ENABLE DHC

INVESTMENT PLAN - FACTSHEET

For the District Heating system in in Ljubljana

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SEN	Sensitive, limited under the conditions of the Grant Agreement	☐
PU	Public, fully open	☒

Nature of the deliverable		
R	Report, document	☒
DEM	Demonstrator, pilot, prototype, plan designs	☐
DEC	Websites, patents filing, press & media actions	☐
DATA	Datasets, microdata, etc.	☐
DMP	Data management plan	☐
ETHICS	Deliverables related to ethic issues	☐
SECURITY	Deliverables related to security issues	☐
OTHER	Software, technical diagram, algorithms, models, etc.	☐

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This template is prepared to support consortia participating in the LIFE Clean Energy Transition subprogramme in developing investment plans for existing or new district heating and/or cooling systems. The goal is to facilitate the preparation of plans that meet the "efficient district heating and cooling" criteria outlined in the Energy Efficiency Directive article 26, which is further explained in Commission Recommendation (EU) 2024/2395 [1].

[1] Commission Recommendation (EU) 2024/2395[1] of 2 September 2024 setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply, available at https://eur-lex.europa.eu/eli/reco/2024/2395/oj/eng

1. Case Study Context and Transformation Objective

1.1. Current state of the system

The district heating system serving Ljubljana is a monopol owned and operated by the public company Energetika Ljubljana, which manages both heat generation and distribution under a single entity. The system was established in 1966 and covers the central part of the city, supplying hot water for space heating and domestic hot water to more than 48% of residential customers.

Heat for the network is produced at two plants, TE-TOL with an installed capacity of 442 MWth and a supplied energy capacity of 787 GWh per year supplies 95% of the total heat delivered to the district heating network. TOŠ with a capacity of 234 MWh and energy production capacity of 195 GWh per year functions as a peaking and redundancy plant, covering the remaining 5% of total heat supply and stepping in when generation from the primary source is insufficient. It also includes a gas-turbine cogeneration unit supplying technological steam to nearby industrial customers.

Fuel consumption across the system consists of coal (20.83 TJ), biomass (827 TJ), and natural gas (78,726,000 Nm^3). Natural gas is used at both plants for CHP and boiler operation, covering both electricity and steam generation, whereas coal and biomass are consumed exclusively at TE-TOL.Total primary energy consumption is approximately 7,300,000 GJ per year, with a primary energy factor of 0.771. Total greenhouse gas emissions amount to around 364,000 tCO_2-equivalent per year.

A key strategic objective going forward is to identify flexible and efficient technological solutions for the district heating system, with a particular focus on renewable energy sources and waste heat. Planned developments include the phased shutdown of the remaining coal-fired units, the conversion of one unit to biomass operation, and the construction of a new waste incineration plant that will also be connected to the district heating network.

1.2. Strategic market analysis

Customer and market competitors with other heat sources: The heat market in Ljubljana is dominated by two network-based systems: district heating, which supplies approximately 61,000 dwellings (48%), mainly in the city centre, and natural gas, which serves around 43,000 dwellings (33%). Although district heating is currently more expensive to operate than natural gas, biomass-based systems, and heat pumps, its competitiveness is supported by several advantages, including price stability, the absence of upfront investment and maintenance requirements, no fuel storage or logistics needs, and compliance with air-quality regulations. District heating tariffs consist of a fixed charge based on connected capacity and a variable charge based on heat consumption. Consequently, heat prices have a limited impact on market share, as consumers also value convenience and practicality. In addition, local and national regulations support district heating through connection requirements and price-setting rules.

Local regulations, requirements and incentives: The regulatory framework for district heating in Ljubljana is defined by national energy legislation, sector-specific regulations, municipal planning requirements, and environmental legislation. National laws, particularly the Heat Supply from Distribution Systems Act (ZOTDS), regulate district heating services, including heat pricing and consumer

protection, while promoting competitive and sustainable heat supply. At the municipal level, the Decree on the Priority Use of Energy Sources and Energy Carriers establishes a hierarchy for heating technologies in new and renovated buildings, prioritising waste heat recovery, renewable energy sources, and energy-efficient district heating in support of decarbonisation objectives. Environmental requirements further govern heating installations through permitting procedures, emission limits based on Best Available Techniques (BAT), monitoring obligations, and regulations on water use and discharges. Additional restrictions apply in areas with degraded air quality and protected drinking-water catchments, creating a comprehensive framework for managing environmental impacts.

Existing and future market needs and tendencies: The district heating strategy in Ljubljana is currently guided by four priorities: decarbonising the heat supply, maintaining high operational reliability, mitigating the decline in heat offtake, and expanding the network's utilisation. New development is concentrated within the existing district heating network, supporting a strategy of increasing connection density rather than network expansion. Although residential growth contributes only modestly to heat demand due to near-zero-energy building standards, commercial developments are expected to generate more significant increases in both heating and district cooling demand. Future district heat demand is projected to heat usage is expected either to remain near current levels or to decline only modestly as a result of system optimisation, reduced heat losses, network improvements, enhanced consumer participation, energy-efficiency renovations of buildings, and the continued trend of milder winters, all contributing to lower heat consumption levels.

1.3. Local Renewable Energy or Waste Heat Sources

The assessment identified and quantified the renewable energy and waste heat resources available for integration into Ljubljana's district heating system. The analyzed portfolio includes an operational pharmaceutical waste heat source supplying 0.6 MW through a heat pump, a 65 MW biomass combined heat and power plant planned from 2028, and large-scale heat pump applications using river water and treated wastewater with capacities of 32 MW and 33 MW, respectively. In addition, heat recovery from residual waste incineration provides 46 MW of relatively constant output. Together, these sources represent a diversified mix of renewable and waste heat resources with capacities ranging from small industrial recovery systems to large-scale district heating supply options.

1.4. Seasonal availability: potential substitution of fossil fuels

There is strong seasonal character of the system: demand peaks above 300–400 MWh during the winter months at the start and end of the year and falls to a summer minimum of roughly 20–50 MWh between approximately hour 3000 and hour 6500. Biomass CHP forms the largest and most stable base layer at around 65 MWh, followed by waste incineration CHP (contributing up to roughly 100 MWh cumulatively), river heat pumps, and wastewater heat pumps, which together bring total available capacity to approximately 175 MWh. Pharmaceutical waste heat appears in the legend but contributes a negligible or near-zero share across the year. The combined RES and WH capacity comfortably cover summer demand, often exceeding it, whereas during the winter peaks demand substantially outstrips the

available renewable and waste heat supply, leaving a considerable gap that must be met when concepting the investment plan scenarios. This seasonal mismatch is a key finding for sizing storage and backup capacity in the investment plan.

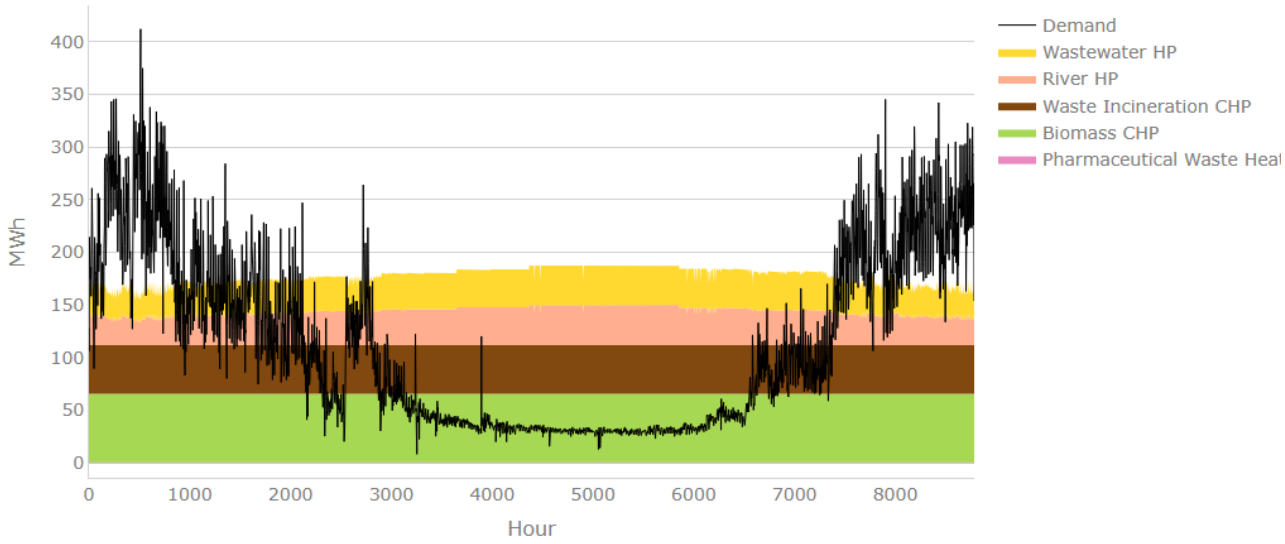


Figure 1: Potential RES and WH availability

Table 1 presents the results and provides a structured comparison of the assets considered as possible technical in the scenario analysis:

Table 1: RES and WH sources and their descriptions

No	Location	RES or WH	Medium	Equipment proposed	Cost of the equipment incl. installation costs and connection [Mio €]	Length to connect to DH	Total cost [Mio €]	Remarks
1	TE-TOL	RES	Biomass	CHP	110	-	110	
2	TE-TOL	RES	Ljubljanica river water	Heat pump	22	-	22	
3	Waste water treatment plant	WH	Cleaned water	Heat pump	30+5*	5 km	35	Network expansion required *Connection costs
4	Waste incineration	RES	Residual waste	CHP	200	Depends on location chosen	200	Cost estimate includes connection to DH and upgrading of waste sorting facility

1.5. Scenarios for the DH network

One baseline scenario and two alternative scenarios were assessed. The **Baseline Scenario** represents the current district heating and cooling (DHC) generation system. **Scenario 1** evaluates the decarbonization of the system through the integration of a biomass combined heat and power (CHP) plant. **Scenario 2** considers the addition of both a biomass CHP plant and heat pumps, with the model selecting the cost-optimal configuration.

2. Solutions and Investment Scenarios Assessed

In the Baseline scenario, the system has an installed generation capacity of around 580 MW, consisting mainly of coal and biomass CHP B3, gas CHP PPE and a number of gas boilers. In the Biomass CHP scenario, CHP B3 is decommissioned and replaced with around 65 MW of biomass CHP B1. This reduces total generation capacity to around 510 MW, while the capacities of the gas CHP PPE and gas boilers remain largely unchanged. In the 'Biomass CHP and HPs' scenario, the addition of approximately 25 MW of river heat pump capacity increases total generation capacity to around 545 MW. No wastewater heat pump is installed due to the higher CAPEX required to connect the source to the grid. Installed thermal-storage capacity remains almost constant across all scenarios at around 850 MWh. Overall, the scenarios demonstrate the technical viability of transitioning from existing coal and biomass CHP to biomass CHP and river heat pumps. The next steps are to replicate the same analysis for 2035 and to add waste incineration CHP as an optional asset. Uncertainties in electricity prices, heat demand and available waste will also be calculated.

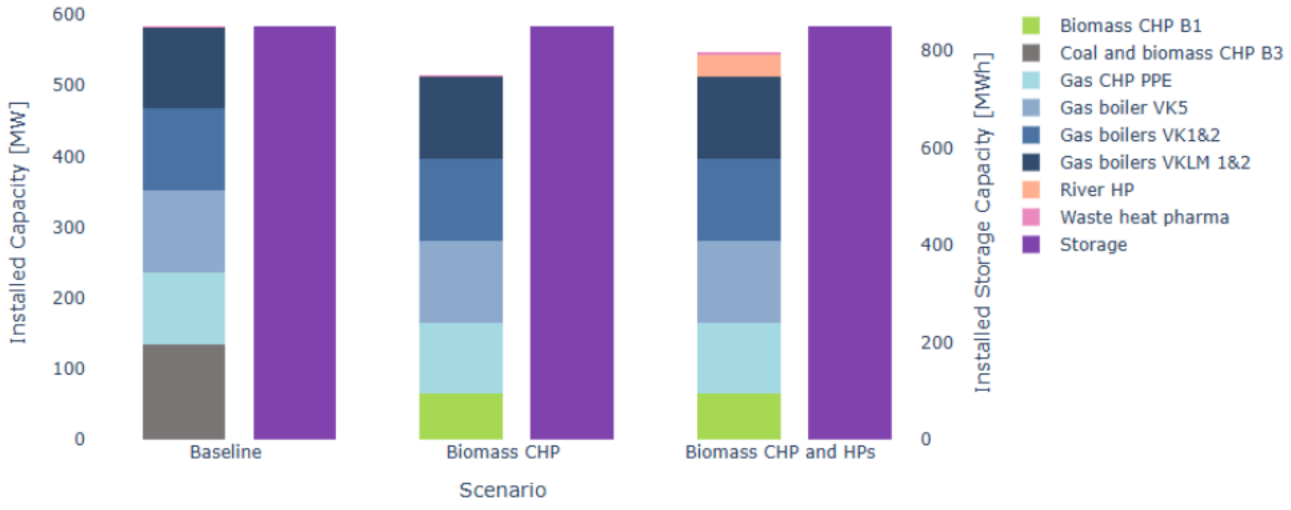


Figure 2: Installed capacities across the scenarios analysed

3. Investment and Implementation Outlook

3.1. Expected Impact

The selected investment pathway is expected to deliver impacts on four fronts. Technically, it enhances system performance, reliability and flexibility. On energy, it cuts primary energy use and losses while increasing the renewable and recovered share of supply. Environmentally, it reduces greenhouse gas and local emissions, quantified as annual tonnes of CO_2 avoided where possible. Socio-economically, it generates local employment, consumer cost savings and regional value creation, captured through indicators such as jobs created and reduced energy bills. Quantitative indicators should be reported alongside the qualitative assessment wherever data allow.

3.2. Implementation Roadmap

The main implementation phases and milestones for the selected investment pathway, including the indicative timeframe and key actions required to progress towards implementation will be discussed with the project partner Energetika in the next project months.

3.3. Key Risks and Enabling Conditions

Political and regulatory risks may arise from changes to policies, regulations, administrative procedures or strategic priorities affecting project implementation, operation, timelines and investment conditions. Effective risk management requires continuous monitoring of the regulatory environment, clear allocation of stakeholder responsibilities, and proactive mitigation measures.

From an economic perspective, energy price volatility can impact operating costs, revenues, expenditure, competitiveness and investment returns, while uncertainty surrounding future CO_2 prices can affect project costs and overall financial performance. To address these risks, the project incorporates ongoing monitoring of market and policy developments, regular updates to financial assumptions, an assessment of alternative price trajectories and sensitivity analyses. These measures support informed decision-making and improve resilience.

Sustained decreases in demand could negatively impact revenues and economic performance. To mitigate these challenges, the project plans to improve the management of production and distribution activities in order to optimise asset utilisation, reduce losses from underutilised capacity, increase operational efficiency and enable the flexible use of lower-cost energy sources. Commercial measures aimed at increasing market penetration and retaining consumers will also support revenue stability and the long-term economic sustainability of the district heating system.

3.4. Stakeholder Engagement & Endorsement

Stakeholder engagement was conducted in close collaboration with Energetika, the local district heating company. Its participation provided valuable operational knowledge and local expertise, helping to assess technology options, validate assumptions, and develop a heat supply transition pathway that is technically feasible, economically viable, and aligned with local needs.

4. Conclusions and Key Lessons

The next step is to draw the conclusions of the investment planning process — setting out the key factors that shaped the selected pathway, the principal lessons from the case study, and the conditions identified as important for progressing to implementation, along with any insights likely to be useful to other DHC systems facing similar transformation challenges.

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GET IN TOUCH WITH US!

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