National action plan for retrofitting DH networks in Italy

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Dissemination Level: Public

Website: Upgrade DH project website: www.upgrade-dh.eu

Cover: Pumping stations in Ferrara's plant (courtesy of Hera)

Project relation: WP6, Task 6.1, Deliverable 6.1

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 785014.

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Acknowledgements

The authors would like to thank the European Commission for supporting the Upgrade DH project as well as Optit and Hera staff, who supported the coordination and review of the document.

Abbreviations

GSE	Gestore dei Servizi Energetici
DH	district heating
DHC	district heating and cooling

1 Introduction

The overall objective of the Upgrade DH project is to improve the performance of district heating (DH) networks in Europe by supporting the upgrading process of selected demonstration cases, which can be replicated in Europe.

The Upgrade DH project supports the upgrading and retrofitting of DH systems in different climate regions of Europe, covering various countries: Bosnia-Herzegovina, Denmark, Croatia, Germany, Italy, Lithuania, Poland, and The Netherlands. In each of the target countries, the upgrading process was initiated at concrete DH systems of the so-called Upgrade DH demonstration cases (demo cases). The developed knowledge and experiences are replicated in other European countries and DH systems (replication cases) to further leverage the impact.

Core activities of the Upgrade DH project include the collection of the best upgrading measures and tools, the support of the upgrading process in selected district heating networks, the organisation of capacity building measures around DH upgrading, financing and business models, as well as the development of national and regional action plans.

This document specifically focuses on the **development of a national action plan** for the retrofitting of inefficient district heating networks **in Italy** and includes the results of the retrofitting approaches (see also the *District Heating Handbook* developed within the project [1]).

District heating in Italy is on an upward trend, however, it only covers around 2.3% of the total residential heating demand. Fossil fuels are important in the energy mix and natural gas is still the main energy source. Waste-to-Energy occupies the second spot as “fuel” used in district heating systems. In terms of renewable sources, bio energies play an important role (in particular biomass), as the third most important fuel in district heating systems. [2]

The Italian National Energy and Climate Plan creates many expectations for the development of DH. However, a national legislative framework for DHC in Italy is still non-existent. Therefore, **a list of solutions / actions / activities** that could support the development or retrofitting of DH networks was elaborated and can serve as inspiration for other countries with a similar DH market situation and legislative framework.

Input to the DHC action plan for Italy contains recommendations over short, medium and long timeframes. The short term strategy mainly focuses on legislative interventions. The medium term strategy details possible retrofitting measures on the production, distribution and consumption sides. Finally, the long term strategy emphasises consumer empowerment, novel business models, multi-energy planning and digitalisation.

Chapters 2, 3, 4 and 5 of the report were written in September 2020. Chapter 6 was added in December 2020 after the national action plan for retrofitting DH in Italy was presented and discussed during the conference “The Future of District Heating in Italy” held on 02 October 2020. Any legislative changes which took place after this period are out of the scope of this report.

2 Current policy framework

The analysis carried out below is linked to the time in which this document is written, considering what has been published until today at a regulatory level and does not take into account the legislation in progress.

Furthermore, most of the following considerations come from the AIRU annual yearbook on the Italian district heating situation, that represents a very detailed report that is utilised by both decision-makers and private companies. [3]

The political aspects emphasize the key role of district heating in Italy for the sustainable development of the country's energy supply and for consequent emissions reduction efforts. The framework documents in this regard are:

- Italian National Energy and Climate Plan (point 2.1);
- High-efficiency cogeneration Law (point 2.2);
- Transposition of the Energy Efficiency and the Renewable Energy Directives (point 2.3).

Despite these measures, the national situation does not support the DH networks development, because the implementing decrees are missing and numerous obstacles still exist, including:

- Emissions Trading System (point 2.4);
- Superbonus (point 2.5).

2.1 The Italian NECP

The Italian energy and climate objectives for the 2021-2030 period are outlined in the Italian national energy and climate plan (NECP), which was drafted by the Ministry of Economic Development in 2018 and revised, under request of the European Commission, in December 2019.

The Italian plan has different targets and is based on the EU 2050 objectives. First of all, the Government aims at reducing the primary energy consumption by 43% compared to the PRIMES 2007 scenario, and cutting greenhouse gas emissions for all non-ETS sectors by 33% compared to 2005. To reach these ambitious goals the Italian Government incentivises the use of renewable energy sources and, for the first time, gives great attention to thermal renewable sources.

The NECP also recognises the role of district heating and cooling (DHC) in contributing to the national energy and climate objectives. Particularly, the NECP focuses on:

– reviewing the Italian DHC potential;

– developing 4th generation DHC systems;

– developing low-temperature DHC networks;

– use of storages;

– integration of different sources: waste heat, heat pumps, solar, and more.

In this sense the plan creates many expectations for the development of DH. However, a national legislative framework for DHC in Italy is still non-existent.

2.2 High-efficiency cogeneration Law

The main benefits that current legislation recognises for high-efficiency cogeneration are:

- priority, in the context of dispatching, of electricity produced by cogeneration over electricty produced by conventional sources;

- tax incentives on the excise duty on methane gas used for CHP;
- possibility of accessing the “on-site exchange” service of the electricity produced by high efficiency cogeneration plants with nominal power up to 200 kW;
- possibility of applying simplified techno-economic conditions for connection to the electricity grid;
- possibility of obtaining tariff concessions for plants powered by renewable energy sources;
- possibility of incentivising the net electricity produced in high efficiency cogeneration, and fed into the grid by plants fuelled by biomethane;
- possibility for a thermoelectric power plant, not fuelled by RES, in a simple production and consumption system, to be considered in high-efficiency cogeneration for the “n” year (necessary requirement for systems of type SEU or SEESEU-B) provided that the energy cogenerated by the unit (ECHP) is, for the year "n-1", greater than 50% of the total gross electricity production of the plant to which this unit belongs.

The high efficiency cogeneration units in the final balance can access the White Certificates mechanism if they:

a. started operation following a new construction or refurbishment after March 6, 2007, for a period of 10 calendar years, starting from January 1 of the year following the entry into operation;
b. started operation as a result of new construction or refurbishment after March 6, 2007 and combined with a district heating network, for a period of 15 calendar years starting from January 1 of the year following entry into operation.

2.3 Energy Efficiency and Renewable Energy Directives

The transposition of the Energy Efficiency Directive has created opportunities for the sector, but national legislation on DHC is still very limited.

The Government has decided, with the Decree 102/2014 - transposing the European Directive 2012/27/UE, to introduce rules on the regulation procedure of the service (Italian Authority) and a Decree to sustain the development of DHC (art. 10 p.5).

DHC in Italy operates on free-market principles and the regulation aspects, introduced by the Decree 102/2014, create market distortions and make DHC less competitive than the alternative heating solutions.

Moreover, the Italian Authority (ARERA) has already started in 2015 to introduce regulations applicable to the sector and the Decree about the support to DHC, that should have been issued in 2014, is still not available.

Finally the Report carried out in 2015 by the Italian Government Agency GSE (Energy Services Operator) detected a very low potential, opposing to numerous previous national and European studies (EU project STRATEGO, for example) which, on the contrary, showed a high potential of DH development in Italy.

After the transposition of the European Directive, which promotes the DHC development, the data analysis found a total lack of growth in the sector. Despite its great potential, DHC in Italy is not developing, but is decreasing instead.

2.4 Emissions Trading System

The ETS is the main EU tool to achieve CO_2 reduction objectives in the industrial and the aviation sector.

The mechanism is similar to cap & trade: it sets an overall maximum value on emissions permitted within the European territory in the sectors concerned (cap) which corresponds to an equivalent number of "quotas" (1 ton of CO2eq. = 1 quota) that can be bought / sold on a specific market (trade). Each industrial / aircraft operator active in the field covered by the scheme must "offset" its actual emissions on an annual basis with a corresponding amount of allowances.

Regardless of the allocation method, the overall quantity of allowances available to operators (cap) decreases over time, effectively imposing a reduction in GHGs emissions in the ETS sectors. In particular, by 2030, the mechanism will guarantee a 43% decrease compared to 2005 levels.

This system, as it is structured, creates a strong barrier to the development of DHC, because energy plants which, due to the absence of renewable sources or nearby waste, use fossil fuels (in a much more efficient manner when compared to individual solutions such as gas boilers) and are subject to the burden of the cost of CO_2 while individual boilers do not have this obligation.

2.5 Super ecobonus (ex Decreto "Rilancio": Decree-Law 19th May 2020, n.34)

The new Decree issued to boost the Italian economy after the COVID-19 crisis, provides a 110% contribution to the costs incurred for the refurbishment and therefore the efficiency of the buildings, including the installation of the condensing boiler.

Connection to a DHC network does not appear among the eligible interventions.

Support measures currently in force are oriented towards the development of individual solutions, which make buildings independent, such as: heat pumps, condensation boilers, fireplaces, pellet stoves. The legislative framework is strongly focused on buildings, but it doesn't look at the urban context.

District cooling using seawater heat pumps could be developed, for example, but the return on investment is very uncertain.

As a result, DHC investments are strongly disincentivized with respect to competing technologies such as heat pumps and gas boilers, with higher GHG or PMx production.

3 State of the art compared to the legislative framework

Operators are rather concerned about the development of DHC systems. In fact, Italy's faith in this technology does not extend beyond good intentions concerning European Directives. In reality, nothing actually gets done. There is widespread perception that DHC is a service with a long-term payoff.

We have analysed the correlation between the support schemes provided and the number of installations built over time. Figure 1 below shows the number of cities served by DHC in the country, grouped by year of commencement of service.

Once the long-awaited goal of 100 cities was reached in 2005 (35 years after the first city was served) – a threshold that would get the sector over the hump, as AIRU hoped for in the 1990s – in the 5 years that followed (from 2006 to 2010) 70 cities got connected to DHC networks. This data gives rise to the following considerations: these 70 cities fall within a short time window in which Green Certificates were issued; the plummeting number of projects, with only

a few timid initiatives left after 2014, corresponds to the inability to have access to the TEE – the white certificate scheme – after the update of the 22T form in 2015.

Had we only taken into account the trend in the volumes connected in more recent years, we would have simply recorded an (unspecified) growth trend.

In reality, growth depended on connections made to existing networks, which is a non-negligible factor.

From 1980 to 2014, new cities chose to commission their DHC systems every year.

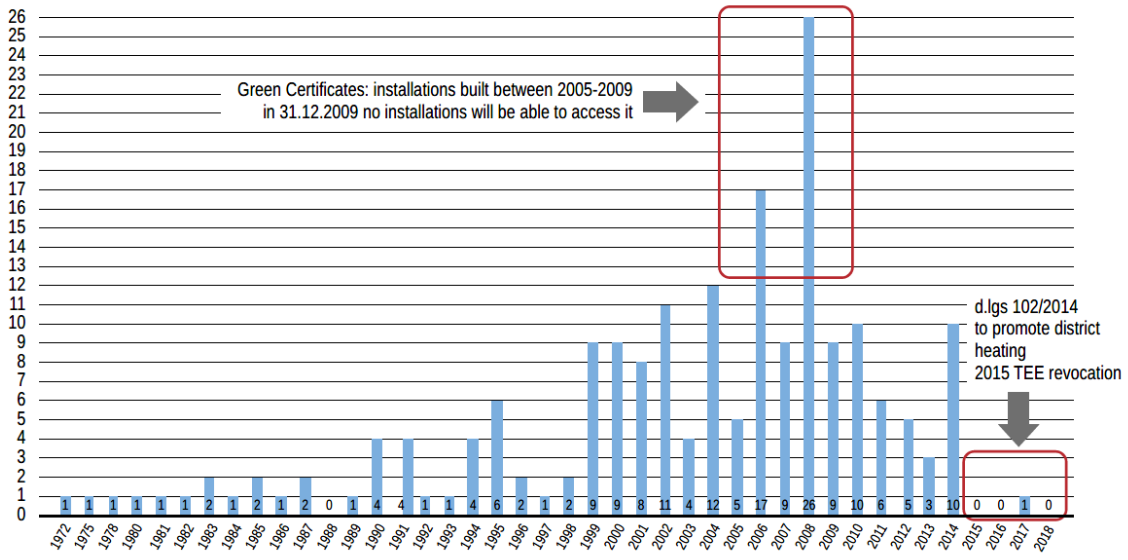
From 2015 to present day, only one DHC system was installed - in 2017- in a city where there was no existing network.

No cities have reported having installed a new DHC system in 2015, 2016 and 2018.

For 34 years in a row we have witnessed a widespread deployment of this technology, but in 2015 everything came to a halt.

This brings us back to the initial assumptions: DHC is experiencing a difficult period, despite the new, remarkable initiatives aimed at making the service more efficient by using recovered industrial waste heat and renewables and reducing fossil-based sources.

FIGURE 1 NUMBER OF CITIES WITH DISTRICT HEATING PER YEAR



4 The opportunity

4.1 District Heating potential: what does the future hold for Italy

Given the outcome of the study on the potential of DHC in Italy, carried out by the GSE, and in the light of its review at the end of 2020, we are convinced that there is a possibility of realising the significant potential. AIRU commissioned two renowned Italian universities, the Polytechnic University of Milan and the Polytechnic University of Turin, to study the technical and economic development potential of efficient district heating in Italy.

This research shows that **DHC in Italy has a technical development potential towards 2050 of more than 4 times the current overall size of DHC systems**. This research proves that **there is a significant potential based on the availability of waste heat and renewable sources**. It shows that **the consequence of DHC system development is the reduction of**

CO_2 emissions of residential sector up to 5.7 Mt and a reduction of fine dust emissions equivalent to 8,000,000 vehicles. [4]

DHC is a technology that can reduce fossil fuel imports from abroad, reduce climate-altering gas emissions, structurally reduce local emissions and pollutants such as fine dust that affect the most populated areas in Italy.

4.2 An important support for regions and municipalities

The results of this research prove that DHC systems can provide fundamental benefits to the Regions of the Po Basin, an area of the northern part of Italy, which, due to its geographic conformation, has an important concentration of pollutants harmful to human health and the environment.

Efficient district heating can use waste heat from industrial and tertiary activities with zero environmental impact to heat homes by replacing fossil fuels that cause polluting and climate-altering emissions.

Developing the infrastructure will give positive impact in terms of job creation both at local and national level.

5 The Action Plan

5.1 Short term strategy

First of all, it is necessary to **develop new DHC networks** and this means providing operators with a **stable legislative framework**, because investing in DHC systems imposes long-term commitment.

Developing DHC systems is needed to achieve the EU goals of decarbonisation. In Italy, the first step is the systematic development of infrastructure. DHC operates on free market principles and it is important to give equal treatment to all the technologies and ensure that DH networks benefit from the same mechanisms as other competitors.

Legislative interventions

The first, essential action for the development of the DHC sector in Italy is to identify a solid and stable legislative framework for efficient DHC.

Starting from the existing law the possible and immediate actions could be the following:

a) Application of Art. 10 paragraph 5 of the Legislative Decree 102/2014 : increasing the potential of efficient district heating within 2020 and 2030 by identifying specific measures.
b) Unlocking of the Ministerial Decree *ex Art. 19 decies* of the law *172/2017*: interventions on cogeneration units combined with efficient district heating networks.
c) Deleting the unequal application in the customers heating technologies market of Emissions Trading System to district heating. The condominiums or single-family homes heat boilers are not subject to ETS. DH networks, heated by fossil sources and that replace the aforementioned boilers, is on the contrary subject to ETS. This creates a distortion on the market.
d) Making sure that efficient DHC projects are considered within the projects supported by the Recovery Fund.

The transposition of the new “Energy Efficiency Directive” (2018/2002) invites to introduce the cost of connection to a DHC network in the "Conto Termico". “Conto Termico” encourages interventions to increase energy efficiency and the production of thermal energy from

renewable sources for small plants. Thanks to “Conto Termico” it is possible to upgrade buildings to improve their energy performance, thus reducing consumption costs and quickly recovering part of the costs incurred. It is very important that this indication is followed up with the revision of the ministerial Decree implementation.

5.2 Medium term strategy

After a stable development of the infrastructure, it is possible to **retrofit DHC networks** lowering the operating temperature of the system and improving the efficiency of the production assets, while also increasing opportunities to participate in the various Electricity Markets. Deploying low-temperature DHC networks means taking a further step towards decarbonisation, by increasing overall performance of the systems due to a general reduction in heat losses and simpler access of waste heat. However, district heating utilities alone cannot make this contribution: a concerted action is necessary, in which the building sector and energy generation industry contribute towards making these scenarios feasible and sustainable in the long run, given that the technology is already in place.

With respect to production improvement, there are several mature P2H technologies (heat pumps, electric boilers, …) available in the market, that allow **heat and electricity sector coupling**. This, together with a **larger waste heat exploitation**, can act as enabler to improve the DHC utility bottom line significantly, introducing more sophisticated approaches towards trading onto the various electric and balancing markets, which can be supported by already available digital technologies.

Expanding incentives for **storage** and implementing the legislation on this (e.g. heat storage in the ground, seasonal storage ...) would permit to massively integrate thermal renewable sources and increase further the opportunities for DHC to act as a balancing mechanism with respect to the electric system, as many existing EU experiences show beyond doubt.

In addition to this, a “Superbonus” that encourages the energy requalification of buildings with the purpose of decreasing the peaks of energy needs would create the conditions for a real approach to Demand Side Management. A mature **energy consumption management** can surely help the lowering of energy demand and this means to make an action to modify the emission terminals (old radiators for example) and make citizens responsible.

Any regulation that may incentivise DHC in this respect may be very effective to unlock a technical and managerial potential that, in the current situation, is far by being explicated and implemented.

5.3 Long term strategy

Thanks to the development of DHC networks, it would be possible to reduce at minimum energy waste and to **empower citizens to become actors** of a heat market system. As well as for the electricity market today, a developed infrastructure and a network extended over the territory would give the faculty to industrial sector and residential sector to deliver heat overproduction in DHC networks, that will become interactive storage systems.

It is evident from early experiences in waste heat exploitation, that **novel business models** may be required to ensure the involvement of multiple stakeholders within the value chain while minimising the industrial risks, yet increasing the awareness. Transition efforts, linked with the possibility to valorise currently wasted resources, may act as a powerful incentive to take potentially gigantic leaps forward in this respect, as the aforementioned study (chapter 4.1) has already shown very clearly.

International experiences have demonstrated how DHC can act as powerful balancing factor for the electric system, which will be under increasing stress as electric mobility becomes more and more widespread, up to the point that **multi-energy planning** should increasingly become

the norm. Being able to evolve the production mix (and seasonal storage assets) to capture these opportunities requires a long-term vision and a more convinced commitment to digitalisation, without having to resort to exceedingly innovative technologies.

Digitalisation is, again, the key to enable a deeper and more sophisticated involvement of the final user, especially as prosumer and smart users become the norm, which would integrate the end-to-end value chain, unlocking further opportunities for optimisation, customer involvement and overall environmental impact, achieving the objective, strongly promoted by Euroheat & Power, to aim for modern, efficient and effective DHC as one of the key enablers of the EU Energy Transition Roadmap.

6 Promotion of the action plan and recommendations

As the content of the present document is relevant for national stakeholders, all the information is available in the Italian language and AIRU is focusing on different aspects of this action plan in their advocacy work. For more information, please get in touch with the responsible contact persons at Associazione Italiana Riscaldamento Urbano.

At the European level, the UpgradeDH project and draft recommendations were presented at the online event “The Future of District Heating in Italy” held on 2 October 2020. A study prepared by the Polytechnic Universities of Milan and Turin regarding the potential of district heating in Italy and a talk about the European project UpgradeDH with a walk-through of the best practices for upgrading district heating networks around Europe were used to start a conversation about the future of district heating in Italy and how it can play a central role in the transition towards a more sustainable Italian energy system.

The event, organized by AIRU, Utilitalia and the UpgradeDH project consortium was joined by representatives of national and international institutions, industrial and consumer associations, with the possibility to actively debate during a series of panels on how best to act to pave the way for a new district heating development wave.

This virtual event was held in Italian and simultaneously translated in English. The event recording includes presentations and discussions with among others:

- Lorenzo Spadoni, President AIRU
- Alice Dénarié, PhD Department of Energy at Polytechnic University of Milan
- Vittorio Verda, Prof. of Technical Physics at Polytechnic University of Turin
- Matteo Pozzi, General Manager OPTIT
- Alessandro Provaggi, Euroheat & Power, Head of DHC+ Technology Platform

It was moderated by Celestina Dominelli, journalist at Il Sole 24 Ore.

The study launched at the event clearly highlighted the great potential of district heating to utilise waste heat from industrial processes, power plants, tertiary sector, as well as renewable sources such as geothermal and solar thermal. The results of the study show that the district heating sector in Italy can already now increase its current size by four times, going from 9 TWh to 38 TWh. It is possible to receive the study free of charge by filling out the request form on the homepage of the AIRU website: https://www.airu.it/

References

[1] UpgradeDH (2019): “Upgrading the performance of district heating networks Technical and non-technical approaches - A Handbook”, Public (Deliverable 2.5). Available online at: https://www.upgrade-dh.eu/images/Publications%20and%20Reports/D2.5_2019-07-02_Upgrade-DH_Handbook_EN.pdf

[2] Euroheat & Power “Country by Country” (2019). Available online at: https://www.euroheat.org/cbc/2019/

[3] AIRU (2018) – Annuario 2018 – Sviluppo storico, situazione attuale e schede tecniche delle reti di teleriscaldamento urbano in Italia (annual statistics report on district heating in Italy) – Editrice Alkes, Italy, www.airu.it

[4] Study by the Polytechnic Universities of Milan and Turin regarding the potential of district heating in Italy (2020). Available on request at: https://www.airu.it/