlights of this chapter

District heating systems can significantly contribute to the green transition by offering cost-effective flexibility through integration with the electricity sector and industries. This integration enables district heating systems to:

- Absorb excess electricity via large heat pumps and electric boilers.
- Store heat in hot water accumulators.
- Utilize waste heat from industries.

Such sector coupling enhances energy efficiency, reduces emissions, and helps balance renewable energy production. However, without appropriate legislation and incentives, this potential might remain untapped, turning district heating into a "techno-economic and environmental lock-in" in the long run.

5. Recommendation: Strengthening the Investment Environment

Ukraine has initiated legislative and regulatory measures to enhance the investment environment in the district heating (DH) sector. These efforts focus on increasing transparency, achieving financial sustainability, and attracting international investments to modernize the infrastructure.

To further bolster the investment climate in Ukraine's DH sector, additional recommendations are provided in this chapter.

5.1. Basis for investment in district heating

Having a clear understanding of the basis for investments in DH is important to set up the right legislative framework that can attract the investments in an optimal way.

5.1.1. The structure of district heating as a framework for investments

Distribution networks

District heating distribution networks are to some extent recognized as natural monopolies. This is largely due to DH systems benefiting from economies of scale because the average cost of providing heat decreases as the size of the system grows. In addition, the structure of the DH network makes it more efficient for a single supplier to supply heat to a specific area, instead of having several parallel suppliers.

Thus, it is economically inefficient for the society to establish parallel or duplicated networks for the distribution of heat - or energy (gas) or electricity for producing heat - to individual consumers. Avoiding waste of investment should be regarded as a vital regulative task, where DH is a vital urban infrastructure. The following regulative approaches are recommended:

- Instruct the municipalities to make heat supply area zoning with mandatory connection.
- Allow to integrate the delivery of communal services and thus utilities under one umbrella.

Mandatory connection to DH networks within designated zones is a strong regulatory approach to avoid isolated disconnections and parallel heat supply infrastructures. In addition, by maximizing the number of customers connected to the DH system, economies of scale can be achieved, reducing the average cost of heat production. Such conditions with a stable and dense customer base will minimize financial risks and attract investors. On the contrary, mandatory connection to DH networks can be seen as a limitation of consumer’s freedom to choose alternative heat supply options and lead to public opposition, especially if the DH company already has a bad reputation due to a historical record of inefficient services.

The integration of the provision of heat, gas, and electricity delivery (and other municipal and possibly private services) under one umbrella (like the German Stadtwerke model), is a highly effective approach to optimize energy distribution and avoid parallel supply systems. Opening the legislation to this organizational option will somewhat adjust the de-monopolization reform that Ukraine has undergone in the last decade. However, it can be considered necessary in the municipal service area under the current

challenges to minimize investment waste, and the limited investments are instead channeled into another and more optimally competitive environment, where heat producers compete, while the heat distribution is monopolized in selected urban zones.

By centralizing management, coordination between different energy supply systems can be improved, leading to higher efficiency and cost savings. Ukraine has experimented with reorganizing its municipal communal services based on concepts like the German "Stadtwerke" model. However, the Ukrainian implementation faced significant challenges, including a lack of clear regulatory frameworks, inefficiencies in coordination, and misalignment of responsibilities among municipal entities. Consequently, many municipalities reverted to operating separate municipally owned companies for the different services including heat supply, water supply, wastewater management, and waste management.

This experience has shown that reorganizing municipal services into one company requires significant political and administrative efforts to ensure that such a multi-service monopolist does not provide inefficient and expensive municipal services. The efforts may include:

- A specialized, politically independent regulatory body should have the authority to supervise the activities of multi-service providers. This includes monitoring service quality and imposing fines for poor performance or inefficiency.
- Periodic reviews are recommended to evaluate whether the monopoly structure continues to benefit the public. These assessments could consider whether certain services, such as electricity, could be reopened to competition. If inefficiencies persist, the regulator should have the power to divest certain local services to reintroduce competition where appropriate.
- Since municipal utility companies typically fall under local authority jurisdiction, a clear legal framework is needed to ensure that municipalities are accountable for the performance of these companies.

The district heating production

The production of district heating should be regarded as a related market to the natural monopoly but is not in itself a natural monopoly. In line with the objectives of the EED, the heat production side of DH systems should be designed to meet competition, if modern system controls are implemented. By means of load dispatch operations, the DH system operator optimizes the use of the cheapest heat available at any time and thus promotes competition between heat producers (see also Chapter 4.1).

This will create an attractive investment basis for competitive heat production technologies, e.g. cogeneration, waste heat recovery and renewable energy sources that can supply heat at different prices based on different conditions and circumstances. It allows third-party energy producers to access the DH systems or encourages PPPs on the heat production side, while keeping the distribution network itself as a regulated municipal monopoly. By sharing the financial burden of heat production modernization with

private entities, municipalities can reduce the strain on public finances, while ensuring that DH distribution remains a natural monopoly.

To avoid/mitigate the risk of market abuse by a dominant non-municipal heat producer, the owner of the municipal DH network should be obliged/recommended to own low-investment heat-only boiler capacity as reserve and as peak load, while competition is on the base/medium load level.

5.1.2. Investments categories and investor priorities

Investments in Ukraine's district heating (DH) systems can be categorized into three primary areas:

1. **Cost-Benefit Investments**
   These prioritize projects with the highest return on investment, focusing on improved efficiency, reduced operating costs, energy savings, and emissions reduction. Examples include new efficient biomass or gas boilers, waste heat recovery, modern heat substations, pre-insulated pipes, and smart control systems. These investments are identified in Heat Supply Schemes for Ukrainian settlements and feasibility studies financed by international financial institutions (IFIs).
2. **Strategic Investments**
   These involve upgrading DH systems for long-term resilience and flexibility by diversifying energy sources, decentralizing heat production, or increasing system flexibility to withstand future shocks and disturbances. Although not always the most cost-effective in the short term, they are crucial for energy security, especially given Ukraine's geopolitical tensions and risk of energy disruptions. These investments are part of long-term programs developed with IFIs or similar entities and align with local and national strategic goals.
3. **Emergency Investments**
   These are immediate or short-term actions to ensure the basic functionality of DH systems, particularly in response to unforeseen events like the ongoing war. Emergency investments include quick repairs and temporary installations, such as mobile heat production units, to restore heat supply to affected customers. Frequent DH infrastructure interruptions can have severe consequences, especially in winter. A prioritization strategy for emergency investments includes:
   - First Priority: Critical actions to prevent system collapse, service interruptions, or safety risks (e.g., freezing water in pipes during winter), ensuring basic system functionality.
   - Second Priority: Immediate measures that significantly enhance DH supply resilience and operational quality, preventing escalation to critical failures.
   - Third Priority: Necessary investments to restore stability and reliability, recommended as soon as possible to avoid escalating critical situations.

While emergency investments deal with the immediate crisis without a focus on cost-benefit, the purpose of strategic investments is to ensure that the system is not just restored but made more resilient to future crises. The purpose of strategic and cost-benefit investments is also to adapt to Ukraine's long-term climate

commitments, in particular the country's movement towards decarbonization and increasing the share of renewable energy.

While both the state budget of Ukraine and local budgets are under significant strain, they have an important role in providing political and regulatory support, facilitating international investment, and can provide limiting co-financing. IFIs, multilateral and bilateral donor organizations, are expected to be key players in the financing of both emergency, strategic, and cost-benefit projects. Whilst private capital is expected to primarily focus on providing capital for cost-benefit investments and strategic investments, if they see a long-term potential, especially under risk guarantees from IFIs and a framework support and incentives from national and local governments.

Ukraine's DH sector has received considerable attention from international donors, such as international financial institutions, USAID, and the EU, which primarily provide grants or loans, especially for priority investments.

Coordinated advocacy can help raise awareness and clarify potential. Central coordination can make the different types of funding effective across all three primary categories and ensure alignment with Ukraine's political goals. The significant EU funding mechanism named the Ukraine Investment Framework (UIF) that was launched in 2024 could found the basis for such central coordination.

5.2. Development of an investment-friendly environment in Ukraine

To strengthen the investment environment in Ukraine's DH sector, it is recommended that the Ukrainian government implements a national strategic roadmap for DH and, on this basis, seeks to attract international investment in a coordinated manner and attract private companies to participate in DH production and operation. Recommended key measures are described below:

5.2.1. National strategic roadmap

Developing a long-term national strategic roadmap for the district heating (DH) sector is essential to demonstrate commitment and attract investors. This roadmap should:

- **Outline Challenges and Define Objectives:** Clearly describe the challenges, set objectives, timetables, and investment priorities.
- **Create Long-Term Stability:** Contribute to political stability in the DH sector, which is crucial for attracting investment in infrastructure with a long technical life.
- **Coordinate with Other Strategic Roadmaps:** Align with Ukraine's other strategic roadmaps in energy and the environment, as well as the EU's long-term climate goals (e.g., EED). This alignment helps achieve the long-term goals of the Ukrainian DH sector.

The roadmap will provide a framework for both regulation and investment; ensuring investors have certainty that Ukraine has a well-defined and predictable regulatory environment for DH.

Pilot projects and subsequent success stories aligned with the roadmap are important to demonstrate the viability of DH modernization projects. These can help build investor confidence and serve as models for nationwide scaling.

Ukraine has various strategies and roadmaps that would complement the proposed strategic roadmap for the DH sector. One notable strategy within energy efficiency and EU integration is the Energy Efficiency Directive (EED).

Strategy for thermal modernization of buildings in Ukraine until 2050

In January 2024, MinInfra issued a thermal modernization strategy extending until 2050, alongside a state-targeted program for thermal modernization running until 2030, with a focus on initiatives during 2024-2026 (the Operational Action Plan). The strategy aims to improve the energy efficiency of buildings, which are among the largest energy consumers. Key aspects include:

- Improving building insulation, replacing inefficient heating systems, and supporting the integration of renewable energy sources.
- Funding through the state budget, international grants, and other mechanisms such as green bonds.
- Assigning tasks to local authorities to identify and manage eligible buildings for modernization, in cooperation with the State Agency on Energy Efficiency and Energy Saving.

While energy efficiency and savings in buildings are the main focus, the strategy also aims to improve the district heating (DH) sector by increasing energy efficiency, reducing reliance on fossil fuels, and integrating renewable energy sources. This strategy takes into account the context of the war, which has damaged critical infrastructure.

5.2.2. Coordination of international investments

To strengthen cooperation with international financial institutions (IFIs) and other investment entities, Ukraine should take several key steps to attract grants and loans on favorable terms, positioning these entities as trusted partners for potential private investors.

1. **National Coordination:**
    - ***Create a National Pool or State-Led Agency:*** This body would assess and coordinate international support based on the national strategic roadmap for the district heating (DH) sector. It would also guide investments into the three primary categories: prioritized cost-benefit, strategic, and emergency investments.
    - ***Bottom-Up Approach:*** The agency could focus on collaborating with municipalities and DH companies, ensuring investments are used efficiently at specific locations without requiring strong centralized management.
2. **Project Bankability:**

- ***Establish Central Rules and Guidelines:*** To ensure projects are well-structured, with clear business models, defined timetables, financial viability, and compliance with environmental regulations.
- ***Conduct Feasibility Studies:*** Business cases and thorough market analysis are essential to attract investors.

3. **Investor Analysis and Attraction:**
    - ***Clarify Investors' Priorities:*** The agency could analyze investors' priorities and requirements, attracting climate-conscious investors by focusing on energy efficiency and emission reductions.
    - ***Integrate Renewable Energy:*** Projects involving biomass, geothermal, and solar energy will attract sustainable finance.
    - ***Transparent Communication:*** Regular updates on the benefits of modernization projects will build investor trust. Emphasizing Corporate Social Responsibility (CSR) aspects can also attract responsible investors.
4. **Risk Mitigation Tools:**
    - ***State-Backed Loan Guarantees or Insurance Schemes:*** These can help reduce risks for international and private investors.
    - ***Simplify Approval Processes:*** The agency can ensure approval procedures are efficient and regulatory barriers are minimized.
5. **Utilizing EU Funding:**
    - ***Ukraine Investment Framework (UIF):*** Launched in 2024, this significant EU funding mechanism could underpin such an agency-led national strategy.

5.2.3. Public-private partnerships

Using public-private collaboration through third-party participants or partnership models (PPP) to share risks and benefits between public and private entities can be an effective way to attract funding and thereby share the financial burden of modernizing DH systems. By, for example, providing incentives, such as tax breaks or guarantees, the government can attract private capital to develop heat production, while at the same time ensuring municipal control over the DH network.

Private participants, partners, and investors should focus on developing the DH base load facilities, while the DH network and the peak and reserve load facilities must be maintained in public or municipal ownership.

In addition, for DH systems struggling with serious operational inefficiencies, it should be considered privatizing certain DH activities or offering long-term concessions to private operators. These arrangements could introduce modern management practices and access to finance, while maintaining public control.

To strengthen legislation in this area, Ukraine should focus on transparent concession agreements, performance-based contracts, and strong public oversight. Additionally, legislation must align with EU standards on energy efficiency and competition.

5.3. Strengthening the district heating companies' financial resilience

In other sections of this report, the critical technical-economic situation facing Ukrainian district heating (DH) companies is analyzed from various angles, followed by recommendations. To break the cycle of technical and financial underperformance (see Figure 3) and strengthen the financial resilience of these companies, the following strategies are recommended:

1. **Establish Cost-Reflective Tariffs and Implement Targeted Social Subsidies:**
    - Ensure tariffs reflect actual costs while protecting vulnerable populations through targeted subsidies, maintaining equitable access to heat.
2. **Align Tariffs for Gas, Electricity, and Heat Across Consumer Groups:**
    - Create parity among energy prices to ensure fair competition, encourage efficient consumption, and prevent households from opting out of DH due to cost discrepancies.
3. **Restore Financial Flows Directly to DH Companies:**
    - Ensure DH companies receive payments directly without intermediaries. Reliable cash flows enable them to cover operating costs, pay for fuel, and invest in modernizing DH systems.
4. **Establish Debt Restructuring with Concessional Loans:**
    - Alleviate immediate financial pressures by consolidating or reducing debts with favorable loan terms, such as low interest rates and long repayment periods, reflecting the long technical lifespan of DH system assets when properly maintained.
5. **Implement a National Scheme Linking Performance Benchmarks to Debt Restructuring and Subsidies:**
    - Tie financial assistance to measurable performance goals, ensuring accountability. This incentivizes DH companies to improve service quality, reduce inefficiencies, and modernize operations in exchange for debt relief and state support.
6. **Attract IFIs, International Donors, and Public-Private Partnerships (PPPs) for Modernization Projects:**
    - Collaborate with IFIs, donors, and private partners to secure financial resources for modernization. Concessional financing or grants, combined with energy efficiency projects, will reduce the financial burden and enhance the sector's capacity to manage existing debts.

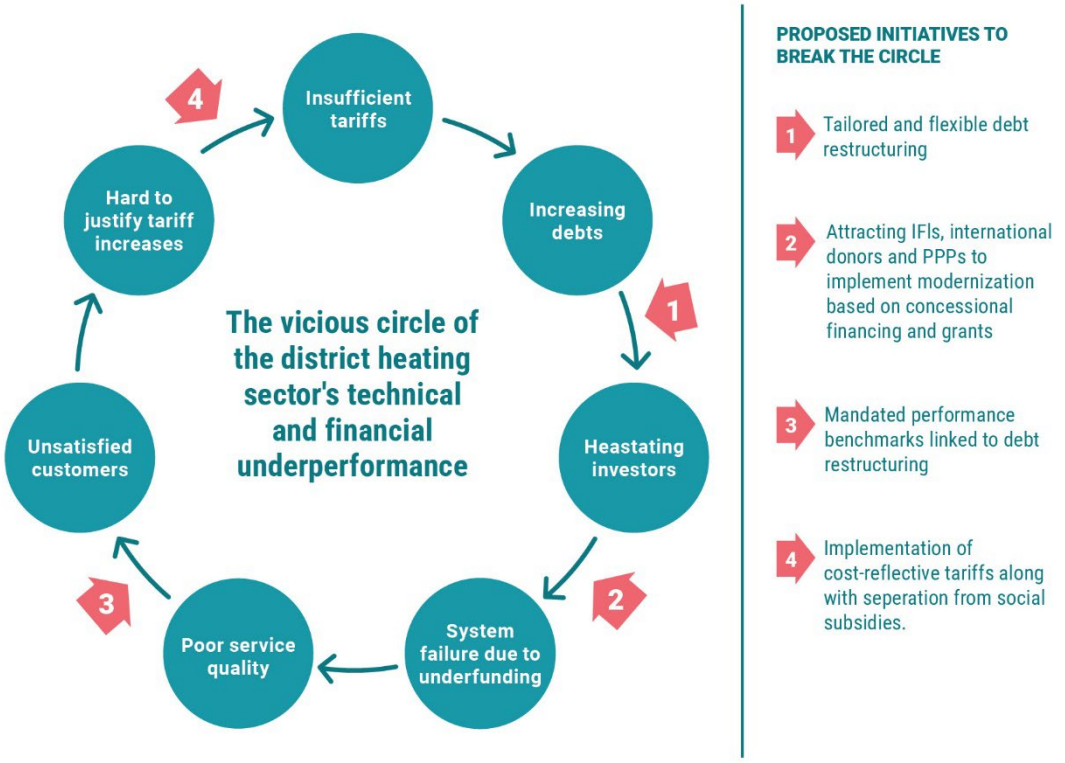

Figure 3: The vicious circle in which Ukrainian district heating companies are trapped and proposals for breaking the circle.

5.4. Streamlining the Heat Supply Schemes

The Ukrainian Heat Supply Scheme (HSS) is a mandatory plan for cities aimed at analyzing local heat supply systems to find and implement efficient, sustainable, and cost-effective solutions, primarily focusing on district heating. The HSS aligns with EU energy efficiency goals, including improving district heating, integrating renewable energy, and reducing emissions. It involves energy audits, system assessments, performance benchmarks, and cost-benefit analyses to evaluate the current state and future potential of DH systems.

Ideally, the HSS should provide international financial institutions (IFIs) and other investors with a good opportunity to assess the technical and financial viability of proposed modernization projects. However, there are challenges in attracting IFIs and other investors to utilize the HSS. This is also true for the Ukraine Investment Framework (UIF), launched in 2024 to support Ukraine's recovery and the modernization of DH systems. Identified challenges include:

- IFIs and other investors often rely on their own assessments and priorities, which may not align with HSS criteria.

- The HSS provides a snapshot of the system but is not updated regularly, making it less useful for ongoing investment planning.
- Limited local resources and expertise, along with weak coordination between stakeholders, have slowed the development of HSS across Ukraine, with only a few cities completing their plans.

To make the HSS more applicable, consider the following approaches:

1. **Integrate with International Best Practices:**
    - Align the HSS more closely with best practices used by IFIs and other investors, even if there are differences in priorities and requirements. This alignment can facilitate finding common ground.
    - Update the HSS regularly to provide continuous and current data as needed.
2. **Split the HSS into Two Packages:**
    - **Strategic Plan for the DH Company:** Simplify the HSS into a strategic plan by removing detailed technical-economic analyses. This plan will still serve as a useful framework for municipalities and DH companies, promoting technical expertise and institutional capacity.
    - **Individual Project Proposals:** Design individual proposals to include detailed technical, financial, and regulatory frameworks, making them more actionable and aligned with IFI requirements or a national-based investment system like the UIF. A structured mechanism similar to the Danish project proposal and approval mechanism under the Danish Heat Supply Act is recommended. As shown in appendix B, Danish project proposals include sections on technical specifications, environmental assessment, socio-economic analysis, financial analysis for the DH company, and an assessment of the benefits for heat consumers.

Highlights of this chapter

Unique Investment Environment: When district heating (DH) networks are recognized as natural monopolies while heat production remains competitive, it creates a unique investment environment. The regulatory framework plays a crucial role in shaping this environment, ensuring fair access to DH networks, determining pricing structures, and providing incentives for renewable energy integration and energy efficiency improvements.

Centralized State Agency: Ukraine could benefit from establishing a centralized state agency to coordinate investments, oversee municipal DH company restructuring, and facilitate third-party participation and public-private partnerships. This agency would act as a liaison between international investors and the Ukrainian government, ensuring transparency and alignment with national goals and EU standards. The newly launched (2024) Ukraine Investment Framework (UIF) could serve as a foundation for this approach.

6. Recommendation: Enhancing Consumer Protection and Information

While Ukrainian legislation provides a high degree of formal consumer protection in the district heating (DH) sector, the practical implementation of these protections is often lacking. As a result, consumers may appear over-protected on paper, but under-protected due to weak enforcement, inefficiencies, and systemic problems. To address this gap between formal consumer protection in legislation and its actual implementation, legislation using the EED as platform can be improved by focusing on enforcement mechanisms, regulatory oversight, and systemic reforms.

6.1. Creation of an independent regulatory body

The key institutions involved in regulating DH, which include local authorities, NEURC and MinInfra, do not have clear roles, resulting in regulatory oversight often being fragmented across different entities and inconsistent enforcement of the rules. This can contribute to the problems of inefficiency and weak consumer protection. Establishing or authorizing an **independent specialized regulatory body for district heating** can help address these challenges and ensure more focused governance and accountability in the sector.

The EED provides a framework that Ukraine can use to create or authorize a specialized supervisory body for DH. The EED aims to promote energy efficiency and better regulation in the energy sector, including DH, and its provisions can help guide the development of such a regulatory body. EED emphasizes the importance of transparent and effective regulatory governance to achieve energy savings. Ukraine could incorporate these principles into its regulatory structure.

The EED contains provisions that directly relate to consumer protection, such as ensuring that consumers receive adequate information about their energy consumption and improving access to energy saving measures. A specialized DH regulator could enforce these provisions by ensuring that DH companies provide transparent billing, accurate metering, and access to energy-saving technologies such as thermostats and dynamic balancing devices for radiator systems (that automatically adjust the water flow through the radiator system, ensuring optimal distribution of heat and preventing issues like uneven heating or overheating in certain areas).

6.2. Improving transparency and accountability

Many DH consumers in Ukraine lack clear information about how their tariffs are calculated, leading to dissatisfaction. To address this, it is important to provide consumers with transparent and easy-to-understand details about tariffs, service quality, energy consumption and environmental impact.

Tariff setting must be fully transparent, with opportunities for public feedback and oversight. Bills should clearly show how tariffs are calculated and include detailed information about actual consumption and costs.

According to Article 10 of the EU EED, consumers must receive clear, accessible information on energy bills, consumption, and costs. Ukraine can align with this standard by requiring DH providers to issue itemized bills that explain tariffs in a straightforward way.

Additionally, DH companies should regularly publish key operational data, such as service interruptions, maintenance schedules, and efficiency measures, to improve transparency and accountability. This information should be easily accessible to the public. Recommended measures to mandate or to crosscheck:

- Clear and detailed Billing using simple language and visual aids, such as graphs or charts, to help consumers better understand their energy use and costs over time.
- Online tools or apps that allow consumers to monitor their energy use in real time and calculate expected costs.
- Regular online publication of operational data, such as service interruptions and their causes, maintenance schedules and costs, and energy efficiency measures and progress.
- Clear, accessible process for consumers to file complaints and have them resolved promptly.

By mandating or strengthening these measures, Ukraine's DH sector can build a stronger relationship with its customers, improve service quality, and adapt to international standards.

To specifically strengthen the DH sector in terms of regulation, it is recommended to establish an independent, specialized DH regulator. This would provide several advantages compared to a broader regulator overseeing all utility services (heat, gas, electricity, etc.). An independent DH regulator can focus exclusively on improving DH services, ensuring accountability, and dealing effectively with consumer complaints. Moreover, it can implement incentives and frameworks to promote renewable energy integration, cogeneration, and other sustainable practices specific to DH systems. A broader utility regulator could potentially streamline administrative processes and reduce costs. However, the risk of losing sector-specific focus is believed to outweigh these efficiency gains, especially during the current critical challenges where DH needs significant attention.

Highlights of this chapter

Despite strong formal protections in Ukrainian district heating (DH) legislation, practical implementation is often lacking. To bridge this gap, recommended enhancements include:

- **Independent Regulatory Body:** Establish an independent regulatory body for DH to ensure effective governance and accountability, drawing on the EED framework for guidance.
- **Transparency and Accountability:** Improve transparency in tariff calculations and service quality. Ensure clear and detailed billing, real-time energy use monitoring tools, and regular publication of operational data.
- **Consumer Education:** Enhance consumer protection by providing clear information about their rights, obligations, and energy-saving measures.

An independent DH regulator is essential for addressing sector-specific challenges and ensuring focused oversight.

7. Cases from Eastern Germany

This chapter comprises a review of the Eastern German district heating sector as inspiration for Ukraine, as the Eastern German district heating systems have undergone significant transition since German reunification in 1990, evolving in their technical, institutional, and financial dimensions. These results have only been possible through a strong investment environment.

7.1. Gas Transition

After the German reunification in 1990, the DH systems in Eastern Germany were in poor condition. The infrastructure largely based on coal-fired plants and inefficient boilers had suffered from years of neglect under the former GDR. These systems were characterized by:

- Old coal-fired plants with low energy efficiency combined with significant heat losses in distribution networks.
- High emissions of CO_2, sulphur dioxide (SO_2), and other pollutants, contributing to poor air quality, due to reliance on domestic coal.
- Outdated DH networks with a lack of modern equipment and controls, although generally in better condition than in other countries in the former Eastern Bloc at that time.
- Lack of financial viability.

To address these problems and revitalize DH, gas-fired CHP plants emerged as a key solution. It was in line with Germany's broader energy policies of the 1990s, which aimed to move from coal to cleaner energy sources while modernizing the infrastructure. Although an explicit national strategy was never developed, and there were challenges related to the large initial investment costs as well as to dependency on imported natural gas, the long-term benefits made this approach effective in terms of improving both DH companies' finances and the environment.

Thus, several major cities in Eastern Germany (e.g. Leipzig, Dresden, Magdeburg, Rostock, Erfurt, Chemnitz, Potsdam, and Halle) have successfully implemented gas-fired CHP as part of their DH modernization, typically by replacing older, inefficient coal-fired boiler plants. In the larger Eastern Germany's DH systems, high efficient and flexible combined cycle CHP plants (gas turbine combined with steam turbine, also named CCGT), became the preferred choice for new installations despite higher initial investment. The solid extra income from the sale of electricity became the driving force behind this fruitful business.

The Western German electricity companies played a significant role in the modernization of the energy infrastructure in Eastern Germany, including the DH systems. Their involvement typically included both direct investment in the new CHP plants, full or partial ownership of the DH companies and public private partnerships (PPPs). The specific strategy varied depending on the local conditions and the strategic interests of the Western German companies. Additionally, state and EU funds were directed towards investments in DH systems and gas-fired CHP.

Today, the Eastern German DH sector is characterized by significant progress in energy efficiency with a considerable reliance on gas-fired CHP, but also an increasing integration of renewable energy sources. DH serve a significant share of households in cities in this region, contributing to Germany's broader climate goals. Efforts are underway to further expand DH with a view to achieving climate-neutral heat supply in the future. This includes plans to reduce and eventually phase out gas-fired CHP.

7.2. Financial and institutional approaches

The experience of Eastern Germany in the 1990s can be a relevant model for organizing and financing the modernization of Ukraine's DH sector, as Ukraine's DH companies today face similar challenges of inefficiency and financial instability.

Significant federal government funding as well as contributions from the EU supported the modernization effort in the former GDR. The modernization of the DH sector was driven by efficiency improvements along with conversion from lignite to natural gas, particularly the implementation of gas-fired CHP. At that time, Germany's primary focus was the modernization and privatization of infrastructure, with less emphasis on the transition to renewable energy and decarbonization.

KfW (Kreditanstalt für Wiederaufbau), Germany's federal state-owned development bank, that was established in 1948, following World War II, played a key role in financing modernization projects in the former GDR. KfW offered low-interest and favorable loans to municipalities, utilities, and private investors. For DH systems, KfW utilized funds from initiatives like the European Recovery Program (ERP) to promote energy-efficient upgrades.

Originally provided as U.S. aid through the Marshall Plan after World War II, ERP funds were later restructured into a revolving loan system, which continued to support projects well into the 1990s. The financing programs of KfW aimed to reduce the financial risk and often served as a catalyst for attracting additional investment from private investors and IFIs. The involvement of KfW helped ensure that the modernization projects aligned with German and European energy policy goals.

In addition, Treuhandanstalt, the agency responsible for privatizing and restructuring former East German state-owned enterprises, played in the period 1990-1994 a key role in restructuring and privatized state-owned Eastern German DH companies into limited liability companies and, in some cases, joint-stock companies. Through Treuhandanstalt, several DH systems were sold to private investors or Western German energy companies such as E.ON, RWE, and Vattenfall, which invested in modernizing the infrastructure, especially through the introduction of gas-fired CHP plants.

However, many of these companies were taken over by Eastern German municipalities to establish multi-service companies named Stadtwerke (literally “City Utility”) like in Western Germany, i.e. municipally owned utility companies to provide essential public services such as DH, water, electricity, and gas to their local communities. In some cases, these Eastern German Stadtwerke sold shares to similar Western German Stadtwerke or to large Western German energy companies.

Many DH companies, previously run exclusively as state-owned enterprises, thus came under municipal ownership in the Stadtwerke model, which operated according to the principle of local control, local community service, and reinvestment of profits in the municipality. This model appealed to many Eastern German municipalities, which wanted to ensure that the benefits of modernization, including improved DH systems, were retained locally and not transferred to private, profit-oriented entities.

On the other hand, selling DH to large Western energy companies provided access to expertise, modern technologies, and capital. Thus, some Stadtwerke decided to operate in a hybrid model, where the local government kept a majority share, while private investors or companies were given minority shares. This allowed them to access private capital and expertise, while maintaining a focus on local interests. Some Stadtwerke also formed PPPs or joint ventures with private or regional energy companies to share resources, reduce risk, and expand their service offerings. This helped them to compete more effectively in a liberalized market. The best approach depended on the priorities of the local community – whether they favored local control or effective operation in a liberalized marked.

Like the large energy companies, the majority of the new Stadtwerke invested in gas-fired CHP plants, typically combined cycle CHP plants in the larger DH systems. Since the new Stadtwerke were also given concessions for the electricity supply and for the gas supply in their respective municipalities, this - especially the sale of electricity from the CHP production - provided an important solid financial basis for local modernization.

Thus, the integrated multiple services have allowed for synergies between them, such as integrating DH with electricity generation and gas supply through gas-fired CHP plants. In addition, Stadtwerke have the flexibility to allow cross-subsidization, i.e. allowing profits from their various services, including DH, to support other activities of the company.

This practice of cross-subsidization aims to support services that may not be profitable but are essential for public welfare, such as subsidizing public transportation. This flexibility is considered a key strength of the German Stadtwerke model because it enables municipalities to fulfil public service obligations. However, despite the benefit to support unprofitable but essential services, cross-subsidization can also obscure financial flows, complicating oversight and risking public mistrust. If considered in Ukraine, it should be implemented with proper regulatory safeguards and financial transparency.

The liberalized market in Germany today also allows consumers to choose their electricity and gas suppliers, and the local Stadtwerke have moved from traditional monopolies to competitive market players operating by leveraging their local knowledge and maintaining public trust.

7.3. Modern centralized investment program

In Germany, the BEW program (Bundesförderung effizient Wärmenetze or Federal Funding for Efficient Heating Networks) is a public funding program that runs in the period 2022-2026 and aims to promote the development and modernization of energy-efficient DH networks. The BEW program is crucial to

Germany's strategy to reduce dependence on fossil fuels, especially natural gas, in the heat supply sector. The program is part of Germany's wider climate strategy to decarbonize the heat supply sector and shift towards more sustainable energy sources, such as renewable energy and waste heat.

The BEW program provides grants and low-interest loans to utilities for the following components, as well as support for feasibility studies, planning and preparatory work necessary for project implementation. To qualify for funding, DH systems must meet specific energy efficiency standards.

Applicants must submit a detailed project proposal, including technical specifications, cost estimates and feasibility studies. The proposal is assessed based on its environmental impact, energy efficiency and adaptation to Germany's climate goals. Funding decisions are made by the Federal Ministry for Economic Affairs and Climate Action (BMWK), which oversees the BEW program.

The German federal government primarily finances and guarantees the BEW program with an annual budget. In Ukraine, a similar program could be based on international financial sources since national financing options are considered critical.

7.4. Legislative framework and district heating financing today

Today, Germany's main legal framework regulating the DH sector is the "Heat Supply Act" (WVG), which focuses on the expansion and decarbonization of the DH systems. In addition, Germany's "Energy Efficiency Act" (EEG) and "Building Energy Act" (GEG) set specific requirements for the DH sector, around the integration of renewable energy and waste heat.

Municipalities play a key role in the development of district heating, as the municipalities are now obliged to develop municipal heat plans under the Local Heat Planning Act (WPG) , which came into force in 2024 in conjunction with the "Heat Planning and Decarbonization of Heating Networks Act", which encompasses a broader framework for the decarbonization of DH networks. Unlike in Denmark, the DH sector in Germany has long been characterized as an unregulated natural monopoly, but this new legal framework represents a significant step forward in the systematic regulation of heat planning as part of the country's energy transition strategy.

In this context, new district heating projects are increasingly being financed or incentivized through state subsidies or programs to ensure that they are in line with climate goals. The BEW program (described in Chapter 7.5.3) is a key initiative in this regard and is pivotal for ensuring that DH systems play a key role in decarbonizing Germany's heat supply. Private utilities, energy companies, and other investors contribute to these projects, often through public-private partnerships (PPP). This allows private investors to leverage government grants while managing some of the risks associated with DH projects.

Thus, like in Denmark municipalities in today Germany play a central role in planning and developing DH systems, and both Germany and Denmark are aiming with state support to adapt their DH systems to climate goals by increasing the use of renewable energy and phasing out fossil fuels.

7.5. Financial and institutional recommendations for Ukraine

In Ukraine, the DH companies operate differently from the German Stadtwerke, as they focus on heat supply and do not manage other municipal services or utilities, and thus do not have the opportunity to practice the same type of cross-subsidization but are subject to stricter regulatory control. The Ukrainian water supply and wastewater service companies (Vodokanals) are also organized as separate municipal companies, while electricity and gas supply (sales to consumers) are carried out by mostly few privately owned companies in a liberalized market.

To help vitalize the finances of Ukrainian DH companies, lessons from the reforms in the 1990s German DH sector could be valuable to develop financial viability. Recommendations inspired from those reforms are listed below:

7.5.1. Modernizations on international financing

German case: Germany invested heavily in modernizing the DH infrastructure, e.g. with government concessional loans from Germany's federal state-owned development bank, as well as with contributions from IFIs and EU funds. However, this was not based on a targeted master plan specifically for the DH sector.

Recommendation for Ukraine: government concessional loans can be recommended. Funding can be supplemented by IFI and EU programs but can be effectively coordinated through a central government financial institution/scheme and justified as cost-effective priority investments based on a national master plan for DH. The newly launched (2024) Ukraine Investment Framework (UIF) could provide the basis for such an approach.

7.5.2. Privatization of selected activities

German case: After reunification, Germany used the Treuhandanstalt to privatize DH companies, convert them into limited liability companies or encourage the formation of PPP, provided private capital and expertise, helping to modernize systems and improve economic performance. There were successfully implemented CHP plants in German DH systems, improving the overall energy efficiency and financial performance of DH companies.

Recommendation for Ukraine: Partial privatization or PPP of DH companies can bring investment, improve efficiency and cost-effective operation, but it is recommended to retain municipal control.

Where private investment can particularly contribute is in increasing the diversity of heat production and thus create the basis for load dispatch in the DH systems – the basis for both resilience and economic viability. This requires that the regulatory framework provide clear steps for connection of private or partially private heat production facilities to the DH networks, while the networks remain under full municipal control. Access for CHP plants should be supported through regulation, both to the DH networks and to the electricity grid. Electricity from CHP plants may qualify for Ukraine's "green" feed-in tariffs if renewable fuels are used. If the municipality participates in CHP projects, it provides the opportunity for additional revenue streams for its DH company.

7.5.3. Transparent and accountable management

German case: Germany introduced transparent governance structures and professional management practices to ensure that privatized or municipalized utilities operated efficiently and with public accountability.

Recommendation for Ukraine: Strengthen governance and accountability in DH companies. Ensure that these companies operate under professional management, adhere to international accounting standards (to build trust with IFIs and international support programs), and are subject to regular audits. Transparency in finances and operations will improve trust and help attract investment.

7.5.4. Tariff reform and cost-reflective pricing

German case: After reunification, Germany reformed its district heating tariff system to ensure that prices reflected actual costs. This ensured financial sustainability and thus attracted investors.

Recommendation for Ukraine: Realize cost-reflective tariff structures that allow DH companies to charge customers based on actual costs of heat production and distribution. At the same time, low-income households should be secured financially through targeted social subsidies. This secures the DH company's finances for the future and attracts investors.

7.5.5. Focus on integration of renewable energy

German case: In recent years, Germany has integrated renewable energy sources into its DH systems as part of its broader energy transition (Energiewende) policy.

Recommendation for Ukraine: Explore the integration of renewable energy in district heating, such as biomass, biogas, geothermal heat, and solar heat to reduce dependence on fossil fuels and lower operating costs. Such investments have a high priority with IFIs, EU support schemes and other climate-focused investors. The potential can be uncovered through the recommended national master plan for the DH sector, thus also ensuring that the investments are targeted at Ukraine's commitments to environmental sustainability and energy security.

7.6. Inspiration from other East European countries

In the early 1990s, other Eastern European countries also faced modernization of the DH sector, but typically in a less centralized way than in Germany and yet with a successful outcome. While Treuhandanstalt handled privatizations and modernizations in a top-down manner, this process was carried out in other Eastern European countries in a more decentralized bottom-up approach, where the local governments were responsible for managing and modernizing their local DH, while the central government provided the regulatory framework for the modernization of the DH sector.

In Poland, for example, municipalities either became owners of the DH company, created PPPs, or sold their DH assets to private companies or investors. The Polish DH companies also received financial and technical assistance from IFIs and other international organizations through direct cooperation with municipalities and DH companies to implement modernization projects, while the Polish government played a decisive role through the regulatory framework.

Highlights of this chapter

This chapter explores the evolution of district heating systems in Eastern Germany since reunification in 1990. It highlights technical, institutional, and financial changes driven by a robust investment environment.

Ukraine could potentially adopt a similar financial strategy to that used by Germany in the 1990s, combining state-led coordination and international financial support. With the EU, IFIs, and other international actors already interested in supporting Ukraine's energy transition, a centralized agency could streamline efforts, ensuring efficient use of funds and compliance with national and international commitments.

Key cases presented:

- Gas Transition
- Financial and Institutional Approaches
- Modern Centralized Investment Program
- Legislative Framework and District Heating Financing Today
- Financial and Institutional Recommendations for Ukraine

Additionally, the chapter includes examples from other Eastern European countries.

8. Summary of Recommendations

The six main recommendations as described in the previous chapters are summarized below by presenting their **overall objectives, key actions** and an assessment of their **implementation priority** has been carried out:

- **Recommendation 1: Regulatory Framework Enhancement**
  - **Overall Objective:** Modernize legislation using the principle of EU's Energy Efficiency First and improve the Ukrainian method for technical and economic assessment.
  - **Key Actions:** Strengthen legislation to increase energy efficiency, reduce energy losses, support renewable energy and sector integration, and make enhancements on Ukrainian assessment based on the experiences from the corresponding Danish method.
  - **Medium/high implementation priority:** Modernizing legislation to align with the principle of Energy Efficiency First is critical for setting a strong foundation for all other reforms. While necessary for better planning and resource allocation, the task of improving the Ukrainian method is more specialized and can follow once the broader legislative framework is updated.
- **Recommendation 2: Reform of Tariff Design and Structure**
  - **Overall Objective:** Establish cost-reflective, fair, and transparent heat tariffs.
  - **Key Actions:** Realize cost-reflective tariffs, separate social subsidies from pricing, address DH company debts, strengthen oversight and build public trust.
  - **Very High Implementation Priority:** Ensuring fair, cost-reflective tariffs, reestablishing the control of financial flows, and resolving the debt issues of DH companies are urgent to restore financial viability and public trust.
- **Recommendation 3: Integration of Heat Planning with Urban Planning**
  - **Overall Objective:** Align DH development with sustainable municipal city planning.
  - **Key Actions:** Amend planning laws, set national guidelines, and improve zoning to meet EU standards, improving energy independence and decarbonization.
  - **Medium Implementation Priority:** This is an important step toward long-term sustainability and efficiency. However, it can be addressed in parallel with or after more immediate financial and legislative reforms.
- **Recommendation 4: Promotion of Cost-Effective and Sustainable Heat Supply**
  - **Overall Objective:** Enhance DH's role in the green transition by technical modernizations.
  - **Key Actions:** Enable sector coupling (by e.g. large heat pumps, industrial waste heat recovery). Support renewable energy integration through targeted incentives.
  - **High Implementation Priority**: Technical modernization, such as sector coupling and renewable energy integration, is critical for the recovery of the DH systems and the green transition.

- **Recommendation 5: Strengthening the Investment Environment**
    - **Overall Objective:** Create a favorable environment for DH investments.
    - **Key Actions:** Set up a central agency to coordinate funding, oversee municipal DH reforms, and manage partnerships. Leverage the Ukraine Investment Framework (UIF) or the like to attract international funding. Streamlining the Heat Supply Schemes to be more applicable.
    - **High Implementation Priority:** Attracting investments is crucial to fund the necessary recovery and modernization of the DH sector.
- **Recommendation 6: Enhancing Consumer Protection and Information**
    - **Overall Objective:** Empower consumers and build trust.
    - **Key Actions:** Enforce fair pricing, transparent billing, and accessible dispute mechanisms. Strengthen oversight to ensure service quality and accountability by an independent DH regulator. Provide clear information to encourage informed choices and energy-saving behavior.
    - **Medium/high Implementation Priority:** Building consumer trust and providing transparent information is essential for public support, but these measures can proceed alongside or slightly after critical reforms in tariffs and investment frameworks.

Appendices