



Exploratory study of combining Integrated Product and Services Offerings with Industrial Symbiosis in order to improve Excess Heat utilization

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Background

- Approximately 50% of all EH from large energy-intensive industries in Sweden is utilized, mainly in district heating systems [1].
- A mature industry and technology with declining market growth.
- Swedish Energy Agency [1-2]:
 - One goal is that all EH above 55 degrees Celsius in southern Sweden should be fully recovered by 2020.
 - Other goals concern technological development leading to new and better technology for low temperature EH utilization.
- Opens up new business opportunities for companies delivering products and services that solve energy supply using.
- Combining Industrial Symbiosis and Integrated Product Service Offerings

Industrial Symbiosis

IS has been developed as a subset of Industrial Ecology, and can be described as a cluster of operational agreements between normally unrelated industrial companies or other organisations that lead to resource efficiency.

The agreements, for example, can involve reuse of one company's by-products as raw material for another company, as well as the sharing of manufacturing capacity, power, water and steam supplies, logistics and expertise between.

Objective and Research Questions

This paper's objective is to *explore the implications of combining an IPSO with IS in order to facilitate the increased utilization of EH*. In order to do so, five different EH cases that originated from an IS perspective have been investigated. Based on an IPSO-focused literature review, those five EH cases are analyzed in order to identify potential pros and cons, if an IPSO perspective is applied, in order to further improve EH utilization.

- **RQ1** – Why is there a large unutilized potential for the capture of EH?
- **RQ2** – What alternative uses for EH exist, other than those found within district heating systems?
- **RQ3** – What are the opportunities for using district heating systems' infrastructure?
- **RQ4** – What potential opportunities and challenges exist if an IPSO perspective is applied, in combination with IS, in order to further improve EH utilization?

Methodology – Respondents

Respondent	Case	Type of respondent	Number
R1	C1	Energy company: Business area manager	1
R2	C1	Energy company: Market manage	1
R3	C1	Pulp mill: Energy coordinator	1
R4	C1	Pulp mill: Site manager	1
R5	C1	Greenhouse: CEO and owner	1
R6	C2	Site manager	1
R7	C3	Project manager “Open District Heating”	1
R8	C4	Program leader	1
R9	C5	Communicator	1
Total			9

Methodology – Interview Questions

Case Interview questions

- C1
- How did the collaboration start?
 - What are the key success factors behind the collaboration?
- C2
- Why is the EH not utilized?
 - What do you think would be required for an EH collaboration to occur?
- C3
- How does the concept of open district heating work in practice?
 - What are the key success factors behind the project?
- C4
- Who are the typical actors within these heat collaborations?
 - What types of business agreements would occur?
- C5
- What is the desirable development for the Swedish district heating sector?
 - What is required for the increased use of EH?
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Reasons why there is a large unutilized potential for the capture of EH

- These types of heat collaborations require inter-organizational collaboration across the individual business boundaries. Inter-organizational collaborations are often difficult to initiate.
- Trust, shared visions on common goals and transparency behind a clear and well-formulated business agreement, important factors behind successful EH supply collaboration.
- Strategic and farsighted comprehensive planning with the mandate to regulate energy issues concerning planning would be desirable in order to avoid the use of primary energy where there already are existing sources of EH.

Opportunities for using district heating systems' infrastructure

- The conditions for using existing systems of district heating to distribute EH are good from a technical point of view, however requires a Third Party Access (TPA) to the district heating systems.
 - Currently, the Swedish district heating sector has a monopoly position in the heating market. “Open district heating”
- For places with the right conditions, such as dense developments like cities where there are always both excesses of heat as well as demand for heat, these kinds of projects have the ability to be successful.

Potential of the application of an IPSO in order to further improve EH utilization – Potential Opportunities

- The IS theory lacks a business perspective; an interesting way to address this perspective could be to apply an IPSO perspective. Such a perspective has the potential to improve efficiency, which often leads to positive environmental and financial effects for both industry and society at large.
- An IPSO provider with the knowledge and responsibility for the distribution of heat could facilitate the increased use of EH by providing the heat integrated with a service offering.
- Broadly, these heat-related services would consist of offerings facilitating the heat transaction for both the supplier and the recipient of the heat.
- The IPSO would however differ, depending on whether it is addressed to the supplier or the recipient of the heat.

Potential of the application of an IPSO in order to further improve EH utilization – Potential Opportunities

- To simplify, an IPSO regarding EH could be divided into two different explanatory case types, Type 1 and 2.
- Prospective cases similar to “Open district heating” can be categorized as Type 1. Type 1 cases are those where there are a number of suppliers and recipients, as well as a district heating company with the knowledge and existing infrastructure system required for distributing heat. For these cases the district heating company becomes the undisputed IPSO provider.
- For prospective cases outside urbanized areas, categorized as Type 2 cases with other prevailing conditions similar to C4, the IPSO provider is no longer that obvious.

Potential of the application of an IPSO in order to further improve EH utilization – Potential Challenges

- One difficulty, which is the same for both types of cases, is the strong tradition of heat production that prevails among district heating companies.
- The approach of IPSOs has the ability to create a competitive opportunity.
- For the Type 2 cases there is an additional problem associated with planning.
- The organizational preconditions - trust, fine-grained information transfer and joint problem are important factors to consider.
- The business model should be framed individually for different companies in order to fit the specific company's strategy and operations.
- No ready-made templates on how to formulate the business agreement between the actors involved in these kinds of inter-organizational collaborations.

Final Remarks

- The key to the increased utilization of EH is to find a number of new sources and applications for use.
- The results also indicate that applying the IPSO concept, in combination with IS, has the potential to facilitate and improve EH utilization.

