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Strategic perspectives on energy management: A case study in the process industry

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HIGHLIGHTS

- Energy-intensive companies lack a strategic perspective on energy management.
- Most energy-intensive companies do not regard energy as "core" to their business.
- There are means to increase the energy utilization, yet seldom used in practice.
- There are possibilities to increase revenues by selling energy as a by-product.
- This research provides practical examples of good and poor energy management.

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ABSTRACT

Energy issues and energy management gain more interest within the society at large as well as amongst companies of different sizes. Yet, even in energy-intensive companies, like process industries, energy management is seldom treated strategically. The purpose of this study is thus to investigate the necessary prerequisites for putting energy management on the strategic agenda in energy-intensive process industries. This is done by the means of a literature review and a case study, and the analysis is based on how energy management is treated from three perspectives; a strategic perspective, an energy system utilization perspective, and an alternative revenue perspective. The case study shows, similar to other process industry companies, that the strategic importance of energy management, to a large extent, is neglected. The research also indicates necessary prerequisites, for each perspective, for highlighting the strategic importance of energy management for a typical company in the process industry sector.

1. Introduction

The importance of energy issues in industry escalates rapidly due to the increase of cost for energy supply and due to the enhanced environmental awareness and consideration [1–3]. The latter include concerns such as the international task of reducing emissions of greenhouse gases, and their respective effect on climate change [4]. According to a recent research report from Cambridge [5], significant changes are needed in order to make the industrial system sustainable. Therefore energy becomes an increasingly important issue. This is especially true for the process industries, which are in focus in this study, that normally use a relatively large amount of energy [6]. Many process industries are dependent on external supply of energy, whereas others are less dependent on external supply of energy due to the fact that energy becomes a by-product when the incoming raw materials are transformed in the main production. The latter group has the opportunity to increase revenues by selling the energy surplus to other companies and to the surrounding community [7,8]. However, both groups can gain from effective and profitable use of energy, and should therefore treat energy as an important and strategic issue. In addition to this, the increasing and fluctuating energy prices can also affect the operations of process industries. The strategic dimension of effective energy management can furthermore be exemplified by companies in the process industry segment that have been forced to reduce, or even stop, their production in times of high electricity prices [2,9].

Even though it has been anticipated that energy efficiency is to become an important competitive factor in the near future [10], energy management is seldom prioritized even in the energy-intensive industries [2]. In energy-intensive industries the costs of energy can be between 5% and 15% in relation to the added value, whereas it can be well beyond 20% for the most energy-intensive process industries [2]. In other words, the energy cost in many

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process industries is similar to the cost of direct labour in the engineering industry. For process industries with such a high cost related to the supply of energy, it should be imperative to treat the energy management strategically and to establish an energy management system, as well as making sure that the energy system is utilized in a proper way. Furthermore, the process industries that have the possibility to extract an energy surplus from the by-products, and thereby offering the possibility to sell electricity, heating, etc., to the surrounding community should of course include this issue at the top management level in the company. Hence, there are many areas to improve, and effective energy management should play a central role in the energy-intensive process industries.

The research in this study is explorative, with the general purpose of investigating the necessary prerequisites for putting energy management on the strategic agenda in energy-intensive process industries. We do this by a literature review and by analysing current practices at a typical energy-intensive process industry company based on the following three research questions:

RQ 1. What issues are important to consider for *establishing a strategic perspective* on a company's energy system?
RQ 2. What issues are important to consider for getting *strategic attention* on the *utilization* of a company's energy system?
RQ 3. What issues are important to consider for getting *strategic attention* on investigating the possibilities for finding *alternative revenues* from a company's energy system?

The first question relates to the fact that few companies treat energy strategically even though energy makes up a large proportion of total costs, and that energy, as a part of the increasing environmental awareness, most likely will increase in importance in a near future. Within this first research question we treat policy deployment, government regulations and corporate strategy, and their respective impact on the possibilities to put energy on companies' strategic agenda. The second research question is more tactical and relates to the ways companies are utilizing their energy system to reach high efficiencies, e.g. in terms of the proper choice of fuels, the actions taken to minimize energy losses, and the use of energy with respect to the specific energy quality (exergy levels), etc. Even though this second research question focuses on the tactical level, management on the tactical level is a direct effect of the strategic management employed within the company. Hence, tactical management is a good indicator for analysing the realized strategy of the company. Finally, the third research question analyses the opportunities, or lost opportunities, for energy-intensive companies to generate alternative revenues from the energy system. Hence, in this study we treat energy management from three perspectives; a strategic perspective, a tactical utilization perspective, and a revenue generating perspective. In this specific study, the research questions are used to evaluate the energy management at a case company in an explorative manner to identify the necessary prerequisites for putting energy management on the strategic agenda for a company in the process industry sector. In doing this, we also contrast theoretical aspects on energy management with the current practices at the case company. The remainder of this paper is structured in the following way. At first we introduce the reader to the methodology used in this research. Thereafter follow the literature review and the case description. Finally we analyze the case, provide conclusions, managerial implications, and ideas for future research.

2. Methodology

From a methodological perspective, this research is based on a literature review and a case study. The literature review is centred on energy management in process industries, whereas the case is explorative. Thollander and Ottosson argue that research concerning actual energy management practices in industries has been scarce [2]. An argument supported by earlier studies [11,12], also asking for more research regarding both theoretical contributions and regarding practical case studies. Owing to the fact that there are few documented cases on the industrial use of energy management in practice, this research is of an exploratory nature, which also explains the use of a single case study. The results of single case studies should be treated with caution but Yin [13] lists five rationales for conducting single case studies, of which two are present in this research. First, the case in this study is considered to be typical (representative) for its industry segment, making it a suitable case in an exploratory study since other companies most likely face similar situations and can gain from the insights provided from this case study. Secondly, the case could be argued to be revelatory, since there are few, if any, similar cases documented in literature, thereby offering the possibility to observe energy management in practice at an energy-intensive process industry.

The case company is a Swedish process industry company producing specialty chemicals sold globally. The company is one out of seven companies in a five year government funded research project on how to improve the operations in the Swedish process industry sector. The case company in this study is regarded to be typical for its industry segment, since it is energy-intensive (energy costs at approximately 15% of their total costs), it has taken part in a government issued energy conservation programme, it has started initiatives to increase their energy efficiencies, and it does have the opportunity to generate energy from by-products in the production process. The main sources of case information are meetings and semi-structured interviews with several key informants at the company, as well as internal documentation. The data is validated through triangulation with both multiple sources of information and by key informants' verification of interview transcripts, case study reports, and the draft paper. A case study database and case study protocol are further on used to ensure reliability [13]. The data collection period lasted for 6 months (in 2010 and 2011) and was divided into four phases.

The first phase included a site visit and the start-up meeting with the company outlining the research process, followed by a full day roundtable session with the plant managers, a project manager, the process owner and an energy engineer from the company. The main purpose was to understand the operations of the case company, including the production process and the company's energy system. After the roundtable session the company provided company reports, power point presentations, Excel-files analysing the energy usage and balance, company performance data, and so forth. Based on the results of the first phase and the literature review, a semi-structured interview guide was developed. In the second phase in-depth interviews were carried out with the plant manager, the project manager and an energy engineer with overall responsibility for all the plants at the site. Each interview lasted 2–3 h, and was also complemented with a couple of telephone interviews to clarify some issues. The results from the interviews were documented in a tabulated format in the case study protocol, for easy comparison of the answers. The third phase consisted of an interview with the site manager, the energy engineer and the process engineer who was responsible for mapping the energy balance at the site. The interview with the site manager had two purposes; firstly to get more information on the company's strategic management and secondly for verifying the results of the second phase interviews. The interviews with the energy and the process engineers focused on getting more detailed information on energy utilization and the possibilities for alternative revenues from by-products. Between the third and the fourth phase, all data was coded, reduced and analyzed, and a draft case study report was