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Assistance to the Development of the Mykolaiv Masterplan

Energy

Roadmap - Moving towards the Vision 2050

Final

May 2024

COWI

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Contents

List of Annexes

List of Tables

List of Abbreviations

4GDH	4th Generation District Heating
4GDH&C	4th Generation District Heating and Cooling
CHP	Combined Heat and Power
CHP	Combined Heat and Power
CMU	Cabinet of Ministers of Ukraine
COP	Coefficient of Performance
DAM	Day Ahead Market
DC	District Cooling
DH	District Heating
DSO	Distribution System Operator
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
FIT	Feed-in-Tariff
GHG	Greenhouse Gas Emissions
IDM	Intra-Day Market
IEA	International Energy Agency
JSC	Joint Stock Company
MCHPP	Mykolaiv Combined Heat and Power Plant, Private Joint Stock Company
MOTE	Mykolaivoblteploenergo, Municipally Owned Heat Supply Company
NEURC	National Energy and Utilities Regulatory Commission
NPP	Nuclear Power Plant
PPA	Power Purchase Agreement
PV	Photovoltaic
PVT	Photovoltaic/thermal
RES	Renewable Energy Sources
SAEE	State Agency on Energy Efficiency and Energy Saving of Ukraine
SDH	Solar District Heating
SMR	Small Modular Reactor
SPP	Solar Power Plant
TPP	Thermal Power Plant
WPP	Wind Power Plant
WtE	Waste to Energy

1 Introduction

This report has been developed within the framework of the project “Mykolaiv - Denmark partnership – Technical support unit” financed by the Danish Ministry of Foreign Affairs (MFA). The project, which has been entrusted COWI, is a framework contract, which, among others, includes assistance to the Mykolaiv City Administration (MCA) in developing the Mykolaiv Masterplan in close cooperation with an Italian company, One Works.

Box 1-1 COWI's contribution to Mykolaiv Masterplan in a nutshell

Mykolaiv Masterplan, which has been requested by the Mayor of Mykolaiv City, has a time horizon till 2050. It provides a compass for actions to be taken by the Mykolaiv City to ensure that it will develop into a thriving city attractive to its citizens and business community.

COWI and One Works have assisted Mykolaiv City Administration in developing the masterplan. In this work, COWI focused on three sectors:

- Water and wastewater
- Energy, including power, district heating and renewable energy sources
- Solid waste management.

COWI established a project organization consisting of a project management team and three sector teams of professionals, each headed by a Discipline Leader. Three sectoral Focal Points were responsible for monitoring cross-cutting activities, ensuring coordination between the parties and maintaining consistency in the deliverables.

To enhance transparency in the development of the Mykolaiv Masterplan, given its significant public interest and exposure, COWI established three sector-specific Sounding Boards inviting all potentially interested parties to take part in these.

It builds upon the results of the work carried out by the energy team of COWI, in close cooperation with the MCA and coordinated with the Italian company One Works.

The work resulted in the seven reports in addition to the current report, including the Priority Investment Programme, Energy, namely:

- Vision 2050
- Current Situation and Future Trends in District Heating and Power Sectors, Report
- Institutional Analysis Report
- Potential Alternative Energy Sources in District Heating and Power Sectors, Report
- Potential of Solar Energy Sources in Power and District Heating Sectors, Report
- Potential of the Wind Energy Sources in Power and District Heating Sectors, Report
- Potential of Bioenergy Sources in DH and Power Sectors, Report.

The Vision 2050 report outlines the 2050 sector targets for heat and power in Mykolaiv City. This vision has been discussed with all relevant stakeholders and approved by the MCA.

The findings outlined in the seven other reports (see overview above) describe and analyse the existing situation within WSS in Mykolaiv and puts forward a few recommendations on renewable energy sources, thereby facilitating energy security.

The current report outlines the steps required for the city, its residents, leaders, and industry professionals to meet the 2050 sector targets for heat and power, as they are laid down in the 2050 Vision – taking into due account the existing situation. That is, it addresses the question: How to move from existing situation to the Vision 2050?

The principal audience for this report comprises the MCA and One Works, given their central roles in the realization of the steps suggested in the roadmap. Following COWI's approach to visibility and transparency in supporting the process of rebuilding a better and greener Ukraine, this report, along with all others, is shared with the sounding board members and is open to any relevant stakeholders.

The report includes six chapters in addition to the current introduction, namely:

- **Chapter 2** outlines the Vision 2050 for the energy sector in Mykolaiv City, a vision, which assumes a thorough transformation of the district heating and electricity generation system.
- **Chapter 3** provides the summary of the current situation in the district heating and power sectors in the city. It addresses the existing legal and regulatory framework, takes into consideration progress made in recent years, also after 24 February 2022, aimed at improving the legal and regulatory framework in Ukraine so that it comes closer to the energy chapter of the EU acquis. Strengths, weaknesses, opportunities and threats of existing framework are highlighted, thereby paving the way for reforms to overcome prevailing barriers for further development of the energy sector.
- **Chapter 4** focuses on the need to focus on proper maintenance of the infrastructure and affordability of the population when moving forward so as to ensure that it is possible, through taxes, tariffs and transfers (development aid), to finance, not only investments (or capital expenditure) to be made, but also operating expenditure in future.
- **Chapter 5** outlines the basis for moving forward, i.e. the fundamental principles that should guide the implementation of the Roadmap.
- **Chapter 6** provides an overview of the Priority Investment Programme (PIP) which focuses on prioritization and sequencing of the projects and envisages cost and financing options as well as timelines and involvement of the partners, including the IFIs and donors. The PIP is broken down by investment projects and enabling projects, as well as by short-term, mid-term and long-term projects. It also suggests grouping the projects included to the PIP into three Investment Packages, each consisting of a number of projects sharing a common objective and very much interlinked.
- **Chapter 7** focuses on the actions to be carried out to facilitate implementation of the roadmap and sequence of these.

Three so-called cross-cutting reports have also been prepared, see Box 1-2 overleaf.

Box 1-2 Three cross-cutting reports

Three so-called cross-cutting reports have been prepared by COWI in connection with its contribution to the development of the Mykolaiv Masterplan. They are cross-cutting in the sense that they address issues of relevance for more than one of the three sectors (water, energy and waste). They are:

- Water and District Heating Affordability
- Financing Options for Municipal Infrastructure
- Impacts of Climate Changes.

2 Vision for Energy

This chapter defines the goals and major steps to transform the energy sector in Mykolaiv City into sustainable and carbon- free sector in the most cost efficient and environmentally prudent way.

Envisioning a future framed by innovation and ecological integrity, the "Vision" chapter of Mykolaiv's Energy Sector Roadmap is a declaration of the city's commitment to a sustainable and carbon-neutral trajectory. This chapter is not merely aspirational; it is a blueprint for action that reimagines Mykolaiv's energy systems, transitioning from traditional, carbon-heavy technologies to cutting-edge solutions that harmonize with the environment.

Within these pages lies a strategic vision that elevates Mykolaiv's electricity and district heating services from relics of outdated Soviet infrastructure to pioneers of a green and sustainable future. The roadmap champions the adoption of low-temperature heat sources, waste and biomass utilization, and Combined Heat and Power (CHP) technologies independent of fossil fuels. Such an ambitious overhaul pledges to markedly diminish Mykolaiv's carbon footprint, elevate its air quality, and secure its status as a beacon of urban resilience.

Mykolaiv is poised to embrace an array of innovative technologies, such as modern CHP plants, heat pumps, and the integration of renewable energy resources, which together form the cornerstone of a comprehensive, carbon-neutral energy policy. This document details how leveraging the potential of the Southern Bug River, geothermal heat, green fuels, and combined heating and cooling systems can lead to significant energy savings and reduced emissions.

Anticipating the next 20 to 30 years, we see not only an upgrade in infrastructure but also a transformation in the engagement of Mykolaiv's community. This chapter invites every resident and business to be part of a collective movement towards energy efficiency, imbued with the ethos of sustainability, and supported by policies that reward eco-friendly decisions.

As we embark on this transformative journey, our goal is clear: to foster a Mykolaiv that breathes cleaner air, treads more lightly on the planet, and marches into a future where energy is plentiful, green, and ensures the well-being of all its inhabitants.

- Towards a sustainable and carbon-neutral city

The vision outlined in this document presents a transformative path for Mykolaiv's electricity and district heating generation system, moving away from outdated Soviet technology towards a sustainable and carbon-neutral future. By embracing low-temperature heat sources, waste and biomass utilization, and modern CHP methods utilizing green instead of fossil fuels, Mykolaiv can drastically reduce its carbon footprint, improve air quality, and lead the way in creating a greener, more resilient city.

- Combined Heat and Power (CHP) without Fossil Fuels

Mykolaiv can adopt modern CHP technologies that avoid the use of fossil fuels. Implementing CHP plants e.g., waste incineration plants, biomass plants, biogas-fired engines allow simultaneous production of electricity and heat.

In the coming decades, Mykolaiv may implement waste and biomass utilization to produce heat. Organic waste and biomass may be converted into biogas or syngas through anaerobic digestion or gasification processes. Such biofuels can be then burnt to generate heat. It is also possible to directly recover energy through the combustion process of biomass or pre-sorted municipal waste, which will be separated from the waste that can undergo recycling processes. This renewable energy source can reduce dependence on traditional fossil fuels and lower greenhouse gas emissions.

- Low-Temperature Heat Sources like Heat Pumps

To further enhance the sustainability of the district heating system, Mykolaiv should transition towards incorporating low-temperature heat sources e.g., heat pumps into its district heating system. Heat pumps can efficiently extract heat from the surrounding environment, including air, water bodies, the ground or surplus heat. Flowing through Mykolaiv, the Southern Bug River can serve as an excellent low-grade heat source for a high-capacity heat pump. This renewable energy technology can significantly reduce carbon emissions and provide a reliable and consistent source of heat for the city's residents.

- Integration of Renewable Energy Sources

To achieve carbon-neutrality, Mykolaiv must integrate various renewable energy sources into its district heating system.

Creating the system combining biofuel running CHP technologies with electrode boilers and heat pumps powered by renewable sources, such as solar or wind energy, can further enhance the city's ability to optimize its energy use, minimize energy wastage, and decrease overall carbon emissions. Also, the utilization of geothermal energy in urban district heating systems offers a green and reasonable solution with minimal environmental impact. An opportunity for sustainable urban development could also lie in the utilization of green hydrogen in the urban energy sector, drawing examples and lessons from Danish solutions.

- Geothermal heat

Geothermal resources are important and promising in Ukraine’s national energy production, and there is potential for geothermal energy to become one of the leading sources of the country’s heat and power generation. According to investigations of the potential for utilisation of deep geothermal heat sources, Mykolaiv's’ location in the Black Sea coastal area offers favourable conditions for the extraction of geothermal heat at temperatures suitable for district heating.

- Green fuels

Hydrogen is emerging as a promising new alternative fuel that holds immense potential for decarbonizing various sectors, including transportation and industry. The production of hydrogen, particularly through green methods like electrolysis using renewable energy sources, generates a substantial amount of waste heat. To maximize the efficiency and sustainability of our energy systems, this waste heat must not go unused. By integrating this surplus heat into district heating systems, cities like Mykolaiv can enhance their thermal energy supply, reducing the reliance on fossil fuels and further contributing to their goal of becoming carbon neutral. Harnessing the waste heat from hydrogen and other green fuels' production presents a significant opportunity to create a more circular and eco-friendly approach to energy utilization, fostering a greener future for the city and its residents. As a fuel in the district heating and energy sector, hydrogen enables the use of fuel cells

and co-firing gas engines, gradually transitioning from natural gas to hydrogen. Additionally, it can serve as a seasonal energy storage medium for district heating systems. Excess renewable energy can be used to produce hydrogen, which is then stored and used for heating during colder months when energy demand is higher.

- Combined district heating and cooling

By combining district heating and cooling it is possible to obtain considerable energy savings resulting in a reduced need for fuel combustion and reduced greenhouse gas emissions. Particularly, the utilization of cold in urban buildings can contribute to improving the energy balance. The location of Mykolaiv furthermore enables the use of river water for district cooling which offers the opportunity for further energy savings.

- Upgrade of Energy and Heat Production and Distribution

Over the next 20- 30 years, the existing district heating network should undergo a comprehensive upgrade. This includes retrofitting buildings with energy-efficient measures like insulation and modern heating systems. Additionally, investing in advanced monitoring and control systems, production and distribution software can further optimize heat distribution, reducing heat losses and enhancing overall system efficiency. Further efficiency gains will be obtained through the usage of automation of key processes such as precise temperature regulation. The system should be prepared to quickly detect and respond to emergency situations in the district heating network - this includes detecting leaks, damages, sudden pressure drops, etc. The IT system should be integrated with the billing system, allowing precise billing of customers for their consumed thermal energy. The system should gather data related to energy consumption, system operation, and other indicators to enable data analysis and making strategic decisions. Smart grid technologies should be employed to efficiently manage the fluctuating supply from renewable sources and balance the energy demand.

- Community Engagement and Support

The success of this vision depends on active community engagement and support. Public awareness campaigns, incentives, and policies should be implemented to encourage residents and businesses to adopt energy-efficient practices and technologies. Stakeholder collaboration is crucial for the seamless integration of the new district heating infrastructure.

3 Existing situation, Summary

This chapter provides a summary of the report on the current situation in the district heating (DH) power and renewable energy sectors in Mykolaiv. The baseline situation as of end of 2021 and 2023 has been determined through questionnaires and interviews with the utilities in Mykolaiv.

When drafting the report and analyzing the current situation in the DH and power sectors of Mykolaiv, our team encountered constraints due to limited access to information regarding the current state, operational statistics, and the consequences of military actions. This limitation is outlined in the NEURC Resolution dated March 26, 2022, regarding information protection. It stipulates that, under martial law conditions, access to information, including data related to critical infrastructure objects, may be restricted. Consequently, this limitation has impeded our ability to obtain necessary operational data and comprehensive information about system performance.

3.1 District heating

Throughout the country, and in Mykolaiv City the capacities of district heating systems are excessive, and the technologies employed are both inefficient and outdated. The capital stock is in a critical condition, with most assets either approaching or surpassing the end of their designated lifespans. Energy losses are significant.

The primary providers of heat supply for the customers of Mykolaiv are two major entities: Combined Heat and Power Plant (MCHPP), and Mykolaivoblteploenergo, a municipally owned heat company (MOTE).

MOTE, the leading heat energy enterprise, caters to approximately 60% of Mykolaiv's consumers. As of January 1, 2023, MOTE operates:

- 94 active boiler houses with a total installed capacity of 440,519 Gcal/hour (94 boiler houses are on the enterprise's balance sheet, and 92 are operational).
- 23 Centralized Heating Points (CHPs) and 95 Individual Heating Points (ITPs).
- 33 booster pumping stations.

Meanwhile, MCHPP plays a role in covering both thermal and electrical loads. Its primary equipment comprises 4 power boilers, 2 water boilers, and 3 turbogenerators. Most of the heating networks for both MCHPP and MOTE were commissioned in the 1960s.

For MOTE, the length of its heating networks within the city is almost 255 km, with 20 km being outdated. About 10.2% of the enterprise's heating networks have been in operation for more than 25 years, surpassing the permissible service life specified in regulatory documents.

As for MCHPP, the length of its heating networks within the city is nearly 50 km, including 3 km of emergency sections and 47 km of outdated sections. Approximately 80% of the enterprise's heating networks have been operational for more than 25 years, exceeding the permissible service life specified in regulatory documents.

In addition to its primary functions, MOTE actively engages in various activities to address the consequences of hostilities and the ongoing shelling of the city. These activities include among others:

- Technical maintenance of water pumping stations to ensure the proper functioning of water pumping stations.
- Provision of services related to issuing technical conditions for connecting to the centralized heating system for entities seeking to connect to the heating network.
- Conducting hydraulic tests on heating system pipelines to assess the integrity and performance of the heating infrastructure.

The improvements are needed across all stages: from production and distribution to the consumption of heat for space heating and hot tap water. Given the disruptions called by war, there is a pressing need for decentralization, such as adopting smaller systems like gas boilers, or conversely, strengthening centralization and expanding the utilization of alternatives to natural gas as a heat source.

All these issues have been addressed in the Mykolaiv Master Plan to achieve heat supply reliability, increased comfort, and affordable heat prices. The benefits of a well-designed and effectively operated district heating system are threefold: heightened energy efficiency, greater flexibility and security of supply, and a reduced carbon footprint.

3.2 Power

Power production in the region is provided by the Southern Ukrainian Nuclear Power Plant, Oleksandrivska Hydroelectric Power Plant, Tashlytska Hydro Accumulating Power Plant, Mykolayiv Combined Heat and Power Plant, and numerous sources harnessing renewable energy, including wind and solar.

Power distribution for the consumers in the Mykolayiv region is provided by the Joint Stock Company Mykolayivoblenergo (MOE), founded in 1995. 70% of the company's shares are owned by the National Joint-Stock Company "Energy Company of Ukraine.

MOE is a distribution system operator (DSO) and is engaged in licensed activities within the Mykolayiv region, covering an area of 24.6 thousand km^2 and providing services to more than 1,093.4 thousand people in Mykolaiv and 19 districts.

The electricity distribution service tariffs offered by MOE for the period from July 1, 2023, to December 31, 2023 (inclusive), were as follows:

- First voltage class: UAH 423.35/MWh (excluding value-added tax)
- Second voltage class: UAH 1,992.55/MWh (excluding value-added tax)

The wear and tear of electricity network facilities and equipment causes substantial rise in maintenance costs required to ensure the functionality of power lines and substations. This requires more intense utilization of machinery, structures, materials, and an increased workforce for both planned and unplanned inspections, routine maintenance, and emergency repairs. As per the provided data, 70% of the primary high-voltage equipment, including power transformers, has surpassed its service life, exceeding 25 years.

3.3 SWOT analysis

This section provides the overall SWOT analysis carried out with regards to the whole energy sector.

SWOT analysis of the energy sector in Mykolaiv City is presented in Table 3-1.

The strengths and opportunities should be taken into consideration to realize the necessary rapid green transition of Mykolaiv City energy sector, thus creating a reliable foundation for a competitive economy and achieving energy self-sufficiency. A thorough examination of weaknesses and threats that impede the development of a resilient and sustainable energy framework is essential.

Table 3-1 SWOT analysis of the energy sector in Mykolaiv City

SWOT analysis of the energy sector in Mykioaiv City	
STRENGTHS	**WEAKNESSES**
• Focusing on ensuring a robust and self-sustaining energy supply • Implementing measures to strengthen the resilience of the economy and safeguarding energy and environmental interests • Initiating structural changes and improvements within the economic and energy sectors • Encouraging practices and technologies that lead to increased energy efficiency. • Investing in research and development to harness scientific advancements for economic and energy-related benefits • Supporting employment growth through various initiatives and sectors • Facilitating upgrades and advancements in both energy and industrial sectors for modernization • Utilizing tax incentives to drive positive economic and energy-related behaviours • Promoting the use and development of sustainable and renewable energy options • Recognizing and capitalizing on opportunities to conserve energy resources effectively	• Ongoing conflict poses a significant obstacle to the stability and growth of the energy sector • Unsettled political conditions can create uncertainties and impede long-term energy planning • Adhering to European Union standards may pose challenges in the integration and compliance process • Outdated equipment and networks may result in inefficiencies and reliability issues • Escalating costs of energy resources can strain economic viability and competitiveness • Failing to harness available natural resources to their full potential limits sustainable energy options. • Inadequate funding, especially from private sources, can impede necessary infrastructure developments • Challenges in aligning energy strategies with national objectives may hinder progress • The lack of a cohesive policy framework for urban energy planning can lead to inefficiencies • Lagging behind in technological advancements can hinder the adoption of modern and efficient energy solutions • Aging and deteriorating energy supply systems may lead to disruptions and inefficiencies • Corruption and lack of transparency can undermine effective governance

OPPORTUNITIES	THREATS
• Opportunities for rebuilding and modernizing the energy infrastructure to improve efficiency and reliability • Support for the development of strategic plans, particularly in regions affected by external aggression, to ensure energy stability and security • Collaboration with the European Union for aligning energy practices and fostering the growth of sustainable, green energy sources • including the development of small-scale generation, implementation of energy storage facilities • Adoption of cutting-edge technologies such as microgrids and smart grids to enhance efficiency and reliability • Initiatives to reform the energy system for better governance, sustainability, and responsiveness to emerging challenges • Expanding international collaboration and connectivity for mutual benefits and resource-sharing. • Creating opportunities for foreign investments to support infrastructure development and modernization • Implementing measures to reduce energy consumption and improve overall energy efficiency • Exploring and utilizing domestic resources efficiently for energy production. • Reducing dependence on a single source by diversifying energy imports for increased resilience • Establishing reserves to mitigate potential shortages and enhance energy security	• Ongoing conflict can disrupt the transportation routes of energy resources, leading to instability in the supply chain • A reliance on energy imports from foreign sources can expose the country to geopolitical risks and vulnerabilities • War-related disruptions may lead to the offshoring of economic activities, impacting the stability and growth of the domestic energy sector • Amid conflict, there may be a tendency to prioritize immediate energy needs over long-term environmental considerations, potentially undermining decarbonization efforts • Failure to comply with EU regulations or inadequately implementing them may result in self-isolation from regional and international energy cooperation initiatives, limiting collaborative solutions to common challenges

3.4 Legal and regulatory framework

The Government of Ukraine is strongly committed to the green transition. It has expressed its determination to collaborate with the EU to focus on aligning existing legislation with the EU acquis to advance reforms in the energy sector. This section provides an overview of situation regarding further development of the legal and regulatory framework to support these reforms – at national level and at the level of Mykolaiv City.

Ukraine has implemented the EU legislation to enable market coupling. For example, the EU Regulation No1227/2011[1] on the wholesale energy market integrity and transparency (REMIT).

The rehabilitation of the energy sector in Ukraine will be based on the renewable energy sources (RES) development and energy efficiency improvement. The Government of Ukraine has consistently pursued the RES agenda and efficiency goals.

In line with this commitment, the National Energy Strategy until 2035 aims for 25% of electricity production to come from RES, while the National Economic Strategy until 2030 sets an even more ambitious target of 25% electricity production from RES. The proposed National Action Plan for the Development of Renewable Energy until 2030, developed to implement Directive 2018/2001/EC[2], envisages a significant increase in the RES share in gross final energy consumption – from 9% in 2020 to 27% in 2030.

[1] Regulation - 1227/2011 - EN - REMIT - EUR-Lex (europa.eu)
[2] Directive - 2018/2001 - EN - EUR-Lex (europa.eu)

The RES policy support has been strengthened by adoption of the Law No. 3220-IX aiming at advancing towards a liberalised market providing incentives for the development of the renewable energy sources. It introduces amendments to 18 laws in Ukraine (most importantly to the Law on Alternative Energy Sources and the Law on the Electricity Market) governing guarantees of origin, self-consumption contracts for difference for green auctions, a market premium system for producers operating under the green tariff, improved mechanisms for corporate PPAs.

Legislative framework in the field of electricity supply has significantly improved after the Law on Electricity market came into force in July 2019. It aligns Ukraine's national legislation with the European Union's regulation on the energy markets.

The efforts were taken to ensure the improvements energy market as follows:

- Diversification of energy supply. Since March 2022 the electricity grids of Ukraine (and Moldova) were successfully synchronized with the European power system operated by ENTSO-E.

- Unbundling and increased transparency in the financial and economic activities of energy companies.

However, electricity market in Ukraine is largely regulated as the Public Service Obligation (PSO) and price caps are still in force.

Significant efforts have been made in addressing energy efficiency measures in recent years. The approval of the Energy Efficiency Law, developed to implement Directives 2012/27/EC[3] on energy efficiency, 2009/125/EC[4] on eco-design requirements for energy-related products, and Regulation (EU) 2017/1369[5] on energy labeling, is a pivotal step.

The more ambitious goals are reflected in the new Energy Strategy of Ukraine for the period of up to 2050[6]. The strategy determines the achievement of carbon neutrality in energy by 2050. By 2050, Ukraine has the potential to increase the capacity of wind generation - up to 140 GW, solar - up to 94 GW, which will additionally require appropriate energy storage - up to 38 GW, nuclear generation - up to 30 GW, CHP and bioenergy capacities - up to 18 GW, hydro generation - up to 9 GW.

In view of the ongoing energy transition, the State Energy Efficiency Department, under the Ministry of Energy, has successfully adopted the National Action Plan on Energy Efficiency until 2030. This strategic plan is a commitment to advancing energy efficiency goals, sustainable and environmentally conscious practices.

In the battle against climate change and the reduction of greenhouse gas emissions (GHG), Ukraine has made substantial commitments. During the UN Conference of the Parties (COP) in November 2021, Ukraine presented its Second Nationally Determined Contribution (NDC-2) aimed

[3] Directive - 2012/27 - EN - EUR-Lex (europa.eu)
[4] Directive - 2009/125 - EN - EUR-Lex (europa.eu)
[5] Regulation - 2017/1369 - EN - EUR-Lex (europa.eu)
[6]CMU Resolution No.373-p dated 21.04.2023, https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text

at reducing GHG by 65% by 2030 as compared to 1990. Ukraine has presented National Energy and Climate Plan for the period of 2025–2030, at the UN Climate Change Conference[7] in Dubai.

On the level of communities and businesses the support on energy efficiency efforts will be implemented through The National Decarbonization Platform - the main platform offering the wide range of financial instruments, services, as well as modern equipment and technologies from global manufacturers[8].

Certain amendments are required in the legal and regulatory framework to untap the renewable energy potential to facilitate more sustainable environment for the city and the residents.

The measures for the improvement of the power supply are outlined in the Institutional analysis report and comprise the following:

- At the national level, implement military risk insurance mechanisms based on international models, ensure investment protection, foster a competitive environment, and pursue market liberalization strategies to facilitate the adoption of green transition practices.

- At the local level, focus on rehabilitating infrastructure to minimize vulnerability and enhance capacity to meet the demands of both industry and private households. Explore distributed generation options and actively implement renewable energy projects to diversify and strengthen the local energy supply.

Solar

- Imposing specific obligations on using PV and/or thermal solar systems in new residential buildings to accelerate the deployment of sun technologies in Ukraine’s cities.

Wind

- Simplifying permit acquisition procedures by eliminating legislative obstacles that contribute to prolonged and sometimes corrupt processes: land allocation, environmental impact assessments, power grid connections, and construction permits.

- Developing a comprehensive offshore wind strategy to establish a clear, national role for offshore wind technology. Setting up realistic short-, medium-, and long-term goals and actions.

- Prioritizing local manufacturing of wind turbine components to leverage Ukraine's manufacturing capabilities, intellectual potential, and skilled workforce, the country has the potential to integrate into the European wind power supply chain.

[7] Ukraine has presented the report on the decarbonization of the energy sector by 2050 and the preliminary version of the National Energy and Climate Plan at the UN Framework Convention on Climate Change COP 28 | Ministry of Economy of Ukraine
[8] The National Decarbonization Platform will become a key tool for energy-efficient transformation and "green" reconstruction of Ukraine, Держенергоефективності України (saee.gov.ua)

Bioenergy

- Approval of the Bioenergy Development Roadmap until 2050 or the inclusion of long-term goals for bioenergy in the updated Energy Strategy until 2050.
- Development of an effective and ambitious state program to reduce and replace the consumption of imported gas.
- Define the state's position on the use of agricultural residues for energy production
- The obligation to pay a CO2 emissions tax for boilers and thermal power plants utilizing biomass and biogas has been addressed in the draft Law proposing amendments to the Tax Code of Ukraine. This proposed law establishes a zero tax rate for carbon dioxide emissions and outlines the creation of a register of installations using solid, liquid, and gaseous biofuel as the sole type of fuel to manage tax exemptions.
- Lack of profitability arises when replacing natural gas with solid biomass in individual and district heating due to state subsidies for the cost of natural gas for the population compared to the market price. Addressing this issue requires a uniform market price for gas across all consumer categories, along with the monetization of subsidies.
- Creation of biomass exchange, an electronic platform for trading biomass, and the adoption of the draft Law proposing amendments to certain legislative acts of Ukraine on developing electronic trade in alternative fuels.

4 Addressing the backlog

Deliberately, the heading of this chapter is ambiguous. The chapter addresses the prevailing backlog in the energy sector due to several decades of negligence of investments, renovation and proper maintenance, while at the same time pointing to the need to address the backlog properly in the years to come. Improved asset management and an increase in, especially, tariffs are key. This is the message of this chapter. The solution is anything but easy since it involves stakeholders at various levels, not only the Mykolaiv City Council, MOTE and MCHPP. Focus is on heating.

4.1 Maintenance

For many years MOTE and MCHPP have suffered from insufficient funds. One result is high heat losses in district heating compared to countries in the EU.

Below we provide our estimates of the proper maintenance costs of the district heating system in Mykolaiv City. More precise figures will be determined during feasibility studies for investment preparation.

The infrastructure can be replaced to completely new components, it can be rehabilitated with renewal of most critical elements, or it can be continued to be used as it is. Consequently, we can distinguish three types of maintenance that are required – old previously underfinanced system, rehabilitated system with renewed critical components, and completely new system.

1. For prevailing district heating system where repair and maintenance works were previously inadequate and lead to significant system degradation, it's expected that maintenance costs will need to increase substantially during a rehabilitation phase. A reasonable estimate could be that maintenance costs may need to reach **10-12% of total operating costs** for several years. This number is limited by the capacity of servicing companies and producers of equipment such as pipes. The increased maintenance costs are necessary to address accumulated backlog and to restore the system to optimal operational condition.

2. For newly installed equipment and especially networks, the initial years typically require lower maintenance due to the condition of the equipment. An estimated maintenance cost for these first years (2-3 years) is about **1% of the total investment cost**. However, as the system ages and components start to wear, maintenance costs are likely to rise, possibly to **2-4% of total investment** in subsequent years (4-7 years after investment). This increase reflects the natural aging process of the infrastructure and the corresponding need for more extensive maintenance activities.

3. For systems that have undergone rehabilitation is the most complex to estimate due to varying degrees of refurbishment. A general estimation might place maintenance costs in the range of **4-7% of the total investment**. This figure takes into account that the rehabilitated systems, again especially networks, has been significantly improved, reducing maintenance needs compared to its state prior to rehabilitation. But still, it will require more maintenance than a brand-new system.

4.2 Affordability

To investigate potential impact of current and forecasted tariffs on households, an affordability analysis for district heating services has been conducted. Affordability was defined as a share of monthly household expenditure, which is spent on utility bills. This indicates the actual financial

ability of households to pay for utility services. The threshold level for district heating was set at 10% of household income/expenditure.

Average household with all similar characteristics, except income levels, have been investigated. Ten household income groups have been considered, from lowest till highest income decile. Levels of income into the future have been forecasted using wage increase index, and they were compared to utility bill, based on forecasted tariffs. Tariff rates have been forecasted to increase using average compounded growth rate from 2018 to 2023. In calculating the average household bill, the rate for of consumption for district heating services, forecasted tariffs, and VAT rate of 20% have been used.

The results of analysis suggest significant affordability problem for district heating. The households in all income deciles 1-8 will experience a heat affordability problem today and in the future since projected household bill for heating services was above 10% threshold. In the analysis we assume that heat tariffs increase yearly by 6% in the period 2023-2032. If the increase in heat tariffs is even more then affordability problem will be even larger than suggested by the results.

The affordability results call for policy implications.

There are two major types of policy implications we consider when supporting poor households: direct household assistance and subsidizing the utility companies. Direct household assistance involves providing cash transfers directly to households which are facing difficulties with affording heat. In contrast, when utility companies are subsidized, it is the utilities themselves who receive financial support from the municipality and the company is then responsible to charge lower tariffs for the households with affordability problems. We do not believe that it is beneficial to have the utility companies distinguishing between households. Additionally, we aim to avoid subsidies to utilities, as they often yield unfavorable outcomes. So that, as in the case of water, we recommend implementation of direct household assistance program.

For more information about the affordability analysis carried out, see the cross-cutting report, titled “Water and District Heating Affordability”.

5 Basis for moving forward

As we chart the course for Mykolaiv's energy future, the chapter titled "Basis for moving forward" serves as a critical juncture in our comprehensive Roadmap. It encapsulates the foundational directives and principles that will steer the city towards an advanced, integrated energy landscape. The progression of the energy sector is guided by robust European Union directives, specifically the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED), which include RED I (2009) and RED II (2018). These legislative instruments embody the commitment to modernizing our energy system and achieving energy efficiency and sustainability, in tandem with Mykolaiv's overall Masterplan.

This Roadmap chapter underscores the importance of aligning with EU regulatory standards and demonstrates how Mykolaiv will adopt and adhere to these frameworks. Elevating the role of renewable energy and advocating for increased energy efficiency are at the forefront of our strategy, as we aim to construct a forward-thinking energy sector reflective of broader environmental and sustainability goals.

The "Basis for moving forward" outlines the fundamental principles that will guide the implementation of the Road Map:

- Maintaining high energy security and ensuring Ukraine's harmonious integration into the European energy market.
- Committing to the development of a smart, modernized, and dependable energy system that addresses the end consumers' needs.
- Cultivating a marketplace that is free, competitive, and efficient.
- Boosting the energy efficiency of the local economy and the energy sector's environmental sustainability through significant investments in renewable energy sources, like solar, wind, and hydro power.

Structured to align with the Mykolaiv Masterplan, this chapter examines the Road Map's intended legal and regulatory framework, investment prioritization, finance strategies, affordability considerations, and the projected climate and environmental impact.

The aspirations for Mykolaiv's energy sector include drawing investment to fuel sectoral advancements and the introduction of new renewable energy and energy efficiency technologies. The principles outlined here provide a sturdy foundation for moving forward, ensuring that our journey towards energy modernization is strategically plotted and well-informing our city's dynamic energy evolution.

5.1 Legal and regulatory requirements - Harmonization with EU regulatory framework

For Mykolaiv's energy sector to evolve sustainably and align with the broader objectives of energy transition and climate resilience, all planned actions within the Road Map for the Power Energy and District Heating sectors must be consistent with leading EU directives and legislation. These

underpin not only strategic alignment with EU standards but also commitment to environmental stewardship and economic efficiency.

The following EU directives serve as primary pillars in the regulatory framework, guiding the development of both the district heating and power energy sectors in Mykolaiv:

- Renewable Energy Directive (RED III): The recently revised Renewable Energy Directive (EU/2023/2413) establishes binding and indicative targets that relate explicitly to renewable energy's share in the heating and cooling markets, with special emphasis on district systems. This directive cements our goals of increasing renewable energy generation, advancing our ambition towards a cleaner energy mix, and reducing our reliance on imported fuels.

- Energy Efficiency Directive (EED): The Energy Efficiency Directive (2012/27/EU) is central to the execution of energy efficiency improvements at the municipal level. It reinforces the importance of optimizing current district heating systems, encouraging energy-saving initiatives, and designing new infrastructure that adheres to the highest efficiency standards to minimize energy wastage.

- Energy Performance of Buildings Directive (EPBD): The EPBD actively promotes the integration of high-efficiency district heating and cooling systems in buildings. It is a cornerstone directive for achieving near-zero emission buildings, ensuring that new and existing buildings align with our decarbonization objectives and contribute to the overall energy efficiency of Mykolaiv.

These directives collectively form a critical component of the EU's strategy to combat climate change and bolster energy security. By adhering to these standards, Mykolaiv is positioning itself within a modern, forward-thinking energy framework that emphasizes decarbonizing our heating and cooling sector. In doing so, we contribute to the broader societal goals of promoting sustainable development and securing a cleaner, more resilient energy future.

To optimally integrate these directives into Mykolaiv's Road Map, following shall be prioritized:

- Adopting clear energy and emissions targets that reflect these directives.
- Encouraging investments and innovation in renewable energy infrastructures.
- Promoting energy conservation through modernization and smart technology deployment.
- Fostering collaborative partnerships among public authorities, energy providers, and the private sector to deliver integrated solutions.

Through this principled approach, groundwork is laid for a transformative energy sector that not only meets today's needs but is also future proofed against the challenges of tomorrow.

5.2 Engagement and transparency

The effective implementation of the Road Map for the energy sector in Mykolaiv requires dedicated engagement with stakeholders and transparency in all operations and decision-making processes. This chapter lays down the principles and describes the mechanisms that will ensure active collaboration, openness, and accountability throughout the transformation of the power energy and district heating sectors.

Stakeholder Engagement:

- Inclusivity with Local Authorities: Regular consultations with local government bodies are crucial to creating a Road Map that is sensitive to local needs and priorities. This includes structured dialogue with municipalities, regulatory agencies, and urban planners to ensure alignment with local policies and strategies.

- Public and Private Sector Collaboration: A cooperative approach with energy providers, businesses, investors, and technology partners is essential. This allows for leveraging private sector innovation, capital, and expertise. Establishing Public-Private Partnerships (PPPs) can be a key to successful project realization and sustainability.

- Community Participation: Direct involvement of the community provides valuable insights into consumer needs and fosters public support. Mechanisms for community engagement include public forums, citizen panels, and feedback systems for ongoing projects.

- International and Donor Community Relations: Commitments from international partners and donors must be transparently managed. This includes clear communication of donor expectations, alignment of projects with donor priorities, and regular reporting on project progress and use of funds.

Transparency Mechanisms:

- Open Access to Information: All key documents, decisions, and performance reports related to energy sector projects should be made readily accessible to the public, unless restricted by law. A dedicated portal or platform for sharing project information can facilitate transparency.

- Regular Reporting: Frequent and regular updates on the Road Map's progress, including setbacks and challenges, help to maintain trust. Annual reports, dashboards, and real-time status updates online can ensure ongoing accountability.

- Clear Accountability Frameworks: Roles, responsibilities, and expectations for each stakeholder must be clearly defined and communicated. Establishing clear lines of accountability ensures that all parties are aware of their obligations.

- Anti-Corruption Policies: A strong stance against corruption must be part of the foundational principles. Implement robust anti-corruption measures, including reporting mechanisms for irregularities, audits, and ethical guidelines for all participants.

- Performance Monitoring and Evaluation: Establish an independent oversight body or use third-party evaluators to periodically review and assess the performance of energy projects. This helps ensure objectives are being met and to identify areas for improvement.

- Feedback Channels and Grievance Redressal: Creating formal channels through which stakeholders can report concerns, provide input, and receive responses boosts confidence in the system's integrity.

By pledging commitment to these principles, Mykolaiv strives to create an environment of trust and shared responsibility, which lays a solid foundation for the successful implementation of the energy sector Road Map and the transition towards a more sustainable and efficient energy landscape.

6 Priority Investment Programme

This chapter introduces the Priority Investment Program (PIP) in relation to the energy sector, with detailed information available in 7Annex 20, where the complete PIP is presented in its entirety.

In the remaining part of this chapter two issues are dealt with. Section 6.1 provides an overview of the PIP in question in terms of a timetable, whereas Section 6.2 puts forward a few investment packages, each of which is aimed at achieving a common objective and may be presented to possible investors, such as IFIs and donors, for a blended finance arrangement.

6.1 PIP. Timetable

The **Error! Reference source not found.** below presents the timeline for the projects aimed at u pgrading the heat supply infrastructure and promoting the development of renewable energy sources (RES) in the energy sector in Mykolaiv City.

Table 6-1 Schedule of Investment Projects

No	CODE	CATEGORY	INVESTMENT PROJECT	2024-2030	2030-2040	2040-2050	CAPEX
District Heating Development Projects							
1	1-STIP	CONSUMPTION	Building of the new substations (IHS) and piping system inside the buildings for existing consumers to restore domestic hot water supply				1.MEUR 2.1-2.7 2.MEUR 1.6-2.1
1.1	1-MTIP	CONSUMPTION	Building more of the new substations (HIS)				TBD
1.2	1-LTIP	CONSUMPTION	Building more of the new substations (HIS)				TBD
2	2-STIP	CONSUMPTION	Thermal modernization of the buildings				MEUR 80-120
2.1	2-MTIP	CONSUMPTION	Thermal modernization of the buildings				TBD
2.2	2-LTIP	CONSUMPTION	Thermal modernization of the buildings				TBD
3	4-STIP	DISTRIBUTION	Replacement of the distribution pipes of Mykolaiv CHPP				MEUR 35-40
3.1	3-MTIP	DISTRIBUTION	Replacement of the distribution pipes				TBD
3.2	3-LTIP	DISTRIBUTION	Replacement of the distribution pipes				TBD
4	5-STIP	DISTRIBUTION	Building of the new transmission pipelines				MEUR 18-22
4.1	5-MTIP	DISTRIBUTION	Building of the new transmission pipelines				TBD
4.2	5-LTIP	DISTRIBUTION	Building of the new transmission pipelines				TBD
5	5-MTIP	DISTRIBUTION	Building of the new distribution pipes due to connecting new consumers				TBD
6	7-STIP	PRODUCTION	Complete reconstruction and rehabilitation of Mykolaiv CHPP				MEUR 15-20
7	8-STIP	PRODUCTION	Construction of new waste incineration CHP				TBD
8	9-STIP	PRODUCTION	Building cogeneration units				MEUR 25-30
9	10-STIP	PRODUCTION	Building flue gas recovery heat pumps at biomass-waste CHP				TBD
10	11-STIP	PRODUCTION	Building air to water heat pumps				TBD
11	12-STIP	PRODUCTION	Building electrode boiler				TBD
11.1	11-MTIP	PRODUCTION	Building electrode boiler				TBD
11.2	11-LTIP	PRODUCTION	Building electrode boiler				TBD
12	13-STIP	PRODUCTION	Building heat storage accumulator				TBD
13	8-MTIP	PRODUCTION	Building heat pumps on Bug river				TBD
14	9-MTIP	PRODUCTION	Building sewage water heat pumps				TBD
15	10-MTIP	PRODUCTION	Heat recovery from excess heat sources				TBD
16	12-MTIP	PRODUCTION	Hydrogen/hydrogen compounds fuel cells and engines				TBD
17	13-MTIP	PRODUCTION	Building heat storage accumulator				TBD
18	13-LTIP	PRODUCTION	Building geothermal plant				TBD
19	21-STIP	MONITORING and MANAGEMENT	Implementation of an automated control system for technological processes				MEUR 0.3
20	22-STIP	MONITORING and MANAGEMENT	Implementation of an automatic consumption metering and dispatching system				MEUR 0.26
Renewable Energy Projects							
21	6-STIP	PRODUCTION	Construction of biomethane plant at agricultural company «Promin» (Pervomaiskyi district) to provide consumption of biomethane in Mykolaiv city				MEUR 9
22	14-STIP	PRODUCTION	Installation of a several network PV installations				MEUR 4-4.5
23	15-STIP	PRODUCTION	Installation of wind turbine for small business or utility				MEUR 0.15
24	16-STIP	PRODUCTION	Wind power for Mykolaiv innovative industrial park, Mykoliv Sea Port or MykolaivVodoKanal				MEUR 1.6-1.8
25	17-STIP	PRODUCTION	Wind Power for Community				MEUR 1.6-1.8
26	19-STIP	PRODUCTION	Small wind turbine for private household				MEUR 0.01
27	20-STIP	PRODUCTION	Rooftop small wind turbine for multistorey building				
28	13-LTIP	PRODUCTION	Building geothermal plant				TBD

6.2 Investment packages

The Table 6-2 below presents a few investment packages, aimed at upgrading the district heating and develop renewable energy projects in Mykolaiv City. These initiatives include refurbishment of current distribution, and transmission pipelines, measures to mitigate thermal losses from buildings, measures to enable domestic hot water (DHW) supply, and projects integrating solar, wind, and bioenergy facilities into district heating and power systems. Some of these projects can be initiated in the short term, with plans for ongoing implementation in the mid-term and long term.

Table 6-2 Proposed investment packages

No	Title	Objective	Investment projects included (PIP)	CAPEX, Total, EUR
1.	Complete upgrade of the District Heating Network	Renovating existing pipelines merging dispersed DH systems connecting new areas	3,4,5	MEUR 18-20 (solely for transmission pipelines) MEUR 35-40 (for distribution lines)
2.	Thermal modernization of the buildings	Efficiency Boost: Minimizing Thermal Losses from the buildings	2	MEUR 240-360
3.	Revitalizing End-User Infrastructure for Domestic Hot Water Supply	Complete renovation of end users' installation: constructing new substations (IHS) and internal pipe network to enable DHW supply	1	MEUR 3.7-4.8 (in the short term)
4.	Integrating Renewable Energy into District Energy and Power Systems	Transitioning Towards a Greener Future: Increasing the Renewable Energy Share in the Energy Mix	21-27	MEUR 17
5.	Introducing a Biomass-Waste Incineration Plant as a New Base Load Unit	Sustainable Energy Generation	7	To be developed under enabling project (3.6 STEP)
6.	Replacement of existing decentralized heat sources with zero-emission sources	Green transition	8-11,13-16	MEUR 25-30 (for 9 STIP, short term)
7.	Monitoring and Management	Implementation of an automatic consumption metering and dispatching system; Implementation of an automated control system for technological processes	19, 20	MEUR 0,55

7 Action Plan

The Action Plan on energy has been developed in coordination with the MCA and consists of the investment and enabling projects outlined by COWI in the PIP. The Action plan is designed as a dynamic database capable of incorporating additional projects proposed or under consideration by the MCA in the future. Table 7-1 below indicates the Action Plan activities including contact person and responsible entities in relation to the projects. This database will be made publicly accessible via the City's website, promoting transparency, and facilitating the coordination of efforts among various IFIs and donors.

Table 7-1 Action Plan activities indicating the responsible persons for actions in relation to project included into PIP

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
1	Building new Individual Heating Substations (IHS) and piping system inside the buildings for existing consumers	1	2024-2030 (short-term), 2030-2040 (mid-term), 2040-2050 (long-term)	Pilot Project 1 - MEUR 2.1-2.7; Pilot Project 2 - MEUR 1.6-2.1 (in the short-term)	MOTE, MCA	To restore domestic hot water system by building new Individual Heating Substations (IHS) and renovating the worn internal piping. To reduce the consumption of thermal energy, especially in thermomodernized houses. Two pilot projects: first - Installation of 107 IHSs in residential buildings supplied from the rehabilitated boiler house located at 42 Samoilovicha st.; second- Installation of 84 IHSs in residential buildings supplied from the rehabilitated boiler house located at 71 Bila st.	District Heating Energy Efficiency Project (DHEEP)	International Bank for Reconstruction and Development (IBRD) and the Clean Technology Fund (CTF)	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
2	Thermal modernization of the buildings	1	2024-2030 (short-term), 2030-2040 (mid-term), 2040-2050 (long-term)	MEUR 80-120 in the short term	MOTE, MCHPP, MCA	Increasing the efficiency of heat consumption and cost savings on heat bills for end users. Long-term aim is to ensure that 100% of the buildings connected to the District Heating (DH) network undergo thermal modernization (by 2050)	1. Government Program for Thermal Modernization targeting buildings built before the 1990s, planning to retrofit 5,000 multi-family buildings. Managed by UKRFINZHYTLO (UFZhK), it provides long-term loans to local governments at 3-5% interest. Local governments select buildings for upgrade and offer grants covering up to 30% of costs 2. Energy Independence Program by President Zelenskyy: Aims to reduce imported energy consumption, expected to lower heating costs for over 1.5 million citizens and create about 170,000 jobs. 3. Program of Assistance to Communities in Thermal Modernization: offers energy consulting, supports thermal modernization projects, and includes measures like energy audits, insulation, and installation of energy-saving windows and renewable energy sources. 4. IQ Energy Project by European Bank for Reconstruction and Development (EBRD): Provides compensation of up to 20% for the cost of thermo-modernization in houses and flats. Participants can purchase energy-efficient equipment on hire purchase terms and apply for compensation via the IQ Energy website.	Government Program for Thermal Modernization, Energy Independence Program by President Zelenskyy, IQ Energy Project by EBRD	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
3	Rehabilitation and reconstruction of distribution electrical grids of Distribution System Operator “MykolaivOblEnergo” (MOE)	1	2024-2026	MEUR 60-65 for the full investment Programme	MOE, MCA, Utilities	• Constructing a 150 kV cable line of approximately 6.5 km to enhance city-wide electrical communication. • Developing an automated dispatch control system for electrical networks. • Reconstructing the 150 kV external electrical networks, including integration of wind farm generation from Ochakiv district to the "Lisky" substation. • Upgrading the distribution network voltage from 6 kV to 20 kV.	Development plan and investment program for the enterprise for the years 2022-2026 based on the resolution of the National Energy and Utilities Regulatory Commission dated 04.09.2018 № 955 "On the Approval of the Procedure for the Development and Submission for Approval of Development Plans and Programs of Distribution System Operators"	To be identified	MOE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
4	Replacement of the distribution pipes of Mykolaiv CHPP and MOTE	1	2024-2030 (short-term)	MEUR 35-40 in the short term	MCHPP, MOTE, MCA	1.Replacement of approx. 50 km of existing pipes for highly insulated pipes, adjusted for low temperature operation for MCHPP and MOTE DH networks.	There is a detailed scheme and description of priority of pipes section to be replaced available at Mykolaiv CHPP. Regarding MOTE DH networks, decision making process require further investigation (supported with hydraulic analysis).	Replacement of 720 mm pipe section in 2023 financed by IOM	MCHPP, MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
5	Building new interconnecting pipelines	1	2024-2030 (short-term)	MEUR 18-22 in the short term	MOTE, MCHPP, MCA	1.Building approx.15 km of new interconnecting pipelines. (Possibly starting from connecting new built CHP with the location of the well-developed DH network).	N/A	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
6	Construction of biomethane plant at agricultural company «Promin» (Pervomaiskyi district)	2	2025-2028	9 MEUR for 4 mln m3/yr capacity biomethane plant, including: • Cost of Equipment: 6.9 MEUR • Cost of Civil Works: 2.1 MEUR	Agricultural company “Promin” Ltd, MOTE, MCHPP	• Perform a feasibility study for the construction of a biomethane plant at agricultural company «Promin» Ltd. • Study the possibility and feasibility of supplying the produced biomethane into existing nearby GTS/GDS pipelines.	• The National Recovery Plan. • The Program of complex modernization of Combine Heat and Power (CHP) plants and heating plants of Naftogaz Group. • Memorandum on reconstruction (March 2023) signed between Denmark and the Mykolaiv oblast.	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
7	Complete reconstruction and rehabilitation of Mykolaiv CHPP	1	2024-2027	MEUR 15-20	MCHPP	• Replace the existing inefficient turbine with a new 15 MW capacity turbine to provide a reliable base source of electricity with high energy efficiency.• Install frequency converters on the motors of smoke exhaust fans and ventilators for more precise control of the combustion process, reducing gas and electricity usage. • Install an industrial electrical energy storage system for emergency disconnection reserve and regulation of the thermal and electrical energy balance. • Build heat pumps on the Bug river to utilize the thermal energy of the waters of the Buzkyi estuary, with the plant's own generators as a power source. • Install a set of 80 MW gas piston generators with heat recovery boilers to equip the station with flexible and responsive units. • Install condensing heat utilizers for each steam boiler to increase energy efficiency and lower gas consumption. • Reconstruct the boiler-turbine department by replacing existing burners on steam boilers TKP-2 No. 1 and No. 2 with energy-efficient burners to improve efficiency and significantly reduce emissions.	Concept of a Dynamic Thermal Power Plant, which includes all the technical solutions described in this project and models the thermal power plant's operation within Ukraine's energy system (developed by Wärtsilä in 2021-2022). Prozorro bids. Feasibility study for the MCHPP reconstruction (March 2024)	Swedfund	MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
8	Construction of new biomass-waste incineration CHP	1	2024-2030	To be developed by Feasibility Study	MOTE, MCHPP, MCA	Develop a feasibility study to find the optimal location and capacity for a biomass-based CHP (alternatively biomass-waste). Develop project documentation, including the preparation of an Environmental Impact Assessment (EIA) and conducting public hearings.	Technical and economic feasibility study for the object: New construction of MW treatment complex in Mykolaiv City" with the SE "Scientific-research and design-technological institute of urban economy". According to the ToR the FS will analyse different technical options for MW treatment facility and assess the costs of various options (March 2024).	Swedfund	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
9	Installation of gas cogeneration units (gas engines)	1	2024-2030 (short-term)	MEUR 25-30 (short-term)	MOTE	• Develop a hydraulic model of the network to determine specific locations and capacities for installations. • Coordinate network reconstruction to align with diameters and layout schemes. • Coordinate with MCHPP, given that some boiler houses proposed for reconstruction lie within the MCHPP heating supply zone, and their consumers could be connected to MCHPP, significantly reducing necessary investment sizes.	According to MOTE the agreement has already been reached for the supply of several cogeneration units with USAID and IOM	USAID, IOM	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
10	Installation of flue gas recovery heat pumps at biomass-waste CHP	2	2028-2029		MOTE, MCHPP	Flue gas recovery heat pumps may operate as the initial stage for preheating district heating water, which could then be reheated at the CHP plant.	N/A	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
11	Installation of heat pumps on Bug River	2	2028-2029 (short-term), 2034-2035 (mid-term)	TBD	MCHPP	Finding optimal location for placing of heat pump on Bug River	N/A	To be identified	MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
12	Installation of electrode boilers	2	2024-2026 (short-term), 2036-2040 (mid-term), 2047-2050 (long-term)	To be developed by Feasibility Study	MOTE, MCHPP	Identify the location; potential sites may include existing boiler house areas or adjacent to heat pumps, to reheat water from the heat pumps to the desired temperature.	N/A	To be identified		Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
13	Building heat storage accumulator	2	2027-2030	TBD	MOTE, MCHPP	Identify the location – it should be situated close to the base load unit (biomass-waste Combined Heat and Power (CHP) plant)	The necessity for constructing a heat storage accumulator for the Municipal Combined Heat and Power Plant (MCHPP) was discussed in the concept of a Dynamic Thermal Power Plant developed in 2021-2022 by Wärtsilä. This concept encompasses all the technical solutions described in this project, as well as modeling the operation of the thermal power plant within Ukraine's energy system.	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
14	Installation of multiple local network-connected PV installations	1	2024-2025	4 to 4.5 MEUR	Department of Energy, Energy Saving and Innovative Technologies	Independent power supply source, cost saving, reducing load on electricity system. PV installation on the territory of utilities would prevent potential power outage resulting from the energy system destruction. The City administration has proposed a number of priority buildings (mostly hospitals, schools etc) where solar power plants might be installed.	Develop a design documentation	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
15	Installation of wind turbine for small business or utility	2	90 days, target - 2025	MEUR 0.15 including: • WT cost (including 40 m mast, 50 kWh accumulator, cables, 50 kW off-grid inverter etc) – 0.12 MEUR • Construction cost (logistics excluded) 0.03 MEUR	• Mykolaiv Water Treatment Facility • Mykolaiv Water Utility • Private Small Business Facility	• Determine the specific purpose/application (stand-alone system, reduced consumption, self-generation, uninterrupted operation). • Ascertain the wind potential of the site. • Assess site compliance with Ukraine's sanitary standards (setback distance). • Calculate the required generation capacity/output. • Select appropriate wind equipment / Wind Turbine (WT). • Procure necessary equipment. • Construct foundation. • Install WT and complete system setup.	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
16	Wind power for Mykolaiv innovative industrial park, Mykolaiv Sea Port or MykolaivVodoKanal	2	2028-2030	1.6 – 1.8 MEUR per MW installed and grid-connected	• Mykolaiv innovative industrial park • Mykolaiv Sea Port • Mykolaivvodokanal (MVK)	• Conduct a wind potential assessment • Assess site compliance with Ukrainian sanitary standards (700 m setback distance) • Determine the required generation capacity/output • Select a wind turbine/equipment and prepare tender documents • Conduct the procurement process • Construct the foundation • Install wind turbine (WT) • Perform system setting and adjustments	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
17	Wind Power for Community	2	2028-2030	1.6 – 1.8 MEUR per MW installed and grid-connected	Mykolaiv Community	• Determine the applications (stand-alone system, reduced consumption, self-generation, uninterrupted operation) • Assess wind potential • Calculate required generation capacity • Select wind equipment or Wind Turbines (WT) • Conduct an Initial Site Environmental Assessment (ISEA) • Procure equipment • Construct foundation • Install WT • Configure the system	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
18	Hybrid Street Lighting	2	2028-2030	Estimated unit cost is EURO 3,845, inclusive of: • A 24 V 400 W wind generator. • Two 200 W photovoltaic (PV) panels. • A 400 W LED module. • System controller. • Necessary battery storage, etc.	Mykolaiv Sea Port	• Procure equipment• Install the hybrid system • Configure the system for optimal performance	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
19	Small wind turbine for private household	2	2024-2025	7.48 kEUR	Community members	• Develop project documentation • Select suitable wind equipment / Wind Turbine (WT) • Procure necessary equipment • Construct the foundation • Install the WT • Configure the system for operation	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
20	Rooftop small wind turbine for multistorey building	2	2024-2025	3.86 kEUR	Community members	• Develop project documentation • Select appropriate wind equipment / Wind Turbine (WT) • Procure the equipment • Construct the foundation • Install the WT • Carry out system configuration and setting	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
21	Implementation of an automated control system for technological processes of MCHPP	2	2024-2026	MEUR 0,3	MCHPP	• Assess current processes and needs. • Design the system components. • Procure necessary hardware and software. • Install and integrate the system. • Test and commission the system. • Train staff and create documentation. • Deploy and optimize the system. • Maintain and provide ongoing support.	Project documentation to be developed	To be identified	MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
22	Implementation of an automatic consumption metering and dispatching system	2	2024-2027	1-1,2 MEUR	MOTE, MCHPP, MOE	Equip residential buildings that were previously not equipped with commercial accounting units for thermal energy; replace thermal energy metering units that fail metrological verification, are out of order and beyond repair, and are outdated and lack the capability for remote transmission of measurement results with new ones.	In Ukraine, the installation of commercial accounting for all consumers is mandated by the Law of Ukraine "On Commercial Metering of Heat Energy and Water Supply," enacted on 2 August 2017. This law is part of a package of legislative acts aimed at modernizing the housing and communal services market in Ukraine, promoting energy saving, and, consequently, energy independence of the country	To be identified	MOTE, MCHPP MOE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
23	Replacement of the distribution pipes due to thermal modernization	2	2030-2040 (mid-term), 2040-2050 (long-term)	TBD	MOTE, MCHPP	The replacement of approximately 110 km of existing pipelines with new pipes designed for highly insulated and low-temperature operation (long-term)	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
24	Building new distribution pipes for connecting new consumers	2	2030-2040 (mid-term), 2040-2050 (long-term)	TBD	MOTE, MCHPP	Construction of approximately 60 km of new pipes to expand the network (long-term)	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
25	Installation of energy storage at MCHPP	2	2036-2040	MEUR 1,1 – 1,4	MCHPP	Development of a comprehensive feasibility study, development of detailed project documentation	Project documentation to be developed	To be identified	MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
26	Installation of gas cogeneration units (gas engines)	2	2030-2035 (mid-term), 2046-2050(long-term)	TBD	MCHPP, MOTE	Development of a feasibility study to determine the number of subscribers, and thus, the demand for heat. Creation of a financing program aimed at the systematic planned annual replacement of old gas water boilers with cogeneration units.	Project documentation to be developed	To be identified	MCHPP MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
27	Installation of additional heat pumps on Bug River	2	2040-2043 (long-term)	TBD	MCHPP	Identifying the optimal location for the installation of a heat pump along the Bug River	Project documentation to be developed	To be identified	MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
28	Installation of sewage water heat pumps	2	2030-2035 (mid-term), 2045-2047(long-term)	TBD	MOTE, MCHP	Finding optimal location for placing of sewage water heat pump (preferably at wastewater treatment plant). Sewage water heat pumps, base load unit	Project documentation to be developed	To be identified	MOTE MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
29	Heat recovery from excess heat sources	2	2030-2035 (mid-term), 2043-2045 (long-term)	TBD	MOTE, MCHP	Determine the potential location of excess heat sources and make connection between those and district heating network. Possibly installing heat pumps next to the excess heat source to increase the operating temperature	Project documentation to be developed	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
30	Hydrogen/hydrogen compounds fuel cells and engines	2	2036-2040 (mid-term) 2045-2050 (long-term)	TBD	MOTE, MCHP	Finding the location. Utilizing excess heat generated during the synthesis of hydrogen to ammonia or methanol. Additionally, co-firing hydrogen and compounds synthesized from it in gas engines or using hydrogen and compounds synthesized from it to fuel cells	Project documentation to be developed	To be identified	MOTE, MCHPP	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
31	Building heat storage accumulator	2	2032-2034	TBD	MOTE, MCHPP	Finding the location - possibly next to sewage water heat pumps	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
32	Installation of additional air to water heat pumps	2	2046-2050 (long - term)	TBD	MOTE+MCHP	Finding the location for the installation: one of the considered locations may be the location of the existing boiler houses. By 2050 operation temperature shall be low so the heat pumps may supply directly to the distributed network	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
33	Building geothermal plant	3	2040-2045	TBD	MOTE, MCHPP	Analysis to be carried out checking availability and parameters of the sources. Potentially need for placing heat pumps next to geothermal sources to increase operating temperature.	To be developed provided a detailed analysis is performed confirming the availability and potential of the geothermal sources.	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
34	Comprehensive Hydraulic Modelling and Energy Planning Tools	1	2024-2025	TBD	MOTE, MCHPP, MOE	Provision and training in the use of two kinds of software. These are for: • Hydraulic and thermal modelling of DH system including optimal design of DH network • Energy planning: modelling of heat and power system. Optimization of operation of heat and power production units.	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
35	Establishment of a Decarbonization Office	1	2024-2025	TBD	Mykolaiv utilities, Department of Energy, Energy Saving and Innovative Technologies at MCA	• Define the main tasks of the future office and plan cooperation with the State Agency on Energy Efficiency and Energy Saving of Ukraine • Promote initiatives aimed at ensuring energy efficiency by utilizing low-carbon fuels, feedstocks, and energy sources. • Analyse the opportunities for the carbon capture, utilization, and storage (CCUS), net zero electricity generation, energy saving and green buildings, and sustainable transportation • Analyse availability of finance, assess opportunities for educating people and introduction of the modern technologies, modern infrastructures, including the implications of eventual higher energy and carbon intensities of consumption	Is being developed in close cooperation with State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) through Ukrainian National Decarbonization Platform (UANDP)	Ministry of Climate, Energy and Utilities of Denmark, Danish Energy Agency	Department of Energy, Energy Saving and Innovative Technologies	AllaLutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
36	Heat Supply Scheme Development	1	2024-2025	TBD	MOTE, MCHPP	• Reviewing the current heat supply scheme, elaborated in 2019 incl. scope, limitations, and what precisely need to be updated in the new version of the scheme. • Drafting a ToR taking into account potential synergies with the analysis carried out by COWI as part of the development of Mykolaiv Masterplan and the development of a Heat Roadmap Ukraine, and what could be the roles of each of the stakeholders.	ToR under development	Danish Energy Agency	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
37	Enhancing Public Awareness for Sustainable Solutions	1	2024-2030	TBD	Department of Housing and Municipal Services, Department of Energy, Energy Saving and Innovative Technologies at MCA	• Public awareness campaigns • Creating incentives • Work out and implement policies • Scheduling public gatherings	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
38	Geothermal Potential Research	1	2024-2027	TBD	MOTE, MCHPP	The primary tasks involve: • Identifying potential locations for geothermal heat sources within the city or its vicinity and determining the distance between these sources and the city. • Assessing the depths and temperatures) of the geothermal sources. As an expansion of this analysis, consideration may be given to: • Investigating the restoration potential of previously discovered thermal water wells under conservation for further exploitation as a system for extracting geothermal heat. • Establishing combined energy technology nodes to generate electricity, heat, and extract valuable components from geothermal sources.	Project documentation to be developed	To be identified	Department of Energy, Energy Saving and Innovative Technologies	Alla Lutska, Department of Energy, Energy Efficiency and Innovative Technologies t.+38 050 576 89 57
39	Prefeasibility study for defining preconditions for construction of new biomass-waste incineration CHP	1	2024-2026	TBD	MCA, Mykolaiv utilities	• Identify the location of the CHP • Evaluate the optimal capacities under different scenarios • Implement the green transition and sustainability goals	Project documentation to be developed	Swedfund	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57
40	Reintroduction Program for Domestic Hot Water Systems in Urban Housing: Technical Analysis	1	2024-2032	TBD	Department of Energy, Energy Saving and Innovative Technologies, Department of Housing and Municipal Services within Mykolaiv City Administration	• Building new installations for domestic hot water and the exchange of existing space heating installations (heat exchangers + pipe networks). Most remote consumers to be connected at this stage. • It is estimated that approx. 100% of connected consumers shall have exchanged installations in 2050 which corresponds to ~56000 consumers (if households, service, industry, and public consumers are considered).	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

Nr.	Project Title	Priority	Expected duration	Estimated CAPEX/Euro	Beneficiary	Key tasks (from PIP)	Available documentation (link)	IFI potentially interested in the project	Responsible authority	Contact person
41	Technical and Economic Analysis for the Reduction of the Number of Boiler Houses	1	2024-2032	TBD	MOTE, MCHPP, MCA	The further detailed technical and economic analysis is required. Overview of the existing production units and projects suggested by MOTE, which are: • Rehabilitation of 27 boilers houses; • Construction of a 4 MWe boiler house at Yantarna Street; • Construction of a 5 MWe modular boiler house at Metalurgiv str; • Construction of 7 biomass fueled CHP plants, each with a capacity of 2-4 MW; • Reconstruction of the boiler room building of the Mykolaiv School of I-III degrees No. 23 at the address: Garnizonna str 10. The project should consider the individual capacities, local heat demand, distances, and available space at the site. Islanded DH networks supplied by BHs that will be classified for cancelation should be connected to neighboring BHs intended for future use.	Project documentation to be developed	To be identified	MOTE	Alla Lutska, Department of Energy, Energy Saving and Innovative Technologies t.+38 050 576 89 57

During the development of the time of Mykolaiv Masterplan MOTE, MCHPP, and DEESIT identified priority projects aimed at securing distributed generation in the event of Russian attacks, targeting critical infrastructure. The highest priority is given to the installation of cogeneration units to enhance system reliability, alongside with PV installations intended to serve as backup power sources. There are also the projects that would help provide energy efficiency and better services for the customers Table 7-2 summarizes the aforementioned projects.

Table 7-2 Overview of the priority projects defined by the MCA

Installation of multiple local network- connected PV (immediate)		
No	**Title**	**CAPEX, thousand EURO**
1	Installation of a network PV Installation for the needs of the City Children's Hospital No. 2 at 5, Ryumina st., 95 kW	110
2	Installation of a network PV Installation for the own needs of City Hospital No. 1 at 4 of 2a Ekipazhna st., of capacity 150kW	130
3	Installation of a network PV Installation for the needs of the City Hospital No. 3 at 97, Cosmonavtiv st., 210 kW	180
4	Installation of a network PV Installation for the needs of City Hospital No. 5 at 336 Bogoyavlenskyi Ave. 160 kW	150
5	Installation of a PV Installation on a tracker for the needs of Preschool educational institution No. 140 at 7A, Hlinky st., 20 kW	20
6	Installation of a PV Installation on a tracker for the needs of Preschool educational institution No. 144 at 42, Okeanivska st., 20kW	20
7	Installation of a PV Installation on a tracker for the needs of Preschool educational institution No. 20 at 6, Korabeliv st., 20 kW	20
8	Installation of a PV Installation on a tracker for the needs of Preschool educational institution No. 68 at 4 of the 1st Ekipazhna st., 20 kW	20
9	Installation of a PV Installation on a tracker for the needs of Preschool educational institution No. 143 at 5V Ozerna st., 20 kW	20
12	Construction of a ground-based PV Installation of the Mykolaivvodokanal MCP Water treatment facilities at 324, Yantarna st.,1050 kW	920
13	Construction of a ground-based PV Installation of the Mykolaivvodokanal MCP of the TsVDN, 2508 kW	2,190
14	Construction of ground-based PV Installation of MKP "Mykolaivvodokanal" Pumping station III lift at 14, Mykolaivska, st, 321 kW	290
15	Construction of a ground-based PV Installation in the dispensary of the CPMSD No. 6 at the address: Mykolaiv, Velyka Korenikha township, str. Garrison, 1st, 30 kW	50
16	Construction of a rooftop PV Installation in the Communal Institution "City Geriatric House of Mercy named after Saint Nicholas" at 2 Naberezhna st., 1-d, 25 kW	20
17	PV installation on the territory of MCHPP (0,8 MW) to prevent potential power outage resulting from the energy system destruction	350

Thermomodernisation		
No	**Title**	**CAPEX, thousand EURO**
1	Reconstruction in the part of thermal sanitation of the building of the Mykolaiv Secondary School of I-III degrees No. 23 at the address: Mykolaiv, str. Garnizonna, 10 (High priority)	800
2	Reconstruction with thermal sanitation of the building in the Communal Institution "City Geriatric House of Mercy named after Saint Nicholas" at 2 Naberezhna st., 1-d,	1.070
3	Reconstruction with thermal sanitation of the building of the Mykolaiv Secondary School of Grades I-III No. 45 at.4 Longitudinal st., 58	490

4	Reconstruction with thermal sanitation of the building of the Mykolaiv Secondary School of Grades I-III No. 56 at Cosmonautiv st., 138-A. (1 start-up construction complex)	670
5	Capital repair with thermal modernization of the building of the Mykolaiv secondary school of grades 1-III No. 1 named after O. Olzhicha at Aivazovsky st., 8	2.190
6	Reconstruction with thermo-modernization of the building of DNZ No. 111 "Buratino" at Korabeliv Ave., 4A	1.000
7	Reconstruction in terms of thermal sanitation of the building of preschool educational institution No. 144 at Okeanivska st., 42	730
8	Reconstruction with thermal sanitation of the building of preschool educational institution No. 106 at 297, Bogoyavlenskyi ave.	270
9	Reconstruction with thermal sanitation of the building of the Mykolaiv Secondary School of Grades I-III No. 4 at M. Morska st., 78	330
10	Reconstruction with thermal sanitation of the building of preschool educational institution No. 52 at Parusny Ave., 7-B	1.240
11	Reconstruction in the part of thermal sanitation of the building of the Mykolayiv secondary school of grades I-III No. 20 at 70 Cosmonauts st.	2.290
12	Reconstruction of the part of thermal sanitation of the building of the Mykolaiv Secondary School of Grades I-III No. 44 at 2/6 Znamenska st.	1.140
13	Capital repair and thermal modernization of the building of the Mykolaiv Secondary School I-III grades No. 6 of the Mykolaiv City Council of the Mykolaiv Region at the address: Mykolaiv, Kurortna, 2-A	2.070
14	Reconstruction with thermal sanitation of the building of gymnasium No. 4 at 48, Lazurna st., Mykolaiv (1-launch construction complex)	1.140

Boiler houses		
No	**Title**	**CAPEX, thousand EURO**
1	Reconstruction of the boiler room building of the Mykolaiv School of I-III degrees No. 23 at the address: Mykolaiv, str. Garnizonna, 10	350
2	Construction of a modular boiler house to provide heat supply to a residential building at the address: Mykolaiv, str. Kherson highway, 1B	50
3	Reconstruction of the boiler house at 11, Kurortna st, Mykolaiv providing heat supply for 2 schools, 2 preschool educational institutions, and 74 residential buildings, 10MW	1.490
4	Reconstruction of the boiler house at 51, Karpenko st, Mykolaiv providing heat supply for 1 school, 1 preschool educational institution, and 48 residential buildings, 5MW	1.410
5	Installation of the modular boiler house at 67, Yantarna st, Mykolaiv (final stage) 4MW	110

Cogeneration units		
No	**Title**	**CAPEX, thousand EURO**
1	Installation of 2 cogeneration units (3MW) at 42, Samoilovycha st. Units have been connected to the gas supply. Remaining work includes telemechanics and electricity supply.	1.060
2	Installation of 2 cogeneration units (1MW) at 71, Bila st.Remaining work pertain to telemechanics, gas and electricity supply.	540
3	Installation of 5 cogeneration units (11MW) at 36, Vodopiyna st. Dismantling and site preparation are currently underway.	4.700

Annex 1 Detailed Vision

This annex is provided in a separate file.

Annex 2 Priority Investment Programme (PIP)

This annex is provided in a separate file.