MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

Mykolaiv
city on the wave

Assistance to the Development of the Mykolaiv Masterplan

Energy and District Heating – Vision 2050

Report

Final

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COWI

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Contents

List of Abbreviations

CDH&C	Combined District Heating and Cooling
CHP	Combined Heat and Power
DH	District Heating
GHG	Greenhouse Gas
MCA	Mykolaiv City Administration
MCHPP	Mykolaiv Combined Heat and Power Plant, Private Joint Stock Company
MFA	Ministry of Foreign Affairs
MOTE	Mykolaivoblteploenergo, a Municipally Owned Heat Supply Company
PH	Photovoltaic
RES	Renewable Energy Sources
SGD	Sustainable Development Goals
SPP	Solar 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.

Text box: COWI's contribution to Mykolaiv Masterplan in a nutshell

COWI and One Works are collaborating on various sectors of the Mykolaiv masterplan, which is being carried out for the Mykolaiv City Administration. COWI is responsible for three specific sectors:

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

COWI has established a project organization consisting of a project management team and three sector teams of professionals, each headed by a so-called Discipline Leader, and each supported by a Focal Point. The three focal points are 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 has established three sector-specific Sounding Boards inviting all potentially interested parties to take part in these.

This report presents the vision for the Energy and District Heating in the city of Mykolaiv in the year of 2050.

A draft vision has been presented to colleagues in the MCA and One Works. Furthermore, it was discussed at the 1st meeting of the Sounding board on energy. All comments have been incorporated to the final version of the report.

The primary target group is the MCA and One Works.

The report consists of two chapters, including the current. Chapter 2, titled “Towards a sustainable and carbon-neutral city” presents the rationale and describes how the energy and district heating in Mykolaiv City should look like by the year 2050.

2 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.

2.1 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. Additionally, the integration of 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.

2.2 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.

2.3 Integration of Renewable Energy Sources

To achieve carbon-neutrality, Mykolaiv must integrate various renewable energy sources into its district heating system. Apart from heat pumps, solar thermal collectors, photovoltaics, wind power, and hydroelectricity can contribute to the energy mix.

2.4 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.

2.5 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 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.

2.6 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.

2.7 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.

2.8 Utilization of Waste and Biomass

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.

2.9 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.