



District heating in Lombardy Region (Italy): Effects of supporting mechanisms



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ARTICLE INFO

Article history:

Available online 27 July 2014

Keywords:

District heating
Public subsidies
CO_{2eq} reduction

ABSTRACT

Nowadays energy and environmental issues represent the main emergencies for all the governments, globally and locally. The importance of operating on the three levels of the energy system (by reducing energy demand; by optimizing generation and management and by integrating local renewable energy sources) has been strongly recognized. To that end urban neighborhoods could represent an optimal scale for the implementation of innovative energy strategies, despite barriers at the economic, regulatory and administrative level are still present.

In recent years, as a result of an important agreement with the Italian Ministry of Environment, Lombardy Region has supported numerous measures for energy efficiency and renewable energy sources integration among its territory, including district heating plants. All the interventions were analyzed in the framework of a wider monitoring campaign aimed to evaluate effects, effectiveness, pros and cons of the several calls and programs. The financed district heating plants represent the case of studies described in the present paper.

The most important characteristics, conditions and technical features of these interventions were analyzed. Globally we deal with 21 interventions distributed in the territory of Lombardy Region and fueled by fossil fuels, waste or biomass. The results obtained were described in terms of environmental, energy and economic performances, taking into account the public spending and the global investment costs. The main aim of the analysis is to comment the effectiveness of the adopted local energy policies and also to orient future policies toward the improvement of the energy and environmental performances of communities and territories.

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1. Introduction

In Italy district heating networks and distributed generation systems are constantly increasing with many effects related to the relationship between people and their territory (Bottio, Caminiti, Gangale, Stefanoni, & Magnelli, 2008).

In 2010 the Italian district heating plants were about 442 (Ufficio Energia e Clima di Legambiente, 2012), with a total capacity of 6303 MW_{th} (of which 2370 MW_{th} in cogeneration), 153.9 MW_{tc} and 853 MW_{ej}. Presently the most part of these plants is fueled by fossil fuels. In fact natural gas is feed in 77.1% of the plants, urban waste in 9%, biomass in 5.3% and the remaining 8.6% is fueled by coal, fuel oil, geothermal and heat from industrial processes. The district heating in Italy is mainly distributed in the north of country with an important diffusion in Lombardy Region, where the total installed

capacity is 2354 MW_{th} (nearly 40% of the national plants) (AIRU, 2012).

Several factors may influence the technical and economic performances of district heating systems: goals about climate change and renewable energies integration, climatic and morphology context, improvement of the buildings energy performance; competition with other technologies and other energy sources (in particular with heat pump systems and technologies fueled by natural gas); non-technical barriers; energy policies and market strategies.

Looking at the available data, it is possible to argue that the diffusion of district heating in Italy is constantly increasing despite of the many barriers related to the regulatory, administrative and economic difficulties. In this framework supporting measures play of course a fundamental role (Cansino et al., 2011; FIPER; Lessons, 1998; Lind, 2012; Madlener, 2007; Magnusson, 2012); another important help for their further development and upgrading can come from the coordination among policy and technological aspects (Agrell & Bogetoft, 2005).

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Nomenclature

Abbreviations

CCGT	combine cycle gas turbines
CHP	combined heat and power
DPB	discounted payback time
GHGs	greenhouse gases
RE	renewable energy

Subscripts

el	electric
tc	thermal cooling
th	thermal heating

In order to overcome the economic barriers, the diffusion of district heating systems is generally supported by incentive policies. Several experiences, as for example the Sweden one (Aberg & Henning, 2011; Nilsson, Reihav, Lygnerud, & Werner, 2008; Persson & Werner, 2011; Rezaie & Rosen, 2012), demonstrate the importance of developing focused and reasonable subsidies. This topic is thus investigated also in the present paper.

The national framework of the incentive policies related to district heating in Italy is mainly related to benefits for the final users and bonus for CHP renewable plants, as briefly described in the following Table 1.

In this context, in order to complete and integrate the supporting framework suggested by the ordinary energy policy, the Italian Ministry of Environment in collaboration with the administration of Lombardy Region has developed several measures for energy efficiency and local renewable integration in the regional territory, within the so-called “Accordo di Programma Quadro in materia di Ambiente e Energia” (Framework Program Agreement in the field of Environment and Energy). So many calls were launched since 1999. These calls were devoted to promote renewable energy sources penetration and energy efficiency, but also to improve expertise and know how about energy issues among public administrations and citizens.

Public supports were provided as grants to finance utilities and privates, on the basis of a public selection. The supported measures include those related to the diffusion or upgrading of district heating plants (52.9% of the total public funding), subject of the present paper, and other related to the installation of solar plants (20.2%

Table 1
The national framework of the incentive policies related to district heating in Italy.

Supporting mechanism	Legal reference
Tax deduction (0.01033 €/kWh of heat) for final users in the coldest climatic zones (zone E and F as defined in D.P.R. 412 (1993)).	Financial laws from year 1999 to today
Energy efficiency titles (white certificates)	D.Lgs. 79 (1999), D.Lgs. 164 (2000), D.M. (2004), Decreto (2007) and D.Lgs. (2008)
Tax deduction (0.01549 €/kWh of heat) for final users in the coldest climatic zones	D.L. 268 (2000) and Financial laws from 2009 to today
Contribution (€ 20.6583 for each kW of heating power) for final users who decide to be connected to a district heating network	Financial laws from 2001 to today
Guarantee fund for district heating utilities	D.Lgs. 28 (2011)
Additional bonus for small plants (<1 MW _{el}) that generate electricity from REs and that are able to cogenerate heat for district heating	D.M. (2012)

of the total public funding), the improvement of energy efficiency of envelopes (14.3% of the total public funding) and heating systems (8.9% of the total public funding) in buildings (Aste, Buzzetti, Caputo, & Manfren, 2014) and actions in the field of innovative fuels and sustainable mobility (3.7% of the total public funding). In particular, district heating was supported by following calls:

- D.G.R. 6/42621 in 1999 for biomass plants (D.G.R. 6/42621, 1999);
- D.G.R. 6/44589 in 1999 for fossil plants (D.G.R. 6/44589, 1999);
- D.G.R. 7/20119 in 2004 for biomass and fossil plants (D.G.R. 7/20119, 2004).

As a whole Lombardy is a high density populated region, with many important urban areas (i.e. Milan). Its built environment is very complex, with an important presence of all the sectors: residential, commercial, industrial and urban structures. Lombardy has a large flat land but also many mountain areas, a rather cold climate during winter and a hot and humid climate during summer, especially in the flat land. Many areas have characteristics suitable for developing district heating plants. This situation justifies the decision to use part of the available public funds for these interventions that are characterized by significant investment costs.

For a better understanding of the elaborations provided in the following sections, we outline also the main characteristics of the energy system in Lombardy. The regional energy balances in recent years highlight the remarkable stability of the total final consumption, the importance of the civil sector (43% of total consumptions) and the predominance of the heating consumptions of buildings (68% of the total energy consumptions of the civil sector). In Lombardy power plants are more than enough to cover the peak demand for electricity. The main energy source adopted is natural gas in big combine cycle gas turbines (CCGT) plants. Further, the most part of the national hydro-electric plants are located in Lombardy. These plants and other REs installations determine a penetration of renewable energy sources in line with the European and national objectives related to the year 2020. Not least, in Lombardy there are economic resources that can be activated in the energy field.

This paper is devoted to investigate the actual performance of the district heating plants supported by the mentioned mechanisms. The main aim is to understand the effectiveness of these supports taking into account the so-called “3E” approach (Economy, Environment and Energy aspects). Final considerations about the lessons learned will be provided in order to give directions for future energy policies at district, municipal and regional level.

1.1. Monitoring campaign of a local energy efficiency program for district heating

At the end of the mentioned national program “Accordo di Programma Quadro in materia di Ambiente e Energia” (Framework Program Agreement in the field of Environment and Energy), the Italian Ministry of the Environment and Lombardy Region financed a monitoring campaign with the scope of deeply analyzing the results achieved and getting useful insights for future programs and projects. The monitoring involved all the supported measures, including district heating plants, and was carried out by our research group of Politecnico di Milano.

The present paper takes into account the most important results of the monitoring campaign related to district heating plants and includes further investigations.

Incentives were provided both for the creation of new plants and district heating networks and for the extension of existing systems. Further, the calls promoted both biomass and fossil fueled plants. The first call dates back to year 1999 (D.G.R. 6/42621, 1999; D.G.R. 6/44589, 1999) and it had the aim of financing new plants and

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