ENABLE DHC

INVESTMENT PLAN

For the District Heating system in Acqui Terme

November 2026

Prepared for:
Deliverable 3.2

Prepared by:
Optit

© 2024 Enable DHC. All Rights Reserved.

Co-funded by
the European Union

ENABLE DHC

Project: 101167576 — LIFE23-CET-ENABLE DHC — LIFE-2023-CET
Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

T3.1 – Strategic Investment Planning and Evaluation	
Deliverable number	D3.2
Responsible partner	AEE INTEC
Due date of deliverable	October 31, 2026
Actual submission date	November 3, 2026
Version/document history	V1
Authors	Diana Cremoncini, Stefano Morgione
Reviewers	Diana Cremoncini, Stefano Morgione
Work package number and title	WP3 – Strategic investment planning and evaluation
Work package leader	OPTIT
Work package participants	All partners

Dissemination level		
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.	☐

TABLE OF CONTENTS

1. Case Study Context and Transformation Objective 6

2. Solutions and Investment Scenarios Assessed 7

3. Investment and Implementation Outlook 8

3.1. Expected Impact 8

3.2. Implementation Roadmap 8

3.3. Key Risks and Enabling Conditions 9

3.4. Stakeholder Engagement & Endorsement 10

4. Conclusions and Key Lessons 10

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

The Acqui Terme district heating (DH) network, operated by Gruppo IREN, has been in operation since 2009. Heat is generated at a single plant comprising two natural-gas combined heat and power (CHP) units (4.8 MWth / 4.7 MWel combined) and three gas boilers (22.4 MWth total). In 2024 the system delivered 31.7 GWh of heat to 134 users (77% residential), with a CHP share of 55%. The network extends over approximately 8.9 km (12.8 km including building connections), with estimated thermal losses of around 15% per year; peak demand is approximately 25 MW.

The system is currently supplied entirely by natural gas and does not meet the Energy Efficiency Directive (EED) criteria for efficient district heating, as no renewable energy or waste heat is used. The main local renewable/waste-heat resource identified is low-enthalpy geothermal heat, available either as waste heat from the existing thermal facilities or through direct aquifer abstraction; solar thermal potential has also been assessed as a complementary resource.

The transformation objective is to decarbonise the system through a geothermal heat pump (HP), while adding thermal energy storage (TES), so as to reach the EED efficient-DH thresholds (minimum 35% renewable/waste-heat share, 80% renewable+waste-heat+CHP share) by 2035, within the framework of national (PNIEC, OIERT decree) and regional (Piedmont PEAR) renewable-heat targets.

Figure 1 illustrates the strong seasonal variability of heat demand across the network, ranging from approximately 25–30 MWh/day in summer to peaks above 240 MWh/day in winter. The graph also displays the maximum capacity of the existing CHP units alongside the capacity of the reference geothermal heat pump and the solar thermal production profile. The heat pump has to be sized taking into account the winter peaks, while the solar field is sized to cover the summer demand curve without causing overheating. The existing CHP units cover the baseload throughout the year, and gas boilers meet only a small residual portion of the peak winter demand.

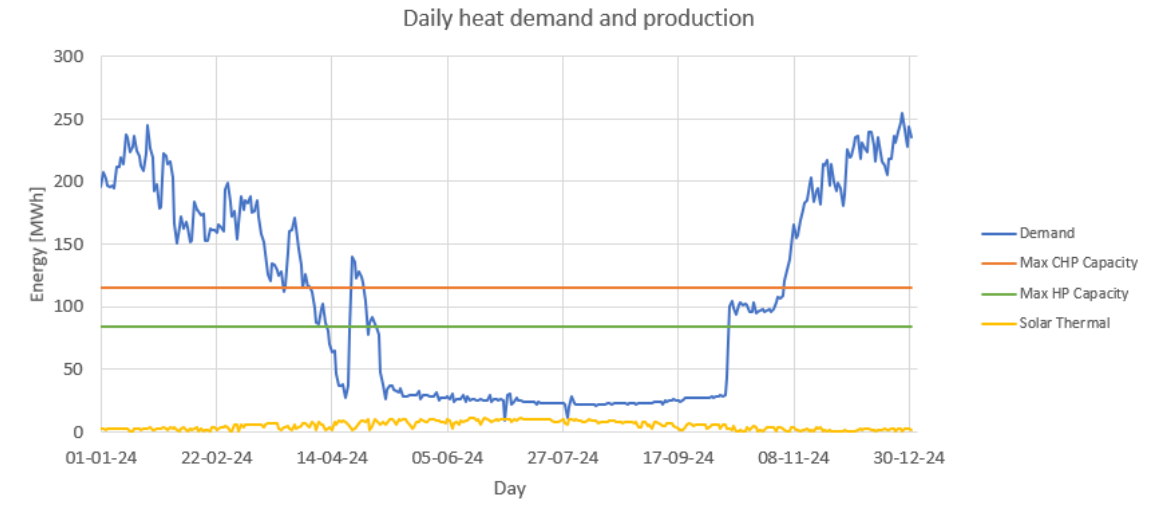


Figure 1: Daily heat demand and expected production with a 3.5 MW HP (reference size) and a 2500 m² solar thermal field

2. Solutions and Investment Scenarios Assessed

Three investment scenarios, all based on a geothermal heat pump (HP) combined with thermal storage, were assessed against the current all-gas baseline (optimised considering revamping conditions of 2025):

- Scenario 1 (thermal waste heat pump) is supplied by geothermal waste heat from the thermal facilities (estimated HP COP of 3), with thermal storage (250 or 500 m^3 variants). For the 500 m^3 storage variant, CAPEX equals 6.4 M€; renewable/WH share is 29%; simple payback is 18 years; estimated subsidy for a 10-year payback is 2.8 M€ (43% of CAPEX).
- Scenario 2 (aquifer heat pump) is supplied by direct aquifer abstraction (≈60°C), reaching a higher coefficient of performance (COP 4.0) and an optional CHP self-consumption configuration. CAPEX is 11.0 M€ and the renewable/WH share is 33%; simple payback is 16 years; estimated subsidy is 4.3 M€ (39%). Economically, it is the most favourable scenario, but it is subject to significant permitting and resource uncertainty (aquifer abstraction concession, unconfirmed flow/temperature).
- Scenario 3 (thermal waste heat pump and solar thermal field) combines a larger heat pump (5.31 MW) with a 2,500 m^2 solar thermal field and dual thermal storage (2 x 500 m^3). CAPEX is 12.5 M€ and the renewable/WH share is 35%; simple payback is 34 years; estimated subsidy for a 10-year payback is 8.8 M€ (71% of CAPEX).

Scenario 3 is the only configuration that reaches the EED efficient-DH thresholds by 2035; Scenarios 1 and 2 reach 29% and 33% renewable/WH share respectively, at a fraction of Scenario 3's CAPEX.
Even if it is the most profitable, Scenario 2 is not recommended at this stage, since its aquifer-based resource is still only partially characterised: its actual performance can only be confirmed through further hydrogeological investigation, making the associated economic benefits uncertain. Scenario 1 instead emerges as the most viable near-term option, combining lower investment and permitting complexity with a comparatively modest public-support requirement. Its renewable share, while the lowest of the three, could still improve over time through network efficiency measures, demand-side management, or the connection of new customers, without changing the size of the heat pump. It is also consistent with the pace of national renewable-heat regulation, which tightens gradually rather than all at once (the OIERT decree sets short-term renewable targets of approximately 8.3% by 2030), and does not rule out a later expansion towards the solar-assisted configuration of Scenario 3. Scenario 1 therefore represents a balanced starting point, at lower cost and complexity, with a smaller but consistent increase in renewable share, while Scenario 3 remains the reference pathway for full EED compliance, to be pursued under favourable funding and regulatory conditions.

3. Investment and Implementation Outlook

3.1. Expected Impact

Scenario 3, presented here as the long-term EED-compliance pathway identified in D3.1, yields the following KPIs:

Project KPI	Scenario 3 (long-term pathway)
New generation assets	5.31 MW heat pump + 2,500 m^2 solar thermal field + dual thermal storage (500 m^3 + solar-side store)
Generation mix	46% heat pump / 45% CHP / 5% solar thermal / 4% gas boiler
Renewable/WH share	35%
Renewable+WH+CHP share	80%
CO2 emissions avoided	2760 t/year
Total CAPEX	12.5 M€
Change in operating margin	+363 k€/year
Marginal heat production cost	78.1 €/MWh
Simple payback (no external support)	34 years
Subsidy required for a 10-year payback	8.8 M€ (71% of CAPEX)
IRR (with subsidies)	8.8%

In the selected scenario, the heat pump and solar thermal field are expected to cover the base and mid-range of the heat load throughout the year, with the existing CHP units and gas boilers retained to meet peak winter demand and to provide back-up during heat pump or solar-field downtime. Compared with the current all-gas baseline, dispatching dynamics change significantly, with the heat pump and CHPs covering the majority of annual production, 46% and 45% respectively.

From an economic perspective, the higher CAPEX of Scenario 3 compared with Scenarios 1 and 2 results in a longer payback period. Achieving a 10-year payback instead requires a high external subsidy, underlining the scenario's dependence on public financial support.

From an environmental point of view, reaching a renewable/waste-heat share of 35% and a renewable+waste-heat+CHP share of 80% allows the system to meet the EED efficient-DH thresholds by 2035. This is estimated to avoid approximately 2,760 tonnes of CO2 per year compared with the optimised gas baseline, and to eliminate the renewable-share penalty currently estimated at 286 k€/year (for a non-renewable system).

3.2. Implementation Roadmap

The implementation plan for Scenario 3 spans approximately three years from the start of detailed studies to commissioning, assuming an investment start in 2026 and commercial operation from 2029:

- **Phase 1 – Detailed resource studies (3 months, 0.05–0.30 M€):** hydrogeological and thermal-resource surveys; confirmation of solar field site availability.

- **Phase 2 – Permitting and concessions (6–10 months, 0.15–0.45 M€):** municipal and environmental permits for water abstraction/discharge; supply agreement with the thermal facility operator; building and electrical permits.
- **Phase 3 – Preliminary and detailed design (4–6 months, 0.25–0.60 M€):** plant layout; HP, storage and solar field technical specifications; hydraulic and electrical design.
- **Phase 4 – Strategic procurement (3–6 months, 5–6 M€):** supplier selection and ordering of the HP, storage units, solar collectors, heat exchangers, pumps and piping.
- **Phase 5 – Infrastructure works (8–12 months, 2.5–3.5 M€):** foundations, technical building, piping, installation of both storage tanks, abstraction/discharge works, solar field preparation.
- **Phase 6 – Electromechanical installation and controls integration (4–8 months, 2–3 M€):** HP and solar circuit installation, hydraulic and electrical connections, SCADA upgrade.
- **Phase 7 – Commissioning and start-up (4–6 months, 0.15–0.45 M€):** functional testing, control tuning, seasonal optimisation, operator training.

Financing is expected to draw on own capital from Gruppo IREN (≈30% of CAPEX), regional ERDF structural funds (PR FESR 2021–2027, Piedmont) and bank financing (≈20% of CAPEX), complemented by operating-phase incentives (White Certificates, estimated at 80 k€/year).

3.3. Key Risks and Enabling Conditions

The main risks identified for Scenario 3 are:

- **Regulatory:** complex multi-authority permitting for geothermal resource use (drilling/exploration authorisation, water abstraction and discharge concessions) and an unresolved thermal facility concession framework, currently held by private operators, with the Comune di Acqui Terme engaged in renegotiating usage rights; no defined arrangement for DH system management beyond the concession expiry.
- **Financial:** strong dependence on public subsidy (an estimated 71% of CAPEX is required for a 10-year payback); exposure to investment and O&M cost escalation.
- **Technological:** uncertainty over actual geothermal/thermal-water flow rate, temperature stability and water quality, which could affect heat pump performance (COP) and the achievable renewable share.
- **Demand-side:** an unexpected reduction in heat demand (efficiency measures, climate trends) would reduce investment profitability.

Identified mitigation measures include: sensitivity analysis under divergent cost/price scenarios and diversification of financing sources (EU/national funds, bank loans, green bonds); early resource measurement ahead of procurement decisions, with the heat pump sized on confirmed values; early agreement on solar field land availability; and demand-side management together with commercial actions to secure revenue and retain customers.

3.4. Stakeholder Engagement & Endorsement

A DHC Working Group was established by the technical partners Ambiente Italia, Optit, IREN Energia and the technical staff of the Comune di Acqui Terme, bringing together around twenty organisations, including public authorities, the network operator (IREN Energia), energy service providers, trade associations (AIRU, ANACI), the regional social-housing agency, professional bodies and research institutes (Politecnico di Torino, Environment Park).

The Working Group meetings among the stakeholders covered project scoping, optimisation results, and helped consolidate first data and later energy and economic results and risk analysis of the scenarios. This process contributed to defining the scope of the decarbonisation plan and validating its technical and economic assumptions.

With the Comune di Acqui Terme specifically, discussions focused on the feasibility of Scenario 3, and in particular on the conditions for acquiring the land needed for the solar thermal field. With the wider group, the discussion extended beyond the 2035 horizon, to assess whether the proposed pathway makes sense within a longer-term perspective for the local energy system. Stakeholders also discussed how Italian policy and incentive mechanisms relate to the broader European regulatory framework, as well as the conditions surrounding the geothermal resource and the concessions tied to the thermal facility.

4. Conclusions and Key Lessons

Local low-enthalpy geothermal heat, combined with a heat pump and thermal storage, offers a viable decarbonisation pathway for the Acqui Terme DH system, which is currently entirely gas-based and does not meet the EED efficient-DH criteria. Among the three scenarios assessed, only Scenario 3 (larger heat pump, solar thermal field and dual thermal storage) reaches full EED compliance by 2035, at a CAPEX of 12.5 M€.

The pathway selected is influenced primarily by confirmation of geothermal resource availability and performance, the complexity of permitting associated with the thermal facility concession framework, and the extent of public financial support that can be secured.

A general lesson for other DHC systems facing a similar transformation is that early resource characterisation and early engagement with local authorities on permitting and concession matters are critical path items, independent of the scenario ultimately selected. Additionally, starting from a non-decarbonised system, reaching a moderate renewable share is comparatively easy and cheaper, while progressing beyond it becomes markedly harder and less cost-effective: in this case, moving past approximately 30% RES in a single step requires high investments and public support relative to the additional renewable share gained, suggesting that a staged approach may be more practical than pursuing full compliance in one move.

ENABLE DHC

GET IN TOUCH WITH US!

Project Coordinators

Riccardo Battisti

Chiara Lazzari

E-mail

riccardo.battisti@ambienteitalia.it

chiara.lazzari@ambienteitalia.it

Website

https://enabledhc.ambienteitalia.it

© 2024 Enable DHC. All Rights Reserved.