Energy strategies in the pulp and paper industry in Sweden: Interactions between efficient resource utilisation and increased product diversification

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1. Introduction

The pulp and paper industry faces several challenges linked to climate and environmental impact, resource efficiency, rising energy prices, increased competition for biomass resources, and declining demand for traditional printed paper products. However, these challenges also offer strategic opportunities for the industry to develop into a competitive, resource-efficient, and low-carbon industry in line with a biobased economy. Against this background, this paper aims to analyse current energy strategies in the pulp and paper industry in Sweden. Specifically, the paper analyses how companies combine continuous process efficiency to reduce energy costs with activities that could be developed into new energy-related products to increase revenue. Most of the analysed companies work to various degrees with both these strategies, employing methods that include improving energy efficiency, energy security, and energy conversion, as well as developing a wide range of biobased energy products. However, our study indicates that there is an untapped potential associated with energy product development, and we conclude that energy efficiency measures can free up resources, enabling the development of new energy products. Finally, several potential managerial outcomes and implications are outlined.

Received 18 June 2020; Received in revised form 26 April 2021; Accepted 24 May 2021

https://doi.org/10.1016/j.jclepro.2021.127681

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electricity (Ottosson and Magnusson, 2013).

Hence, current developments are creating both strategic opportunities and threats for the pulp and paper industry. Specifically, there is a need for companies to work with constant process efficiency to reduce energy costs, while at the same time not missing arising strategic opportunities that could be developed into new energy-related products in the growing renewable and biobased economy.

While previous studies have had a one-sided focus on either efficiency measures or product development, we view these as two sides of the same coin. To the best of our knowledge, this is the first time that this perspective has been used in research on energy strategies. This approach makes it possible to identify synergies and trade-offs between efficiency measures and activities aimed at developing new energy-related products. To meet the abovementioned challenges and at the same time seize new opportunities, pulp and paper companies can benefit from increasing their understanding of how strategic choices regarding efficiency interact with the development of energy products. Against this background, this paper aims to analyse current energy strategies in the pulp and paper industry in Sweden. Specifically, it analyses how pulp and paper companies combine continuous efficiency measures with activities aimed at developing new energy-related products. This has been studied by using a qualitative research design, and three research questions guide the study:

RQ1. How do the studied pulp and paper companies work with continuous efficiency measures to reduce energy use and the associated costs?

RQ2. How do the studied pulp and paper companies work to develop energy-related products?

RQ3. How do the companies combine continuous efficiency measures with activities aimed at developing new energy-related products?

This paper contributes primarily to the literature on energy strategies by providing a novel approach identifying synergies between efficiency measures and activities aimed at developing new energy-related products. Furthermore, by offering managerially applicable results, this paper constitutes a practical contribution for the industry as well as for business associations, suppliers, customers, and policy advisors.

2. Analytical framework

2.1. Energy strategies

Andrews (1971) defined a strategy as a pattern of objectives, purposes, or goals and the major policies and plans for achieving these goals. Mintzberg and Waters (1985) argued that a strategy is not always formulated and articulated but can also consist of a pattern in a stream of decisions. An energy strategy has traditionally been described as a company’s overall intention and direction with regard to energy performance; that is, the measurable results of energy efficiency, the type and amount of energy used, and how the energy is used (Swedish Institute for Standards, 2011). The strategy should be adapted to each specific organisation and should result in improved energy performance and reduced energy costs.

Previous research on energy strategies can be divided into research on barriers to energy efficiency investments and research on the energy efficiency measures (energy management) used to improve energy efficiency (May et al., 2015; Schulze et al., 2016). For example, Fleiter et al. (2012) distinguish between investments in new, energy-efficient technology and organisational measures, e.g. changes in routines and behaviour. However, both research on barriers to energy efficiency investments (see e.g. (Bhadhade and Patel, 2020; Haraldsson and Johansson, 2019a; Johansson, 2015; Soepardi et al., 2018; Thollander and Ottosson, 2008; Trianni et al., 2013a; Trianni et al., 2013b) and research on organisational measures (see e.g. (Ahmad et al., 2020; Caifall, 1995; Hassain et al., 2020; Johansson and Thollander, 2018; Sola and Mota, 2020; Thollander and Ottosson, 2008, 2010) have focused solely on how such strategies may increase energy efficiency. Hence, previous studies have only a one-sided focused on the cost-saving dimension of energy strategies.

However, in energy-intensive companies, the energy strategy can also be linked with, or integrated into, the business strategies, enabling increased revenues. The goal of a business strategy is to outperform competitors (Porter, 1980) and the focus is on a strategic business unit or division. For energy-intensive companies, the energy strategy is integrated into the company’s functional strategies such as development, production, marketing, and service. Hence, this strategy is multifaceted and cannot be looked upon as a separate functional strategy but is instead related to several functions. As an example, the energy strategy can relate to the production function because energy is a major cost of production, but it can also relate to marketing in the sense that energy could be transformed and sold as one or more products.

Hence, we define an energy strategy as a company’s overall intention and direction regarding energy. Such strategies cover both process efficiency, with an energy-cost focus, and activities aimed at developing new energy-related products or increasing the sales of such products in order to increase the company’s revenues. The company’s energy strategy in relation to sustainability can thus take one or several directions, including energy conservation, improving energy efficiency, and increasing the proportion of renewable energy (van der Westhuizen and Young, 2018).

2.2. Combining exploitation with exploration in energy strategies

Production-oriented companies focusing on a cost leadership strategy (Porter, 1985), which has traditionally been the prevalent strategic type within the pulp and paper industry, usually base their competence and competitive advantage on superior process efficiency (Ottosson, 2011). Competitive pulp and paper production requires significant economies of scale and large amounts of invested capital (Ojala, 2006). According to March (1991), such strategies are based on exploitation, focusing on control, efficiency, and reliability, or what Porter (1996) would term operational efficiency.

In contrast, market-oriented companies focus on a differentiation strategy and pay more attention to the ability to identify and subsequently fulfil the needs of customers (Porter, 1985). Such strategies are based to a larger degree on the exploration of new possibilities focusing on innovation, product development, and market intelligence (March 1991). Traditionally, the question has been which of the two to choose; to be either production oriented or market oriented (Porter, 1985). Some studies (Bierly and Chakrabarti, 1996; Ghemawat and Ricart Costa, 1993) even suggest that these two strategies are based on competing organisational activities, consequently resulting in the need for organisations to focus on either production orientation or market orientation.

However, most scholars (Benner and Tushman, 2003; Eisenhardt and Martin, 2000; Gibson and Birkinshaw, 2004; He and Wong, 2004; Lubatkin et al., 2006) argue that production orientation (exploitation) and market orientation (exploration) include a set of activities that need to be combined in order for the company to remain competitive in the long term. This concept of companies combining exploitation and exploration strategies to ensure long-term survival is referred to as organisational ambidexterity (Tushman and O’Reilly III, 1996). Therefore, today, the challenge is often to find an optimal balance between these strategies, i.e. to adopt a market orientation while remaining operationally effective. A company is therefore not solely market oriented or production oriented, but rather exists somewhere along a continuum (Baker and Sinkula, 1999). Companies cannot survive by focusing solely on process efficiency since, among other things, they risk becoming locked into current technologies, products, and markets (Dosi, 1984; Nelson and Winter 1982). In mature industries, this risk is especially high because the rate of product innovation is often low, and the focus is instead on process innovation intended to increase productivity and profitability (Ottosson and Magnusson, 2013). Hence, research suggests that companies must be simultaneously both market and
production oriented (Atuahene-Gima, 2005; He and Wong, 2004), aiming for both differentiation and cost-leadership competitive strategies (Hall, 1980). Even though adopting both of these strategies may seem contradictory, it can be seen as necessary for organisational success (Kim and Mauborgne, 2005) in the current competitive environment. This argument is also supported in many ways by the literature on organisational ambidexterity, which shows that “…ambidextrous organisations [that] are capable of simultaneously exploiting existing competencies and exploring new opportunities” (Raisch and Birkinshaw, 2008), p. 685) can have a competitive advantage. Smith and Lewis (2011) also argue that the ability to handle the simultaneous existence of contradictory yet interrelated elements is increasingly important in contemporary management, and perhaps even more so in today’s pulp and paper companies. Moreover, previous research has shown that companies’ existing resources and capabilities are important in the development of products that are new to the company (Onufrey and Bergc, 2020a, 2020b).

As discussed by Gomes et al. (2020), improving sustainability in industrial firms requires production transformations that are based on complex, intertwined paths in order to simultaneously pursue incremental and more disruptive changes (Gualandris et al., 2018). Moreover, organisational ambidexterity requires a management team with a strong and shared vision, shared values and collective goals (Jansen et al., 2008). In energy-intensive companies, which are responsible for the vast majority of the industrial sector’s emissions, energy strategies are key for reducing emissions. We argue that ambidexterity (March 1991; Raisch and Birkinshaw, 2008) is fundamental in pursuing successful energy strategies.

Previous studies have suggested that ambidexterity constitutes a valuable foundation for the study of increased sustainability in industrial companies (Gomes et al., 2020; Maletic et al., 2014), but to the best of our awareness, no previous research has investigated the role of ambidexterity in successful energy strategies in energy-intensive companies. Hence, our analytical framework will focus on analysing how pulp and paper companies in Sweden combine exploitation with exploration in their energy strategies in order to manage the increased pressures linked to climate and environmental impact and resource efficiency.

3. Method

This study is exploratory in nature and aims to answer questions such as ‘Why’, ‘What’ and ‘How’. Therefore, a qualitative research method is appropriate (Kvale and Brinkmann, 2014). In-depth interviews are a qualitative data-collection method that can be used to elicit in-depth information from relatively few persons (Kvale and Brinkmann, 2014). The three key questions also guide the planning of an interview study: 1) ‘why’: clarifying the aim of the study, 2) ‘what’: acquiring knowledge about the subject being investigated, and 3) ‘how’: acquiring knowledge about different interview-related approaches in order to determine which one is appropriate in this context (Kvale and Brinkmann, 2014). There are several previous studies that have used a qualitative research design based on interviews to study improved energy efficiency (e.g. Apeaning and Thollander, 2013; Nehler et al., 2018) and energy management in industry (e.g. Dahlqvist and Söderholm, 2019; Johansson, 2015; Mahapatra et al., 2018).

In this study, semi-structured interviews were used to collect empirical data that could enable us to gain an in-depth understanding of the energy strategies within the pulp and paper industry in Sweden. The Swedish Forest Industries Federation’s registry of pulp and paper mills in Sweden was used to identify relevant mills. In 2019, there were 19 pulp and paper companies, owning 49 mills in Sweden (Skogsindustrierna, 2019); 27 integrated mills, 10 mills producing only pulp, and 12 producing only paper. Two of these mills produce dissolving pulp for textile production. All 19 companies were contacted by email or telephone. Eight companies agreed to be part of the study: five of them own several mills in Sweden and three own one mill each (see Table 1). In total, the interviewed companies own 27 mills in Sweden. The companies in our study differ in terms of company size, product portfolio, geographical location, and number of mills in Sweden. The sample thus yield qualitative richness and diversity of data, rather than to deliver statistical representativeness (Eisenhardt and Graebner, 2007; Yin, 2018). Thus, the sample selection is based on theoretical rather than statistical sampling, in order to identify superior patterns and generalisable findings. Two interviews were conducted per company; thus, 16 interviews were conducted in total, see Table 1. One of the interviews at each company focused on production orientation (exploitation) and one on market orientation (exploitation). The interviews about how the company’s energy strategy is positioned regarding market orientation were conducted with managers at the corporate level. One mill per company was selected for the interviews about the energy strategy’s production orientation. The interviewees were selected in consultation with the companies; they were asked to identify the individual(s) most suitable to answer questions regarding the company’s business (at the corporate level) and energy issues (at the mill level, due to the operational nature of the questions). The interview themes (listed below) were briefly presented to the companies in the discussions concerning the choice of interviewee(s).

A document containing the themes to be studied was prepared. The work of formulating the interview questions was based on a literature search on both the theoretical framework of ambidexterity (see Section 2.2) and the subject being studied (see Section 2.1 and Section 1). A brief literature search of the companies’ websites, annual reports, and sustainability reports was also performed. This literature search was used to gain an overview of the specific companies’ business strategies, their energy strategic work and energy-related innovations and activities. The information gained from this study also served as input for the formulation of questions for the semi-structured interviews. The company energy strategies were, however, not presented on either of the company

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Information about the companies in the study.</th>
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<tbody>
<tr>
<td>Company</td>
<td>Size(^a)</td>
</tr>
<tr>
<td>1</td>
<td>Medium</td>
</tr>
<tr>
<td>2</td>
<td>Small</td>
</tr>
<tr>
<td>3</td>
<td>Medium</td>
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<td>4</td>
<td>Large</td>
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<td>5</td>
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<td>6</td>
<td>Large</td>
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<tr>
<td>7</td>
<td>Large</td>
</tr>
<tr>
<td>8</td>
<td>Small</td>
</tr>
</tbody>
</table>

\(^a\) Small 2-10 million EUR turnover; Medium 10-50 million EUR turnover; Large >50 million EUR turnover.

\(^b\) 1. Market-orientation interview. 2. Production-orientation interview.
websites, in annual reports, or sustainability reports. This literature search did not provide information about reasoning or trade-offs between different activities and strategic orientations, which further motivated the in-depth interview study. An iterative process was used during question formulation, in order to avoid issues such as unclear questions or leading questions encouraging a specific answer (Bryman, 2018).

The semi-structured format of the interviews provided the freedom to change the order of the questions and to follow up on interesting answers and discussions (Kvale and Brinkmann, 2014). An interview guide was formulated containing questions on the following themes:

1) market orientation (exploration): an overview of the strategy, value chain and cost structure, product innovation, product differentiation, and product diversification.

2) production orientation (exploitation): the format and content of the strategy and goals, the process of formulating and implementing the strategy, external factors that affect the energy-strategy work, considerations of how the strategy affects others outside the company, and the company’s strategic energy intentions for the future.

The interviews were conducted during 2017–2018. They were conducted face to face, apart from one that was conducted by telephone due to practical circumstances. The interview lengths varied between one and 2 h and were audio-recorded and transcribed verbatim. To gain an overview of the material and identify interesting data and results, the material was coded and categorised using NVivo software (QSR International, 2019). In terms of market orientation, the coding focused on exploration dimensions, e.g. “innovation”, “product differentiation”, and “product development”. With regard to production orientation, the coding looked for verbal and conceptual repetitions, similarities, and differences in various parts of the interviews (Kvale and Brinkmann, 2014; Ryan and Baenhard, 2003).

The preliminary results were presented during a 2.5-h workshop in spring 2020. The invitation was distributed to all pulp and paper mills in Sweden, the participants in the project reference group, and the Swedish Energy Agency as the funder of this project. Ten industry experts from pulp and paper companies (representatives from the mills), of whom three had previously participated in the interview study, and four representatives from regional and national energy agencies (representatives from the project reference group and from the funder of the project) participated in the workshop. The national energy agency was invited as one of the recipients of the projects results, and due to their ability to influence national policy development.

The workshop was led by a moderator and held digitally using the Zoom platform (Zoom Video Communications, 2020). Zoom offers a digital tool that was used to present and visualise the results. Following a presentation of the results from the interviews, the workshop group was split into three smaller groups in breakout rooms and the moderator introduced the topic to be discussed, i.e., how pulp and paper companies can create synergies between increased product diversification and efficient resource utilisation. The group discussions followed a focus group method. In line with the purpose of focus groups, the aim of these group discussions was to view the energy-strategies of these companies as what Mintzberg and Waters (1985) termed a pattern in a stream of decisions regarding the companies’ overall intention and direction.

Three mills had a written energy strategy, and a fourth stated that it had just initiated the writing of such a strategy. According to Johansson and Thollander (2018), a long-term energy strategy is one essential factor for successful energy-efficiency work. However, the companies all have environmental and energy policies, including goals to improve energy efficiency and to work strategically with energy issues. Generally, the corporate level sets overall goals, which are then broken down into more specific goals by the management teams at individual mills. Hence, it is possible to view the energy strategies of these companies as a tool to achieve successful energy efficiency. This management system offers a method and enables structured routines to work with improving energy efficiency. One of its cornerstones is to have an energy policy, which could explain why the mills already have such policies in place. The mills that did not have an energy management system, however, said that they had integrated their energy goals into the environmental management system.

Our study shows that the companies focus their strategic activities on one or several of the following areas: improving energy efficiency and energy savings, being self-sufficient in energy, selling energy products, and increasing their proportion of renewable energy (see Table 2). This is partly in line with the study by van der Westhuizen and Young (2018), who stated that a company’s energy strategy in relation to sustainability can take one or several of the following directions: energy conservation, improving energy efficiency, and increasing the proportion of renewable energy.

The identified energy-strategy directions have been categorised into an exploitation focus, emphasising cost minimisation, and an exploration focus, pursuing innovation and the development of new energy products (see Fig. 1). Conversion to renewable energy targets both costs, through energy prices, and the market, for example through renewable electricity production.

4.2.1. Energy efficiency and energy savings

All eight mills in the study have an exploitation focus to continuously improve energy efficiency. Within this production-oriented strategy, energy is considered one cost among others and reducing costs therefore involves improving energy efficiency. Energy investments compete with other investments, where work safety, product quality, capacity, and the environment are often prioritised more highly. However, the respondents stated that energy costs are considered in investment calculations. Several respondents explained that few projects are pure energy projects, but that energy is incorporated into other projects:

Very, very few projects exist that are only energy projects. (…) it’s in connection with other investments that we include energy improvement measures. (…) However, it is a conscious strategy to choose the best energy solution in projects, so to speak.

When replacing worn-out equipment, the mills have the ambition to choose the most energy-efficient alternative. This was also shown by Broberg et al. (2015), who found that energy-efficiency investments were often taken in connection with other investments to overcome the barrier of limited access to capital (Robdin et al., 2007; Thollander and Ottosson, 2008). Moreover, previous research states that energy-efficiency measures are seldom implemented based on energy
savings alone, but instead are due to productivity improvements (Nehler and Rasmussen, 2016; Pye and McKane, 2000).

Since the pulp and paper industry is energy intensive, energy constitutes a large part of its total operational costs, which may explain the ambition to improve energy efficiency. This is confirmed by Thollander and Ottosson (2008), who showed that reducing costs through lower energy use is one of the highest-ranked driving forces for improving energy efficiency in the Swedish pulp and paper industry.

The interviews revealed that improving energy efficiency could be a strategy to enable increased production capacity, i.e. more products could be manufactured without installing more energy capacity:

(...) if we can reduce our specific energy use, then we can manufacture more products (...) and to be able to increase production, we have to be more energy-efficient in our production so that the energy production in the boilers will be enough (…)

In this case, improved energy efficiency does not result in reduced energy use, which is an example of the so-called rebound effect (Amjadi et al., 2018). Research has shown that the rebound effect is higher in energy-intensive sectors, such as the pulp and paper industry, than in non-energy-intensive sectors in Sweden (Broberg et al., 2015). However, two respondents stated that their mills have the goals to both improve energy efficiency and reduce the mill’s total energy use:

(...) it’s how we work with savings, or, what can I say, to produce more cost-efficient products.

The work with continuous energy-efficiency improvements involves many activities, and commonly the mills have a group constellation working with these issues. The frequency of meetings varies from once a month to four times a year. One respondent explained that their meetings were important for communication between the energy coordinator and the mills, both in terms of informing each other about the company’s overall intentions and to capture the situations at the individual mills. Top management support has been identified as an important factor for successful energy management (Johansson and Thollander, 2018; McKane et al., 2008); thus, these meetings may constitute an important part of their work with energy efficiency.

The mills have working routines regarding energy in the sense that energy use is monitored, and specific energy use is calculated, followed up on, and evaluated. In addition, frequent energy audits are performed, and energy-efficiency measures are identified. This work is often coordinated at mill level by their energy or environmental management systems.

There are activities designed to engage employees in improving energy efficiency and to anchor the company’s strategy, e.g. one mill involved employees from production when formulating energy goals at the division and section level. In this way, the goals make sense to the people working daily to achieve them. Other examples are education in basic energy knowledge for all employees, encouraging them to make suggestions for measures to improve energy efficiency, and software tools to visualise production efficiency, deviations, implemented measures, and work orders. This visualisation increased the operators’ awareness of the relation between production and energy use. Energy performance and ongoing energy projects are communicated to

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### Table 2

The companies’ energy-strategy activities.

<table>
<thead>
<tr>
<th>Company</th>
<th>Written energy strategy</th>
<th>Energy management system at the mill</th>
<th>Energy-strategy direction</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improve energy efficiency/Energy savings</td>
</tr>
<tr>
<td>1</td>
<td>No</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>In progress</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>ISO50001</td>
<td>Yes</td>
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<td>4</td>
<td>Yes</td>
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<td>8</td>
<td>No</td>
<td>ISO50001</td>
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Fig. 1. Energy strategies in pulp and paper mills in Sweden, divided into exploitation and exploration focus. Conversion to renewable energy relates to both production-orientation and market-orientation.
employees in different ways, e.g. at division meetings, on the intranet, and through energy reports. These activities are in line with the recommendations by Johansson and Thollander (2018), who showed that continuous energy-efficiency education for employees and visualising energy-efficiency progress are important factors for successful in-house energy management. However, the interviews revealed that the mills could be better at informing employees about energy issues.

4.2.2. Self-sufficient in energy (energy security)

Energy security can be addressed in different ways, and two trends can be identified among the studied mills: in-house electricity production, and the choice of fuel. All but one of the mills in the study produce electricity. One mill declared an aim to become self-sufficient in electricity and three mills have targets to cover a certain percentage of electricity demand with their own production. One respondent said:

(…) we have a goal for the mill to produce 53% of its own electricity consumption, but this is broadly speaking, and depends on how things go in production.

Geopolitical factors affecting the availability of supply and fuel prices are brought up as affecting the choice of fuel used in the production processes. One of the interviewees described how their mill had initiated the process of changing their natural gas boiler to a biofuel boiler and stated:

Locally, we believe it’s a safer alternative. You have, so to speak, political uncertainty associated with gas. We also believe that the price of emissions trading will rise.

The meaning of energy security has evolved over time. Definitions nowadays highlight both access to various forms of energy and that it should be affordable (Proskuryakova, 2018). If a company is self-sufficient in energy, this may imply energy security and resilience in the face of fluctuating energy prices. Neither the number of employees nor the production capacity seem to influence whether companies apply this strategy.

4.3. Exploration-focused energy strategy

4.3.1. Energy products

Overall, it can be observed that a majority of the companies innovate, develop, produce, and sell energy products to varying degrees. This relates to products that are not normally part of the company’s core business. Hence, most of the companies have an exploration focus in their energy strategies. However, even though most companies sell energy products to some extent, not all have a market-oriented energy strategy, but merely occasionally sell surplus electricity or other energy by-products. One of the companies with a market-oriented energy strategy explained:

(…) our units are very energy intensive. So, to some extent, it’s obviously about not using unnecessary energy, it’s a production cost. But, for us, energy is also a facilitator and a revenue carrier. We have a lot of energy streams that we can make money from. And then it’s about being able to increase production or to find sales opportunities, collaborations and other things where we can make money from the energy.

Thus, the reasons for these product developments are multifaceted. One interviewee stated that the reason is improved energy efficiency and revenues, while two others declared that, in one case, it is related to the company’s profile in the form of positive “storytelling” and, in the other, a strategy for broadening the “product palette”.

The companies produce and sell several energy products made from waste and excess streams; electricity, excess heat sold to nearby district heating networks, lignin, bioethanol, tall oil, bark, etc. In some cases, in-house energy-efficiency measures have created opportunities for, and led to the development of, these products:

Previously we burned the bark in boilers internally, now we sell it externally. (…) at this mill we’ve managed to change the use of the bark and are now able to sell it (…). So, we’ve somehow found new products, or by-products, perhaps we should say.

Hence, exploitation strategies enabled exploration leading to new products, proving the benefits of organisational ambidexterity. Other companies seek new markets for renewable electricity production, and this is exemplified by one large company:

(…) we conduct forestry, but if we can have other income from the land, that generates complementary revenues besides forestry, then we do that as well, and for us this is wind power. (…) This is also a strategic question in the sense that we’ve seen the benefits of delivering electricity to the grid, because we have industries with high electricity demand.

This development illustrates the increased interest shown by these companies in not solely delivering pulp and paper products, but also developing a wide range of energy products.

The strategic work on how to use existing materials and energy flows more efficiently is ongoing. Five of the eight interviewed companies stated that they have internal discussions about possibilities for bio-based vehicle fuels. However, most of them have concluded that the investments are too large or not profitable at the moment. For example, one respondent said:

(…) we can’t really see that we would get paid enough for the gas that it would be worth it today.

Uses of excess heat, other than for district heating, such as heat delivery to greenhouses and fish farms, have been discussed at two of the companies, but the business case differed between them. One is planning a pre-study, whereas the other says that it is “not our business (…) it would only be goodwill”. To summarise, most of the companies are working actively to understand the future needs of customers related to energy and several have made major investments in new products to fulfil these needs. Furthermore, they are working extensively with market analysis and product development related to energy products.

4.4. Conversion to renewable energy – concerning both exploitation and exploration

All the studied mills except one are working strategically to increase the proportion of renewable energy used. One respondent declared that their primary goal is to be carbon-dioxide neutral.

(…) it is our foundation to be carbon-dioxide neutral. In addition, we will be energy efficient.

Laurijssen et al. (2012) studied energy conversion strategies in the pulp and paper industry in three European countries, including Sweden. Their results show that the conversion strategies differed in each country depending on historical factors and the availability of resources. Their results indicate that, because Sweden has large forest assets, Swedish industry will continue its path of converting to wood-based energy, which is in line with our results. However, our results also show that there is general interest in renewable energy sources, and several companies have invested in hydro and wind power. The reason for this is twofold: both to increase the proportion of renewable energy used in production and to increase the amount of renewable electricity they sell. This is illustrated by one of the respondents:

The main goal is to use a certain proportion of renewable electricity and we have our own production of wind and hydropower. Our production also includes a back-pressure turbine with electricity production from biomass.

This strategic change towards increased on-site electricity production in the pulp and paper industry is in line with the findings of Ericsson et al. (2011); Ottosson and Magnusson (2013). They determined that this reorientation is mainly a result of government policy affecting the economic conditions in this sector. However, these studies argue that it is not solely due to energy prices but also to reasons relating to sustainability. One of the mills we studied has experienced a change in management focus from prioritising measures that reduce the use of fossil fuels to measures that improve energy efficiency and reduce costs. This movement started with a change of ownership – the mill is now owned by a foreign company. The mill did not have a strategy to
increase the proportion of renewable energy, nevertheless it investigated the possibility of investing in a biomass boiler. The respondent explained that the reason for this is not the climate, but energy prices. (…) the electricity price was terribly high and the oil price too. (…) It was a matter of costs. And as icing on the cake, we have of course the climate.

Another interviewee declared that their mill uses renewable fuels whenever this is cheaper than fossil fuels, which is most of the time. However, the respondent stated that: “(…) it is not forbidden to use fossil fuels in our company.”

The companies’ strategies for converting to renewable energy are affected by energy prices, local environmental terms, and operational security. Renewables compete with fossil fuels when it comes to costs, and local environmental caps on emissions of particles, NOx, and other pollutants must also be taken into consideration. Furthermore, if renewables cannot provide operational security, they are not of any interest to the companies.

4.4.1. Ambidextrous integration between exploitation and exploration

Only one company had a pure exploitation and production-oriented energy strategy. The other seven companies also included exploration and a market focus in the sense that they had goals to convert to renewable energy. Four of the companies had further extended their market focus by creating a strategy of innovating, developing, producing, and selling energy products, thereby combining exploitation and exploration. Thus, the energy-strategy activities found in the pulp and paper companies in this study can be seen as green innovations: “all the changes in the product portfolio or in the production processes that tackle sustainability targets, like waste management, eco-efficiency, reduction of emissions, recycling, eco-design or any other action implemented by firms to reduce their environmental footprint” (De Marchi (2012), p. 615). Such innovation activities are independent of the initial intention and include both incremental and radical improvement.

Most of the companies that strategically sold energy products were large, with a high degree of vertical integration, i.e. they control all stages of production, from the acquisition of raw materials to sale of the final product (Encyclopaedia Britannica, 2020). One interviewee explained that the company’s vertically integrated business strategy is a strength in this sense, because they can see the broad picture and integrate several business ideas. Another respondent stated that, in order to increase the amount of energy products they sell, they have a goal to improve energy efficiency in-house. These are examples of how companies have integrated production orientation and market orientation within their energy strategies.

Additionally, it was observed that there could be different intentions at the company versus the mill level. One respondent stated that, at company level, the focus was on producing pulp at low cost. However, the mill also produces biofuel products, and, at mill level, there was a desire to be a biorefinery and work with long-term energy efficiency, thus combining exploitation and exploration in their energy strategy.

Our results show that energy is an integrated part of the companies’ businesses, even if it is not part of the core business:

Energy is not a part of our core business; however, it is an important and active part of supporting it. Minimising the fossil carbon-dioxide emissions that arise along the value chain is a vital strategic priority for us. Our choice of fuels, and that we use them efficiently, are crucial factors in achieving our targets to combat climate change, and today we see that efficiency in energy can help us to minimise our fossil dependence.

Generally, the companies stated that their business strategy focuses on selling products at a profit and that energy is seen as an enabler to accomplish this. There is never any question of improving energy efficiency or converting to renewable fuels if this means that they cannot sell their products. However, customers’ awareness about sustainable production may imply that they are willing to pay more for a product that is produced with renewable energy and less energy input (Zimmerman and Hall, 2019). The mills in the study declared that, in order to remain competitive, they must guard their good reputation, and customers have started to take an interest in products’ environmental and climate impact during the production phase, using surveys such as the Dow Jones Index to evaluate performance regarding these issues. One respondent stated that the interest taken by the mill’s marketing department in its energy performance has increased because of these surveys. Other studies have also acknowledged that customer demands can be an incentive for industrial companies to work with improving energy efficiency or converting to renewable energy, see e.g. Haraldsson and Johansson (2019b). The companies that have a business strategy to promote their biobased products as a sustainable alternative to fossil-based products, e.g. plastics, emphasised the importance of fossil-free and energy-efficient production. This is in line with previous studies, which found that companies have moved from simple profit-oriented strategies to incorporating sustainability-oriented goals and recognising sustainable supply-chain management (Beckmann et al., 2014; Meckenstock et al., 2016).

Even though energy can generate revenue, there may be other primary reasons for selling energy products. One respondent explained that their mill sold excess heat to the district heating company primarily for goodwill and PR purposes and not for economic reasons. The profit was small in relation to the mill’s total profit and the heat delivery agreement imposes limitations on how the mill can be run. However, this mill is evaluating the possibility of developing and selling other energy products.

The respondents stated that, before formulating their energy goals, a market intelligence analysis was conducted. Analysed factors included the market for electricity and biomass and future policy instruments, such as green certificates for electricity production. One respondent mentioned the competition for biomass and the fact that it is a limited resource. This is one of the reasons why they deliver excess heat to the district heating network, since this reduces the demand for biomass outside the mill and increases the amount that the mill can buy to develop its business. The pulp and paper industry’s business organisation, the Swedish forest industries, was mentioned by several respondents as an important source of support during their market intelligence analysis.

4.4.2. Managerial implications

The results identified and discussed in this research study are the cornerstones of an energy strategy for pulp and paper companies aiming to increase ambidexterity within their organisations. These results offer managers insights into the aspects on which they should focus in their efforts to enhance exploration and exploitation regarding energy. Because pulp and paper companies are typically path-dependent in relation to previous investments, managers must understand their specific situation, the market in which their mill operates, and the pace of change, so as to choose and develop situation-specific energy strategies. The sequence in which the following actions are developed and implemented may thus vary according to the pulp and paper company’s current situation and to external inducements.

Below, the potential managerial outcomes and implications for managers are summarised.

- **Energy strategic intent** – At an overall level, the key to a successful energy strategy is to have a clear focus and aim as well as internal strategic leverage. This should be implemented into company-wide acceptance and defined goals, ensuring coordinated actions and resource availability.
- **Clear energy-related goals** – The company should review its energy-strategy goals because certain energy-strategy decisions tend to be in opposition to others. The choice to be self-sufficient in energy (in whole or in part) could for example be incompatible with the goal of selling energy products.
• **Energy-related collaborations** – In some pulp and paper companies, there is a lack of internal resources. In such companies, it may be necessary to form new constellations with external actors in order to create new opportunities to work strategically with energy and create long-term competitiveness.

• **Exploitation enables exploration** – Energy efficiency can enable the development of new energy products. It is important that the mills do not work with energy issues in isolation, but together with other functions in the company to identify the opportunities and develop them into innovations.

• **Converting to renewables enables branding** – Converting to renewable energy in production enables companies to brand their products as sustainable, creating long-term sustainable competitive advantages.

5. Concluding discussion

This paper has analysed how pulp and paper companies combine continuous efficiency measures to reduce energy use and related costs with activities that can be developed into new energy-related products. The case studied in this paper was the Swedish pulp and paper industry, which currently faces several challenges, all linked to the importance of efficient use of resources. Primarily, our results contribute to research on energy strategies in industrial companies (e.g. (Johansson and Tholander, 2018; Tholander and Ottosson, 2008)) by integrating a focus on cost and revenue in the analysis. Furthermore, our findings have practical implications, guiding managers in the pulp and paper industry on how to exploit existing competencies while at the same time exploring new opportunities. An in-depth analysis of eight pulp and paper companies showed that:

- Most of the companies work, to varying degrees, with both production-oriented and market-oriented strategies regarding energy. This includes energy efficiency and energy savings, energy security through in-house production, and energy conversion, as well as developing a wide range of bio-based energy products.
- Improving energy efficiency can enable the production of new energy products.
- Only a few companies had developed radically innovative energy products, while the majority sold incremental energy products originating from by-product streams, such as electricity, excess heat, and bark.
- All the large companies in our study with a high degree of vertical integration had strategies in place to develop and sell energy-related products. This observation might indicate that companies which control and integrate all parts of their supply chain are more likely to explore new opportunities. Moreover, large companies might find it easier to access the required competence and financial resources. However, confirming this correlation requires further investigation with a larger sample.
- The results suggest that there might be a strategic choice to be made between either developing and selling energy products or being self-sufficient in energy. However, more research is needed to confirm this hypothesis.

Generally, energy efficiency is said to have a positive impact on industrial productivity and competitiveness, as well as reducing greenhouse gas emissions (Ryan and Campbell, 2012), and this was also confirmed in the present study. Pulp and paper companies have opportunities to become more active energy suppliers.

Despite discussions and research on biorefinery concepts in recent years (e.g. (Brunnhofen et al., 2020; Demuner et al., 2019; Mongkonsiri et al., 2020; Mongkonsiri et al., 2018)), this study shows that such developments have only been moderate. This is in line with Karltorp and Sandén (2012) findings, which indicates that there might still be an untapped potential associated with energy product development.

Previous research (Hansen and Coenen, 2017) has shown that investments in the pulp and paper industry are focused on core business activities and that the development of new, biobased products is hindered by path-dependencies and a mismatch with prevalent business models. The authors suggest that, in order to move away from a business-as-usual model, the companies may need new managerial competences and different foundations for decision-making. In that sense, our study provides insights into how pulp and paper companies can combine exploitation and exploration strategies regarding energy in order to remain competitive. This is supported by recent research on increasing sustainability in industrial companies (e.g. (Gomes et al., 2020; Maletić et al., 2014)), pointing out the importance of companies both exploring and exploiting knowledge (Gupta et al., 2006; Jansen et al., 2006; Lichtenhalter and Lichtenhalter, 2009; March 1991; Princes, 2020). Specifically, companies that conduct exploration and exploitation simultaneously in incremental and discontinuous innovation can create a competitive advantage in both mature and emerging markets (O’Reilly III and Tushman, 2008; Princes, 2020), and can move their organisations towards increased sustainability (Awan et al., 2018; Princes, 2020). Given that pulp and paper producing companies are encumbered with capital-intensive investments that were often made decades ago, it has been important to focus on activities that take account of historical paths while opening strategic windows of opportunity. An increased focus on electricity production from biomass, and investments in biomaterials and biofuels, are examples of incremental sustainability innovations that pulp and paper mills can use to break free of the past and move in a more sustainable direction, even though their scope for action is limited and largely determined by previous decisions and infrastructure.

This research is not without potential limitations. Its qualitative approach and case-study methodology, as well as limitations associated with sample selection, suggest that further studies are needed to improve our knowledge about how combining exploitation with exploration in energy strategies affect energy-intensive companies’ long-term competitiveness. Similar studies in other industrial sectors are also encouraged in order to establish more general patterns or deviations.

CRediT authorship contribution statement

Maria T. Johansson: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration, Funding acquisition. Sarah Broberg: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. Mikael Ottosson: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This project was funded by the Swedish Energy Agency, grant number 423441. We would like to warmly thank the interview respondents for giving us insight into their energy strategies. We would also like to thank Dr Ksenia Onufrey and Professor Anna Bergek for good cooperation throughout the project.


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