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Pioneering industry/municipal district heating collaboration in Sweden in the 1970s☆

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ABSTRACT

The aim of the article is to reach increased understanding of the potential obstacles and opportunities for industry/energy-company collaborations. This is achieved through exploring a pioneering collaboration regarding waste heat from a steelworks to a local district heating system in northern Sweden that was established in the 1970s. With a historical qualitative approach and focus on the long-term and dynamic explanatory factors behind the collaboration, the article complements previous studies typically focusing on barriers/drivers at the end of the process from idea to actual waste heat supplies (e.g., the allocation of costs among parties). From a long-term perspective, concerns over the actual waste heat supplies were found to be protracted and more critical. Hence, although the collaboration from start rested on firm beliefs of sufficient supplies, concerns over actual supplies remained critical throughout the 11-year long process. The article suggests that: a) market fluctuations and the industrial company's continuous strive for profit maximization tend to be underestimated in previous literature on obstacles to waste heat supplies; and b) targeted government subsidies could be an essential policy tool for promoting future waste heat collaborations, in turn resting on a mix of societal rationales (e.g., energy security, climate mitigation, regional development, etc.).

1. Introduction

District heating (DH) may help reduce the use of fossil fuels for heating purposes and contribute to efficient energy systems, and can therefore be an important component of a transition to sustainable energy systems.[1] Industrial waste heat[2] can in turn both save primary energy and help reduce emissions of carbon dioxide and sulfur dioxide as base load in DH systems, depending on the availability of alternative types of production types (e.g., Grönkvist and Sandberg, 2006). In Sweden, where DH systems are common,[3] industrial waste heat in 2015 represented about eight percent of the total amount of energy supplied in the Swedish DH sector, with biomass, municipal solid waste and heat pumps being the most common base loads (www.svenskfjarrvarme.se/Statistik). In a recent government investigation, it is concluded that the overall potential for additional waste heat supplies to the DH systems is considerable. Specifically, there is a potential for a doubling of waste heat supplies from Swedish industry (see SOU, 2011:44, see also Arnell et al., 2012). Hence, an increased utilization of industrial waste heat is desirable for the industry as well as for the energy sector and society at large in order to optimize the use of resources and reduce overall environmental impacts (SOU, 2011:44; COM/2016/051 final).

The aim of this article is to provide a better understanding of potential obstacles and opportunities for further recovery of industrial waste heat in DH systems. This is achieved through studying a collaboration process in the 1970s that eventually led to the first supply (to a local DH system) of industrial waste heat taking place in Sweden. This first industry-/energy company-collaboration on waste heat was introduced in the early 1970s between Luleå Energiverk AB (municipally owned energy company, LEAB) and the local steelworks, Norrbottens Järnverk AB (NJA), in Luleå town in northernmost Sweden. As the first utilization of industrial waste heat in a municipal DH system in Sweden (and probably in the world), this was a pioneering project. In addition, it took place in a sub-arctic environment, and in part during a deep economic recession with all that implies in terms of technical and

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[1] DH systems enable the use of waste heat and may facilitate the use of renewable energy sources. It could further hold the important task of balancing the power grid by accommodating excess power production (Di Lucia and Ericsson, 2014; Lund et al., 2014).

[2] Variations of the external use of waste heat can be in the form of steam sold to another industry, or if the waste heat is used to generate electricity by an external actor (Jönsson et al., 2007).

[3] DH systems are common in a number of European countries alongside China and Russia (Euroheat and Power, 2015).

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economic challenges. Still today the DH system relies heavily on waste heat supplies, and provides the lowest DH price in Sweden (see www.nilsholgersson.nu). In itself this makes it an interesting case to study more closely with the intention of drawing general lessons for today's challenges to achieve a more sustainable society: how were technical and economic challenges solved? The historical case is of generic interest also since it highlights the critical importance – to industry/energy-company collaborations – of changing market and production conditions for the expected long-term waste heat supplies. The case further highlights how government funds can facilitate energy projects of this kind, as well as how the selection between general and technology-specific government support may be critical for success.

2. Previous literature and analytical starting points

There is a number of complex processes that industry- and energy companies need to confront in order to go from idea to actual waste heat deliveries, such as to agree on how to: (a) divide the cost of the investment that waste heat collaborations typically cause; and (b) value[4] the waste heat (Swedish Energy Agency, 2008b). In addition, there are potential technical and cultural barriers to overcome as well. A number of previous, largely empirical studies, several of which were compiled by Swedish authorities, have surveyed the potential barriers to the establishment of successful waste heat collaborations (for an overview, see Krook-Riekkola and Söderholm, 2013).

Largely, these earlier studies highlight barriers linked to the substantial investments that waste heat collaborations typically imply, such as those related to the adaptation of the plant where the waste heat is generated, to ensuring reserve capacity in the event of interruption of waste heat deliveries and/or of increasing waste heat temperatures. The typically high investment costs (versus low initial returns) may hinder the establishment of successful waste heat collaboration, and where thus industries must weigh the benefits of the investment to other possible investments and prioritize their core business (Grönkvist and Sandberg, 2006). DH companies may apply a return which is even below market level (Ganslandt, 2011).

Thus, DH companies tend to be willing to enter into long-term contracts for the supply of heat while the incentives of industry to enter long-term contracts are limited by, e.g., the need for long-term flexibility for its core business (Krook-Riekkola and Söderholm, 2013). It is also about transaction costs arising from lengthy information retrieval (such as due to a technically complex waste-heat source) and/or contract negotiations (Ganslandt, 2011; Fors, 2004; Thollander et al., 2010). Furthermore, although several studies illustrate that lack of capital does not constitute a central barrier to the establishment of successful waste heat collaborations (e.g., Thollander et al., 2010), there are disagreements about who (the industry or the DH company) should account for the investment (see e.g., SOU, 2005:33).[5] Previous studies see barriers linked also to disagreement on the economic value of waste heat, where a DH company may want the parties to share equally the benefits of waste heat, and the industry that may argue that the valuation should be just below the alternative cost of the DH company (SOU, 2005:33).

In addition, previous studies on the potential barriers to the establishment of successful waste heat collaborations identify cultural barriers that need to be overcome, such as information- and communication failures and organizational/cultural barriers. Hence, the presence of asymmetrically distributed information between the parties involved waste heat negotiations may lead to inefficient outcomes (Thollander et al., 2010). Moreover, it may be difficult to reach an agreement because while the waste heat issue often is strongly linked to the core business of DH companies, it is often peripheral to the industry (Fors, 2004). Previous studies also find that the "lack of information" and large investments linked to waste heat collaborations in turn make personal relationships and the presence of enthusiasts very important (Trygg et al., 2009; Fors, 2004; Thollander et al., 2010; Swedish Environmental Protection Agency, 2005; Swedish Energy Agency, 2008a; County Administrative Boards of the counties of Östergötland and Örebro, 2011).[6] Previous studies also identify barriers in the form of policy instruments displacing waste heat from the DH market, such as high taxation of fossil fuels benefitting biofuel cogeneration, and bans on landfill of combustible waste benefitting incineration plants (Rydstrand, 2005; Jönsson et al., 2007; Energy Agency 2008a; Energy Agency 2008b; Ganslandt, 2011).

In sum, previous studies have adopted a relatively static approach, and with a strong focus on identifying barriers/drivers to the establishment of successful waste heat collaborations. The barriers/drivers identified typically relate to communication and the allocation of costs between the parties, but relatively little attention has been devoted to external impacts on the collaboration. These results are reasonably in part influenced by the chosen method and material while previous studies have largely been based on personal interviews. Thus, we can assume that individuals who are interviewed about a process (from idea to actual waste heat supplies) – and often only after the waste heat supply has been secured following a successful agreement – may tend to highlight barriers and drivers that primarily emerged at the end of the process and that in turn were most evident for the individual (given her professional position). There is however a risk that important factors throughout the entire process are ignored. Furthermore, limits of the human memory and the individual's inability to grasp the entire process she participates in means that the personal interview is not always suitable as a scientific method (or at least that it should be complemented with other sources of information, such as minutes from board meetings, working groups etc.). Unconscious bias (e.g., internalized norms, cultural scripts, etc.) and even conscious and deliberate attempts to mislead the interviewer could be further reasons for questioning the interview as a reliable (and sole) source of information (Alvesson, 2003).

In this article, we are interested in identifying the more long-term and dynamic explanatory factors to successful waste heat collaborations, such as how the collaborative initiatives evolve over time under internal as well as external influence. It is here justified to adopt a more longitudinal perspective when we study waste heat collaborations since the process from idea to actual supplies of waste heat usually may take 5–10 years (e.g., Swedish Energy Agency, 2008b). In the present case, the entire process took between 6 and 11 years.[7] With a longer time-perspective and especially when, such as in our case, the process took place about 40 years ago, it is in turn central to adopt a typical historical qualitative method and use documents rather than interviews as main sources.[8] Hence, in this case the sources consist of documents in

[4] A standard model contract for waste heat collaborations in Sweden is profit sharing, where both parties stand for a part each of the investment, and receive part of the profit in proportion to their investment. However, there are also cases where the heating company takes the entire investment and the full return during the repayment period (Energy Agency 2008b).

[5] In this context, it is interesting to note that several collaborations (judging from the views of representatives of the collaborating partners) are considered to have been established thanks to national and/or local state co-financing (County Administrative Boards of the counties of Östergötland and Örebro, 2011; Jönsson et al., 2007).

[6] In addition, a common vision, transparency, continuous communication, successful information dissemination and operational dialogue about ex. disturbances in production, have been identified as important for successful waste heat collaborations (e.g., Thollander et al., 2010; Grönkvist and Sandberg, 2006; Jönsson et al., 2007; SOU, 2005:33).

[7] After six years, the local steelworks supplied a heat-only boiler with waste gas, which in turn supplied the local DH system with thermal energy. After 11 years from idea, the local steelworks supplied a CHP plant with waste gas, which in turn supplied both the local DH system with thermal energy and the steelworks with electricity, the latter being the idea pursued from start.

[8] The study is mainly based on a rich selection of documents complemented by one interview (conducted in Luleå, February 13, 2017) with the former manager of Luleå DH