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Cogeneration and district heating networks: Measures to remove institutional and financial barriers that restrict their joint use in the EU-28

Antonio Colmenar-Santos*, Enrique Rosales-Asensio, David Borge-Diez, Francisco Mur-Pérez

Department of Electric, Electronic and Control Engineering, UNED Juan del Rosal, 12 – Ciudad Universitaria, 28040, Madrid, Spain

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ABSTRACT

The aim of this research is to identify actions that dissipate the institutional and financial barriers that are faced by those energy projects which comprise the joint use of district heating networks and cogeneration in the EU-28. From this evaluation, institutional and financial barriers were identified, which included: distinctive competence, fuel price volatility, and much of the current regulatory framework. In order to achieve an effective removal of these barriers, and apart from generic and common actions to all the schemes, such as creating anchor loads, adopting an active marketing strategy by the local authorities, or the proposition of updating some communitarian directives on energy issues; it is also necessary to adopt those actions that respond to the casuistry of each Member State. Such actions will ultimately represent the most effective way to get a generalised implementation of energy projects that include a joint use of district heating networks and cogeneration.

1. Introduction

The development of the different energy infrastructures in the local energy systems, which are often disorderly, is causing growth in the number and complexity of the resulting interactions [1]. In a conventional heating system, gas is transmitted from basic transmission networks and distribution networks, located in the cities, to individual domestic boilers [2]. However, the concept is different if one considers a joint use of district heating networks and cogeneration plants. In this case, as the system expands, some externalities occur in the district heating networks [3], such that the economies of scale in the provision of heat, and a more efficient use of the fuel in individual boilers (which normally operate at partial load), can be achieved [4].

The European Commission's analysis of the evolution of the amount of cogeneration installed in the Member States between 2004 and 2008, showed an average annual growth of 0.5%, but masked a great deal of divergence in the degree of implementation of this technology. Indeed, there are only a few countries that can claim to have an effective national law resulting from the 2004/08/EC Directive on the promotion of cogeneration [5].

Even though an increasing number of local authorities are considering the joint use of cogeneration power plants with district heating networks as a technology that can be aligned with EU-28 long-term energy strategies [6] (as well as that of each one of the Member States that integrate it) and thus reduce its pollutant emissions, the fact is that, as shown in (Fig. 1), even being one of the most CO_2-reducing technologies at a lowest cost [7,8], there are significant barriers to both institutional [9] and market levels [10] that hamper its optimal implementation. Therefore, although it may seem that Member States' energy policies favour the development of the joint use of cogeneration power plants and district heating networks, a greater degree of investment in the necessary infrastructure for this development is not being stimulated because energy policies and regulations, far from promoting alternative solutions such as local energy infrastructures, continually reinforce a centralised energy regime [11]. In general, the various EU-28 national energy frameworks promote incremental changes and restrict some of the radical structural changes necessary to clearly [12,13].

* Corresponding author. Tel.: +34 913 987 788; fax: +34 913 986 028.
E-mail addresses: acolmenar@ieec.uned.es (A. Colmenar-Santos), enrique.rosales.uned@gmail.com (E. Rosales-Asensio), archeop@gmail.com (D. Borge-Diez), fmur@ieec.uned.es (F. Mur-Pérez).

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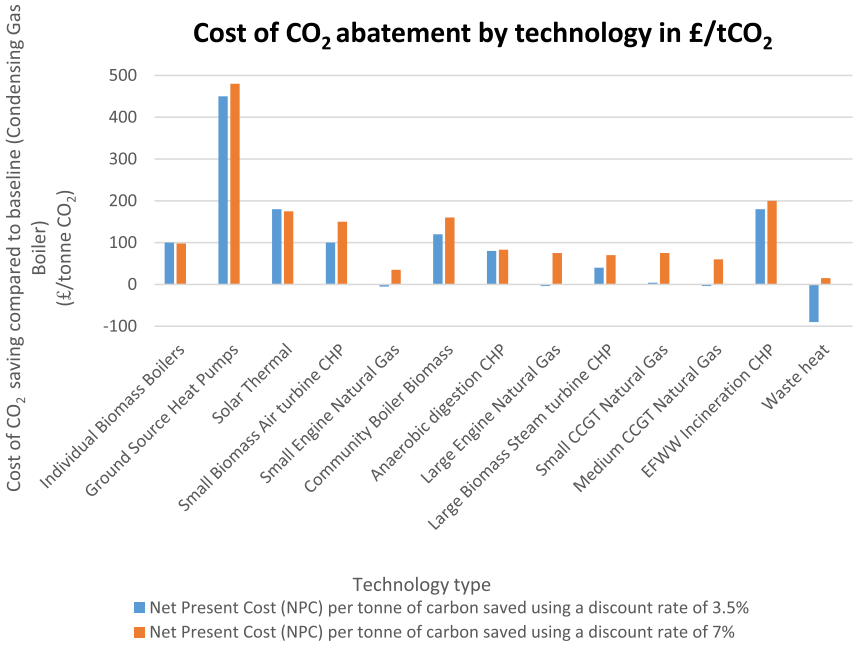

Fig. 1. Cost of CO_2 abatement by technology in £/tCO_2 [7].

As an example, and as noted in most of the EU-28 Member States, efforts to achieve decarbonisation in the demand side have focused on measures such as an all-electric future [14], the development of techno-economic models that do not take into account local circumstances [14], and opportunities and incentives for energy efficiency that are based on market failures [15–18]. Such incentives tend to consider users on an individual basis, and consequently neglect the potential economies of scale that could be achieved through the combined use of district heating networks and cogeneration power plants [19]. The European Commission officially became interested in cogeneration technology in 1997, with the Community Strategy to promote Combined Heat and Power, COM(97) 514 [20]. The strategy focused on the promotion of the cogeneration power plants' electricity generation [20].

However, this attempt by the European Commission to achieve cogeneration power plants with a lower heat to power ratio, only provoked an improvement of power plant efficiency [21,22] and did not spread the use of district heating networks. Subsequent directives, such as Directive 2004/08/EC on the promotion of cogeneration, was not a real "positive financial stimulus" to many of the EU-28 Member States [23]. The Commission, after the observed stagnation in the diffusion of district heating since 1990 [22], developed a Directive on Energy Efficiency (the Directive 2012/27/EU). This directive explicitly recommended (in article 14) the use of district heating networks as a potential technology to meet the targets for energy efficiency, as proposed for 2020 [24]. However, in paragraph 14(7), it only alluded to "take into account" those cogeneration and district heating facilities that have a positive outcome from an economic perspective, which *de facto* legitimises the authorities to discretionarily choose the technology they deem as appropriate [25], and essentially, does not change the legal situation prior to that Directive. District heating networks have particular technological and institutional characteristics (such as being a natural monopoly), which makes them a non-conventional consumer good [26]. Since a market equilibrium (where the prices are equal to marginal production costs) [27] is not achieved but a monopolistic situation, production costs will fall as production increases [28]. Consequently, it is more cost effective to have a unique infrastructure dominating the market [29]. Due to the fact that under a market failure situation private investment will not exist (or at least it will be much diminished), public investment or the development of adequate regulation is necessary [30].

In the residential sector of the EU-28, loads associated to heating equipment, ventilation, and air conditioning are those that represent a greater share of total energy consumption [31,32], with a ratio of about 70% [33,34].

It is expected that in the medium term, heating loads will stabilise or decrease moderately [35]. It should be noted that improved insulation [35], optimised ventilation (with heat recovery) [36], the growth of cities (which involves the creation of heat islands), and global warming [37] will lead to a decrease in the thermal load. On the other hand, the rise in population [38] and housing comfort levels [39], will contribute to the increase of the load to be heated.

From 2020, when stricter requirements to achieve zero-energy buildings are implemented [40], it is expected that the thermal heating load will decrease more rapidly (Fig. 2) and higher primary energy savings will be obtained (Fig. 3).

With regard to the cooling thermal load, and although in the medium term it is expected that it will increase its importance [41],

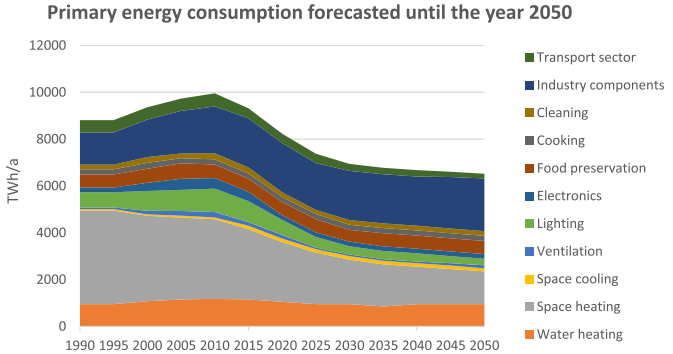

Fig. 2. Primary energy consumption forecasted in the EU-28 until the year 2050 (energy sector impact not shown) [41].